Course Descriptions

For the most current course descriptions, view online at **registrar.okstate.edu/**.

This *Catalog* offers information about the academic programs and support services of the University. This *Catalog* is as accurate as possible, but the information may not remain current for all of the academic year. Circumstances may prompt changes in courses, course content, credit, fees, regulations, semester calendar, curriculum, degrees offered, and other University matters. Such changes authorized by the University apply both to prospective students and to those previously enrolled, unless the latter are specifically exempted.

Not all courses are offered each semester or session. Students should consult the current class schedule and the departmental office for specific details regarding frequency of offerings in specific courses.

Course descriptions are listed alphabetically by fields. (See the BIOM prefix and the *OSU Center for Health Sciences Catalog* for osteopathic medicine course descriptions.)

Explanation of Course Descriptions

A course description is comprised of the following elements, in order:

Course Number. All courses are identified by numbers composed of four digits. The first digit indicates the class year in which the subject is ordinarily taken, although enrollment is not exclusive as to student classification, the second and third digits identify the course within the field and the last digit identifies the number of semester credit hours the course carries. A course number beginning with 0 indicates that the course does not carry University credit. A course number ending in 0 indicates that the course carries variable credit. An asterisk (*) following the four-digit number indicates the course is approved for graduate credit.

Those numbered 5000 and above are primarily for graduate students, and only graduate students and selected seniors with consent of the instructor may enroll in them.

Graduate Sections of Mixed Credit 3000 or 4000-level Courses

(Undergraduate courses that are approved for graduate credit). Many courses have been approved to be offered for both undergraduate and graduate credit. These 3000 and 4000-level courses are identified by an asterisk next to the course number in the Catalog. A student must perform extra work as specified in the course syllabus to earn graduate credit for such a class. The instructor for any course for which graduate credit is received must be a member of the Graduate Faculty. Mixed courses which are available for both undergraduate and graduate credit are identified as to which type of credit is being offered through the use of different section numbers for each type of credit. Undergraduate sections are denoted by section numbers that are wholly numeric, and graduate sections contain the letter 'G' in the section number, usually in the last digit. For example, any semester PHYS 4513* (Introductory Quantum Mechanics) is offered for graduate credit, at least two sections may be open. PHYS 4513-001 will be for students seeking undergraduate credit and PHYS 4513-01G for students seeking graduate credit. Both sections will meet at the same time, on the same days, in the same classroom, with the same instructor. For further information regarding this policy, view the FAQ section of the Registrar website at **registrar.okstate.edu**.

General Education Requirement Codes. The capital letters in parentheses preceding some course titles designate courses fulfilling various undergraduate general education requirements. (See "Academic Regulations.") Not all courses that are approved for general education credit are offered each term. Please refer to the General Education course search on SIS to locate what courses are offered by term or for a complete list view the General Education Credit Course List on the Registrar website at **registrar.okstate.edu**.

Course Title. The title of the course is printed in boldface letters.

Statement of Variable Credit. Each course number ending in zero is followed by a statement of the credit that may be earned. Typical entries are 1-6 credits, maximum 6 and 1-3 credits, maximum 12, the first part of the entry indicating the permissible credit per enrollment, followed by a statement of the maximum credit which may be earned in the course through repeated enrollment.

Laboratory Hours. If a course contains a laboratory, the number per week of laboratory hours are stated, e.g., Lab 3.

Prerequisite(s). Prerequisites from the same department as the course being described are listed first, with no departmental abbreviation and in increasing numerical order. If from another department, that departmental abbreviation must precede the number of the prerequisite course. Those courses having prerequisites from both within and from outside the department bear combination entries such as 3303 and STAT 2012. Prerequisites are listed in the following manner:

Prerequisites: A or B or C
A or B or C is acceptable

Prerequisites: A or B, C
A or B is acceptable, and C is required

Prerequisites: A, B and C
A and B and C are required

Prerequisites: A, and B or C
A and either B or C

Prerequisites: A and B, or C
Both A and B, or C required

Prerequisites: A, or B and C
Either A or both B and C required

Prerequisites: A or equivalent and B
Both A, or the equivalent of A, and B are required

Prerequisites: A, and B or equivalent
Both A and B, or the equivalent of B, are required

Prerequisites: A and B, or equivalents
Equivalents of both A and B are acceptable.

Where no prerequisites are listed for courses numbered 3000 or 4000 level, it is understood that the prerequisite is approval of the student's adviser. The prerequisite for courses numbered 5000 or 6000 level is graduate standing in addition to any other prerequisites listed. Instructors may waive prerequisites when student background justifies this action. Prerequisites for lower-division courses may also be waived by a student's academic adviser if examination of the student's academic record warrants such a waiver. Prior approval of instructor may be required in problems courses, independent study, internships, thesis and dissertation courses, and courses taught in a professional school.

Description of Course Content. The content of the course and its major emphases are described. Courses which are taught under another name and number are indicated by the statement "same course as." Credit may not be earned in both courses so cross-referenced.

Courses with Equivalent or Overlapping Content

Equivalent Courses. Some courses are academically identical or equivalent to other courses that are at a different level or are offered in different departments. Such equivalent courses (sometimes referred to as *crosslisted*) should include "same as…" statements in their catalog course descriptions. Equivalent courses are denoted on the official transcript in accordance with the repeat policy (see Academic Regulation 6.13). Credit for only one of the courses will count in the earned hours section of the transcript.

Overlapping Courses. Other courses that are not identical/equivalent but contain similar or significantly overlapping content include "no credit for…" or "may not be used with…" statements in their catalog course descriptions. Overlapping courses are not listed as repeats in SIS, but students may not apply credit for both significantly overlapping courses toward a degree. For example, if the description for Course X indicates "No credit for students with credit in Course Y" or "May not be used for degree credit with Course Y," this means that a student may not use both courses to meet requirements for a single degree program. The student may use either Course X or Course Y, regardless of the order in which the courses were completed, but both courses may not be used to fulfill requirements for a single degree program. Thus, once a course is applied to a degree program, the (overlapping/redundant) course may not be used to fulfill requirements for that program, including major hours, elective hours, total hours, etc.

A&S	Arts and Sciences
ACCT	Accounting
AERO	Aerospace Studies--Air Force
AG	Agriculture
AGCM	Agricultural Communications
AGEC	Agricultural Economics
AGED	Agricultural Education
AGIN	International Agriculture
AGLE	Agricultural Leadership
AMIS	American Indian Studies
AMST	American Studies
ANSI	Animal Science
ANTH	Anthropology
ARCH	Architecture
ART	Art
ASL	American Sign Language
ASTR	Astronomy
AVED	Aviation Education
BADM	Business Administration
BAE	Biosystems and Agricultural Engineering
BCOM	Business Communications
BHON	Business Honors
BIOC	Biochemistry
BIOL	Biological Science
BIOM	Biomedical Sciences
BOT	Botany
CDIS	Communication Sciences and Disorders
CHE	Chemical Engineering
CHEM	Chemistry
CHIN	Chinese
CIED	Curriculum and Instruction Education
CIVE	Civil Engineering
CMT	Construction Management Technology
CPSY	Counseling Psychology
CS	Computer Science
CTED	Career and Technical Education
DHM	Design, Housing and Merchandising
DIVR	Diversity
ECEN	Electrical and Computer Engineering
ECON	Economics
EDLE	Educational Leadership
EDTC	Educational Technology
EDUC	Education
EEE	Entrepreneurship and Emerging Enterprise
EET	Electrical Engineering Technology
ENGL	English
ENGR	Engineering
ENSC	Engineering Science
ENTO	Entomology
ENVR	Environmental Science
EPSY	Educational Psychology
ETM	Engineering and Technology Management
FDSC	Food Science
FIN	Finance
FLL	Foreign Languages and Literatures
FPST	Fire Protection and Safety Technology
FREN	French
FRNS	Forensic Sciences
FSEP	Fire Safety and Explosion Protection
GENE	Genetics
GENG	General Engineering
GENT	General Technology
GEOG	Geography
GEOL	Geology
GRAD	Graduate
GREK	Greek
GRMN	German
GWST	Gender and Women's Studies
HCA	Health Care Administration
HDFS	Human Development and Family Science
HHP	Health and Human Performance
HIST	History
HONR	Honors College
HORT	Horticulture
HRAD	Hotel and Restaurant Administration
HRAE	Human Resources and Adult Education
HS	Human Sciences
IEM	Industrial Engineering and Management
ITOX	Interdisciplinary Toxicology
INTL	International Studies
JAPN	Japanese
LA	Landscape Architecture
LATN	Latin
LBSC	Library Science
LEIS	Leisure
LSB	Legal Studies in Business
MAE	Mechanical and Aerospace Engineering
MATH	Mathematics
MBA	Master of Business Administration
MC	Mass Communications
MSE	Materials Science and Engineering
MCAG	Mechanized Agriculture
MET	Mechanical Engineering Technology
MGMT	Management
MICR	Microbiology
MKTG	Marketing
MLSC	Military Science
MMJ	Multimedia Journalism
MSIS	Management Science and Information Systems
MUSI	Music
NATS	Natural Science
NREM	Natural Resource Ecology and Management
NSCI	Nutritional Sciences
OCED	Occupational Education
PHIL	Philosophy
PHYS	Physics
PLNT	Plant Science
PLP	Plant Pathology
POLS	Political Science
PSYC	Psychology
REL	Religious Studies
REMS	Research, Evaluation, Measurement, and Statistics
RES	Research
RMTR	Recreation Management and Therapeutic Recreation
RUSS	Russian
SC	Strategic Communication
SCFD	Social Foundations
SDEV	Student Development
SMED	Science and Math Education
SOC	Sociology
SOIL	Soil Science
SPAN	Spanish
SPCH	Speech Communication
SPED	Special Education
SPM	Sports Media
STAT	Statistics
TCOM	Telecommunications Management
TH	Theatre
UNIV	University
VBSC	Veterinary Biomedical Sciences
VCS	Veterinary Clinical Sciences
VMED	Veterinary Medicine
ZOOL	Zoology

Accounting (ACCT)

ACCT 2103 Financial Accounting. Prerequisite(s): 24 semester credit hours, including ENGL 1113 and MATH 1483 or equivalent. Financial accounting concepts and the use of financial accounting information in decision-making.

ACCT 2203 Managerial Accounting. Prerequisite(s): 2103. Managerial accounting concepts and objectives, planning and control of sales and costs, analysis of costs and profits.

ACCT 3013 Federal Income Taxation. Prerequisite(s): 2203; by permission only; satisfactory score on a qualifying exam covering basic accounting concepts. Federal income tax and its relationship to business decision-making; primary emphasis on recognition of the important tax consequences that attach to business transactions and the impact on business decision-making.

ACCT 3103 Intermediate Accounting I Prerequisite(s): 2203 with a grade of "C" or better; by permission only; satisfactory score on a qualifying exam covering basic accounting concepts. Theory and concepts underlying financial accounting and reporting.

ACCT 3113 Intermediate Accounting II. Prerequisite(s): 3103 with a grade of "C" or better. Theory and concepts underlying financial accounting and reporting. Continuation of 3103.

ACCT 3183 Agribusiness Accounting and Taxation. Prerequisite(s): 60 semester credit hours, including ENGL 1113 and MATH 1483 or equivalent. Development of the ability to read, analyze and use accounting information to improve decision-making and tax planning. (Same course as AGEC 3183)

ACCT 3203 Cost Accounting. Prerequisite(s): 2203, STAT 2023; by permission only; satisfactory score on a qualifying exam covering basic accounting concepts. Cost accumulation systems, allocating product costs, planning and controlling costs, standard costing, and profitability analysis.

ACCT 3603 Accounting Information Systems. Prerequisite(s): 2203; by permission only; satisfactory score on a qualifying exam covering basic accounting concepts. Accounting system design and installation.

ACCT 4033 Advanced Federal Income Taxation. Prerequisite(s): 3013. Federal income tax law applicable to individuals, corporations, partnerships, trusts and estates, and other specialized topics.

ACCT 4133 Advanced Accounting. Prerequisite(s): 3113 with grade of "C" or better. Accounting for business combinations and consolidations, accounting for governmental and not-for-profit entities.

ACCT 4233 Internal Auditing. Prerequisite(s): 3103 and 3603. Examination of theory and practices utilized by internal auditors in performing operational audits to assure an organization's operational effectiveness, efficiency, and control over resources.

ACCT 4503* Auditing and Assurance Services. Prerequisite(s): 3103 and 3603. Auditing theory, procedures and practices.

ACCT 4553 Ethical Issues in Accounting. Prerequisite(s): Admission to the MS/PPA or permission of department. Basic theories of ethics, including moral reasoning, moral values, relativity and objectivity, freedom and responsibility. Lecture and case approach for examination of issues such as independence, integrity, objectivity, client relationships, employee-employer relations, advertising, preferential treatment, core values and the corporation, and corporate governance, such as Sarbanes-Oxley Act, Foreign Corrupt Practices Act, and SEC regulations.

ACCT 4653 Contemporary Integrated Accounting and Business Systems. Prerequisite(s): 3603. Concepts and software applications underlying the design and use of databases for financial, managerial, and tax accounting measurement, compliance disclosure, and decision-related reporting in traditional and electronic commerce settings.

ACCT 4733 International Accounting. Prerequisite(s): 2103 and 2203. Diversity in financial reporting across countries and its effect on global capital flows. Using corporate financial information across borders. Accounting in emerging markets.

ACCT 4763 International Accounting Abroad. Prerequisite(s): 2103 or consent of instructor. A four-week visit to a European country or countries. An integrated approach to the cultural, economic, political, historical, and technological effects of the region on international accounting. Comparison of the accounting issues of the region to that of the U.S.

ACCT 4930 Accounting Projects. 1-9 credits, max 9. Prerequisite(s): 3113, 3203, and consent of instructor. Special topics, projects and independent study in accounting.

ACCT 5013* Tax Research. Prerequisite(s): Admission to MS in accounting. Development and administration of federal tax law with emphasis on the development of tax research skills.

ACCT 5023* Estate and Trust Taxation. Prerequisite(s): Admission to MS in accounting. Federal and Oklahoma wealth transfer tax systems, including estate, gift, and generation-skipping transfer taxation. Also, treatment of income taxation of estates and trusts and estate planning vehicles.

ACCT 5033* Natural Resource Taxation. Prerequisite(s): Admission to MS in accounting. Federal income tax laws applicable to the acquisition, operation, and disposal of natural resource properties.

ACCT 5043* Partnership Taxation. Prerequisite(s): Admission to MS in accounting and completion of 5013. Federal income tax laws applicable to partners and partnerships.

ACCT 5053* Corporate Taxation. Prerequisite(s): Admission to MS in accounting and completion of 5013. Federal income tax law applicable to corporations and shareholders.

ACCT 5083* MBA Tax Management. Prerequisite(s): Admission to MBA program or consent of MBA director. An introduction to the basic framework of the federal income tax system with an emphasis on recognition of the tax implications of business transactions and how taxes affect managerial decision-making. An exploration of the social and economic policy ramifications of the tax system.

ACCT 5103* Seminar in Contemporary Accounting Theory I. Prerequisite(s): 3113 with a grade of "C" or better and admission to the MS in accounting program. Origins and development of accounting theory. Critical study of issues in contemporary accounting theory.

ACCT 5113* Financial Accounting Research. Prerequisite(s): 3113 with a grade of "C" or better and admission to the MS in accounting program. Research and presentation of solutions for complex issues in contemporary accounting practice; using databases, SEC, FASB, AICPA, IASB, as well as other publicly available information.

ACCT 5123* Enterprise Resource Planning. Prerequisite(s): Graduate standing, ACCT 5103 and 5113. Resource planning for global business organizations. Integrated data flow and computer software for enterprise resource planning. Integration of transactional analysis, fundamental accounting practice, financial planning, and supply chain analysis forming the basis for study in this integrated approach to enterprise resource planning.

ACCT 5133* International Oil and Gas Accounting. Prerequisite(s): 3113 with a grade of "C" or better and admission to the MS in accounting program. Financial accounting and reporting for U.S. and international oil and gas operations. Domestic and international joint interest accounting. Accounting for international concession and profit sharing agreements.

ACCT 5153* Financial Statement Analysis. Prerequisite(s): 3113 with a grade of "C" or better and admission to the MS in accounting program. Study of the demand and supply of financial data, properties of information derived from financial statements, the role of financial information in investment decisions, and features of the decision-making environment.

ACCT 5183* MBA Financial Reporting. Prerequisite(s): Admission to a SSB graduate program or consent of MBA director. Fundamentals of financial reporting, preparation and analysis of financial statements, and the role of financial accounting in decision making.

ACCT 5203* Seminar in Contemporary Accounting Theory II. Prerequisite(s): 3113 with a grade of "C" or better and admission to the MS in accounting program. Origins and development of accounting theory. Critical study of issues in contemporary accounting theory. Continuation of 5103.

ACCT 5233* Valuation and Advanced Cost Management. Prerequisite(s): Admission to MS in accounting. Valuation of assets using a variety of interdisciplinary business methods. Advanced topics in cost management including the role of risk and its impact on valuation and cost management issues.

ACCT 5283* MBA Managerial Accounting. Prerequisite(s): 5183 and admission to MBA program or consent of MBA director. Interpretation of accounting data in planning, controlling and decision-making.

ACCT 5503* Auditing and Assurance Services. Prerequisite(s): Admission to professional program in accounting (PPA)/MS in accounting program. Auditing theory, procedures and practices.

ACCT 5513* Advanced Auditing and Assurance Services. Prerequisite(s): 5503 or equivalent. Introduction to fraud examination and legal issues involved in investigative process. Advanced topics in statutory auditing, operational auditing and investigative services.

ACCT 5543* Fraud Examination. Prerequisite(s): Permission of SSB Graduate Programs office. Schemes used in the commission of white-collar fraud, as well as causes, symptoms and prevention methods related to these crimes.

ACCT 5553* Forensic Accounting Tools. Prerequisite(s): Permission of SSB Graduate Programs office. Provides in-depth study and practice with tools that are most critical in conducting proactive fraud detection and fraud investigations.

ACCT 5603* Accounting-Based Information Systems. Prerequisite(s): Permission of SSB Graduate Programs office. Concepts underlying the design and use of an effective accounting information system.

ACCT 5613* Business Systems Control and Risk Analysis. Prerequisite(s): Permission of SSB Graduate Programs office. Controlling and auditing business information systems, including management and applications controls, electronic commerce and Internet-related controls and evaluation of system.

ACCT 5753* Seminar in International Accounting. Prerequisite(s): 3113 with a grade of "C" or better and admission to the MS in accounting program. Not available for students who have credit in 4733. Accounting issues faced by multinational enterprises and internationally listed companies, including diversity in financial reporting and harmonization.

ACCT 5783* MBA International Accounting. Prerequisite(s): 5183 and admission to MBA program or consent of MBA director. Diversity in financial reporting across countries and its effect on global capital flows. Corporate financial information across borders. Accounting in emerging markets.

ACCT 5830* Graduate Internship in Accounting. 1-3 credits, max 3. Prerequisite(s): Admission to MS/PPA in accounting; consent of graduate

coordinator and either 5503 or 5013. Supervised internship in public accounting, industry, or not-for-profit organizations. *May be counted as elective hours only.*

ACCT 5840* Special Topics and Individual Work in Accounting. 1-10 credits, max 10. Prerequisite(s): Consent of instructor. Individual work on special topics, projects or readings selected to acquaint students with significant accounting literature.

ACCT 5850* Practicum in Professional Accounting. 1-6 credits, max 6. Prerequisite(s): Admission to MS/PPA in accounting program. Study of accounting policies, retirement policies, tax issues, and other relevant business issues associated with mergers, acquisitions, and divestures.

ACCT 5880* MBA Special Topics in Accounting. 1-3 credits, max 3. Prerequisite(s): 5183 and admission to MBA program or consent of MBA director. Individual work on special topics, projects or readings to acquaint students with accounting literature.

ACCT 5932* Research Report. Prerequisite(s): Consent of supervising professor and admission to MS in accounting. Restricted to candidates seeking the MS in accounting degree and not available to students who have credit in 5940. Methods used in research and report writing in accounting. Independent investigation and writing of an acceptable report on a topic approved by the student's supervising professor.

ACCT 5940* Thesis. 1-6 credits, max 6. Prerequisite(s): Admission to MS in accounting. For students writing reports and theses in accounting.

ACCT 6000* Doctoral Research and Dissertation. 1-18 credits, max 36. Prerequisite(s): Approval of advisory committee. For students working on the doctoral degree.

ACCT 6110* Graduate Readings and Special Topics in Accounting. 1-3 credits, max 20. Prerequisite(s): Consent of supervising professor and coordinator of graduate programs in accounting. Supervised reading of significant literature and study of special topics not covered in regularly scheduled accounting courses.

ACCT 6703* Seminar in Accounting Research. Prerequisite(s): Doctoral student status and consent of coordinator of graduate programs in accounting. The theoretical literature and research methodology in accounting.

Aerospace Studies - Air Force (AERO)

AERO 1111 Foundations of the U.S. Air Force I. Lab 1. Doctrine, mission and organization of the United States Air Force through a study of the total force structure, strategic offensive and defensive forces, general purpose forces and aerospace support forces.

AERO 1211 Foundations of the U.S. Air Force II. Lab 1. Continuation of the doctrine, mission and organization of the United States Air Force; review of Army, Navy, and Marine general purpose forces.

AERO 2111 Evolution of U.S. Air Force Air and Space Power I. Lab 1. Growth and development of aerospace power through history beginning with first manned flights and continuing through World War II.

AERO 2211 Air Power History II. Lab 1. Development and growth of aerospace power from the period following World War II through the Vietnam conflict; concepts of peaceful deployment of U.S. air power.

AERO 3103 Air Force Leadership Studies I. Lab 2. The study of the fundamental leadership, management, and communication skills required of an Air Force junior officer. Basic managerial processes, management of forces in changing environments, organizational power, politics, and managerial strategy and tactics.

AERO 3203 Air Force Leadership Studies II. Lab 1. The application of leadership, management, and communication skills required of an Air Force junior officer. The individual as a leader in the Air Force environment, individual, motivational, and behavioral processes, group dynamics, leader and management ethics, counseling and evaluating are discussed.

AERO 3504 Field Training Encampment Program. Prerequisite(s): Consent of professor of aerospace studies. Practical training on an Air Force base. Junior officer training, familiarization training in most functional aspects of a typical Air Force base. Includes career orientation, small arms firing, flight orientation rides, and survival training.

AERO 4103 National Security Affairs I. Lab 2. The formulation, organization and context of national security; civil-military interaction and the evolution of strategy. Review of the military profession and officership.

AERO 4203 National Security Affairs II. Lab 1. Strategy and management of conflict; implementation of national security and regional world issues. Review of societal issues in the military profession and the military justice system.

AERO 4402 Summer Professional Development Training Program. Prerequisite(s): Consent of professor of aerospace studies. Students spend from two to three weeks on an Air Force base working in their intended specialty under supervision of experienced officer. Leadership and management principles applied to day-to-day experiences.

AERO 4554 Introductory Flight Training Program. Prerequisite(s): Consent of professor of aerospace studies. Academic and flying phase. Flight characteristics, meteorology, navigation, FAA regulations, and radio procedures.

Agricultural Communications (AGCM)

AGCM 2113 Communications in Agriculture. Lab 2. Prerequisite(s): ENGL 1113 and major in AGCM or consent of instructor. Fundamentals of agricultural news writing and other communication methods. Careers in and the role of the media in agriculture and related fields.

AGCM 3100 Special Topics in Agricultural Communications. Prerequisite(s): consent of instructor. Investigation of specialized and/or advanced topics and issues related to agricultural communications.

AGCM 3103 Written Communications in Agricultural Sciences and Natural Resources. Prerequisite(s): Junior standing in the College of Agricultural Sciences and Natural Resources or consent of the instructor. Understanding and application of writing principles and communications theory as related to public issues in agriculture and the environment. Practice in writing for a variety of media and preparation of other communications as part of a communications campaign strategy.

AGCM 3113 Writing and Editing for Agricultural Publications. Lab 2. Prerequisite(s): 2113 with a grade of "C" or better; major in agricultural communications; score of 3 or better on writing assessment; or consent of instructor. Interviewing, reporting, writing, and editing for agricultural publications.

AGCM 3123 New Media in Agricultural Communications. Lab 2. Prerequisite(s): 3113 and 3233. Exploration and application of emerging media technologies for agricultural communicators as used in promoting, marketing and communicating about agriculture, food, natural resources and the environment.

AGCM 3203 Oral Communications in Agricultural Sciences and Natural Resources Lab 2. Prerequisite(s): ENGL 1213 or consent of instructor. Application of oral communications skills used in the dissemination of information related to agricultural sciences and natural resources, and related topics. Acquisition of interpersonal communications skills and small group, impromptu and professional presentation skills.

AGCM 3213 Layout and Design for Agricultural Publications. Lab 4. Prerequisite(s): 2113 or JB 2003; major in agricultural communications or consent of instructor. Fundamentals of layout and design as applied to agricultural publications. Practical application of design principles, typography, desktop-publishing software and printing practices. Opportunity for service-learning experiences.

AGCM 3223 Web Design for Agricultural Organizations. Lab 4. Prerequisite(s): 2113 or JB 2003; major in agricultural communications or consent of instructor. Development of World Wide Web sites for agricultural organizations. Practical application of theory and skills related to graphic design, computer software, writing, editing and project management. Opportunities for service-learning experiences.

AGCM 3233 Basic Photography and Photo Editing for Agriculture. Lab 4. Prerequisite(s): 2113 or JB 2003; major in agricultural communications or consent of instructor. Beginning course focusing on photographic equipment, related software and photo composition in an agricultural setting.

AGCM 4113* Features Writing and Editing for Agricultural Publications. Prerequisite(s): 3113 with a grade of "C" or better; major in agricultural communications or consent of instructor. Brainstorming, researching, interviewing, developing, writing and editing feature stories for agricultural publications.

AGCM 4203* Professional Development in Agricultural Communications. Prerequisite(s): 2113 or JB 2003; major in agricultural communications or consent of instructor. Professional preparation and development for careers in agricultural communications. Professional communications, resume and portfolio development, presentations, networking and job interviews. Introduction to event planning.

AGCM 4233 Agricultural Photography Tour Lab 2. Agricultural photography travel course focused on advanced composition techniques including but not limited to night photography, portraits, painting, etc. Students will be exposed to many cultural and agricultural sites from a photographic perspective. *No credit for students with credit in AGCM 5233.*

AGCM 4300 Internships in Agricultural Communications. 1-6 credits, max 6. Prerequisite(s): Consent of internship coordinator and adviser. Supervised work experience with approved employers in agricultural communications. Presentation required following the internship experience.

AGCM 4403 Planning Campaigns for Agriculture and Natural Resources. Lab 4. Prerequisite(s): 3113 or JB 3263; AGCM 3213; major in agricultural communications or consent of instructor. Communications campaign development for agriculture and natural resources activities and issues, including development of materials, budgets and contracts.

AGCM 4413* Agricultural Communications Capstone. Lab 4. Prerequisite(s): 3213, 3233; JB 3263 or AGCM 4113; senior or graduate standing and consent of instructor. The development of agricultural communications projects with focus in either broadcast or print media. Practical application of writing, editing and design skills as well as software applications.

AGCM 4990 Problems in Agricultural Communications. 1-6 credits, max 6. Prerequisite(s): Consent of instructor. Small group and individual study and

research in problems relating to communications within the agricultural sector and from the agricultural sector to other constituencies.

AGCM 5000* Research and Thesis. 1-6 credits, max 6. Prerequisite(s): Graduate standing. Independent research and thesis under the direction and supervision of a major professor.

AGCM 5100* Special Topics in Agricultural Communications. 1-3 credits, max 6. Prerequisite(s): Consent of instructor. Investigation of specialized and/or advanced topics and issues related to agricultural communications.

AGCM 5101* Orientation to Graduate Programs in Agricultural Education, Communications and Leadership. Prerequisite(s): Graduate standing. Orientation to graduate programs in agricultural education and communication including degree expectation, understanding scholarship, orientation to the discipline, introduction to research agendas, and identification of support systems. (Same course as AGED 5101)

AGCM 5103* History and Philosophical Foundations of Agricultural Communications. Prerequisite(s): Graduate standing. Discussion of the history, philosophical foundations and current issues regarding agricultural communications and the land-grant system.

AGCM 5132* Writing for Scholarly Publications in Agricultural Sciences and Natural Resources. Development of scientific writing skills for agricultural sciences and natural resources disciplines, including research proposals, theses, dissertations, conference papers, and journal articles.

AGCM 5203* Theory and Practice in Agricultural Communications. Prerequisite(s): Graduate standing. The study of major communication theories and theorists in the context of agricultural communications.

AGCM 5213* Advanced Concepts in Agricultural Publishing. Prerequisite(s): Graduate standing. Analysis, redesign and creation of agricultural publications. Evaluation of audience, production, advertising and editorial content.

AGCM 5233* Agricultural Photography Tour Lab 2. Agricultural photography travel course focused on advanced composition techniques including but not limited to night photography, portraits, painting, etc. Students will be exposed to many cultural and agricultural sites from a photographic perspective. *No credit for students with credit in AGCM 4233.*

AGCM 5303* Communicating Ethical Issues in Agriculture. Prerequisite(s): Graduate standing. An introduction to communicating ethical theories in the context of agriculture. Ethical theory and current research are used to critique contemporary issues in agriculture.

AGCM 5403* Public Relations Campaigns in Agricultural Sciences and Natural Resources Lab 2. Prerequisite (s): AGCM 5213* Public relations campaign development for agriculture and natural resources organizations and issues, including public relations theory, strategic planning and campaign material development. *No credit for students with credit in AGCM 4403.*

AGCM 5503* Disaster Management and Communication in Agricultural Sciences and Natural Resources. Development of disaster management and communication skills and knowledge, with special application to agricultural sciences and natural resources disaster and terrorism situations.

AGCM 5990* Studies in Agricultural Communications. Prerequisite(s): Consent of supervising professor. Individual and small group study or research in agricultural communications topics and issues.

Agricultural Economics (AGEC)

AGEC 1113 (S) Introduction to Agricultural Economics. Economic theory of production, marketing, and consumption of agricultural products and natural resources. The role and structure of agricultural sciences and natural resources within the American economy. Policies to achieve efficiency and welfare goals in agriculture. *No general education credit for students also taking ECON 1113 or ECON 2103.*

AGEC 2303 (D) Food Marketing to a Diverse Population. Food and beverage demand and preferences of socially and ethnically constructed groups in American Society. Real life issues of marketing to a diverse population, including Native, Asian, African, and Hispanic Americans, and low-income populations.

AGEC 2313 (I) Case Studies in Agricultural Trade and Development. Prerequisite(s): A course in economics or marketing. Real world issues in international trade and development of agricultural and food products. Development of an understanding of issues facing policymakers, producers, consumers, and other groups in examining the costs and benefits of various trade and development programs.

AGEC 3010 Internship in Agricultural Economics. 1-3 credits, max 3. Prerequisite(s): Approval of internship committee and adviser. Supervised work experience with approved public and private employers in agricultural economics, including banks, farm credit services, agriculture chemical firms, Soil Conservation Service, congressional offices and other opportunities. *Credit will not substitute for required courses. Graded on a pass-fail basis.*

AGEC 3101 Professional Career Development. Prerequisite(s): Junior standing and agricultural economics or agribusiness major status. Overview of the various areas of specialization within agricultural economics and agribusiness and their associated career opportunities and obligations. Development and improvement of written communication, oral communication and leadership skills.

AGEC 3183 Agribusiness Accounting and Taxation. Prerequisite(s): 60 semester credit hours, including ENGL 1113 and MATH 1513 or equivalent. Development of the ability to read, analyze, and use accounting information to improve decision-making and tax planning. (Same course as ACCT 3183)

AGEC 3213 Quantitative Methods in Agricultural Economics. Lab 2. Prerequisite(s): 1113 or ECON 2103, and STAT 2023 or equivalent. Indices, graphics, budgeting, interest calculations, compounding and discounting, basic statistic measures, regression, optimization and computer applications.

AGEC 3323 Agricultural Product Marketing and Sales. Prerequisite(s): 1113, ENGL 1113, SPCH 2713. Fundamentals of agricultural marketing management and planning applied to specific agricultural product (input and output) marketing problems. Institutional differences between agricultural and non-agricultural marketing environments. The role of the individual sales representative in a marketing and sales organization. *Written and oral presentations of marketing and sales information required of all students.*

AGEC 3333* Agricultural Marketing and Price Analysis. Prerequisite(s): 3213 or concurrent enrollment. Supply, demand, and price determination within the institutional environment of agricultural commodity markets. The roles provided by government intervention, marketing agreements, and cooperatives in agricultural markets. Some graphical analysis of commodity market data. Fundamentals of futures markets applied to agriculture.

AGEC 3403 Agricultural Small Business Management. Prerequisite(s): 1113 or ECON 2103. The essentials of operating an agricultural small business. An introduction to the planning, organizing, marketing, managing, financing, controlling and operating an agricultural small business. *Not recommended for agricultural economics or agribusiness majors. No credit for students with prior credit in 4423.*

AGEC 3423 Farm and Agribusiness Management. Prerequisite(s): 1113 and ACCT 2103 or ACCT 3183 or AGEC 3183. Fundamentals of managerial functions as applied to agricultural firms. Organization and management of human, financial, and physical assets for the profitable operation of an agricultural business. An introduction to business planning, enterprise budgeting, financial statements and record keeping.

AGEC 3463 Agricultural Cooperatives. Prerequisite(s): 1113 or ECON 2103. An evaluation of the fundamental principles, objectives, structure, finance, and management associated with the cooperative organization. An analysis of the cooperative business organization within the modern economy: history, legislation and evolution. An examination of careers related to cooperatives.

AGEC 3503 Natural Resource Economics. Prerequisite(s): 1113 or ECON 2103. Framework for analyzing natural resource management decisions. Applications of microeconomic theory to the management of soil, water, and other resources, with special emphasis on the institutions having an impact on management opportunities. Supply of and demand for natural resources, resource allocation over time, rights of ownership, public issues of taxation, police power and eminent domain.

AGEC 3603 Agricultural Finance. Prerequisite(s): 3213 and 3423. Analyze farm and agribusiness financial statements. Understand the relationship between firm growth and financial leverage. Time value of money concepts and their application to capital budgeting. Discuss how agricultural lenders acquire and use funds.

AGEC 3703 Issues in Agricultural Policy. Prerequisite(s): 1113. Emerging issues related to agricultural policy in the United States.

AGEC 3713 Agricultural Law. Prerequisite(s): 1113. Survey of law with emphasis on agricultural problems, applications, and strategies for managing legal risk in the agribusiness setting. Contract law, tort law, property law, real estate transactions, business organization, estate planning, debtor/creditor law, environmental law, and water/resources law.

AGEC 3990 Special Problems in Agricultural Economics. 1-3 credits, max 3. Directed study of selected agricultural economics topics.

AGEC 4101 Agricultural Economics Seminar. Prerequisite(s): Senior standing and agricultural economics or agribusiness major status. Contemporary problems in agricultural economics.

AGEC 4213* Advanced Quantitative Methods in Agricultural Economics. Prerequisite(s): 3213, 3333, MATH 2103, and ECON 3023 or 3113. Quantitative analysis of agricultural supply and demand in situations involving risk and uncertainty within the institutional setting of agricultural markets. Use of spreadsheets to perform regression analysis and simulation of potential market outcomes. Analysis of specific agricultural market cases with written and oral presentation of the results.

AGEC 4333* Commodity Futures Markets. Prerequisite(s): 3213 and 3333. The economics of commodity futures markets. The vocabulary of futures markets and the mechanics of trading and hedging. Basis and producer marketing strategies. Fundamental analysis and statistical analysis of data. Technical analysis, behavioral finance, efficient market hypothesis, and basics of option pricing.

AGEC 4343 (I) International Agricultural Markets and Trade. Prerequisite(s): 1113 or ECON 2103. Contemporary international agricultural trade theory and applications. Tools to identify, evaluate critically, and seek solutions to complex international trade and development problems, such as gains from trade, comparative advantage, impacts of trade barriers on social welfare, export

promotion effectiveness, trade impacts on environment and land degradation, free trade areas, and impacts of genetically modified crops on trade.

AGEC 4403* Advanced Farm and Ranch Management. Prerequisite(s): 3213, 3333, 3603, MATH 2103, and ECON 3023 or 3113. The development of problem solving and risk management skills needed on the modern farm or ranch. Use of spreadsheets to perform production planning and analysis of farm and ranch problems with linear programming, simulations, and other tools. Analysis of the acquisition of resources and the use of information systems in managing the individual farm or ranch business.

AGEC 4423* Advanced Agribusiness Management. Prerequisite(s): 3213, 3333, 3603, MATH 2103, and ECON 3023 or 3113. Application of modern decision theory in the uncertain environment that the agricultural business operates. Planning, organizing, implementing, coordinating, and controlling problems associated with establishing an agricultural business, achieving firm growth, and operating the firm through time. Use of spreadsheets to perform production planning and analysis related to agricultural business operation with linear programming, simulations, and other tools. Analysis of the interaction of resources, prices and production alternatives.

AGEC 4503* Environmental Economics and Resource Development. Prerequisite(s): 3503 or ECON 3113 or consent of instructor. Economic, social, and political factors relating to conservation, natural resource development, and environmental quality. Valuation of priced and non-priced natural and environmental resources. Analysis of environmental and natural resource policy and the role of public and private agencies in conservation and development.

AGEC 4513* Farm Appraisal. Lab 2. Prerequisite(s): 3423. Estimating the market value of agricultural real estate using the three approaches to value - sales comparison, cost, and income approaches. Analysis of sales to value the different characteristics of the farm.

AGEC 4703* American Agricultural Policy. Prerequisite(s): 3213, 3333, MATH 2103, and ECON 3023 or 3113. Economic characteristics and problems of agriculture; evolution and significance of programs and policies.

AGEC 4723* Rural Economics Development. Prerequisite(s): 1113 or ECON 2103. Concepts, theories, and applications of regional and community economics, including the theories of economic development, analytics techniques, infrastructure and community services, targeted development, and associated policies. Focus on domestic rural areas.

AGEC 4803 (I) International Agricultural Economics Tour. Prerequisite(s): Consent of instructor. A two-three week international travel component. An integrated approach to the cultural, agricultural, historical, technological, political, economic, and religious backgrounds of the region. Comparison of the agricultural business environment of the region to that of the U.S.

AGEC 4990* Problems in Agricultural Economics. 1-6 credits, max 6. Open to students with consent of instructor only. Research on special problems in agricultural economics.

AGEC 5000* Master's Thesis/Report. 1-6 credits, max 6. For students working on an MS degree in agricultural economics. Independent research and thesis under the direction and supervision of a major professor.

AGEC 5010* Professional Experience in Agricultural Economics or Agribusiness. 1-6 credits, max 6. Prerequisite(s): Approval of internship committee and adviser. Supervised professional experience with approved public and private employers in agricultural economics or agribusiness. Designed for Master of Agriculture program. *Graded on pass-fail basis.*

AGEC 5101* Research Methodology. Prerequisite(s): Selection of a thesis adviser and a thesis topic. Using the scientific method to solve problems related to agriculture. Preparation of a thesis proposal required.

AGEC 5103* Mathematical Economics. Prerequisite(s): Differential calculus and ECON 3113. Mathematical tools necessary for formulation and application of economic theory and economic models.

AGEC 5113* Applications of Mathematical Programming. The application of concepts and principles of existing linear and nonlinear programming techniques to agricultural problems.

AGEC 5203* Advanced Agricultural Prices. Prerequisite(s): 5103, STAT 4043. Demand and price structures, price discovery, time series and agricultural price research methods.

AGEC 5213* Econometric Methods. Prerequisite(s): 5103 and ECON 4213 or STAT 4043. Application of econometric techniques to agricultural economic problems, theory and estimation of structural economic parameters.

AGEC 5233* Primary Data Analysis in Economic Research. Prerequisite(s): 5213 or ECON 5243 or concurrent enrollment. Development and analysis of surveys and experiments designed to collect primary data for economic research. Basics of survey and experimental design, survey delivery, and sampling. Methods, economics, and econometrics of valuation methods including contingent valuation, experimental auctions, factor analysis, cluster analysis, and structural equations modeling, including limited dependent variable models such as the logit, probit, ordered probit, multinomial logit, tobit and interval censored regression.

AGEC 5311* Agricultural Marketing: Concepts and Tools. Role of marketing and prices in the food system. Price variation across space, time, and form.

AGEC 5321* Agricultural Marketing and Economic Development. Prerequisite(s): 5311. Role of marketing in economic development, focusing on international economics; role of institutions in a market economy.

AGEC 5331* Agricultural Marketing: Advanced Concepts. Prerequisite(s): 5311. Advanced topics in price variation across space, time, and form. Market and firm efficiency. Market structure, conduct, and performance; role of information in a market economy; and other selected topics.

AGEC 5343* International Agricultural Markets and Trade. Contemporary international agricultural trade theory and applications. Broaden students' understanding of contemporary cultural and economic issues outside the U.S. that affect global demand. Gains from trade and the theory of comparative advantage. *No credit for students with credit in AGEC 4343.*

AGEC 5353* Advanced Case Studies in Agricultural Marketing and International Development. Prerequisite(s): Consent of instructor. Advanced real world issues in marketing and international development of agricultural and food products. Development of an understanding of issues facing policy makers, producers, consumers, and other groups in examining the costs and benefits of various international marketing, trade and development programs.

AGEC 5403* Production Economics. Prerequisite(s): 5103. Analysis of micro-static production economics problems; factor-product, factor-factor and product-product relationships; functional forms for technical unit and aggregate production functions; maximizing and minimizing choice rules; firm cost structure; scale relationships.

AGEC 5423* Agribusiness Management. Prerequisite(s): Consent of instructor. Application of quantitative analysis to the evaluation of business plans for agribusiness firms. Preparation of business plans, including mission statements, financial analyses, marketing plans, personnel, and organization requirements of the firm, production and operations plans as well as a contingency plan. Analysis of risk factors associated with agriculturally-based companies. *No credit for students with credit in AGEC 4423.*

AGEC 5463* Advanced Agricultural Cooperatives. Prerequisite(s): 3463 or consent of instructor. Advanced understanding of cooperative business model and management skills. Advanced cooperative finance including profit center analysis, equity management, working capital management, budgeting, and capital budgeting.

AGEC 5483* Bio-Energy Feasibility and Commercialization. Prerequisite(s): 1113. Feasibility and commercialization of bio-fuel and bio-based projects. Issues and processes in transitioning a project from pilot scale into commercialization.

AGEC 5503* Economics of Natural and Environmental Resource Policy. Prerequisite(s): 4503 or ECON 3113 and MATH 2103. Economics of long term resource use with particular emphasis on agricultural and forestry problems. Methods for estimation of non-market prices. Cost benefits analysis of long term natural resource use and environmental policy. Elementary computer simulation of long term resource use and environmental policy.

AGEC 5603* Advanced Agricultural Finance. Prerequisite(s): 3603 or FIN 3113, ECON 3023 or 3113 and ECON 4213 or STAT 4043. Financial management concepts applied to agricultural firms. Financial models that incorporate uncertainty and risk via stochastic simulation. Risk/return tradeoff for stocks and portfolio management.

AGEC 5703* Economics of Agriculture and Food Policy. Prerequisite(s): 4703 and 5103. Application of welfare criteria and economic analysis to agricultural, food, and rural development problems and policies.

AGEC 5713* Rural Regional Analysis. Prerequisite(s): 5103. Concepts of market and nonmarket based rural welfare; theories of regional growth as applied to rural areas; methods of regional analysis including computable general equilibrium; analysis of policies and programs for improving welfare of rural population groups.

AGEC 5723* Planning and Policy for Development. Prerequisite(s): Master's-level microeconomics, macroeconomics, and regression analysis. Economics of market-based planning and policy analysis for developing countries, topics and tools in macro- and microeconomics of development, and social cost-benefit and project analysis with emphasis on agricultural and public policy. Hands-on application of econometrics, input-output analysis, and cost-benefit analysis using econometric software.

AGEC 5733* International Agricultural Policy and Development. Global welfare analysis of national food and agricultural trade and development policies of developed and developing countries. Analysis of import demand systems using real world data and incorporating economic and demographic variables.

AGEC 5783* Bio-Energy Economics and Sustainability. Prerequisite(s): 1113. Economic issues related to supply chains producing bio-energy and bio-based products. Economic, sustainability and social dimensions of these industries. Triple bottom line objectives, life cycle analysis and the principles of feasibility analysis.

AGEC 5990* Advanced Studies. 1-6 credits, max 6. Open to graduate students with consent of instructor only. Investigation in designated areas of agricultural economics.

AGEC 6000* Doctoral Dissertation. 1-15 credits, max 24. Open to students pursuing graduate study in agricultural economics beyond the requirements for a master's degree. Independent research and thesis under the direction and supervision of a major professor.

AGEC 6102* Teaching Practicum in Agricultural Economics. Lab 4. Prerequisite(s): Two semesters of graduate study in agricultural economics. Philosophies of resident and nonresident teaching, general tasks performed, review, evaluation and lecture organization, preparation and presentation.

AGEC 6103* Advanced Applications of Mathematical Programming. Prerequisite(s): 5103, 5113. General presentation of nonlinear optimization theory and methods followed by applications of nonlinear programming. Use of GAMS/MINOS optimization software package.

AGEC 6213* Advanced Econometrics. Prerequisite(s): 5213 or ECON 5243; STAT 4203 and 4213 recommended. Using advanced econometric techniques in applied research. Linear and nonlinear hypothesis testing; non-nested hypothesis tests; Monte Carlo hypothesis testing; stochastic simulation; misspecification testing. Extensive use of SAS statistical software package.

AGEC 6300* Agricultural Marketing Seminar. 1-6 credits, max 6. Prerequisite(s): Consent of instructor. Current developments in theory, techniques for evaluating marketing behavior, market legislation and market development.

AGEC 6303* Advanced Agricultural Marketing. Prerequisite(s): 5303. Marketing theory, market structure and performance, governmental regulation and policy and bargaining in agricultural markets.

AGEC 6400* Seminar in Farm Management and Production Economics. 1-6 credits, max 6. Prerequisite(s): 5403 or consent of instructor. Scientific research methodology applied to problems of resource efficiency.

AGEC 6403* Advanced Production Economics. Prerequisite(s): 5403. Formulating and solving applied economic optimization problems in agricultural production economics. Expected profit maximization; analyzing data from agronomic experiments; credit scoring; risk models such as stochastic dominance and expected utility.

AGEC 6700* Agricultural Policy and Rural Resource Development Seminar. 1-2 credits, max 2. Frontier issues in agricultural policy, natural resources and rural development.

Agricultural Education (AGED)

AGED 2011 Topics and Issues in Agricultural Education. An exploration into the world of teaching secondary agricultural education with a focus on the role and purpose of the comprehensive agricultural education program. Observation of teachers in an experiential manner by actively interviewing agricultural education teachers, school principals, and appropriate state staff; assisting with FFA activities; and observing students' SAE opportunities.

AGED 3101 Laboratory and Clinical Experiences in Agricultural Education. Pre-professional clinical experiences in agricultural education teaching and related careers. Requirement for admission to professional education, student teaching, and internships.

AGED 3103 Foundations and Philosophies of Teaching Agricultural Education. Lab 2. Prerequisite(s): 21 semester credit hours of agriculture with a 2.50 GPA. Roles and responsibilities of the agricultural education teacher; types of program offerings; steps of the teaching-learning process; place of agricultural education in relation to other educational programs in school systems.

AGED 3203* Planning the Community Program in Agricultural Education. Lab 2. Prerequisite(s): 3103. Determining resources and trends of local communities with respect to agricultural production and agribusiness. Emphasis on agricultural education program policies, FFA chapter advisement, planning and managing the instructional program, identification and completion of records and reports required of a teacher of agricultural education in Oklahoma.

AGED 4103* Methods and Skills of Teaching and Management in Agricultural Education. Lab 2. Prerequisite(s): 3101 and 3203 and EPSY 3213 (or 3413) and SPED 3202 and concurrent enrollment in 4113 and 4200 and full admission to the University Professional Education program. Facets of the teaching-learning process including teaching methods, basic teaching skills, proper classroom management techniques, and motivational techniques and ideas. Preparation for student teaching which is to be completed during the same semester.

AGED 4113 Laboratory Instruction in Agricultural Education. Lab 2. Prerequisite(s): 3101 and 3203 and EPSY 3213 (or 3413) and SPED 3202 and concurrent enrollment in 4103 and 4200 and full admission to the University Professional Education program. Methods of teaching agricultural education in a laboratory setting. A study of laboratory safety instruction, methods of teaching, and application of technical agricultural skills to the secondary program.

AGED 4200 Student Teaching in Agricultural Education. 1-9 credits, max 9. Prerequisite(s): 3101 and 3203 and EPSY 3213 (or 3413) and SPED 3202 and concurrent enrollment in 4103 and 4113 and full admission to the University Professional Education program. Full-time directed experience in an approved agricultural education department. Applications of methods and skills in agricultural education as related to selecting, adapting, utilizing, and evaluating curriculum materials and experiences to meet educational goals and facilitate learning for individual students. Roles, responsibilities, and organization and operation of school systems.

AGED 4713 (I) International Programs in Agricultural Education and Extension. World hunger and its root causes. The function of international agencies, organizations, foundation and churches in improving the quality of life for people of the developing nations. Roles of agricultural education and extension at all levels for enhancing the effectiveness of indigenous programs of rural development and adult education.

AGED 4803 (I) International Study Tour in Agricultural Education. Prerequisite(s): Consent of instructor. An experiential learning course featuring an international travel component. Provides an integrated approach to studying the agriculture, education, natural resources, culture, history, government, economy, and religion of a particular region. Special emphasis placed upon formal and informal educational programs focusing on agriculture and natural resources.

AGED 4990* Seminar and Problems in Agricultural Education. 1-3 credits, max 6. Small group and/or individual study and research in problems relating to programs of occupational education in agriculture.

AGED 5000* Research and Seminar. 1-6 credits, max 6. Independent research and thesis under the direction and supervision of a major professor.

AGED 5101* Orientation to Graduate Programs in Agricultural Education, Communications and Leadership. Prerequisite(s): Graduate standing. Orientation to graduate programs in agricultural education and communications including degree expectation, understanding scholarship, orientation to the discipline, introduction to research agendas, and identification of support systems. (Same course as AGCM 5101)

AGED 5102* Creative Component in Agricultural Education. Prerequisite(s): 5983 or equivalent; consent of instructor. Independent research or project management under the direction and supervision of a major adviser.

AGED 5123* Adult Programs in Agricultural and Extension Education. Determining adult needs, priorities, participation in educational activities, and adoption of new ideas and practices. Designing, organizing, conducting, and evaluating adult education programs in agricultural and extension education.

AGED 5203* Grant Seeking. Prerequisite(s): Graduate standing or consent of instructor. External funding proposal development for foundation and government agencies. Conceptualizing projects, identifying funding sources, and develop proposals that follow RFP guidelines including a literature review, need for the project, approach, timeline and budget.

AGED 5500* Directing Programs of Supervised Experience. 1-3 credits, max 6. Prerequisite(s): Consent of instructor. Determining the supervised training needs and opportunities of individual students. Planning for supervision of agricultural education training programs and 4-H club projects. Analysis of training opportunities in production agriculture, agricultural businesses and individual career development.

AGED 5623* Volunteer Management in Agricultural and Extension Education. Prerequisite(s): Graduate standing. Concepts, theories and practices relevant to the management of volunteers with an emphasis on recruiting, managing, and training in formal or non-formal educational settings.

AGED 5703* Cultural Competency for Working in Agricultural and Extension Education. Prerequisite(s): Graduate standing. Examination of strategies to increase intercultural intelligence, and cultural competence. Focus on concepts of cultural values and stereotypes, intercultural sensitivity, cultural differences, cultural transitions, and intercultural theories for agricultural and extension educators.

AGED 5803* International Study Tour in Agricultural Education for Graduate Students. Prerequisite(s): Consent of instructor. Experiential learning course for graduate students featuring an international travel component. Provides an integrated approach to studying the agriculture, education, natural resources, culture, history, government, economy, and religion of a particular region. Special emphasis placed upon formal and informal educational programs focusing on agriculture and natural resources.

AGED 5813* College Teaching of Agriculture and Natural Resources. Prerequisite(s): Consent of instructor. Facets of the teaching-learning process used to teach agriculture and natural resources in higher education including teaching methods, instructional skills, application of instructional technology, student motivation, and evaluation of learning.

AGED 5823* Advanced Methods of Teaching Agriculture. Advanced concepts and methods relevant for both formal and informal presentations. Effects methods may have on individuals involved in the learning experience. Demonstrations of proficiency in use of various advanced methodologies, technologies and concepts.

AGED 5863* Methods of Technological Change. Processes by which professional change agents influence the introduction, adoption, and diffusion of technological change. Applicable to persons who work closely with people in formal and non-formal educational settings.

AGED 5900* Graduate Internship in Agriculture. 1-6 credits, max 6. Prerequisite(s): Admission to Master of Agriculture program; consent of graduate coordinator. Supervised internship in agricultural education, government agency, industry, Cooperative Extension, or not-for-profit organizations.

AGED 5983* Quantitative Research Methods in Agricultural Education. Prerequisite(s): Graduate standing. A comprehensive examination of quantitative research methods including identifying a problem, data collection, statistical analysis, ensuring validity and reliability, and reporting.

AGED 5990* Problems in Agricultural and Extension Education. 1-3 credits, max 8. Securing and analyzing data related to special problems or investigation in designated areas of agricultural education.

AGED 5993* Data Analysis and Interpretation in Agricultural Education. Prerequisite(s): Graduate standing; 5983 or equivalent; REMS 5953 or equivalent. A course designed for Agricultural Education students, who have gathered or are gathering data for a research study, to analyze and interpret that data. Both quantitative and qualitative data analysis techniques will be studied. The discovery method will allow the students and instructor to work together to identify resources to analyze and interpret the data sets.

AGED 6000* Research in Agricultural Education. 1-16 credits, max 16. Prerequisite(s): Approval of major adviser. Open to students pursuing graduate study beyond the requirements for a master's degree. Independent research and thesis under the direction and supervision of a major professor.

AGED 6100* Graduate Seminar in Agricultural Education. 1-3 credits, max 6. Discussion of issues, problems and trends in agricultural education.

AGED 6103* History and Philosophical Foundations of Agricultural and Extension Education. Prerequisite(s): Graduate standing. History and philosophical foundations of agricultural and extension education. Philosophy and its role in life, rise of education in America, philosophical foundations of education in America, legislation having an impact on agricultural and extension education, education in agriculture and current issues in agricultural extension education.

AGED 6223* Program Evaluation in Agriculture and Extension. Prerequisite(s): Graduate standing. Program evaluation theory and methodology (quantitative and qualitative) presented through a service learning framework. Problem-based approach having students submit a proposal that addresses an evaluation need presented by a community-based program.

AGED 6983* Qualitative Research Methods in Agricultural Education. Prerequisite(s): Graduate standing, AGED 5983 or other graduate level social science research methods course. A comprehensive examination of qualitative research methods including identifying a problem, data collection, interpretative analysis, ensuring trustworthiness, theory construction and reporting.

Agricultural Leadership (AGLE)

AGLE 1511 Introduction to Leadership in Agricultural Sciences and Natural Resources. Introduction to the concept of leadership as a field of study. Emphasis placed on the application of acquired knowledge to practical problems.

AGLE 2303 Personal Leadership Development in Agricultural Sciences and Natural Resources. How leaders identify key attributes of leadership and link them to their own unique vision, values, and personal strengths.

AGLE 2403 (D) Agricultural Leadership in a Multicultural Society. The study of leadership as it relates to a multicultural society. Cultural changes in the agricultural workplace and future impact on the industry. Personal barriers to fulfilling leadership roles in the agricultural sciences and natural resources. Skills related to managing teams in a diverse workplace specifically related to differences in gender, race and ethnicity.

AGLE 3101 Introduction to Agricultural Leadership. Prerequisite(s): Major in AGLE or consent of instructor. Exploring leadership in the context of agriculture. Specific topics will include authentic leadership, independent thinking, commitment to agriculture, open minds and professionalism. *Graded on a pass-fail basis.*

AGLE 3303 Agricultural Leadership: Theory and Practice. A study of the concepts and theories of leadership with emphasis on the development of leadership abilities in the individual for different group situations.

AGLE 3333 Contemporary Issues in Leadership. Prerequisite(s): 2303, 3303. Explore current issues in the study of leadership. Themes based on current leadership research and writings that reveal new understandings of the leader's role as a servant, facilitator and collaborator.

AGLE 3403 Facilitating Social and Technological Change in Agriculture. Examination of processes by which professional agriculturists influence the introduction, adoption, and diffusion of technological change.

AGLE 3503 Introduction to Cooperative Extension. Cooperative Extension mission, philosophy, history, organization, structure, administration, and program areas. Extension program development, Extension teaching and delivery methods, and the involvement and use of volunteers.

AGLE 3803* (I) Global Leadership in Agriculture. Contemporary global leadership in the context of agriculture. Challenges, cross-cultural conflict, managing diversity, and ethical behavior. Exploration of global leaders including Africans, Asians, Europeans, and Middle Easterners.

AGLE 4101* Seminar in Leadership Education. Prerequisite(s): 2303, 3303. In depth exploration of leadership topics related to agricultural sciences and natural resources.

AGLE 4203 Professional Development in Agriculture. Prerequisite(s): 3101; junior standing. Preparation of professionals in agricultural business and industry and related areas who have career goals directed toward service, leadership, management, communications, production, processing, marketing, and education outside the public school setting. Development of professionalism through relationship building, networking, interviews, community involvement, business correspondence, websites and the resume.

AGLE 4300 Agricultural Leadership Internship. 3-6 credits, max 6. Prerequisite(s): 3101, 4203 and consent of instructor. Supervised full-time internships in approved agribusinesses, governmental agencies or county extension offices. Requires written reports and a final presentation.

AGLE 4303* Facilitating Leadership Education Program. Prerequisite(s): 2303, 3303. Identification and application of methods and techniques for teaching leadership education programs in formal and non-formal educational settings. Focus on using experiential methods of teaching leadership.

AGLE 4803 International Agricultural Leadership Tour. An experiential approach to the study of contemporary culture, agriculture, and leadership in a region outside the United States. Contemporary leadership of the region and implications related to agriculture. Comparison of leadership and agricultural practices in the designated region to that of the United States. Includes a two-week international travel component.

AGLE 4990 Problems in Agricultural Leadership. 1-6 credits, max 6. Prerequisite(s): Consent of instructor. Small group and/or individual study and research in problems related to agricultural leadership.

AGLE 5102* Creative Component in Agricultural Leadership and Extension Education. Prerequisite(s): Consent of instructor. Independent project under the direction and supervision of a major advisor. Creative component projects address an agricultural leadership and/or extension education issue with the goal to inform or improve practice based upon scholarship. Open to students pursuing a Master of Agriculture degree (M.Ag.) with an option in Agricultural Leadership.

AGLE 5303* Foundations of Leadership Theory. Study of leadership theory including definitions of leadership, a history of modern leadership theory, and current trends in leadership practice and research. Models of leadership including contingency models, situational leadership and transformational leadership.

AGLE 5353* Leadership in Agriculture. Prerequisite(s): 5303 or consent of instructor. Concepts, principles, and philosophies of leadership applied to agricultural contexts. Importance of traits, perceptions, and behaviors to success of agricultural professionals in leadership roles. Dimensions and style of leadership for varying situations.

AGLE 5990* Problems in Agricultural Leadership and Extension Education. Prerequisite(s): Consent of instructor. 1-3 credits, max. 6. Investigation in designated areas of agricultural leadership and/or extension education.

AGLE 6203* Extension Program Development. A systematic study of the history, culture and functions of the Cooperative Extension System in America. Focus on program planning, including needs assessments, involvement of local constituent groups, use of the logic model, teaching methods, program evaluations, marketing and planning for the future.

Agriculture (AG)

AG 1011 Orientation. Required of all freshmen in the College of Agricultural Sciences and Natural Resources. Methods of study, advisement system, organization of curriculum and discussion of requirements and career opportunities in various fields of agriculture.

AG 1111 Career Exploration in Agricultural Sciences and Natural Resources. Application of the career planning cycle and detailed exploration of career opportunities in the agricultural industry and natural resources field.

AG 3010 Internships in Agriculture. 1-3 credits, max 12. Prerequisite(s): Junior standing or consent of instructor. Supervised internships with business, industry or governmental agencies, including cooperating veterinarians. *Graded on pass-fail basis.*

AG 3080 (I) International Experience. 1-18 credits, max 36. Prerequisite(s): Consent of the associate dean of the college. Participation in a formal or informal educational experience outside of the USA.

AG 3090 (I) Study Abroad. 1-18 credits, max 36. Prerequisite(s): Consent of the Study Abroad office and associate dean of the college. Participation in an OSU reciprocal exchange program.

AG 3111 Career Planning and Skill Development. In-depth application of career research and literature to the internship search, full-time job search, and graduate school application and decision-making processes, as related to the agricultural industry and natural resources field.

AG 3733 (H) Food and Culture. Interdisciplinary examination of the history and culture of food production and consumption in the U.S. with an emphasis on how U.S. food ways relate to those of other countries. Examines topics such as: food and the formation of social bonds, food and identity, the cultural meaning of foodways, issues of justice and equality in food production and consumption, and how food cultures have developed over time and in relation to other societies. (Same course as AMST 3733)

AG 3803 (I) International Study Tour in Agricultural Sciences and Natural Resources. Prerequisite(s): Consent of instructor. A two-three week international travel component. An integrated approach to the study of

agriculture, natural resources, culture, history, and technological advances of a region.

AG 4010 Honors Seminar. 1-6 credits, max 6. Role of agriculture in society and adjustments to change in the economy.

AG 4990 Special Problems in International Agriculture and Natural Resources. 1-3 credits, max 6. Prerequisite(s): Consent of instructor. Individual and/or small group study or research on specialized problems or issues in international agriculture.

American Indian Studies (AMIS)

AMIS 2013 (D) Introduction to American Indian Studies. This course is designed to present an indigenous perspective to explore both the historical and contemporary issues facing Native American people. The course examines the history and development of American Indian Studies as an academic discipline and provides an introduction to the field employing a broad interdisciplinary approach. A range of topics are covered, including Native history, sociology, art/culture, literature, geography, law, and entrepreneurship.

AMIS 4013 (D) American Indian Sovereignty. Critically analyzes historical and contemporary experiences of American Indians in society. Examines the importance of tribal sovereignty for the sociopolitical, cultural, and religious rights of Native people. Federal Indian law provides a context for understanding historical indigenous experience and informs understanding of the Native American perspective. Explores contemporary sovereignty issues and proposed solutions that impact American Indians in relation to broader American culture.

American Sign Language (ASL)

ASL 1115 American Sign Language I. Learners will use fingerspelling, signing, eye gazing, classifiers, mime, and facial expressions presented in context and through meaningful and experimental activities.

ASL 1225 American Sign Language II. Prerequisite(s): 1115 with grade of "C" or better or permission from instructor. Continuation of 1115.

ASL 2113 American Sign Language III. Prerequisite(s): 1225 with grade of "C" or better or permission from instructor. Intermediate level study of American Sign Language.

ASL 2233 American Sign Language IV. Prerequisite(s): 2113 with grade of "C" or better or permission from instructor. Continuation of 2113.

American Studies (AMST)

AMST 2103 (D,H) Introduction to American Studies. Interdisciplinary study of American civilization through case studies of four different time periods in order to understand the multiple roles of culture in American life.

AMST 3223 (H) Theory and Method of American Studies. Introduction to assumptions, methods, and theory of cultural analysis in American studies scholarship.

AMST 3253 (H) Globalization and American Culture. Transmission, reception, and influence of American culture in one or more of the following: Europe, Asia, Latin America, the Middle East. The cultural history of globalization and American culture.

AMST 3333 (S) Crime, Law and American Culture. Study of crime, law and the legal system from a cultural perspective. Examine how race, gender, and social class play different roles in issues related to crime, law and the legal system.

AMST 3423 (H) American Popular Culture. Emergence and development of American Popular culture forms, rituals, and consumerism. Parades and festival; circuses; minstrelsy; motion pictures; popular music; sports; comic books; the Internet and cyberspace. Specific attention to issues of race, class and gender.

AMST 3473 (D) Race, Gender, and Ethnicity in American Film. A survey of race, gender, and ethnicity as they have been represented in American films. *Same course as ENGL 3473.*

AMST 3503 (DH) Television and American Society. Examination of television within the social and cultural context of the U.S. Looks at the aesthetic and industrial practices that shape representation on TV and the effects of those practices, particularly for socially disempowered groups. *Same course as ENGL 3503.*

AMST 3513 (H) Film and American Society. Examination of U.S. film in its social, political, economic, and cultural contexts. Topics may include the history of U.S. film production, distribution and consumption; Hollywood film genres; independent cinema; the star system; and/or representations of historical events, political issues, or social groups in U.S. film.

AMST 3550 The Arts and American Society. 3 credits, max 6. Interdisciplinary study of major figures, trends, themes, periods, and modes of representation in American thought and cultural expression. Emphasis on the relationship between the arts and social, political, and historical context. Examples include Realism, American Modernism, Regionalism, American Postmodernism, the City and the Country, the Other, Nationalism, Time, and Space. *Topics vary by semester.*

AMST 3653 (D,H) The Body in American Culture. The body and its impact on American culture examined through a survey of diverse cultural productions and social practices. Examine the intersections of ideas of embodiment with discourses of race, class, gender, sexuality, disability, and nationalism.

AMST 3673 (D,H) History of American Art. Visual arts in America from the Colonial period to present. Major styles, ideas and uses of material in architecture, painting, sculpture and design. (Same course as ART 3663).

AMST 3683 Culture in the Making. Applied cultural analysis. Practical instruction in the use of cultural tools and technologies to tell American stories. Students will create hands-on projects in public culture using the artistic and historical resources available in the community.

AMST 3723 (D,H) Cultural History of American Sports. Examines the role of sports in American cultural history; analyzes issues of class, ethnicity, gender, nationalism and race; interprets the importance of athletic heroes, fans, performance, and rituals; evaluates amateur, collegiate, Olympic, and professional institutions.

AMST 3733 (H) Food and Culture. This course offers an interdisciplinary examination of the history and culture of food production and consumption in the U.S. with an emphasis on how U.S. food ways relate to those of other countries. It examines such topics as: food and the formation of social bonds, food and identity, the cultural meaning of food ways, issues of justice and equality in food production and consumption, and how food cultures have developed over time and in relation to other societies. (Same course as AG 3733)

AMST 3743 (D,H) Harlem Renaissance. This course will examine the Black cultural movement of the 1920s and 1930s. Evolving in Harlem, New York, it affected the United States, Europe, the Caribbean, and Africa. This course will examine the impact of this period on the arts, class, culture, gender, leisure, literature, music, sports, and racial and social equality in the United States. Weekly reading assignments, primary documents, and interdisciplinary material will be used to understand both the cultural and historical significance of this period.

AMST 3803 (H) War in American Culture. Study of war and its impact on American culture through an examination of diverse cultural productions and social practices. Emphasis on the circulation of common (and contested) representations of war within American visual, literary, and memorial culture.

AMST 3813 (D,H) Readings in the American Experience. Life in the New World from the colonial to the postmodern era using a multiplicity of interdisciplinary texts that demonstrate the emergence and ongoing evolution of distinctive American identities. (Same course as ENGL 3813)

AMST 3823 (D,H) U.S. As Business Culture. Examines American business in relation to political, social and cultural phenomena, emphasizing the implications of business for race, class, gender and nation. Themes considered may include business literature, advertising, film, documentary, and other forms of popular and visual culture. The course examines changes in business and business culture over time, and offers students opportunities to synthesize sources that are not usually considered together.

AMST 3950 Special Topics in American Studies. 3 credits, max 12. Particular topics (popular culture, regionalism, myth, subcultures, race, ethnicity) to illustrate the use of interdisciplinary methods in American studies.

AMST 4553 (D) Gender in America. Cultural, societal and political reflections of American men and women from the colonial era to the present. Examination of the women's movements and their opponents. Exploration of changing notions of masculinity and femininity. (Same course as HIST 4553)

AMST 4593 (H) America in International Perspective. Prerequisite(s): HIST 1103 or lower-division survey course in U.S. History, any period. A transnational interpretation of American history from the colonial era to the present day. Uses a variety of interdisciplinary sources to place the history of the United States within a comparative, global framework. (Same course as HIST 4593)

AMST 4633 (H) The Frontier and American Visual Culture. The frontier and its impact on American culture examined through a survey of paintings, sculpture, photography, film, television, and other forms of popular imagery. The frontier as a zone of cultural interaction that is seldom tied to a single culture. (Same course as ART 4633)

AMST 4910 American Period Seminar. 3 credits, max 12. In-depth study of a particular period or era in American historical experience. Examples include The Colonial Period, The 1890's, The Jazz Age, The Great Depression, The WWII Home front, The Civil Rights Movement, Cold War America, The Sixties, The 1970's, and Post Modern America. Topics vary by semester.

AMST 4973 Senior Seminar in American Studies. Prerequisite(s): 3223. Writing of senior thesis based on original research and its analysis and evaluation or completion of independent project based on practical community experience.

AMST 4990 Internship. 1-3 credits, max 6. An internship opportunity which combines independent study and practical fieldwork experience focusing on a particular problem or topic related to America culture and experience. (Examples: Internship in Archival Fieldwork, Material Culture Fieldwork, Museum Management, Sound Recordings and Native American Heritage Site).

Animal Science (ANSI)

ANSI 1111 Animal and Food Science Experience. Student development through connections among the student's major curriculum, career goals specific to animal or food science, and eventual careers and career development through resume building and networking.

ANSI 1124 Introduction to the Animal Sciences. Lab 2. Species adaptability, product standards and requirements, areas and types of production, processing and distribution of products, includes meat animals, dairy and poultry.

ANSI 1223 Exploring the Science of Animal Agriculture. Lab 2. An introductory course describing the principles, methods, applications and value of biological research with farm animals. Course also offered for honors credit.

ANSI 2112 Live Animal Evaluation. Lab 4. Prerequisite(s): 1124. Using tools for selection including performance records, pedigree information and visual appraisal, in the evaluation of cattle, swine, sheep, horses and poultry.

ANSI 2123 Livestock Feeding. Lab 2. Nutrients and their functions, nutrient requirements of the various classes of livestock; composition and classification of feed stuffs and ration formulation. *Not required of animal science majors*.

ANSI 2253 Meat Animal and Carcass Evaluation. Lab 2. Prerequisite(s): 1124. Evaluation of carcasses and wholesale cuts of beef, pork, and lamb. Factors influencing grades, yields and values in cattle, swine and sheep. (Same course as FDSC 2253)

ANSI 3212 Advanced Dairy Cattle Evaluation. Lab 4. Advanced evaluation of type traits as they relate to longevity and profitability in the dairy cow.

ANSI 3222 Advanced Equine Evaluation. Lab 4. Advanced evaluation of halter and performance horses. Includes both Western and English disciplines.

ANSI 3232 Advanced Meat Evaluation. Lab 4. Prerequisite(s): 2253. Advanced evaluation of carcasses and wholesale cuts of beef, pork and lamb. (Same course as FDSC 3232)

ANSI 3242 Advanced Livestock Evaluation. Lab 4. Prerequisite(s): 2112. Advanced evaluation of beef cattle, sheep, and swine.

ANSI 3252 Advanced Wool Evaluation. Lab 4. Advanced instruction in wool grading.

ANSI 3310 Advanced Competitive Evaluation. 2 credits, max 6, Lab 6. Prerequisite(s): Consent of instructor. Advanced instruction in animal and/or product evaluation. For students competing on collegiate judging teams. (Same course as FDSC 3310)

ANSI 3312 Advanced Meat Animal Evaluation. Lab 4. Advanced evaluation and pricing of meat animals. For students competing on the Meat Animal Evaluation Team.

ANSI 3322 Applied Meat Animal Selection. Lab 6. Prerequisite(s): 3310 and consent of instructor. Applied selection of meat animals using principles of genetics, animal breeding, and phenotypic evaluation in real world selection scenarios to predict the value of breeding and market livestock.

ANSI 3333* Meat Science. Lab 3. Prerequisite(s): 2253, CHEM 1215 or equivalent. Anatomical and basic chemical and physical characteristics of meat animals studied. The application of scientific principles to the processing and economical utilization of meat animals, as well as in the manufacture of meat products emphasized in the laboratory. (Same course as FDSC 3333)

ANSI 3402 Equine Training Methods. Lab 4. Basic techniques of equine training. Performance of various maneuvers including halter breaking, saddling, longing, driving, and riding.

ANSI 3410 Peer-Led Team Learning in Animal Science. Prerequisite(s): Consent of instructor. 1-6 credits, max 6. Lab 1-5. Selected undergraduate students work as peer leaders for learning teams for Animal Science courses. Development of oral and written communication skills of technical concepts in animal science. Duties include meeting regularly with discussion and laboratory sessions, participating in instructional activities and evaluating class performance.

ANSI 3414 Form and Function of Livestock and Poultry. Lab 2. Prerequisite(s): 1124 and BIOL 1114 or consent of instructor. Form and function of livestock and poultry. Major systems (muscle, skeletal, neural, endocrine, cardiovascular, respiratory and gastrointestinal) with emphasis on comparative anatomy and integrated function related to livestock in agricultural production systems.

ANSI 3423* Animal Genetics. Prerequisite(s): Introductory biology. The basic principles of heredity including: kinds of gene action, random segregation, independent assortment, physical and chemical basis of heredity, mutations, sex-linkage, chromosome mapping, multiple alleles and chromosomal abnormalities. Also a brief introduction to quantitative inheritance and population genetics.

ANSI 3433* Animal Breeding. Lab 2. Prerequisite(s): 3423. The application of genetic principles to livestock improvement; study of the genetic basis of selection and systems of mating; development of breeding programs based on principles of population genetics.

ANSI 3443* Animal Reproduction. Lab 2. Prerequisite(s): Introductory biology. Physiological processes of reproduction in farm animals, gonad function, endocrine relationships, fertility, and factors affecting reproduction efficiency. Emphasis on principles of artificial insemination in the laboratory.

ANSI 3453 Canine and Feline Genetics. Prerequisite(s): BIOL 1114 or consent of instructor. Overview of fundamental genetic principles and the control of genetic variation in coat color, various disorders and other inherited feline and canine characteristics. Inherited conditions, the underlying genetic mutation if known, genomic technologies used to identify the mutations if unknown, and development of genetic tools to assist in canine and feline genetic testing and selection programs.

ANSI 3463 Equine Genetics. Basic Mendelian genetics with direct application to horses. Genetic principles and inheritance of particular equine characteristics and common genetic disorders.

ANSI 3523 Pet and Companion Animal Management. Current concepts and management principles related to pet and companion animal species and their roles in society. Discussion of the human-animal bond, service animals, kennel and cattery management, anatomy, internal and external parasites, toxins, restraint and handling, training, reproduction, nutrition, genetics, and breeding.

ANSI 3533 Equine Management and Production. Current topics and trends in the horse industry. Basic principles of equine nutrition, reproduction, marketing, exercise physiology, health care, coat-color genetics, behavior and welfare.

ANSI 3543 Principles of Animal Nutrition. Prerequisite(s): CHEM 1215 or equivalent. Basic principles of animal nutrition including digestion, absorption, and metabolism of the various food nutrients; characteristics of the nutrients; measure of body needs; ration formulation.

ANSI 3623 Livestock Behavior and Handling. Prerequisite(s): 1124. Livestock behavior and handling in production agriculture.

ANSI 3653* Applied Animal Nutrition. Lab 2. Prerequisite(s): 3543. Composition, characteristics and nutritive value of feeds and ration additives; qualitative and quantitative nutrient requirements of each of the classes of livestock; formulation of rations for each of the classes of livestock.

ANSI 3703 Animal Management Techniques. Lab 4. Animal handling and management practices. Basic husbandry procedures for domestic animals in farm, ranch, and/or other production settings or environments. Emphasis on practical handling, restraint, health evaluation, medication and treatment practices.

ANSI 3753 Basic Nutrition for Pets. Nutrients, nutrient requirements, feeding practices, food sources, and diet management for pets and companion animals as well as exotic animals and birds.

ANSI 3903 (I) Agricultural Animals of the World. The production and utilization of agricultural animals by human societies.

ANSI 4023 Poultry Science. Lab 2. Prerequisite(s): 1124 and 2123 or 3543. The relationship of the biological concepts and functions of poultry to management practices, incubation procedures, and economic factors utilized by poultry men in the commercial production of table and hatching eggs, broilers, turkeys, and other poultry meat.

ANSI 4132* Welfare Assessment and Audit of Farm Animals. Prerequisite(s): ANSI 3623. Reliable, science-based, on-farm and slaughter welfare assessment systems for cattle, pigs and poultry as well as a methodology to convey welfare measures into understandable product information.

ANSI 4203* Rangeland and Pasture Utilization. Lab 2. Prerequisite(s): RLEM 3913 or 4613. Investigation of livestock and forage interactions that impact productivity in the utilization of rangeland and improved pastures.

ANSI 4333* Processed Meat. Lab 3. Prerequisite(s): 3033 or 3333. Meat and meat product composition. Techniques in the molding and forming of meat; sausage formulation; curing; quality control; and cost analysis. (Same course as FDSC 4333*)

ANSI 4423 Horse Science. Lab 2. Prerequisite(s): 3433, 3443 and 3653. Current concepts and production principles related to the horse industry including nutrition, reproduction, herd health, functional anatomy and implications, social behavior, and applying principles of psychology in horse management and training.

ANSI 4543* Dairy Cattle Science. Lab 2. Prerequisite(s): 3433, 3443 and 3653. Current concepts and production principles of the dairy cattle industry including value of milk products, milk marketing, physiology of lactation, reproduction, nutrition, mastitis, and housing. Analysis and active learning of dairy production systems using farm visits and field techniques laboratories.

ANSI 4553* Sheep Science. Lab 2. Prerequisite(s): 3433, 3443 and 3653. Breeding, feeding, management, and marketing of commercial and purebred sheep.

ANSI 4613* Beef Cow-Calf Management. Lab 2. Prerequisite(s): 3433, 3443, and 3653. Application of farm and ranch land procurement and management principles with beef cattle acquisition, breeding, nutrition, reproduction, health, life cycle management, marketing and economic analysis of the commercial cow-calf enterprise.

ANSI 4633* Stocker and Feedlot Cattle Management. Lab 2. Prerequisite(s): 3612, 3653. Application of scientific knowledge, management principles, and research advances to modern stocker and feedlot cattle operations.

ANSI 4643* Swine Science. Lab 2. Prerequisite(s): 3433, 3443 and 3653. Application of genetic, physiological, microbiological, nutritional, and engineering principles to the efficient production of swine.

ANSI 4703* Equine Enterprise Management. Prerequisite(s): 3433 and 3443 and 3653. Principles of equine enterprise management including ethical and legal issues, marketing, facility management, business structures, economic analysis and careers.

ANSI 4713 Beef Seedstock Management and Sales. Lab 2. Prerequisite(s): 3433, 3443, and 3653. Principles of beef cattle seedstock acquisition, breeding, nutrition, reproduction, health, life cycle management and economic analysis. Special emphasis on advertising, promotion, marketing and sales.

ANSI 4803* Animal Growth and Performance. Prerequisite(s): An upper-division course in animal science. Physiological and endocrine factors affecting growth and performance of domestic animals.

ANSI 4843 Applications of Biotechnology in Animal Science. Lab 3. Prerequisite(s): 3423 and BIOC 3653. Training in current biotechniques used in protein, hormone, and molecular genetic research in food and animal science. Theory and applications of the various techniques.

ANSI 4863 Capstone for Animal Agriculture. Lab 2. Prerequisite(s): Senior standing. Examination of the role of animal agriculture in society and the importance of research and current issues. *Oral and written reports.*

ANSI 4900 Special Problems. 1-6 credits, max 6. Prerequisite(s): Consent of instructor. A detailed study of an assigned problem by a student wishing additional information on a special topic.

ANSI 4910* Animal Industry Internship. 1-12 credits, max 12. Prerequisite(s): Consent of instructor. Full-time internship at an approved production, processing or agribusiness unit or other agency serving animal agriculture. Maximum credit requires a six-month internship in addition to a report and final examination. *Graded on a pass-fail basis.*

ANSI 4913* Animal Waste Management. Prerequisite(s): SOIL 2124. Aspects of animal waste management related to animal nutrition, system design, land application, socioeconomic issues and environmental impacts. (Same course as SOIL 4913, ENVR 4913)

ANSI 4973 Rangeland Resources Planning. Lab 3. Prerequisite(s): 3612 and AGRON 4954. Inventory or ranch resources, survey and evaluation of ranch practices, and economic analysis. Development of a comprehensive ranch management plan. Managing rangeland and ranch resources in a social context. Written and oral reports. *Field trips required.* (Same course as NREM 4613)

ANSI 5000* Master's Research and Thesis. 1-6 credits, max 6. Prerequisite(s): MS degree. Independent research planned, conducted, and reported in consultation with a major professor.

ANSI 5010* Special Problems. 1-3 credits, max 6. Special problems in areas of animal science other than those covered by the individual graduate student as a part of his/her research and thesis program.

ANSI 5110* Seminar. 1 credit, max 3. A critical review and study of the literature; written and oral reports and discussion on select subjects. (Same course as 6110*)

ANSI 5113* Basic Reproductive Physiology. Prerequisite(s): 3443 or equivalent. Female and male reproductive processes, endocrine control of reproductive functions, and the application of reproductive physiology to animal production.

ANSI 5123* Functional and Molecular Endocrinology. Prerequisite(s): An upper division physiology course. Endocrine regulation of growth, stress, metabolism, and reproduction in domestic farm animals including commercial applications. Focus on the influence of hormones at the systemic and cellular level.

ANSI 5213* Advances in Meat Science. Prerequisite(s): BIOC 4113 and ZOOL 3204 or equivalent. Development of muscle and its transformation to meat. Properties of meat and their influence on water-binding, pigment formation, texture and fiber characteristics. (Same course as FDSC 5213)

ANSI 5303* Advanced Animal Breeding. Prerequisite(s): 3433 or equivalent and STAT 4013. Basic concepts of population genetics as related to theoretical animal breeding, including heritability, genetic correlations, selection methods, inbreeding and heterosis.

ANSI 5313* Marker Assisted Selection in Livestock. Prerequisite(s): 3433 or equivalent and STAT 4013. Use of molecular genetics information to capture variation of quantitative traits in farm animals and to enhance selection improvement programs. Discussion of current DNA based technologies, such as detecting, locating and measuring effects of quantitative trait loci (QTL), genetic markers, gene mapping methods and whole genome selection. Examination of emerging genomics technologies.

ANSI 5333* Carcass Value Estimation Systems. Prerequisite(s): Graduate classification. Analysis of scientific literature regarding carcass composition, quality and palatability. Overview of technology used to evaluate carcass quality factors. (Same course as FDSC 5333*)

ANSI 5553* Interpreting Animal and Food Science Research. Prerequisite(s): STAT 5013 or concurrent enrollment. Critical evaluation and knowledgeable communication on the design, analyses, and reporting of animal science and food science research. (Same course as FDSC 5553)

ANSI 5573* Techniques in Animal Molecular Biology. Lab 4. Prerequisite(s): BIOC 4113. Principles of major basic animal molecular biology techniques in gene cloning and expression. Hands-on experience with basic molecular biology techniques, including DNA cloning and quantitative measurement of mRNA and protein expression in eukaryotic cells.

ANSI 5733* Advanced Ruminant Nutrition. Lab 2. Prerequisite(s): 3653. Factors influencing nutrient requirements of ruminants for maintenance, growth, reproduction and lactation, and their implications with regard to husbandry practices and nutritional management of livestock. Application of current concepts of ruminant livestock nutrition; use of microcomputer programs in diet evaluation and formulation, beef gain simulation and problem solving.

ANSI 5743* Rumenology. Prerequisite(s): 3653 or equivalent. Physiology of development of the ruminant digestive tract; the nature of, and factors controlling digestion and absorption from the tract to include the relative nature and roles of the rumen bacteria and protozoa.

ANSI 5753* Animal Nutrition Techniques and Laboratory Methods. Lab 2. Prerequisite(s): CHEM 3015 or equivalent. Collection, handling, and processing of biological materials. Record keeping, pipetting, preparation of reagents, and conducting routine nutritional analysis. Theory of operation of major laboratory equipment. Application of current techniques to problem solving in animal nutrition research.

ANSI 5763* Advanced Nonruminant Nutrition. Prerequisite(s): BIOC 3653. An in-depth study of the digestion, absorption, and metabolism of nutrients in nonruminant domesticated farm animals. Unique metabolic characteristics of nonruminant species contrasted with ruminant animals. Fundamentals of energetics as related to animal performance.

ANSI 5773* Protein Nutrition. Prerequisite(s): BIOC 3653. Nutritional, biochemical and clinical aspects of protein metabolism as it relates to nutritional status.

ANSI 5783* Vitamin and Mineral Nutrition. Prerequisite(s): BIOC 5753. Development of the concept of dietary essential minerals and vitamins. Individual minerals and vitamins discussed for animal species from the standpoint of chemical form, availability, requirements, biochemical systems, deficiencies and excesses and estimation in foods and feed.

ANSI 6000* Doctoral Research and Dissertation. 1-10 credits, max 30. Prerequisite(s): MS degree. Independent research planned, conducted and reported in consultation with, and under the direction of, a major professor. *Open only to students continuing beyond the level of the MS degree.*

ANSI 6010* Special Topics in Animal Breeding. 1-3 credits. Prerequisite(s): Consent of instructor. Advanced topics and new developments in animal breeding and population genetics.

ANSI 6110* Seminar. 1 credit, max 3. A critical analysis of the objectives and methods of research in the area of animal science. Review of the literature, written and oral reports and discussion on select topics. (Same course as 5110*)

Anthropology (ANTH)

ANTH 2353 (N) Introduction to Biological Anthropology. Introduction to human biological evolution, including genetics, paleoanthropology, primatology, and osteology.

ANTH 2883 Introduction to Archaeology. A general introduction to the methods of study of archaeology. Understanding the development of prehistoric cultures as adaptive responses to changing natural and social environments from early Paleolithic to emergence of urban civilizations.

ANTH 3353 (I,S) Cultural Anthropology. Introduction to culture, various subdisciplines of cultural anthropology, anthropological concepts, and capsule ethnographies of assorted ethnic groups.

ANTH 3443 (I,S) Peoples of Mesoamerica. Modern indigenous peoples of Mexico and Central America. Examination of contemporary communities and modern social and cultural practices understood from a historical perspective, leading to an appreciation of regional similarities and diversity.

ANTH 3990 Fieldwork in Anthropology. 1-8 credits, max 8. Prerequisite(s): Consent of instructor. Instruction through ethnographic or archaeological field techniques by participation in a field program. Topics subject to change from year to year depending upon the type of field program offered or available.

ANTH 4123 Archaeology of North America. Prerequisite(s): ANTH 2883. Factors influencing the initial peopling of North America, the spread and diversification of hunting and gathering economies, the rise of agricultural systems and emergence of extensive and complex political units.

ANTH 4223 (H) The Aztec Empire. Society and Culture of the Aztecs of Mesoamerica. Overview of preceding civilizations, analysis of imperial strategies, social organization, religion, and other topics culminating in the Spanish conquest.

ANTH 4443 Prehistory of Oklahoma. Prerequisite(s): ANTH 2883. Surveys social and cultural development of Native peoples of Oklahoma from Paleoindian hunting adaptations to villagers encountered by early Europeans. Using archaeological investigations examines diversity of social and cultural adaptations to various environments of Oklahoma, including development of complex societies.

ANTH 4883 (I,S) Comparative Cultures. Compares environments, economies, social and political organizations and other aspects of culture among selected literate and preliterate societies.

ANTH 4990* Special Topics in Anthropology. 1-3 credits, max 6. Prerequisite(s): Consent of instructor. Directed readings or research on significant topics in anthropology.

ANTH 5243* Globalization and Culture. Prerequisite(s): Admission to Graduate College and International Studies. Critical assessment of 20th century social scientific theories of development culminating in current theories of globalization. Exploration of capitalism's antecedents, origin, and proliferation. Evaluation of global inequality from a cross-culture perspective. Utility of anthropological theories of culture, ideology and hegemony in assessing local responses to globalization. *No credit for students with credit in INTL 5243.*

ANTH 5990* Advanced Problems and Issues in Anthropology. 1-9 credits, max 9. Prerequisite(s): Consent of instructor. Group enrollment or individual research enrollment as needed. Graduate level analysis of special problems and issues in Anthropology not covered in other department offerings.

Architecture (ARCH)

ARCH 1112 Introduction to Architecture. An introduction to the professions of architecture and architectural engineering.

ARCH 1216 Architectural Design Studio I. Lab 16. Architectural graphics and design fundamentals. Students who have not received a grade for 1216 will be given first priority in enrollment. Students who have received a grade in this course will be admitted on a space available basis and at the discretion of the school head and architecture adviser.

ARCH 2003 (H,I) Architecture and Society. Design, planning, and building considered in their social and aesthetic contexts. *Some sections may be restricted to Architecture and Architectural Engineering majors, see course offerings.*

ARCH 2100 Architectural Studies. 1-4 credits, max 4. Beginning studies in graphics and design in architecture.

ARCH 2116 Architectural Design Studio II. Lab 16. Prerequisite(s): Grade of "C" or better in 1216. Students who have not received a grade for 2116 will be given first priority in enrollment. Students who have received a grade in this course will be admitted on a space available basis and at the discretion of the school head and architecture adviser. Problems in architectural design.

ARCH 2203 History and Theory of Architecture Since 1900. Prerequisite(s): 2003 or consent of instructor. History and theory of world architecture in the 20th century and beyond.

ARCH 2216 Architectural Design Studio III. Lab 16. Prerequisite(s): Grade of "C" or better in 1216 and 2116. Problems in architectural design. Students who have not received a grade for 2216 will be given first priority in enrollment. Students who have received a grade in this course will be admitted on a space available basis and at the discretion of the school head and architecture adviser.

ARCH 2263 Building Systems. Prerequisite(s): Grade of "C" or better in 1216 and 2116. Architectural, structural, and environmental control systems.

ARCH 3083 (H) History and Theory of Baroque Architecture. Prerequisite(s): 2003. History and theory of renaissance architecture in the western world, particularly the later Baroque period.

ARCH 3100 Special Topics in Architecture. 1-6 credits, max 12. Subjects to be selected by the faculty in architecture from advances in state-of-the-art areas.

ARCH 3116 Architectural Design Studio IV. Lab 16. Prerequisite(s): Grade of "C" or better in 2216 and admission to third year. Problems in architectural design.

ARCH 3134 Architectural Science I: Thermal Systems and Life Safety. Lab 2. Prerequisite(s): MATH 1513 or 1715. A survey of the fundamentals of thermal comfort, energy concerns and mechanical systems for buildings as well as the basic principles of life safety.

ARCH 3143 Structures: Analysis I. Lab 2. Prerequisite(s): Grade of "C" or better in ENSC 2143. Structural theory for applications in architecture.

ARCH 3173 History and Theory of American Architecture. Prerequisite(s): 2003 or consent of instructor. History and theory of American architecture from the colonial period to the present day.

ARCH 3216 Architectural Design Studio V. Lab 16. Prerequisite(s): Grade of "C" or better in 3116, 3252. Problems in architectural design.

ARCH 3223 Structures: Timbers. Lab 2. Prerequisite(s): Grade of "C" or better in 3323. Analysis and design of timber structures used in architecture.

ARCH 3224 Structures: Steel II. Lab 2. Prerequisite(s): Grades of "C" or better in 3323 and 3143. Design and analysis of multi-story steel frames, trusses, arches, and other architectural structure components.

ARCH 3252 Computer Applications in Architecture I. Prerequisite(s): Grade of "C" or better in 2216 and admission to professional school. Introduction to 2D and 3D computer topics and their application in the design process. *No credit for students with credit in 3253.*

ARCH 3262 Computer Applications in Architecture II. Lab 2. Prerequisite(s): Grade of "C" or better in 3252 and concurrent enrollment in 3216. State-of-the-art applications of computers to the practice of architecture and architectural engineering.

ARCH 3263 Materials in Architecture. Prerequisite(s): Grade of "C" or better in 2263 and admission to third year. Introduction to the basic materials used in the construction of architecture and how such materials affect both the design and implementation of the systems that incorporate these materials.

ARCH 3273 History and Theory of Medieval Architecture. Prerequisite(s): 2003 or consent of instructor. History and theory of the architecture created between the 8th and 15th centuries in Europe, and its impact on the subsequent religious architecture of today.

ARCH 3323 Structures: Steel I. Prerequisite(s): Grade of "C" or better in ENSC 2113 and admission to the professional program, or permission of school head and adviser. Analysis and design of steel structures used in architecture.

ARCH 3353 Advanced Graphics and Theory of Representation. Lab 2. Prerequisite(s): Admission to Professional School or consent of instructor. Manual and digital graphic techniques are explored in a project-based studio learning environment.

ARCH 3370 Urban USA Field Study. 2-3 credits, max 3. Prerequisite(s): Admission to Professional School. On-site analysis and study of architecture, culture and urban design of major urban centers in the USA.

ARCH 3433 Architectural Science II: Acoustics and Lighting. Prerequisite(s): MATH 1513 or 1715. A survey of architectural acoustics, electrical, and lighting systems for buildings.

ARCH 3442 Computer Applications in Architectural Engineering. Lab 2. Prerequisite(s): Admission to the professional program, co-requisite enrollment with 3252. Computer applications in architectural engineering introducing computer programming and the use of commercial analytical software.

ARCH 4073 (H) History and Theory of Early Modern Architecture. Prerequisite(s): 2003. History and theory of modern architecture in the western world from the industrial revolution to the early twentieth century.

ARCH 4093 Architectural Project Management. Prerequisite(s): Concurrent enrollment in 4216 or 5226 or consent of instructor. Principles of management as applied to architectural and architectural engineering projects.

ARCH 4100 Special Topics in Architecture. 1-6 credits, max 12. Prerequisite(s): Consent of instructor and head of the school. Subjects to be selected by the faculty in architecture from advances in state-of-the-art areas.

ARCH 4116 Architectural Design Studio VI. Lab 16. Prerequisite(s): Grade of "C" or better in 3216 and 3262. Problems in architectural design.

ARCH 4123* Structures: Concrete I. Lab 2. Prerequisite(s): Grade of "C" or better in 3223. Analysis and design applications in architectural problems using concrete structures.

ARCH 4134 Architectural Science I: Thermal Systems and Life Safety for Architectural Engineers. Prerequisite(s): ENSC 2213 or concurrent enrollment. Engineering based fundamentals of thermal comfort, energy concerns, and mechanical systems for buildings, as well as the basic principles of life safety.

ARCH 4143* Structures: Foundations for Buildings. Lab 2. Prerequisite(s): Grade of "C" or better in 4123. Interaction of frames and supports for structures used in architecture. Subsurface conditions and design of foundation systems and retaining walls for buildings.

ARCH 4173 History and Theory of Skyscraper Design. Prerequisite(s): 2003 or consent of instructor. History and theory of the development of the skyscraper in the USA from the late 19th century to the present.

ARCH 4183* History and Theory of Architecture: Cities. Prerequisite(s): 2003. The development of cities as an aspect of architecture from ancient times to the twentieth century.

ARCH 4216 Architectural Design Studio VII. Lab 16. Prerequisite(s): Grades of "C" or better in 3134, 3433, 4116, and 4123. Concurrent enrollment in 4263. Problems in architectural design.

ARCH 4224* Structures: Concrete II. Lab 2. Prerequisite(s): Grade of "C" or better in 4123, 3442, and 4143. Design and analysis of multi-story reinforced concrete frames and prestressed and post-stressed concrete structural components used in architecture applications.

ARCH 4233* Sustainability Issues in Architecture. Prerequisite(s): Grade of "C" or better in 3134. Sustainability topics and their application to architecture.

ARCH 4263 Architecture Seminar. Prerequisite(s): Concurrent enrollment in 4216 or 5226. Topics in architecture and architectural engineering.

ARCH 4273* History and Theory of Islamic Architecture. Prerequisite(s): 2003. Architecture of the Islamic World.

ARCH 4293 (H) The Ethics of the Built Environment. Prerequisite(s): Admission to the professional program or consent of instructor. Analysis of basic values that determine the form of the built environment.

ARCH 4373* Field Study in Europe I. Prerequisite(s): Senior standing in architecture or consent of instructor. On-site analysis and study of European architecture, culture, and urban design.

ARCH 4433 Architectural Science II: Acoustics and Lighting for Architectural Engineers. Lab 2. Prerequisite(s): ENSC 2613 or concurrent enrollment. Engineering based fundamentals of architectural acoustics and electrical/lighting systems for buildings.

ARCH 4444* Structures: Analysis II. Lab 2. Prerequisite(s): Grade of "C" or better in ARCH 3143, 3442 and MATH 3263. Mathematical formulation of architectural structural behavior. Matrix applications, finite element, finite differences, stability considerations and three dimensional structural modeling.

ARCH 5023* Masonry Design and Analysis. Prerequisite(s): Grade of "C" or better in 4123. Analysis and design of low-rise masonry structures and multi-story masonry shear walls, including code requirements, analysis techniques, design of components, and detailing of architectural engineering contract documents conforming to the relevant codes.

ARCH 5083* History and Theory of Japanese Architecture. Prerequisite(s): Admission to the professional school or consent of instructor. Historical Japanese architecture from 200 BC to 1980; Shinto, Buddhist, Zen Sukiya, Zukuri, Minka and contemporary subjects.

ARCH 5093* Real Estate Development. Prerequisite(s): Admission to professional program, or consent of instructor. Introduction to real estate development as a function of project conception, analysis, design and delivery.

ARCH 5100* Special Topics in Architecture. 1-6 credits, max 12. Prerequisite(s): Consent of instructor and head of the school. Subjects to be selected by the faculty in architecture from advances in state-of-the-art areas.

ARCH 5117* Architectural Design Studio VIII. Lab 16. Prerequisite(s): Grade of "C" or better in 4216 or permission of school head or adviser. Problems in architectural design.

ARCH 5143* Structures: Special Loadings. Lab 2. Prerequisite(s): Grade of "C" or better in ARCH 4444. Mathematical formulations and modeling in architectural structures. Human response to vibrations. Seismic design in building. Design for extreme winds on buildings. Approximate methods for preliminary design of architectural structures.

ARCH 5193* Management of Architectural Practice. Prerequisite(s): Fifth-year standing in architecture or architectural engineering or consent of instructor. Principles of management as applied to the private practice of architecture and architectural engineering.

ARCH 5217* Architectural Design Studio IX. Lab 16. Prerequisite(s): Grade of "C" or better in 5117 or consent of instructor. Problems in architectural design.

ARCH 5226* Architectural Engineering Comprehensive Design Studio. Lab 16. Prerequisite(s): Grade of "C" or better in 3116, 3224, 4134, 4224, and 4433. Problems in architectural and architectural engineering design.

ARCH 5373* Field Study in Europe II. Prerequisite(s): Senior standing in architecture or consent of instructor. On-site analysis and study of European architecture, culture and urban design.

ARCH 5493* Entrepreneurship and Architecture. Prerequisite(s): Senior standing. Introduction to entrepreneurship within the context of architecture, with direct application to architectural services, activities, and products. Emphasis on implementing the entrepreneurial process in starting and sustaining new ventures that significantly shape the built environment. (Same course as EEE 5493)

ARCH 6000* Special Problems. 1-15 credits, max 15, Lab 3-18. Prerequisite(s): Consent of instructor and head of school. Theory, research or design investigation in specific areas of study in the field of architecture and its related disciplines. Plan of study determined jointly by student and graduate faculty.

ARCH 6073* History and Theory of Non-Western Architecture. Prerequisite(s): Graduate standing or consent of instructor. Architecture in the non-Western and pre-Columbian world.

ARCH 6083* History and Theory of Contemporary Architecture. Prerequisite(s): Graduate standing or consent of instructor. American architecture beginning in the 16th century through the 20th century.

ARCH 6117* Graduate Design Studio I. Lab 20. Prerequisite(s): Admission to graduate program. Problems in architectural design.

ARCH 6193* Financial Management for Architects and Engineers. Prerequisite(s): 3116. Financial aspects of design firm management, including fundamentals of finance, profit planning and control, cash management, and analysis of financial statements.

ARCH 6203* Creative Component in Architectural Engineering. Lab 6. A design project based on a program previously developed by the student, to include a written report and supporting documents when appropriate. Must be approved by the project adviser and completed in the final semester of the graduate program.

ARCH 6207* Creative Component in Architecture. Lab 20. Prerequisite(s): 6117. A design project based on a program previously developed by the student to include a written report and supportive documents when appropriate. Must be approved by the project adviser and completed in the final semester of the graduate program.

ARCH 6243* Structures: Analysis III. Prerequisite(s): Grade of "C" or better in 4444 and admission to the graduate program. Analysis techniques for architectural structures including stability, space frames, computer applications, guyed towers and project research.

ARCH 6343* Structures: Steel III. Prerequisite(s): Grade of "C" or better in 3224. Plastic analysis and design of structural steel frames utilizing load and resistance factor design.

ARCH 6543* Structures: Concrete III. Prerequisite(s): Grade of "C" or better in 4224. Design of prestressed concrete structures, including pre- and post-tensioning.

Art (ART)

ART 1103 Drawing I. Lab 6. A freehand drawing experience designed to build basic skills and awareness of visual relationships. A sequence of problems dealing with composition, shape, volume, value, line, gesture, texture and perspective. A variety of media explored.

ART 1113 Drawing II. Lab 6. Prerequisite(s): 1103. Objective and subjective approaches to visual problem solving in a variety of black and white and color media. The analysis and manipulation of form, light, space, volume, and the formal aspects of perspective.

ART 1203 Two-Dimensional Foundations. Lab 6. Introduction to visual problem solving and two-dimensional media. Organization to the two-dimensional plane; line, shape, value and texture. Color theory including hue, value and saturation.

ART 1303 Three-Dimensional Foundations. Lab 6. Prerequisite(s): 1103. Exploration of three-dimensional form and space stressing organization of design elements, development of concepts, and manipulation of materials. Investigation of linear space, modular ordering, mass/volume and color through projects of a conceptual and applied nature.

ART 1503 (H) Art History Survey I. The arts, artists, and their cultures from prehistoric times through the Early Renaissance. *May not be used for degree credit with ART 1603.*

ART 1513 (H) Art History Survey II. The arts, artists, and their cultures from the Early Renaissance to the present. *May not be used for degree credit with ART 1603.*

ART 1603 (H) Introduction to Art. Introductory survey of art history from ancient times to the present. *May not be used for degree credit with ART 2603 or 2613.*

ART 2002 Studio Methods and Preparation. Lab 4. Portfolio concept development including idea generation, sketchbook, analyzing and evaluating art criticism and select contemporary artists. Professional portfolio presentation, including matting, slide documentation, labeling and resume as a precursor to the sophomore review.

ART 2113 Life Drawing. Lab 6. Prerequisite(s): 1113. Introduction to life drawing with emphasis on preliminary linear construction and structural aspects of the figure, including the study of general body proportions, rapid visualization, and figure-ground relationships.

ART 2223 Oil Painting I. Lab 6. Prerequisite(s): 1113, 1203, 1303, or consent of instructor. The development of skills in oil painting stressing form and content, visual perception, and individual expression. Technical instruction applicable to individual problems and needs.

ART 2233 Watercolor I. Lab 6. Prerequisite(s): 1113, 1203, 1303, or consent of instructor. The development of technical skills stressing color, form, and content. Assignments cover paper preparation and support, brush handling, pigment characteristics and mixing, and all basic dry surface and wet surface painting techniques.

ART 2243 Jewelry and Metals I. Lab 6. Prerequisite(s): 1113, 1303, or consent of instructor. Fabrication and forming techniques for non-ferrous metals. Cold joinery, silver soldering, surface treatment and elementary stone setting. Applications toward either wearable or small scale sculptural format.

ART 2253 Ceramics I. Lab 6. Prerequisite(s): 1113, 1303, or consent of instructor. Introduction to basic building techniques including wheel throwing, coiling, and slab construction, as well as slip and glaze application and a variety of firing processes. Exposure to historical and contemporary references. Emphasis on personal growth through technique and concept.

ART 2263 Sculpture I. Lab 6. Prerequisite(s): 1113, 1303. Studies in clay and plaster. Subtractive and additive processes. Emphasis on sculptural ideas, methods, and materials.

ART 2273 Printmaking I. Lab 6. Prerequisite(s): 1113, 1203, 1303 or consent of instructor. Varied print processes, including monotypes, relief printmaking, and intaglio. Fundamental techniques of each medium that include inking, printing, editioning multiples, and both additive and subtractive approaches.

ART 2283 Studio Art Digital Survey. Lab 6. Prerequisite(s): 1103 and 1303 and 1203 or 2423 and 2433 or by consent of instructor. This studio art course is an introduction to concepts, tools and techniques related to digital technology. Students will work specifically with digital video, sound editing, digital photography, digital imaging and printing. Projects in the course will focus on fostering an introductory to intermediate level understanding of digital technologies and formats, while allowing more advanced students to incorporate media of personal interest, such as performance, assemblage, projection, and installation, as well as other hybrid and emerging art forms.

ART 2403 Illustration I. Lab 6. Prerequisite(s): 1113 and 2.75 graduation/retention GPA. Introduction to historic and contemporary illustration and consideration of a wide range of illustrative styles. Required experiments with

media and consideration of alternate ways of illustrating a message through conceptual and compositional variations.

ART 2413 Typography I. Lab 6. Prerequisite(s): 1113 and 2.75 graduation/ retention GPA. An investigation of letter forms and their characteristics and a study of spacing, leading, type selection, layout alternatives, type specification, and copy fitting. Preliminary introduction to typography as a communication medium. An understanding of typographic terminology and measuring systems while developing hand skills and introducing computer technology.

ART 2423 Graphic Design I. Lab 6. Prerequisite(s): 1113 and 2.75 graduation/ retention GPA. Exploration of basic design principles—line, form, and color, as visual communication. Problem solving, generation of ideas, development of concepts, and the integration of word and image. Technical and presentation skills.

ART 2433 Digital Design I. Lab 6. Prerequisite(s): 1113 and 2.75 graduation/ retention GPA. Introduction to concepts, techniques and methods of using computer software to explore graphic design principles. Discussion of technology and media as applied to visual communication.

ART 2643 Introduction to Museum and Curatorial Studies. Historical and theoretical introduction to museum and curatorial studies. Topics include museum ethics, the function of the curator, and the changing role of the museum.

ART 2693 (H) Survey of Asian Art. Arts of India, China, Japan and related countries in their historical and cultural settings. Traditions of painting, sculpture and architecture from their beginnings to the modern period.

ART 2733 (H) Survey of Latin American Art. An overview of Latin American visual culture from the Precolumbian period to the present. We consider Maya, Aztec, and Inca cultures, the colonial arts of Spanish America, the South American avante garde, Mexican muralism and surrealism, and contemporary video, performance and installation.

ART 3110 Life Drawing Studio. 3 credits, max 9, Lab 6. Prerequisite(s): 2113 or consent of instructor. The development of formal and expressive aspects of drawing by direct observation of the figure and its environment. Emphasis on media experimentation, aesthetic considerations, personal concepts, and anatomy.

ART 3223 Oil Painting II. Lab 6. Prerequisite(s): 2223 and proficiency review or consent of instructor. Oil Painting with emphasis on personal development of visual ideas and techniques.

ART 3233 Watercolor II. Lab 6. Prerequisite(s): 2233 and proficiency review or consent of instructor. Stresses continued growth of technical skills with an emphasis on the individual development of ideas and imagery.

ART 3243 Jewelry and Metals II. Lab 6. Prerequisite(s): 2243 and proficiency review or consent of instructor. Development of technical skills and ideas through assigned projects. Metalworking processes include casting, advanced stone setting, hinge making, and forming of metal.

ART 3253 Ceramics II. Lab 6. Prerequisite(s): 2253 and proficiency review or consent of instructor. Focus on either hand building or throwing techniques. Development of personal expression and technical proficiency with the material and advanced firing and glazing processes. Emphasizing contemporary ceramic issues as well as broader art concepts.

ART 3263 Sculpture II. Lab 6. Prerequisite(s): 2263 and proficiency review. Non-ferrous metal casting. Basic welding techniques using oxy-acetylene, electric arc, and T.I.G. methods. Emphasis on concepts, form, methods and materials.

ART 3273 Printmaking II. Prerequisite(s): 2273 and proficiency review or consent of instructor. Development of technical skills and ideas through assigned projects. Intaglio processes include aquatint, softground, and multiple color work. Relief processes include reduction with stencils and multiblock. Litho techniques with permission of instructor.

ART 3293 New Genres in Studio Art. Prerequisite(s): 2283. This course is a continuation of the Studio Art Digital Survey course. New Genres is a continued, more advanced exploration of the concepts, techniques, and history of non-traditional art forms. Students will work in experimental and interdisciplinary ways with non-traditional media such as video, sound, photography, performance, writing, assemblage, and installation.

ART 3383 Digital Imaging. Lab 6. Prerequisite(s): 2283 or 2423 and 2433 or by consent of instructor. This studio art course is a continuation of the concepts, tools and techniques related to digital technology. Students will work specifically with digital photography, digital imaging and printing. Projects in the course will focus on fostering an intermediate level understanding of digital technologies and alternate process printing formats, while allowing more advanced students to incorporate media of personal interest.

ART 3403 Illustration II. Lab 6. Prerequisite(s): 2403, 2413, 2423 and portfolio review. Exploration of illustrative solutions to maximize visual interest via varied viewpoints, concepts and altered reality. Projects involving different career areas within the field of illustration. Requirements and advantages of each area.

ART 3413 Typography II. Lab 6. Prerequisite(s): 2403, 2413, 2423 and portfolio review. Exploration of typographic communication through a variety of problems. Type as the visual solution with emphasis on its functional, decorative, and creative applications. Solution of more complex typographic problems, dealing with a large body of information via the development of grid systems.

ART 3423 Graphic Design II. Lab 6. Prerequisite(s): 2403, 2413, 2423 and portfolio review. Use of computer and traditional methods to enhance production skills and solution of design projects from concept to the comprehensive. Evaluation and design of symbols and logos and their various applications, leading to an understanding of system design. Introduction to graphic design production and the preparation of art for reproduction.

ART 3453 Motion Design 1. Prerequisite(s): 2403, 2413, 2423 and portfolio review. Introduction to the basic concepts and techniques of motion design as visual communication. Students are introduced to the technical skills and critical thinking necessary for executing creative motion graphics intended to be experienced via electronic media, with an emphasis on typography, composition and design principles.

ART 3463 Interaction Design 1. Prerequisite(s): 2403, 2413, 2423 and portfolio review. Introduction to the basic concepts and techniques of interactive design as visual communication. Use of computer software to execute interactive design work intended to be experienced via electronic media, with an emphasis on typography, functionality and design principles.

ART 3543 Leonardo, Art and Science. Explores the deeply entwined fields of Renaissance art and science though the lens of Leonardo's extraordinarily diverse body of work. This course will consider the broader context of anatomical study, alchemy, early modern medicine, technological innovation, and psychology.

ART 3553 Fashioning and Self Fashioning: The Renaissance Portrait. Exploration of portraits created in Europe during the Renaissance. Addresses self-fashioning and artifice and the portrait as the collaborative product of artist, patron and subject.

ART 3600 Writing Methods in Art History. 1 credit. Prerequisite(s): Consent of instructor. A supervised research and writing project, typically concurrent with enrollment in an upper-division art history course.

ART 3603 (H) History of Classical Art. Stylistic, philosophical, and formal qualities of art in the Classical world. The creation of the Greek ideal and its dissemination in the Roman world through architecture, sculpture, and painting.

ART 3623 (H) History of Italian Renaissance Art. Architecture, sculpture, and painting in Italy, c.1300-1580. Major artists in their local contexts (e.g. Leonardo in Milan, Michelangelo in Florence, and Titian in Venice).

ART 3633 (H) History of Baroque Art. Art in 17th century Europe. Architecture, sculpture and painting of the Catholic Reformation (e.g. Caravaggio and Bernini in Italy, Velasquez in Spain, Rubens in Flanders), concluding with painting in non-sectarian, Protestant Netherlands (Rembrandt and Vermeer).

ART 3643 History of Graphic Design. Evolution of graphic communication from prehistoric times to the present. Investigation of the origins of printing and typography in Europe leading to the design of the printed page, the impact of industrial technology upon visual communication and the study of the growth and development of modern graphic design.

ART 3653 (H) History of 19th Century Art. Art of 19th century Europe-ideals, conflicts, escapes, and triumphs, beginning with the French Revolution and ending in 1900.

ART 3663 (D,H) History of American Art. Visual arts in America from the Colonial period to the present. Major styles, ideas and uses of material in architecture, painting, sculpture, and design. Same course as AMST 3673.

ART 3673 History of Northern Renaissance Art. Art in Northern Europe, c. 1200-1550. Emphasis on panel painting in the Netherlands (e.g. Van Eyck, Bosch), and book illustration in Germany (Durer).

ART 3683 (H,I) History of 20th Century Art. Beginning with the birth of "modernism" in the late 19th century, exploration of the fast-changing artistic styles of the 20th century: abstraction, expressionism, fantasy, realism, surrealism, and social protest. Emphasis on the relationship of art and 20th century society.

ART 3713 (H) Early Medieval Art: Saints, Martyrs, Pagans. Examination of the visual culture (sculpture, manuscripts, architecture, etc.) of the multicultural early Middle Ages in Europe and the wider Mediterranean world, from roughly 400 to 1050; includes Early Christian, Islamic, Byzantine, Germanic, Carolingian, Ottonian, and Anglo-Saxon artistic production.

ART 3723 (H) Court and Cloister: Medieval Art 1050-1400. Examination of the visual culture (sculpture, manuscripts, architecture, etc.) of the later Middle Ages in Europe and the wider Mediterranean world, from roughly 1050 through 1400; includes Islamic, Byzantine, Romanesque, and Gothic artistic production.

ART 3743 (H,I) History of Latin American Art II. Exploration of modern Latin American Art, beginning with academic painting and emerging nationalisms in the nineteenth century and continuing through Mexican Muralism, modern art movements in South America, and contemporary painting, film, video, performance, and installation.

ART 3753 (H) The Arts of Spain and the Spanish World. The art and culture of Spain and the Spanish world, including Paleolithic art, Renaissance and Baroque works from the Iberian Peninsula and American viceroyalties, and ending with Picasso and Miro.

ART 4100 Advanced Drawing. 3 credits, max 9, Lab 6. Prerequisite(s): 3110. Investigation of drawing stressing thematic development, abstract ideas, and individual imagery.

ART 4110 BA Studio Capstone. Prerequisite(s): 2002 and senior standing or consent of instructor. The course provides guided assistance to BA Studio Art students in developing a professional portfolio as it relates to their career interests in the arts.

ART 4211 BFA Studio Capstone Exhibition. Prerequisite(s): Must have passed the *BFA Studio Capstone Exhibition Review*, must have consent of instructor. Provides individual guidance and instruction necessary for mounting the *BFA Studio Capstone Exhibition*. This exhibition is the culminating event of the studio major's studies and a final preparation for a career in the studio arts. Enrollment must occur during the semester in which the *BFA Studio Capstone Exhibition* is to be mounted.

ART 4213 BFA Studio Capstone. Prerequisite(s): Concurrent enrollment in upper-division studio art course and consent of instructor. The purpose of this course is to provide students with the knowledge they need to make a career in art. Using the art they are preparing for the BFA Studio Capstone Exhibition, students will develop presentation and marketing materials in line with the professional standards of the field. They will be taught how to find, recognize and pursue artistic opportunities.

ART 4220 Oil Painting Studio. 3 credits, max 9, Lab 6. Prerequisite(s): 3223. Oil painting with emphasis on continuing personal development of visual ideas and techniques.

ART 4230 Watercolor Studio. 3 credits, max 9, Lab 6. Prerequisite(s): 3233. Stresses continued growth of personal imagery with an emphasis on the development of a consistent body of work and professional portfolio.

ART 4240 Jewelry and Metals Studio. 3 credits, max 9, Lab 6. Prerequisite(s): 3243. Emphasis on further development of personal concepts and technical skills through assigned and individual oriented projects. Broad-based exploration of advanced metalworking processes with emphasis on individual students' direction and technical needs.

ART 4250 Ceramics Studio. 3 credits, max 9, Lab 6. Prerequisite(s): 3253. Intended for students who want to specialize in the ceramic field of art. Will include sophisticated techniques of clay, glaze and firing methods. Emphasis on creation of a unique, well researched, aesthetically concise, and technically successful body of work.

ART 4260 Sculpture Studio. 3 credits, max 9, Lab 6. Prerequisite(s): 3263. A broad-based course which allows students to pursue individual interests using a variety of materials and processes. Emphasis on further development of concepts, skills, and techniques.

ART 4270 Printmaking Studio. 3 credits, max 9. Prerequisite(s): 3273 and proficiency review or consent of instructor. A broad-based course which allows students to pursue individual interests using a variety of printmaking materials and processes. Emphasis on further development of concepts, skills and techniques.

ART 4420 Graphic Design Studio. 3 credits, max 9, Lab 6. Prerequisite(s): 3423, 3443 or consent of instructor. Design and production of projects suited to the professional portfolio. Discussion of practical issues including career options, resume and portfolio preparation, and interview techniques.

ART 4430 Illustration Studio. 3 credits, max 9, Lab 6. Prerequisite(s): 3403, 3443 or consent of instructor. Conceptual development and production of illustrations in series. Development of individual style and assembly of a professional and consistent portfolio.

ART 4450 Motion Design Studio. 3 credits, max 9, Lab 6. Prerequisite(s): 3443 or consent of instructor. Exploration of motion design as visual communication. Development of technical skills and critical thinking necessary for executing creative motion graphics portfolio work intended to be experienced via electronic media, with an emphasis on conceptual development and application of design principles.

ART 4460 Interaction Design Studio. 3 credits, max 9, Lab 6. Prerequisite(s): 3453 or consent of instructor. Exploration of the visual and technical aspects of interaction with various electronic platforms to design effective graphical user interfaces. Emphasis on quantitative and qualitative research, process, and traditional graphic design methods for creating user-centered digital environments.

ART 4493 Portfolio Capstone. Lab 6. Prerequisite(s): Senior standing and consent of instructor. Final preparation of a professional portfolio, culminating in an extensive design project and the design, organization and production of an exhibition of work. Professional study on setting fees, writing contracts, working with an agent and other business practices.

ART 4583 (H) Rome: The Eternal City in Art and Film. The idea of Rome as seen through ancient and modern visual culture. Course begins with the Augustan propaganda machine and subsequently considers the most significant imperial image-makers to follow. A major portion of the course will be devoted to more recent and modern projections of the city, from Mussolini's New Rome to Fellini's Roma. *No credit for students with credit in 5583.*

ART 4593 (H) Art of Conversion: 16th Century Art in Mexico. Art and architecture of the sixteenth century, including mission architecture, early altar-screens, the effect of European imports on native art production, and the role of confraternities and public ceremonies on contact-period culture. *No credit for students with credit in 5593.*

ART 4603 History of Ancient Egyptian Art. Broad survey of ancient Egyptian art and architecture from pre-dynastic to the beginning of the Christian Era under Roman rule (4000 B.C.-320 A.D.) Discussion within the context of religious meaning and overall cultural development of ancient Egypt.

ART 4613 Art Since 1960. Art and art theory from 1960 to the present. Major trends of Minimalism, Pop Art, Photo Realism, Performance, and Conceptual Art. Theories and intellectual bases of each movement as well as major critical responses. *No credit for students with credit in 5613.*

ART 4623 History of Prints and Printmaking. A survey of graphic art in Europe and the United States (c. 1450-1950). Woodcut, intaglio and lithography by major masters (e.g. Dürer, Rembrandt, Goya, Picasso). Print as a document of social history in the West

ART 4633 (H) The Frontier and American Visual Culture. The frontier and its impact on American culture examined through a survey of paintings, sculpture, photography, film, television, and other forms of popular imagery. The frontier as a zone of cultural interaction that is seldom tied to a single culture. (Same course as AMST 4633)

ART 4653 History of Indian Art. The history and culture of South Asia (India and Pakistan) are explored through its arts—architecture, sculpture, painting, and design.

ART 4663 (H) History of Chinese Art. The arts of China in their historical, cultural, religious, and social context. Painting, sculpture, architecture, porcelain, furniture, and decorative arts. *No credit for students with credit in 5663.*

ART 4673 History of Japanese Art. Critical social, religious, and historical issues in the arts of Japan. Painting, sculpture, architecture, landscape architecture, prints, and decorative arts. *No credit for students with credit in 5673.*

ART 4683* Modern and Contemporary Art in Asia. Modern and contemporary art in Asia. Special attention to the role of race, gender, and social class on artistic production.

ART 4693 Gender and Visual Culture. Explores themes and issues surrounding gender in relation to art history and visual culture more broadly. Topics may include artists and creators, sexuality, the body, eroticism, historicizing gender, feminism and feminist theory, etc. *No credit for students with credit in 5693.*

ART 4703 Art East and West: Biases and Borrowings. Explores the complicated interaction, cultural borrowings and responses on many levels of two major world systems, the "West" (Europe and America) and the "East" (South and East Asia). Beginning with the development of the sea trade in the 16th century, the course will study, through works of art, the effect of history, politics, religious struggles, economics, trade and ethnic biases on the cultures of East and West. *No credit for students with credit in 5703.*

ART 4713 The Visual Culture of the Islamic World. Examines the visual culture, including art and architecture, of the Islamic world, dating from the inception of Islam in seventh-century Arabia through today. *No credit for students with credit in 5713.*

ART 4723 History of Museums and Collecting. Investigation of the history of museums and collecting practices in Western Europe and the United States from the sixteenth century to the mid-20th century. Same course as ART 5723.

ART 4763 Native American Art and Material Culture. Survey of the history and material production of the Native American tribes living within the boundaries of the continental United States and Canada. Focus on basic concepts and primary issues related to tribes of the major geographical areas: the woodland areas, which includes the Northeast and Great Lakes area, the Southeast, the Great Plains, the Southwest, the Plateau and West Coast, and the Northwest Coast. *No credit for students with credit in 5763.*

ART 4783 Rembrandt van Rijn. The Dutch artist Rembrandt van Rijn (1606-1669) was one of the most important and innovative painters and printmakers of the seventeenth century. This course is to acquaint students with both his extensive body of work and the central critical issues that interest scholars today. Same course as ART 5783.

ART 4793 Architecture and Space in East Asia. History of Architecture in East Asia from the traditional Chinese timber frame to the 20th century. Will address how architecture delivers political ideologies and structures social relationships, both symbolically and in practice.

ART 4800 Special Studies in Art. 1-3 credits, max 9. Prerequisite(s): Junior standing and consent of instructor. Courses in media exploration, special subjects and current issues. Offered on campus or through extension workshops.

ART 4810 Museum Internship. 1-3 credits, max 9. An on-site museum experience, including exhibition selection and preparation, collection cataloging and research, and museum administration.

ART 4813 Museum Exhibition. Designing an exhibition that draws on the Oklahoma State University art collection. Includes museum history, theory and curatorial practice. Same course as ART 5813.

ART 4820 Graphic Design Internship. 1-6 credits, max 6. Prerequisite(s): 3403 or 3423 and consent of instructor. An on-site graphic design work experience that provides professional practice under the supervision of a design professional.

ART 4830 Apprenticeship. 1-6 credits, max 6. Professional opportunity to work with artists of national and international reputation.

ART 4900* Directed Study in Art. 1-3 credits, max 9, Lab 1-6. Prerequisite(s): Junior standing and written permission of department head. Self-designed special topics in studio art or graphic design. By contract only.

ART 4910* Directed Study in Art History. 1-3 credits, max 9, Lab 1-6. Prerequisite(s): Junior standing and written consent of department head. Self-designed special topics in art history. By contract only.

ART 4920 Art History Symposium. 1 credit.. Prerequisite(s): One hour of ART 3600 and 4933. Specifically for art history majors, and typically taken during the student's final year. Students prepare for, and participate in, a public presentation of a research paper (ART 3600). Special attention is given to a speaker's argument, methodology, visual, and overall presentation.

ART 4933 Art in Context. Prerequisite(s): One hour of ART 3600. Designed specifically for art history majors, and typically taken during the junior year, this course examines select critical theories and their methodological application.

ART 4973* 20th Century Chinese Art. This course will explore the ways in which Chinese artists of the 20th century have defined China's history and culture.

ART 4993 Senior Honors Project. Lab 3. Prerequisite(s): Departmental invitation, senior standing, Honors Program participation. A guided reading and research program ending with an honors thesis or project under the direction of a faculty member. *Required for graduation with departmental honors in art.*

ART 5000* Art History Master's Thesis. 1-3 credits, max 6. Independent study course intended to provide guidance for research and writing of MA Thesis in art history.

ART 5013* Theory and Methods in Art History. This course examines the field of art history in terms of its historiography, research methods, critical frameworks and theoretical underpinnings. Students are expected to develop and articulate their own theoretical and methodological position in the context of and with explicit reference to contemporary praxis and theory.

ART 5583* Rome: The Eternal City in Art and Film. The idea of Rome as seen through ancient and modern visual culture. Course begins with the Augustan propaganda machine and subsequently considers the most significant imperial image-makers to follow. A major portion of the course will be devoted to more recent and modern projections of the city, from Mussolini's New Rome to Fellini's Roma. *No credit for students with credit in 4583.*

ART 5593* Art of Conversion: 16th Century Art in Mexico. Art and architecture of the sixteenth century, including mission architecture, early altar-screens, the effect of European imports on native art production, and the role of confraternities and public ceremonies on contact-period culture. *No credit for students with credit in 4593.*

ART 5613* Art Since 1960. Prerequisite(s): Permission of instructor. Art and art theory from 1960 to present. Major trends of Minimalism, Pop Art, Photorealism, Performance, and Conceptual Art. Theories and intellectual bases of each movement as well as major critical responses. *No credit for students with credit in 4613.*

ART 5663* History of Chinese Art. Critical social, religious, and historical issues in the arts of China. Painting, sculpture, architecture, porcelain, furniture, and decorative arts. *No credit for students with credit in 4663.*

ART 5673* History of Japanese Art. Critical social, religious, and historical issues in the arts of Japan. Painting, sculpture, architecture, landscape architecture, prints, and decorative arts. *No credit for students with credit in 4673.*

ART 5693* Gender and Visual Culture. Explores themes and issues surrounding gender in relation to art history and visual culture more broadly. Topics may include artists and creators, sexuality, the body, eroticism, historicizing gender, feminism and feminist theory, etc. *No credit for students with credit in 4693.*

ART 5703* Art East and West: Biases and Borrowings. Prerequisite(s): Instructor permission. Explores the complicated interaction, cultural borrowings and responses on many levels of two major world systems, the "West" (Europe and America) and the "East" (South and East Asia). Beginning with the development of the sea trade in the 16th century, the course will study, through works of art, the effect of history, politics, religious struggles, economics, trade and ethnic biases on the cultures of East and West. *No credit for students with credit in 4703.*

ART 5713* The Visual Culture of the Islamic World. Examines the visual culture, including art and architecture, of the Islamic world, dating from the inception of Islam in seventh-century Arabia through today. *No credit for students with credit in 4713.*

ART 5723* History of Museums and Collecting. Prerequisite(s): Graduate standing. Investigation of the history of museums and collecting practices in Western Europe and the United States from the sixteenth century to the mid-20th century. Same course as ART 4723.

ART 5763* Native American Art and Material Culture. Prerequisite(s): Permission of instructor. Survey of the history and material production of the Native American tribes living within the boundaries of the continental United States and Canada. Focus on basic concepts and primary issues related to tribes of the major geographical areas: the woodland areas, which includes the Northeast and Great Lakes area, the Southwest, the Great Plains, the Southwest, the Plateau and West Coast, and the Northwest Coast. *No credit for students with credit in 4763.*

ART 5783* Rembrandt van Rijn. Prerequisite(s): Graduate standing or permission of instructor. The Dutch artist Rembrandt van Rijn (1606-1669) was one of the most important and innovative painters and printmakers of the seventeenth century. This course will acquaint students with both his extensive body of work and the central critical issues that interest scholars today. Same course as ART 4783.

ART 5813* Museum Exhibition. Prerequisite(s): Graduate standing or permission of instructor. Designing an exhibition that draws on the Oklahoma State University art collection. Includes museum history, theory and curatorial practice. Same course as ART 4813.

ART 5900* Graduate Studies in Art. 1-6 credits, max 12. Prerequisite(s): BA, BFA or 15 upper-division hours in a discipline; consent of instructor. Projects in art with emphasis on portfolio preparation.

ART 5910* Graduate Studies in Art History. 1-6 credits, max 12. Prerequisite(s): BA, BFA or 15 upper-division hours in art history; consent of instructor. Advanced research in art history.

ART 5920* Art History Graduate Seminar: Special Topics. 3-12 credits, max 12. Special topics graduate seminar in art history.

Arts and Sciences (A&S)

A&S 1111 Freshman Orientation. Orientation for freshmen. Study techniques, evaluation of one's abilities and the making of proper educational and vocational choices.

A&S 1221 Honors Freshman Orientation. Prerequisite(s): Honors Program participation. Orientation for freshmen to Arts and Sciences Honors program, introduction to University academic expectations, techniques for achieving academic success, and substantive introduction to material in selected academic disciplines. *No credit for students with credit in A&S 1111.*

A&S 2000 Special Topics. 1-3 credits, max 6. Selected interdisciplinary topics presented in lecture or seminar format.

A&S 2001 Introduction to European Studies. Overview of the history, languages, and cultures of the nations currently constituting the European Union.

A&S 3080 International Experience. 1-18 credits, max 36. Prerequisite(s): Consent of the associate dean of the college. Participation in a formal or informal educational experience outside of the USA.

A&S 3090 (I) Study Abroad. 1-18 credits, max 36. Prerequisite(s): Consent of the Study Abroad office and associate dean of the college. Participation in an OSU reciprocal exchange program.

A&S 3111 New Student Seminar. Orientation to OSU for new transfer students. Topics include advanced study and writing skills, financial management, career development and the transition from college to work.

A&S 3710 Arts and Sciences Internship. 1-3 credits, max 6. Prerequisite(s): Junior standing. Practicum or internship experiences not included in departmental offerings. Before enrolling, students must have an individual contract approved by the sponsoring Arts and Sciences professor and the dean of Arts and Sciences (or administrative officer). For use in special circumstances by Arts and Sciences departments that do not have an internship course.

A&S 4000 Special Topics. 1-3 credits, max 6. Selected interdisciplinary topics presented in lecture or seminar format. *Some sections may be pass/fail.*

A&S 4013 Liberal Studies Senior Project. Prerequisite(s): Consent of instructor. Research report or other creative activity undertaken to satisfy capstone requirement for liberal studies degree.

A&S 4111 Job Search Strategies for Arts and Sciences Majors. Prerequisite(s): Junior standing. Identification of individual goals and transferable skills, exploration of career options, job market research, and development of employment search tools.

Astronomy (ASTR)

ASTR 1014 (N) The Solar System. Recent discoveries about the sun, planets, moons, asteroids, meteoroids, and comets; formation and future of the solar system; interplanetary travel, colonization, terraforming, and the search for extraterrestrial life. Offered in the fall semester. *No credit for those with credit in 1104.*

ASTR 1024 (N) Stars, Galaxies and the Universe. Recent discoveries about the structure and life cycles of stars, galaxies and the universe; the search for extraterrestrial intelligence; interstellar travel, black holes, wormholes, and tachyons. Offered in the spring semester. *No credit for those with credit in 1104.*

ASTR 4010 Observatory Research. 1-2 credits, max 8. Prerequisite(s): PHYS 2114 and consent of instructor; ASTR 1014 or ASTR 1024 recommended. Team execution of multi-semester observing programs with electronic detectors at OSU's off-campus observatory. Introduction to digital image processing and analysis.

Aviation Education (AVED)

AVED 1114 Theory of Flight. Private pilot ground school. Theory of flight, principles of navigation, meteorology and Federal Aviation Regulations. Preparation for FAA private pilot computer-based knowledge exam. *Special fee required.*

AVED 1222 Primary Flight Laboratory. Lab 4. Meets the flight requirements for the FAA Private Pilot Certificate. Flight instruction conducted under FAR Part 141. *Special fee required.*

AVED 1403 Advanced Theory of Flight. Prerequisite(s): 1114 and passed FAA Private Pilot Examination. Advanced navigation, aircraft performance and meteorology, and introduction to crew resource management.

AVED 2113 History of Aviation. History of aviation from its early developments to the present. Historic events and the role of government as they relate to the evolution of the regulatory infrastructure of the aviation industry.

AVED 2122 Intermediate Flight Lab. Lab 4. Prerequisite(s): 2132. Professional Pilot Course emphasizing IFR cross country operations. Flight instruction conducted under FAR Part 141. *Special fee required.*

AVED 2132 Instrumental Flight Lab. Lab 4. Prerequisite(s): 1222. Professional Pilot Course required for FAA instrument rating. Flight instruction conducted under FAR Part 141. *Special fee required.*

AVED 2142 Commercial Maneuvers Flight Lab. Lab 4. Prerequisite(s): 2122. Professional Pilot Course emphasizing Commercial practical test maneuvers. Flight instruction conducted under FAR Part 141. *Special fee required.*

AVED 2213 Theory of Instrument Flight. Prerequisite(s): 1403. Instrument flight rules, the air traffic system and procedures, the elements of forecasting weather trends. Preparation for FAA instrument computer-based knowledge exam.

AVED 2313 Theory of Commercial Flight. Prerequisite(s): 2213. Advanced aircraft systems, aerodynamics, federal aviation regulations, airports and airspace, navigation, and performance. Preparation for FAA Commercial Pilot Written Examination. *Special fee required.*

AVED 2513 Aviation Career Planning and Development. Assessment of career interests and aviation job opportunities that match those interests. Development of an academic and career learning and development plan consistent with identified interests.

AVED 3231 Theory of Multi-Engine Flight. Prerequisite(s): Private Pilot Certificate. Aeronautical theory and information required for operating the multi-engine airplane safely, efficiently and within its specified limitations. Emphasis on aerodynamics and multi-engine emergencies.

AVED 3243 Human Factors in Aviation. The study of people interacting with the aviation environment. Individual and group performance, equipment design, physical environment and procedure development.

AVED 3333 Advanced Aircraft Systems. Prerequisite(s): 2313. Study of complex aircraft systems. Electronic flight instruments, inertial navigation, and aircraft monitoring systems.

AVED 3341 Multi-Engine Flight Laboratory. Lab 2. Prerequisite(s): 2142. Professional Pilot Course emphasizing multiengine operations, including Commercial certification with Multiengine Rating. Flight instruction conducted under FAR Part 141. *Special fee required.*

AVED 3433 Aviation/Aerospace Ethics. Ethical decision-making as applied to the aviation and aerospace industry, an industry with narrow tolerance for error in terms of human life and economic impact. Awareness of aviation ethical issues and associated decision-making skills.

AVED 3443 Aviation Legal and Regulatory Issues. Insight pertinent to federal governing bodies in addition to local and international laws forming the present structure of aviation law. Practices and pitfalls in aviation activities and a basic legal research capability.

AVED 3453 Aviation/Aerospace Security Issues. Analysis of the legal and regulatory responses to changing threats to aerospace security. Review of technological solutions for airports and aircraft.

AVED 3463 Aerospace Maintenance and Safety. Identification and management of the human errors encountered in all aspects of aircraft maintenance operations. Case studies of maintenance-related accidents: line, hangar, and overhaul maintenance. The role of quality control and quality assurance are also examined as tools in reducing maintenance error.

AVED 3473 OSHA for Aerospace Managers. Occupational safety and health requirements within the aerospace industry. History of OSHA, OSHA regulations relative to aerospace organizations along with recent inspection results and published violations.

AVED 3483 Airport Passenger and Baggage Screening. The history of airport security, the laws and agencies tasked with aviation security and the passenger and baggage screening technologies currently in use or being tested in airports. The role of technology in the aviation layered security program will be discussed.

AVED 3493 Analysis of Aviation Security Countermeasures. A comprehensive approach to identification and analysis of security countermeasures in the Aviation industry.

AVED 3513 Aviation/Aerospace Management Principles. Managing the major elements of the aviation/aerospace industry, including aircraft manufacturing and air transportation system.

AVED 3523 Airport Planning and Management. Prerequisite(s): 3523. Overview of the major functions of airport management, including master planning. Study of the socio-economic effects of airports on the communities they serve.

AVED 3533 Aircraft Turbine Engine Operation. Principles of physics and gas laws pertaining to turbine powered aircraft operation. Turbine power plant systems theory with emphasis on safe and efficient operation of turbine powered aircraft.

AVED 3543 Aerospace Organizational Communications. Aerospace communication to aid aviation students in proper use of written and verbal skills needed in various aerospace leadership roles.

AVED 3563 Aviation Marketing. Marketing aviation products for the major elements of the aviation industry.

AVED 3573 Aviation/Aerospace Finance. Financing the major elements of the aerospace industry, including general aviation, aircraft manufacturing and airports.

AVED 3623 Airport Network Security. Comprehensive evaluation of the airport network landscape to include evaluation and mitigation of potential threats to the overall airport environment.

AVED 3663 Aerospace and Air Carrier Industry. Broad understanding of the air transportation industry and an in-depth knowledge of the organizational structures, managerial functions and operational aspects of today's major, national, and regional air carriers. Historical perspectives, regulators and associations, economic characteristics, labor relations and marketing of modern air carriers.

AVED 3883 Space Flight. A broad understanding and an in-depth knowledge of space flight and exploration of outer space. Emphasis will be placed on a thorough historical review and examination of the types of people and technological advancements involved in space exploration and flight.

AVED 4100* Specialized Studies in Aviation. 1-3 credits, max 6. Independent studies, seminars, and training within selected areas of aviation.

AVED 4103 Aerospace Distribution, Warehousing and Transportation. Aerospace logistics concepts and the management of aerospace distribution activities ranging from top management planning to warehousing and shipping.

AVED 4113* Aviation Safety. Flight safety including studies in human factors, weather, aircraft crashworthiness, accident investigation, and aviation safety programs. Elements of aviation safety and flight operations (private flying, flight instruction, and business flying) and commercial aviation.

AVED 4123 Aerospace Depot Maintenance. Aerospace depot maintenance operational and budget issues related to Economic Order Quality, Materials Requirement Planning, Benefit Cost Analysis, repair expenditures, fleet flight hours, transport modules, handling, shipping and other activities.

AVED 4133 Principles of Flight Instruction. Preparation for the FAA Fundamentals of Instructing and Flight Instructor Knowledge Exams, as well as preparation for the CFI Initial Practical Test.

AVED 4143 Government Operations and Interfaces in Aerospace Management. Government and its impact on aerospace management decisions related to logistics, inventory management, production, and operations.

AVED 4153 Aerospace Sustainment. Prerequisite(s): Senior standing. A capstone course requiring application of all elements of the supply-chain management process to an aerospace organizational problem or project.

AVED 4163 FAA and Aerospace Logistics Regulations and Requirements. Government regulations and requirements and the impact of those requirements on the aerospace supply chain management processes using case scenarios related to logistics, aviation, operations, procurement and the environment.

AVED 4173 Aerospace Logistics Quality Programs. Logistics quality programs, including TQM, Kaizen, Lean, Six Sigma, and ISO 9000 in aerospace organizations.

AVED 4193 Aerospace Human Resource Management and Aerospace Workforce Acquisition. Workforce planning techniques to strengthen knowledge retention practices within the aerospace industry.

AVED 4200 Internship in Aviation. 1-12 credits, max 12. Individually supervised internship in aviation career areas. Directed field experience related to the participant's area of concentration.

AVED 4232 Flight Instructor: Airplane Flight Laboratory. Lab 4. Prerequisite(s): 2142, 4133. Dual flight instruction to meet the requirements for the FAA flight instructor: airplane certificate. Flight instruction conducted under FAR Part 141. *Special fee required.*

AVED 4303* Aviation Weather. Prerequisite(s): GEOG 3033. Familiarization with weather products needed to enhance flight safety.

AVED 4331 Flight Instructor: Instrument Flight Laboratory. Lab 2. Prerequisite(s): 4231. Dual flight instruction to meet the requirements of adding an instrument flight instructor rating to the flight instructor certificate. Flight instruction conducted under FAR Part 141. *Special fee required.*

AVED 4333* Advanced Aircraft Performance. A study of advanced aircraft performance including appropriate physical laws, atmospheric properties and power plant technology.

AVED 4343* Geospatial Technologies for Aerospace Managers. Using geographic information systems (GIS) and other geospatial technologies to effectively manage airports, including project management, maintenance, safety and security, noise and obstruction management, and environmental management.

AVED 4353* Cockpit Automation. Prerequisite(s): 2213, 2132, 3333. A study of aircraft "glass cockpits", including performance management, navigation and guidance, automatic flight control, flight instrument displays, and crew advisory and warning.

AVED 4413* Aviation Terrorism and Asymmetrical Warfare. Origins of modern terrorism and asymmetrical warfare as it related to current aviation security issues. A historical perspective to the headlines of today providing an understanding needed in making future security decisions.

AVED 4423* Aviation Security Organizations and Law. Understanding how security systems and law are organized and managed. Problems facing security management, including recruiting, screening, and hiring of security personnel. Problems associated with 24/7 operations.

AVED 4433 Airport Safety Inspections. Safety requirements of U.S. general aviation airports. Elements of the 5010 airport inspection program, FAA advisory circulars, and other pertinent documents.

AVED 4523 Airport Certified Member Preparation. Prerequisite(s): 3523. Course focus is to earn knowledge necessary to successfully complete the AAAE Certified Member (CM) designation examination. Comprehensive evaluation of airport management and leadership issues to include administration, air service development, construction, finance, legislative affairs, maintenance, marketing and communications, operations, planning, and security.

AVED 4643* Aviation Navigation Global Positioning Systems. Overview of the theory and operation of the GPS in the private and public sector.

AVED 4653 (I) International Aerospace Issues. Fundamental knowledge, comprehension and abilities to apply, analyze, synthesize and evaluate international aerospace issues, including trends in security, safety, technology, and organizations.

AVED 4663 Aerospace Leadership. Leadership theories and practices applicable to the aerospace environment and the types of leadership skills required for 21st Century aerospace organizational leaders.

AVED 4703 Crew Resource Management. Prerequisite(s): 2142, 3243. Discovering how resource management applies to crew behavior in aviation. Special emphasis on decision-making, judgment, teamwork, stress management, situation awareness, leadership, and workload management. Ten hours in a dual flight control multi-engine simulator. *Special fee required.*

AVED 4771 Flight Instructor: Multi-Engine Flight Laboratory. Lab 2. Prerequisite(s): 4231. Dual flight instruction to meet the requirement for adding a multi-engine flight instructor rating to the flight instructor certificate. Flight instruction conducted under FAR Part 141. *Special fee required.*

AVED 4813 Air Transportation Compliance. Regulatory requirements in the management of air transportation and logistics operations including the shipment of hazardous materials in domestic and international transport, US Customs import/export compliance, and Transportation Safety Administration (TSA) requirements.

AVED 4883 Capstone Course in Aviation Management. Prerequisite(s): Aviation Management major with senior status. Applies knowledge and issues obtained in prior aviation courses.

AVED 4943* Basic Aircraft Accident Investigation. A study of statutes, regulations and regulatory agency requirements that influence aircraft accident investigation.

AVED 4953* Corporate and General Aviation Management. Study of management principles and practices of corporate and general aviation. Equipment acquisition, legal requirements, government regulations, flight operations, aircraft maintenance, management and investment decision-making.

AVED 4963* Airport Design. Overview of airport planning and development parameters, airport design considerations, economic impact of airport development, and a global examination of airport expansion projects.

AVED 4983 Aerospace Industry Hazardous Materials or Dangerous Goods. Regulatory requirements and compliance issues in managing aerospace industry hazardous materials and dangerous goods.

AVED 4990 Pilot Proficiency Flight. 1-2 credits, max 4, Lab 32. Required for students entering the aviation education program who possess all FAA certificates/ratings required for the aviation sciences degree.

AVED 4993 Aviation Labor Relations. Aviation industry laws, regulations, and procedures for management and organized labor from historical through current perspectives. Focus on economic, legal, political, and public policy factors in aviation.

AVED 5000* Master's Report or Thesis. 1-6 credits, max 6. Prerequisite(s): Consent of adviser. Students studying for a master's degree enroll in this course for a total of 3 credit hours if writing a report or 6 hours if writing a thesis.

AVED 5020* Seminar in Aerospace Education. 1-3 credits, max 6. Prerequisite(s): Consent of instructor. Individual research problems in aerospace education.

AVED 5053* Guided Reading and Research. Prerequisite(s): Consent of instructor. Guidance in reading and research required for the MS in aviation and space program.

AVED 5103* Aviation Career Development. Aviation career development in private and public aviation organizations.

AVED 5113* Aviation Safety Program Development. Prerequisite(s): 4113. A detailed examination of risk management and accident prevention in the aviation industry. Organization and operation of safety programs including OSHA requirements, performance measurements, cost analysis, and systems safety analysis.

AVED 5153* Capstone in Aerospace Research. Prerequisite(s): 5053. The final culminating project intended to be an in-depth application of the knowledge and skills acquired from the MS Aerospace Education curriculum.

AVED 5200* Graduate Internship in Aviation and Space. 1-6 credits, max 6. Directed field experiences in aerospace education for master's students.

AVED 5203* Aeromedical Factors. Prerequisite(s): 3243. The study of aeromedical factors that influence pilot performance. The study of life support equipment designed to increase aviation safety.

AVED 5303* Aviation and Space Quality Issues. A study of the practice and research involved in implementing aviation and space quality issues.

AVED 5333* Aircraft Performance. Operational flight performance issues, especially transition from propeller-driven to jet aircraft. Use of flight simulation software to determine optimal speeds for climb, descent, range and maximum endurance of a specific aircraft model.

AVED 5363* Aircraft Systems. Flight management systems, data exchange busses, computerized flight control systems, airframe environmental systems, electrical, pressurization, fuel and icing. Earlier generation aircraft systems contrasted with modern aircraft systems.

AVED 5403* Passenger Screening Technology. Understanding of the technologies currently in use or being tested in airports. Passenger screening technologies and their role in establishing a layered security program.

AVED 5413* Landside Security Technologies. Technologies available for protecting the landside of the airport. Access control systems, blast protection and mitigation planning, perimeter security technologies and biometric technologies.

AVED 5423* Security Planning Audits and NIMS. The management of a security program. Written security plans, security audits, emergency management, and the National Incident Management System.

AVED 5433* General Aviation and Cargo Security. Overview of airport operations: regulatory history of air transportation, aviation forecasting, capacity and delay issues at airports, environmental issues, airport emergency procedures and aircraft rescue and fire-fighting, and airport system and master planning.

AVED 5443* International Aviation Security. Civil aviation security structure required of all airports and airlines engaged in international civil aviation operations. Focuses on the requirements of the International Civil Aviation Organization, specifically ICAO Annex 17.

AVED 5453* Advanced Aviation Security. Prerequisite(s): Graduate standing. In-depth look at aviation security. Development of a greater understanding of problems associated with maintaining a secure aviation transportation industry. Familiarity with the history of attacks against aircraft, airports and other aviation facilities.

AVED 5463* Aerospace Risk Assessment. The risks, threats, and vulnerabilities associated with aviation/aerospace assets, and associated decision-making processes. Risk management principles and utilizing cost-benefit analysis and other tools and methodologies applicable to aviation and aerospace challenges.

AVED 5473* Aerospace Education and Training Effectiveness. Curriculum design and instructional effectiveness for aviation/aerospace educators and training professionals.

AVED 5543* Advanced Aerospace Communications. Interdisciplinary area of study drawing from previous knowledge and experience in effective management and leadership communication to meet the unique demands of the field of aviation. A broad range of academic disciplines and technical experience guiding aviation professionals in the refinement of personal, team and organizational communications.

AVED 5553* Aerospace Proposal and Procurement. Analysis of aerospace proposal writing and federal grant development including the basics of government acquisition and procurement.

AVED 5563 Aerospace Leadership and Management. Introductory course on leadership and management issues in the highly volatile aerospace environment. Introduction to management and leadership theory of the past, and exploration of the aviation environment of the future.

AVED 5573* Aerospace Defense Acquisition. Analysis of the Department of Defense (DoD) acquisition process, including the basics of acquisition

management and the life cycle of a defense contract from inception to disposal. Phases of acquisition include: concept exploration, development, production, fielding and deployment.

AVED 5593* Influencing Public Policy in the Aerospace Industry. The aerospace legislative process, researching draft legislation, tracking state and federal legislation, communicating with legislators identifying the fiscal impact and benefits.

AVED 5663* Issues in the Airline/Aerospace Industry. The components, participants, activities, characteristics, scope and economic significance of the air carrier industry and its major segments. The effects of regulation, competition, marketing, manufacturing and environmental control.

AVED 5720* Current Issues in Aerospace Education. 1-3 credits, max 6. Prerequisite(s): Consent of instructor. Current issues in aerospace education.

AVED 5773* Historical Significance of Aviation. Humankind's attempt to conquer the skies from the earliest accomplishments in aviation to the aircraft of tomorrow. Profiles the way people, technology, and events have shaped the modern world of aviation.

AVED 5813* Earth Observation Systems. Prerequisite(s): GEOG 4333. A study of systems orbiting earth that collect data on the land and atmosphere.

AVED 5823* Space Science. A study of the sun, inner and outer planets, asteroid belt, space probe exploration, orbital mechanics and missions.

AVED 5850* Directed Readings in Aerospace Education. 1-3 credits, max 6. Prerequisite(s): Consent of instructor. Directed studies in aerospace education.

AVED 5883* Aviation Economics. The economic significance of the air carrier industry and its major segments. The effects of regulation, competition, schedules, marketing and environmental control.

AVED 5893* Aerospace Executive Decision Making. Application of concepts and lessons of executive decision leadership within the context of the aerospace environment. Utilization of problem solving skills and leadership lessons of the 21st century aerospace leader.

AVED 5910* Practicum in Aerospace Education. 1-3 credits, max 6. Prerequisite(s): Consent of instructor. Directed observation and supervised clinical experiences in aerospace education.

AVED 5953* Labor Relations in Aviation and Aerospace. Labor laws, regulations, and labor-management relations in the U.S. aviation and aerospace industry, underlying the air carriers, public airport infrastructure, and related government employers.

AVED 5963* Airport Operations. Prerequisite(s): Graduate standing. Extensive overview of airport operations. Familiarity with the regulatory history of air transportation, airports, the Federal Aviation Administration, and the Transportation Security Agency. Introduction to a wide variety of organizational structures found at U.S. airports.

AVED 5973* Aerospace Law. Study of the legal system as it relates to aerospace law and governance of the aviation industry.

AVED 5993* Ethics in Aviation. Learning how to protect vital interests and maintain ethical control in highly regulated environments.

AVED 6103* Doctoral Seminar in Aerospace Education. Individual research problems in aerospace education.

AVED 6000* Doctoral Thesis. 1-15 credits, max 15. Required of all candidates for the EdD in applied educational studies. Credit awarded upon completion of the thesis.

AVED 6203* Aviation Physiology. Prerequisite(s): 5203 or equivalent. The study of the complexities of pilot performance as it relates to human physiology, human factors and aviation safety.

AVED 6303* Aviation and Space Safety Data Analysis. A doctoral seminar in the practical application and research of aerospace databases. Qualitative and mixed method tools common to research in the fields of aviation and aerospace are emphasized.

AVED 6313* Administration of Aviation Institutions. A study of the organization and administration of public and private aviation institutions. Study of the impact of economic and governmental system on these institutions.

AVED 6413* Development of Air and Space Flight. Specific air and space missions with emphasis on contributions to humankind.

AVED 6423* Certification of Airplanes. A study of the practices and research involved in the certification of airplanes.

AVED 6443* Certification of Rotorcraft. A study of the practices and research involved in the certification of rotorcraft.

AVED 6613* Aviation Executive Development. A study of the styles of aviation executives in private and public aviation organizations.

AVED 6773* Applied Aviation and Space Research. Prerequisite(s): Consent of instructor and approval of student's advisory committee. Action research topics in aviation and space identified by the aerospace industry with emphasis upon publications in aviation and space refereed journals and trade publications.

AVED 6883* Doctoral Internship in Aviation and Space. Prerequisite(s): Consent and approval of student's advisory committee. Directed field experiences in aerospace education for doctoral students.

AVED 6943* Aviation Regulatory Law. A study of the practical application and research of the FAA regulatory process and associated case law.

AVED 6963* Advanced Aircraft Accident Investigation. Prerequisite(s): 4943. Application and practice of the different statutes, regulations, and regulatory agency requirements that influence aircraft accident investigations.

Biochemistry (BIOC)

BIOC 1990 Freshman Research in Biochemistry. 1-2 credits, max 2, Lab 3. An introduction to biochemical research through guided work on a relevant experimental problem.

BIOC 2101 The Experiments Behind the Facts of Real Science. Prerequisite(s): BIOL 1114 and CHEM 1515. Introduction to research though the study of primary research papers.

BIOC 2200 Medicine and Molecules. 1-3 credits, max 6. Examination of specific diseases at all scales, from the biology of the causal agent to global impacts. The molecular biology of the agent, interactions with the human body, and the etiology, epidemiology, history and current state of the disease, ethical considerations, and prospects for cures.

BIOC 2344 Chemistry and Applications of Biomolecules. Prerequisite(s): CHEM 1225. A descriptive survey of organic functional groups and biomolecules. Mode of formation and function of these molecules in microorganisms, plants and animals as they relate to biotechnology, environmental sciences and health related issues. A terminal course for students in applied biological science education. *Not recommended for pre-professional students or students planning graduate study in biological sciences.*

BIOC 3653 Survey of Biochemistry. Prerequisite(s): CHEM 3015 or 3053. An introduction to the chemistry of living systems. Chemical properties of the constituents of living organisms. Modes of formation, reactions and function of these compounds in microorganisms, plants and animals. Intended for non-majors.

BIOC 3713 Biochemistry I. Prerequisite(s): CHEM 3153. Biochemistry of nucleic acids, proteins, amino acids, carbohydrates, and lipids with an emphasis on the kinetics, thermodynamics, catalytic and regulatory strategies of biochemical reactions and bioenergetics. Designed for biochemistry majors.

BIOC 3723 Analytical Biochemistry and Molecular Biology. Lab 7. Prerequisite(s): 3653 or 3713 or concurrent enrollment. Integrated lecture-laboratory course on fundamental theories and techniques in biochemical, forensic, and clinical research. Hands-on experience in mass spectrometry, DNA analysis, metabolic assays, kinetic assays, and protein purification.

BIOC 3813 Biochemistry II. Prerequisite(s): 3713. Continuation of Biochemistry I with focus on metabolic pathways, cycles, and control mechanisms. This course will cover bioenergetics and metabolism of carbohydrates, lipids, amino acids and nucleotides. *Designed for biochemistry majors.*

BIOC 4113* Molecular Biology. Prerequisite(s): 3653 or 3713 and BIOL 3023 or ANSI 3423 or PLNT 3554. Applications of biochemistry, molecular biology and genetic engineering with emphasis on protein structure and function, regulation of cell function, metabolism and disease processes.

BIOC 4224* Physical Chemistry for Biologists. Prerequisite(s): CHEM 1515, MATH 2133, PHYS 1214 or consent of instructor. Classical and statistical thermodynamics with applications to pure systems, solutions and electrochemistry; transport; chemical and enzyme kinetics, quantum chemistry of structure and chemical bond; and spectroscopy all with emphasis on biological applications.

BIOC 4523* Biochemistry of the Cell. Prerequisite(s): 3653 or 3713 and MICR 3033 and BIOL 3023 or ANSI 3423 or PLNT 3554 or consent of instructor. The biochemistry of fundamental processes in normal and disease states of eukaryotic cells. Primary literature based experimental approaches to the mechanisms of intracellular protein trafficking, cytoskeleton, cell adhesion, mitosis, cell cycle, cytokinesis, and apoptosis.

BIOC 4883 Senior Seminar in Biochemistry. Prerequisite(s): 3813 or consent of instructor. A senior capstone course for the development of scientific verbal and written communications and assessment of cumulative abilities. Focus is on problem solving, group discussion, primary literature review, oral presentation, and writing.

BIOC 4990* Special Problems. 1-6 credits, max 10. Training in independent work, study of relevant literature and experimental investigation of an assigned problem.

BIOC 5000* Research. 1-6 credits, max 6. For MS thesis.

BIOC 5002* Biochemistry Graduate Colloquium. Prerequisite(s): Graduate standing. Introduction to graduate research. Policies for laboratory safety, research compliance, and ethical conduct of scientific research are presented.

BIOC 5102* Molecular Genetics. Prerequisite(s): 3653 or MICR 3033 and one course in genetics or consent of instructor. An introduction to molecular genetics on the graduate level. (Same course as GENE 5102*)

BIOC 5753* Biochemical Principles. Prerequisite(s): CHEM 3153 or equivalent. Chemistry of cellular constituents; introduction to the chemical processes in living systems. The first in a series of courses for graduate students in biochemistry and related fields.

BIOC 5824* Biochemical Laboratory Methods. Lab 6. Prerequisite(s): 4113 or 5753. Lecture and laboratory course in basic biochemistry and molecular biology methods for separation and analysis of biological materials, including chromatography, electrophoresis, centrifugation, use of radioisotopes, molecular cloning and DNA sequencing.

BIOC 5853* Metabolism. Prerequisite(s): 5753 or 4113. Reaction sequences and cycles in the enzymatic transformations of fats, proteins and carbohydrates; energy transfer, biosynthesis and integration in the metabolic pathways.

BIOC 5930* Advanced Biochemical Techniques. 1-4 credits, max 10. Prerequisite(s): 5753, 5824 or concurrent registration, and consent of instructor. Lecture and laboratory course in advanced research techniques, designed to supplement 5824. In subsequent semesters, individual research problems pursued in laboratories of department faculty for six weeks and one credit hour each.

BIOC 6000* Research. 1-15 credits, max 60. For PhD dissertation.

BIOC 6110* Seminar. 1-2 credits, max 2 for PhD or 1 for MS candidates.

BIOC 6723* Signal Transduction. Prerequisite(s): BIOL 3023, BIOC 3653, 4113 or equivalent or consent of instructor. Classical signal transduction mechanisms including MAP kinase signaling cascades, Protein kinase A, Protein kinase C pathways, JAK/STAT pathways, calcium signaling, the cell cycle, programmed cell death, and cell signaling in cancer. Strong focus on the primary literature and experimental strategies used in modern cell biology.

BIOC 6733* Functional Genomics. Prerequisite(s): 3653 or 3713 and 3813 or 5753 or consent of instructor. Principles and techniques of genomics technologies and their applications in basic science and applied animal and plant research. Genome sequencing, variation detection, transcriptomics, proteomics, metabolomics, metagenomics, systems biology, forward and reverse genetics.

BIOC 6740* Physical Biochemistry. 1-2 credits, max 2. Prerequisite(s): One semester each of biochemistry, calculus and physical chemistry. Two independent modules dealing with applications of physical chemistry and math to biological phenomena: 1) numerical analyses and selected spectroscopic methods, and 2) thermodynamics and transport properties. *Modules may be taken together as two credits or individually for one credit.*

BIOC 6753* Epigenetics. Prerequisite(s): 5102 or 5753 or consent of instructor. Principles underlying heritable changes in gene expression caused by mechanisms other than changes in the DNA sequence. The roles of chromatin structure, DNA and histone modification, and small RNAs in plant and animal development and disease. Applications of epigenetic-based therapeutics and the use of RNA interference in plants and animals.

BIOC 6763* Nucleic Acids and Protein Synthesis. Prerequisite(s): 4113 or 5753. Structure and biological function of nucleic acid containing structures with emphasis on recombinant DNA methodologies, information content, nucleic acid-protein interaction, regulation and rearrangement.

BIOC 6773* Protein Structure and Enzyme Function. Prerequisite(s): 4113 or 5753. Theory of and methods for studying the physical and chemical basis of protein structure and function; and the enzyme catalysis, including kinetics, chemical modification and model studies. Examples from current literature.

BIOC 6783* Biomembranes and Bioenergetics. Prerequisite(s): 5853 or consent of instructor. Components, organization and biosynthesis of plasma, mitochondrial and photosynthetic membranes, emphasizing structure-function relationships. Mechanism of metabolites, protons and electrons transport. Energy conservation in bioenergetic apparatus such as mitochondria, chloroplasts or bacterial chromatophores.

BIOC 6793* Plant Biochemistry. Prerequisite(s): 4113 or 5753. Biochemistry of processes and structures of special importance to plants, such as photosynthesis, cell walls, nitrogen fixation, secondary metabolites and storage proteins.

BIOC 6820* Selected Topics in Biochemistry. 1-3 credits, max 15. Prerequisite(s): 5853. Recent developments in biochemistry. Subject matter varies from semester to semester; students should inquire at the department office before enrolling.

Biological Science (BIOL)

BIOL 1114 (L,N) Introductory Biology. Lab 3. Introduction to the integration between structure and function among all levels of biological organization. Application of principles of evolution, genetics, physiology and ecology to understanding the integrated and interdependent nature of living systems through discussions emphasizing the process of science. Current issues and local research and observation and investigation in both lecture and lab. *Recommended for non-science and science majors.*

BIOL 3023 General Genetics. Prerequisite(s): BOT 1404, or ZOOL 1604, or equivalent. Inheritance in plants, animals, and microorganisms; molecular and classical aspects.

BIOL 3034* General Ecology. Lab 4. Prerequisite(s): BOT 1404, ZOOL 1604 or equivalent; MATH 1513 or 1715. Physical and biotic environment, responses of organisms to the environment, behavioral and community ecology, natural ecosystems and man's interaction with ecosystems.

BIOL 3604 Biological Principles for Teachers. Lab 2. Prerequisite(s): 1114, CHEM 1314, ZOOL 3204. Capstone course in biology for potential science teachers. Review of biological phenomena and principles as related to the curriculum.

BIOL 3933 Research Methods. Lab 2. Prerequisite(s): 1114, MATH 1613 or 2144; STAT 2013 or 4013. Students perform independent inquiries and learn to combine skills from mathematics and science to solve research problems. Students will design experiments, collect and analyze data, formulate hypotheses, justify conclusions, create mathematical models, read and evaluate the research literature, and write and present research reports. *No credit for students with degree credit in MATH 3933.*

BIOL 4524* Biological Laboratory Instrumentation. Lab 4. Prerequisite(s): CHEM 1515 and BOT 1404 or MICR 2123 or ZOOL 1604 or equivalents or consent of instructor. Lecture and laboratory course in biological instrumentation use, theory, experimental design, maintenance, and troubleshooting. Topics include liquid handling systems, pH/ISE meters, electrophoresis, spectrophotometers, centrifuges, chromatography, thermocylers, and DNA sequencers. No credit for students with credit in BIOL 5524. (Same course as MICR 4524)

BIOL 5100* Current Topics in Biology for Teachers. 1-4 credits, max 4. Prerequisite(s): Approval of instructor. Acquaints the primary or secondary teacher with recent advances in biology. May include lecture, laboratory or field work.

BIOL 5524* Biological Laboratory Instrumentation. Lab 4. Prerequisite(s): CHEM 1515 and BOT 1404 or MICR 2123 or ZOOL 1604 or equivalents or consent of instructor. Lecture and laboratory course in biological instrumentation use, theory, experimental design, maintenance, and troubleshooting. Topics include liquid handling systems, pH/ISE meters, electrophoresis, spectrophotometers, centrifuges, chromatography, thermocylers, and DNA sequencers. *No credit for students with credit in BIOL 4524. (Same course as MICR 5524)*

Biomedical Sciences (BIOM)

BIOM 5000* Research and Thesis. 1-6 credits, max 6, Lab 1-6. Prerequisite(s): Consent of major adviser. Research in biomedical sciences for MS degree.

BIOM 5003* Statistics for Medical Residents. Prerequisite(s): Employed as a medical resident or permission of instructor. Survey of statistical methodology relevant to health care professionals. Basic understanding of statistics presented in recent medical literature. Hypothesis testing, ANOVA techniques, regression, categorical techniques. *(Same course as STAT 5003).*

BIOM 5013* Biomedical Statistics. Prerequisite(s): Graduate standing. Fundamentals of biostatistics, including parametric and non-parametric statistical methods with applications to biomedical research, clinical epidemiology and clinical medicine.

BIOM 5020* Biomedical Sciences Seminar. 1-4 credits, max 4. Prerequisite(s): Graduate standing. Literature and research problems in biomedical sciences.

BIOM 5116* Clinical Anatomy. Lab 3. Prerequisite(s): Graduate standing in the biomedical sciences program. Presents gross structure of the human body using a regional approach. Topics include topographical and functional anatomy, clinical correlations, and introduction to radiology. The course provides the descriptive basis for understanding human structure and function encountered in succeeding courses and medical practice.

BIOM 5124* Histology. Lab 4. Normal microscopic tissue architecture. Lecture and laboratory presentation for the histological concepts of the basic tissues and organ systems. Basis for pathological and physiological principles.

BIOM 5215* Medical Biochemistry. Broad survey of the chemical classes and metabolic processes that are consistent with the normal functions of biosystems. Functions and interrelationships of these processes in human metabolism to provide a foundation for understanding the chemistry of disease states when discussed in the second-year program.

BIOM 5316* Medical Microbiology and Immunology. Lab 2. Prerequisite(s): 5215. Similarities and differences among pathogenic microorganisms. Characteristics, pathogenesis and control of medically important microorganisms and disorders of the immune system. Laboratory exercises on the basic serological and microbiological procedures used in the diagnosis of infectious diseases.

BIOM 5415* General Pathology I. Prerequisite(s): Graduate standing. The reaction of the body to diseases and the description and identification of basic disease processes in terms of morphology, physiology, and chemistry. Major processes such as cell injury, cell death, healing, neoplasia, inflammation, and diseases of development and aging. Basic disease processes and ability to recognize and describe basic disease processes from gross and microscopic specimens.

BIOM 5425* General Pathology II. Prerequisite(s): Graduate standing. Continuation of General Pathology I.

BIOM 5513* Pharmacology I. Prerequisite(s): 5215, 5616. General principles of drug action, drugs acting on the autonomic nervous system, and drugs used in treating infectious diseases and cancer. The mode of action, pharmacogenetics, physiologic effects, therapeutic indications, and adverse reactions to these drugs.

BIOM 5523* Pharmacology II. Prerequisite(s): 5513. Continuation of Pharmacology I.

BIOM 5621* Introduction to Translational Research. Focuses on biomedical and clinical research from bench to bedside and back. Provides examples of how basic science and clinical observations lead to translational research.

BIOM 5631* Disease Research in Medicine. Prerequisite(s): Biomedical Foundations or equivalent. Permission of instructor. Introduction to selected diseases of priority in medicine and to funding agencies. Includes discussing current clinical and research challenges.

BIOM 5641* Cornerstones of Vertebrate Paleontology. In-depth discussion of topics in Vertebrate Paleontology, emphasizing critical thinking skills. Based on evaluation of the primary literature, and covering diverse methodological approaches to interdisciplinary research questions.

BIOM 5963* Case Studies in Medical Smart. Prerequisite(s): BIOM 4893 or DHM/IEM 4893 or consent of instructor. Designed to activate critical thinking skills needed for problem solving in wearable sensing system development. *(Same course as DHM 5963).*

BIOM 5984* Capstone in Medical Smart Garment Engineering. Prerequisite(s): BIOM or DHM 5963 and three credits of chosen emphasis area. Project-based where interdisciplinary teams identify a wearable sensing application and collaborate to engineer a prototype that addresses a defined need. Industry collaboration encouraged. *(Same course as DHM 5984.)*

BIOM 6000* Research and Dissertation. 1-15 credits, max 15, Lab 1-15. Prerequisite(s): Consent of major adviser. Research in biomedical sciences for PhD degree.

BIOM 6010* Topics in Biomedical Sciences. 1-3 credits, max 3. Prerequisite(s): Consent of instructor. Tutorials in areas of biomedical sciences not addressed in other courses.

BIOM 6013* Educational Methods in the Biomedical Sciences. Prerequisite(s): Graduate standing. Introduces graduate students to a full range of faculty roles and responsibilities related to instructional methods used at the health sciences center.

BIOM 6023* Research Methods and Design. Prerequisite(s): Graduate standing. Introduction to concepts of research design, methodology, sampling techniques, internal and external validity, and the scientific method.

BIOM 6124* Advanced Histology. Lab 4. Prerequisite(s): 5124. Histochemical techniques used in the identification of cells or tissues based on the localization of cell organelles or cell products using electron microscopy, immunofluorescence, cryosectioning and immunoperoxidase labeling.

BIOM 6175* Molecular and Cellular Biology. Prerequisite(s): Consent of course coordinator. Cell biology, including cellular macromolecules, energetics, metabolism, regulation, organization and function of cellular organelles, flow of genetic information, and the regulation of selected cell activities.

BIOM 6183* Cellular and Molecular Biology of Pain. Prerequisite(s): 5133 or 5616. An understanding of the cellular and molecular events that occur in the initiation and transmission of nociceptive (painful) sensory signaling.

BIOM 6214* Advanced Topics in Medical Biochemistry. Prerequisite(s): 5215 or concurrent enrollment. Chemical basis of protein, carbohydrate, lipid, nucleic acid, steroid and porphyrin structure, function, and metabolism as related to health and disease.

BIOM 6233* Enzyme Analysis. Lab 2. Prerequisite(s): 6214. Characteristics, separation, detection, assays, kinetics, mechanisms of catalysis, inhibition or inactivation, and clinical applications of enzyme analysis.

BIOM 6243* Human Nutrition. Lab 2. Prerequisite(s): 5215. Role of vitamins and minerals in maintaining normal metabolism, role of nutrients in providing athletic and immune system performance, and pathophysiology associated with nutrient deficits and nutrient excesses. Role of drugs in inducing cancer and increasing nutrient requirements.

BIOM 6263* Techniques in Molecular Biology. Lab 4. Prerequisite(s): 5215, 5316, consent of instructor. Transformation of bacterial and mammalian cells; purification of nucleic acids; cloning of DNA fragments; labeling of nucleic acids with non-radioactive probes; analysis of DNA and RNA by electrophoresis and hybridization; DNA sequencing; design, synthesis and use of oligonucleotides; site-directed mutagenesis; detection of rare nucleic acids by the polymerase chain reaction and expression of proteins.

BIOM 6333* Immunology. Prerequisite(s): 5215, 5316. The experimental basis of immunology and immunopathology.

BIOM 6343* Microbial Physiology. Lab 2. Prerequisite(s): 5215, 5316. The chemical composition, growth and metabolism of prokaryotic organisms including regulation and control of metabolic pathways with emphasis on metabolism unique to microbes.

BIOM 6353* Molecular Virology. Lab 2. Prerequisite(s): 5215, 5316, consent of instructor. The fundamental molecular biology of the virus life cycle using one virus as a model to examine penetration, gene regulation, replication, assembly and egress, as well as host immunological response and epidemiology.

BIOM 6363* Immunobiology of Infectious Disease. Prerequisite(s): Biochemistry, Medical Microbiology and Immunology. Graduate course to provide an understanding of cellular and molecular events that occur during the initiation of immune response to main causes of human pathogens.

BIOM 6413* Graduate General Pathology. Prerequisite(s): Graduate standing and 5215; permission of the instructor is required; 5616 and 5316 are recommended. An introduction for biomedical researchers to disease processes, from etiologies to cell and tissue responses that manifest as diseases.

BIOM 6523* Cardiovascular Physiology and Pharmacology. Prerequisite(s): 5513, 5523. Physiologic and pharmacologic mechanisms of cardiac and vascular smooth muscle function and control at the molecular, cellular, tissue and organ system levels.

BIOM 6583* Neuroinflammation. Prerequisite(s): Graduate standing. Provides an understanding of inflammation in the central nervous system through discussion of current and experimental pharmacologic strategies designed to modulate neuroinflammation.

BIOM 6613* Environmental Physiology. Prerequisite(s): 5616. Environmental parameters, including barometric pressure, temperature, light, gravity, noise, and crowding, having an impact on homeostatic mechanisms in the normal human with special emphasis on acute and chronic adaptations in response to changes in environmental parameters.

BIOM 6643* Neurophysiology. Prerequisite(s): 5616. Fundamental concepts of the motor and sensory components of the nervous system with emphasis on integrative mechanisms.

BIOM 6662* Research Ethics and Survival Skills for the Biomedical Sciences. Prerequisite(s): Graduate standing. Provides a basic framework for scientific conduct and practice and the skills needed for a career in the biomedical sciences.

BIOM 6663* Neuroethology. Prerequisite(s): Permission of instructor. This course is designed to provide an analysis of the neuroendocrine basis of behavior. Lectures will serve as the format of presentation to provide a sound understanding of the neuroethological concepts discussed.

BIOM 6673* Genomics. Prerequisite(s): 6175. The course begins with a review of molecular biology and then proceeds to the structure and organization of eukaryotic, prokaryotic, and organelle genomes. Techniques in dividing, sequencing, annotating, and mapping genomes are studied as well as those of global gene expression profiling. The course finishes with a look at the many applications of genomics in biomedical science and disease.

BIOM 6705* Advanced Gross Anatomy. Lab 4. Prerequisite(s): Consent of course coordinator. General and specific concepts of regional human anatomy. The primary focus is the range of normal for all organ systems and interrelationships. Provides an advanced descriptive basis for understanding human structure and function encountered in succeeding courses and in the practice of teaching gross anatomy to graduate and medical students.

BIOM 6713* Applications of GIS in Evolutionary Biology. This course introduces students to the applications of Geographic Information Systems (GIS) in Evolutionary Biology. The course will emphasize applications of GIS in methods associated with vertebrate paleontology (e.g. tooth morphology and mapping). The lecture portion will introduce students to the appropriate literature and provide discussions on evolutionary theories and uses of GIS to test such theories, while the laboratory portion will provide hands-on exercises with GIS software.

BIOM 6723* Field Techniques in Vertebrate Paleontology. This course introduces students to techniques and tools necessary to conduct field work in vertebrate paleontology. The primary techniques will include mapping, prospecting and collecting both micro- and macrofossil vertebrate remains. Processing of rock matrix with microvertebrates will be emphasized, but preparation of macrofossil remains for transportation to the research lab will be taught.

BIOM 6733* Microbial Pathogenesis. Prerequisite(s): 5215, 5316, consent of instructor. An in-depth introduction to the fundamental principles and molecular mechanisms by which microbes cause disease in humans. Focuses on current research and provides a comprehensive overview of the molecular basis of pathogenesis with a focus on prokaryotic and eukaryotic model microbial systems to illustrate mechanisms of disease pathogenesis. Discusses the role of the normal flora in health and disease.

BIOM 6743* Foundations in Medical Genetics, Molecular Biology and Development. Human genetics and development, including structure and function of nucleic acids, gene regulation, basis of inheritance, and development of the human embryo.

BIOM 6752* Foundations in Medical Cell and Tissue Biology. Structure and function of cells within tissues as it relates to human health and disease, including cell transport, cell-to-cell communication and organ system control.

BIOM 6762* Foundations in Medical Biochemistry. Biochemistry in human health and disease, including protein structure and function, bioenergenetics, metabolism, nutrition, and membrane structure and function.

BIOM 6771* Foundations in Medical Pharmacology. General principles of pharmacokinetics and pharmacodynamics of drugs used to treat human disease.

BIOM 6781* Foundations in Medical Immunology. Immune system in human health and disease, including antibody and cell-mediated immune responses, inflammation, immune responses to infectious agents and allergens, immunodeficiencies and malignancies of the immune system.

BIOM 6791* Foundations in Medical Microbiology. Infectious agents, including viruses, bacteria, fungi and parasites, their structure, genetics and mechanisms of pathogenesis in human disease.

BIOM 6802* Critical Readings in Biomedical Sciences. Provides experience with the primary literature in biomedical sciences, with training in evaluation methodologies, experimental design, data presentation, and statistical designs.

BIOM 6810* Structure and Function of the Human Cardiovascular System. Prerequisite(s): Permission of Instructor. Provides integrated biomedical study of the human cardiovascular system.

BIOM 6820* Structure and Function of the Human Gastrointestinal/ Hepatic System. Prerequisite(s): Permission of Instructor. Provides integrated biomedical study of the human gastrointestinal and hepatic systems.

BIOM 6830* Biomedical Perspectives on Human Hematology. Prerequisite(s): Permission of Instructor. Provides integrated biomedical study of the human blood and lymphatics, and associated disorders.

BIOM 6840* Structure and Function of the Human Musculoskeletal System. Prerequisite(s): Permission of Instructor. Provides integrated biomedical study of the human musculoskeletal system and associated disorders.

BIOM 6850* Structure and Function of the Human Renal System. Prerequisite(s): Permission of Instructor. Provides integrated biomedical study of the human renal system.

BIOM 6860* Structure and Function of the Human Reproductive Systems and Reproductive Biology. Prerequisite(s): Permission of Instructor. Provides integrated biomedical study of the male and female human reproductive systems and reproductive biology.

BIOM 6870* Structure and Function of the Human Respiratory System. Prerequisite(s): Permission of Instructor. Provides integrated biomedical study of the human respiratory system.

BIOM 6880* Biomedical Perspectives on Psychiatry. Prerequisite(s): Permission of Instructor. Provides clinical presentation, differential diagnosis, etiology (including pathophysiological etiologies), basic pharmacology of medications used to treat the disorder, clinical pharmacology, and psychosocial treatments.

BIOM 6893* Fundamentals of Medical Smart Garment Engineering. Prerequisite(s): Graduate standing or 90+ credit hours. Students will gain elementary knowledge in focus areas of health science, biomedical sensing and analysis, and apparel design necessary to undertake the development of wearable electronic sensing systems. Lecture and laboratory systems. May not be used for degree credit for IEM 4893*, 5893* or DHM 4893*.

BIOM 6910* Structure and Function of the Human Nervous System. Provides integrated biomedical study of the human nervous system.

BIOM 6900* Structure and Function of the Human Endocrine System. Provides integrated biomedical study of the human endocrine system, and associated disorders.

BIOM 6922* Scientific Communication in Biomedical Sciences. Provides experience in scientific writing and oral presentations.

BIOM 6933* Cornerstones of Graduate Biomedical Sciences. Discussion topics in the foundational courses of biomedical sciences, emphasizing critical thinking skills and diverse methodological approaches in understanding interdisciplinary research questions and in evaluations of the primary literature. Intended to be taken concurrently with foundation courses.

BIOM 6943* Advanced Vertebrate Paleontology. Prerequisite(s): Comparative anatomy or human anatomy, and assumes an undergraduate level understanding of vertebrate paleontology, biology, and evolution. Explores vertebrate evolution in a phylogenetic, ontogenetic, and stratigraphic framework using selected peer reviewed articles. Students will lead discussions and practice critical thinking skills to address topics presented. Students will apply what they have learned to lead dissections of specimens belonging to a specific extant phylogenetic bracket.

BIOM 6952* Paleohistology Techniques. Prerequisite(s): Undergraduate level understanding of biology, evolution, and histology. Recognize and interpret modern and fossil bone tissue microstructures. The contributions of paleohistology to understanding extinct vertebrate physiology will be explored through discussions of peer reviewed articles. Students will receive hands-on training in paleohistology techniques.

BIOM 6962* Evolutionary Biomechanics. Prerequisite(s): BIOM 5116* or HHP 2654 or ZOOL 3114*. Evaluation of topics covering the application of engineering principles to biological systems in an evolutionary framework. Topics will examine the material properties of anatomical tissues, how forces act internally and externally on organisms and their structures, kinematics, and biomechanical model systems. Primary literature and experimental designs will also be explored.

Biosystems and Agricultural Engineering (BAE)

BAE 1012 Introduction to Biosystems Engineering. Lab 2. Prerequisite(s): Engineering major. Introduction to the Biosystems Engineering discipline; use of computers in solving engineering problems; and the application of computer software in engineering analysis and reporting.

BAE 1022 Experimental Methods in Biosystems Engineering. Lab 2. Prerequisite(s): 1012 or consent of instructor. An introduction to the basics of instrumentation, measurement techniques, and data analysis, with an emphasis on written communication skills. Lecture and laboratory exercises that address measurement principles, including accuracy, precision and error analysis.

BAE 2013 Modeling in Biosystems Engineering. Prerequisite(s): BIOL 1114 and MATH 2144. Introduction and modeling of various applications in biosystems and agricultural engineering. Case studies that emphasize the interface between engineering and biology in areas such as plant systems, industrial biological processes, sensor and control systems development, intellligent machine design, environmental remediation, water treatment systems and food processing. Use of a fourth generation programming language for solving engineering problems.

BAE 2023 Physical Properties of Biological Materials. Lab 2. Prerequisite(s): 1022, BIOL 1114, PHYS 2014. Basic engineering fundamentals applied to characterization and determination of physical properties of biological materials, including water relations, rheological, thermal, and electromagnetic properties, materials drying concepts, fans, psychrometrics and refrigeration.

BAE 3013 Heat and Mass Transfer in Biological Systems. Prerequisite(s): ENSC 3233, MATH 2233. Mechanisms of heat and mass transfer, with specific applications in transport processes of biological systems. Introduction to steady state and transient heat conduction and convection, radiation, diffusion, simultaneous heat and mass transfer.

BAE 3023 Instruments and Controls. Lab 2. Prerequisite(s): ENSC 2613, MATH 2233. Design of control and instrumentation systems, including sensor and actuator principles, interface electronics, system identification, modeling, and performance specification. Applications in biological and agricultural systems. Design project required.

BAE 3113 Biological Applications in Engineering. Prerequisite(s): 2012, BIOL 1114, ENSC 2213, 3233, MATH 2233 or concurrent enrollment. Introduction to engineering applications of biological processes. Technologies covered include fermentation systems, enzyme kinetics, wastewater treatment and bioremediation.

BAE 3213 Energy and Power in Biosystems Engineering. Lab 2. Prerequisite(s): 1022, ENSC 2213, 2613, ENSC 2143 or concurrent enrollment. Analysis and design of energy generation, transmission, and utilization in the production and processing of biological materials.

BAE 3313 Natural Resources Engineering. Lab 3. Prerequisite(s): 2023 , STAT 2013, and ENSC 3233 or concurrent enrollment. Principles and practices of engineering analysis and design applied to hydrology, water quality, erosion and sedimentation, air quality, irrigation and animal waste management.

BAE 4001 Professional Practice in Biosystems Engineering. Prerequisite(s): Concurrent enrollment in 4012. Preparation for professional practice through case studies about ethics, legal liability, safety, and societal issues. Practical professional communications experience.

BAE 4012 Senior Engineering Design Project I. Lab 2. Prerequisite(s): Completion or concurrent enrollment in 3013, 3023, 3113, 3213, 3313, 4001; admission to professional school. Team work on professional level design projects, using design procedures to develop specifications, propose alternative solutions, consider external constraints, develop drawings or plans, construct, test and evaluate designs.

BAE 4023 Senior Engineering Design Project II. Lab 4. Prerequisite(s): 4012. Second of two-semester sequence of senior design courses.

BAE 4213* Precision Agriculture. Lab 2. Prerequisite(s): MATH 1513, senior standing. Introduction to the concepts of precision agriculture including analysis of spatial variability, relationships of fertility and crop response, geographical information systems, variable rate technology, optical sensing, global positioning systems, and yield monitoring. Case studies included for detailed analyses. (Same course as SOIL 4213)

BAE 4224* Machinery for Production and Processing. Prerequisite(s): 3213. Analysis and design of machine components and machine systems for production and processing of biological materials. Soil dynamics with emphasis on traction and soil compaction. Interactions of machines with biological systems.

BAE 4283* Bioprocess Engineering. Prerequisite(s): 3013, 3113 or consent of instructor, ENSC 3233. Application of fundamental engineering principles to biochemical and biological processes. Introduction to cellular processes, fermentation technology, biological mass transfer and kinetics, bioreactor design and scale-up and downstream processing. (Same course as CHE 4283)

BAE 4314* Hydrology. Prerequisite(s): 3013, 3313, ENSC 3233. Basic principles of surface and groundwater hydrology and their application in engineering problems. The hydrologic cycle, weather and hydrology, precipitation, evaporation, transpiration, subsurface waters, stream flow hydrographs, hydrologic and hydraulic stream routing, probability of hydrologic events and application of hydrologic models. Laboratory component will emphasize the application of hydrologic and hydraulic models and the quantification of hydrologic and hydraulic parameters.

BAE 4400 Special Problems. 1-4 credits, max 8. Investigations in specialized areas of biosystems engineering.

BAE 4413* Food Engineering. Prerequisite(s): 3013 and ENSC 3233, 2213. Analysis and design of various unit operations in food processing including thermal processing, drying, evaporation, freezing, processing non-Newtonian fluids and quality changes during processing.

BAE 5000* Master's Research and Thesis. 1-6 credits, max 6. Prerequisite(s): Consent of major professor. Research and thesis writing.

BAE 5030* Engineering Practice. 1-6 credits, max 15. Prerequisite(s): BS degree in biosystems and agricultural engineering. The identification, analysis and synthesis of an authentic problem in agricultural and biological engineering.

BAE 5213* Renewable Energy Engineering. Prerequisite(s): ENSC 2213, ENSC 3233 or consent of instructor. Renewable technologies such as solar, wind, geothermal, hydroelectric, and biomass to generate energy for electricity, heating, transportation, and other uses.

BAE 5233* Bioseparations. Prerequisite(s): 3013 or CHE 3013. Study of separations important in food and biochemical engineering such as leaching, extraction, expression, absorption, ion exchange, filtration, centrifugation, membrane separation, and chromatographic separations. Course available online only through AG*IDEA consortium.

BAE 5243* Biological Conversion for Advanced Biofuels. Prerequisite(s): ENSC 2213. Fundamental principles and applications of converting biomass to advanced biofuels. Focus will be on biological processes, fermentor design and operation, product recovery and emerging fuels.

BAE 5283* Advanced Bioprocess Engineering. Prerequisite(s): Consent of instructor. Application of fundamental engineering principles to biochemical and biological processes. Introduction to cellular processes, fermentation technology, biological mass transfer and kinetics, bioreactor design and scale-up and downstream processing. (Same course as CHE 5283)

BAE 5313* Watershed Modeling and Water Quality. Lab 6. Prerequisite(s): 4313 or equivalent. A computer modeling course with an emphasis on chemical and physical processes governing nonpoint source pollution (nitrogen, phosphorus, sediment) at the basin scale. The laboratory use of state-of-the-art models applied to a variety of agricultural systems. "Hands on" use of comprehensive hydrologic water quality models that utilize spatial data in a geographic information system. Models and parameter uncertainty, digital data sources, parameter estimation and model testing, calibration and validation. For students with advanced personal computer skills.

BAE 5324* Modeling and Design in Storm Water and Sediment Control. Lab 3. Prerequisite(s): 4313 or equivalent. Analysis and design of storm water, sediment and water quality systems with a focus on application to urban areas and developments in the urban-rural fringe. Advanced concepts in hydrologic modeling with kinematics, diffusion and dynamic modeling of flow; soil erosion, sediment transport and sediment control; storm water quality modeling and the impact of best management practices. In laboratories, use of hydrologic, sediment, and water quality models in analysis and design for real-world problems.

BAE 5333* Applied Water Resources Statistics. Lab 3. Prerequisite(s): STAT 5013 or equivalent. Applied statistical methods for hydrologists, engineers, and environmental scientists for analysis of environmental data. Parametric and nonparametric methods and exploratory data analysis applied to observed environmental data sets. Laboratory exercises emphasize hands-on application of statistical problems to reinforce concepts.

BAE 5343* Environmental Contaminant Transport. Prerequisite(s): 4313. Conceptual and mathematical models for the transport of contaminants in natural systems with an emphasis on agricultural pollutants. Basic transport processes relevant to the three environmental media - air, water, and soil. Common features underlying pollutant transport.

BAE 5353* Environmental and Ecological Risk Assessment. Prerequisite(s): Graduate standing. Process and methodologies associated with human, environmental and ecological risks. Will quantify uncertainty in human perturbation, management, and restoration of environmental and ecological processes. Course available online only through AG*IDEA consortium.

BAE 5363* Life Cycle Assessment. Prerequisite(s): Graduate standing. Design of high level life cycle impact assessment for products, international standards for LCA, implications of functional unit and system boundary choices on comparative LCA. Course available online only through AG*IDEA consortium.

BAE 5413* Advanced Instrumentation and Control Systems for Biological Applications. Prerequisite(s): 3023 or equivalent. Principles and operation of commercial instruments and data acquisition systems used in biological, environmental, and agricultural applications. Hands-on projects that will improve system design, development and programming skills. Introduction of advanced topics including machine vision, spectroscopy, and data communication networks.

BAE 5423* Food Rheology. Lab 2. Prerequisite(s): ENSC 3233. Characterization and analysis of the rheological properties of food products. Focus on measurement techniques and equipment, including tube and rotational type instruments, with specific applications in food processing.

BAE 5433* Biosensors. Prerequisite(s): PHYS 2114 and CHEM 3053 or equivalent. Principles and applications of biosensors in food analysis, disease diagnostics, and environmental monitoring. Emphasis on conceptual design and characterization of biosensors. Introduction to recent advances in biodetection using nanotechnology.

BAE 5501* Seminar. Discussion of current literature with special emphasis on research and experimental techniques.

BAE 6000* Doctoral Research and Dissertation. 1-10 credits, max 42. Prerequisite(s): Approval by the student's advisory committee. Research and doctoral dissertation preparation.

BAE 6101* Teaching Practicum in Biosystems Engineering. Prerequisite(s): One semester of doctoral study in Biosystems Engineering, or consent of instructor. Philosophies and techniques of resident and non-resident teaching, including experiences in preparation, presentation, and evaluation of lectures, laboratories, extension or continuing education programs.

BAE 6213* Advanced Biomass Thermochemical Conversion. Prerequisite(s): ENSC 2213. Advanced study, evaluation, and application of thermochemical conversion pathways in biofuel production. Specific topics include biomass gasification, pyrolysis, liquefaction, and heterogeneous catalysis. Course available online only through AG*IDEA consortium.

BAE 6313* Stochastic Methods in Hydrology. Prerequisite(s): CIVE 5843, STAT 4033. Stochastic and statistical hydrologic analyses of surface water and groundwater systems. Analysis of urban and rural drainage and detention systems. (Same course as CIVE 6843)

BAE 6333* Fluvial Hydraulics. Prerequisite(s): 3013 or equivalent. Principles of sediment detachment and transport in fluvial systems. Design of stable channels and flow resistance relationships for sediment-laden flows.

BAE 6343* Ground Water Contaminant Transport. Prerequisite(s): SOIL 5583 or CIVE 5913 or GEOL 5453. Principles of solute and multiphase transport in soils and ground water. Effects of advection, diffusion, dispersion, degradation, volatilization and adsorption. Relationships between laboratory and field scale transport. Contamination by nonaqueous phase liquids.

BAE 6520* Problems in Soil and Water Engineering. 2-6 credits, max 6. Prerequisite(s): Consent of instructor. Problems associated with erosion control, drainage, flood protection and irrigation.

BAE 6540* Problems in Farm Power and Machinery. 2-6 credits, max 6. Prerequisite(s): consent of instructor. Literature review and analytical studies of selected farm power and machinery problems. *Written report required.*

BAE 6580* Problems in Transport Processes. 2-6 credits, max 6. Prerequisite(s): Consent of instructor. Literature review and analysis of heat and mass transport and interval diffusion in biological materials. Transport phenomena at interfaces, thermal and cryogenic processing, drying, packed and fluidized bed systems. Thermal and moisture control processing affecting quality of food products. *Written report required.*

BAE 6610* Advanced Research and Study. 1-10 credits, max 20. Prerequisite(s): Approval by the student's advisory committee. Research and study at the doctoral level on the topic related to the student's doctoral program and field of interest.

Botany (BOT)

BOT 1404 (L,N) Plant Biology. Lab 2. Basic concepts in the biology of plants from the perspective of structure and function, ecology and evolution, and diversity.

BOT 3005 Field Botany. Lab 6. Prerequisite(s): BIOL 1114 or equivalent. Botanical field techniques, the vegetation of North America, and the flora of Oklahoma. Terminology of description, use of taxonomic keys, techniques of specimen preservation, field recognition of plant taxa and communities and controlling ecological factors, economic and wildlife significance of dominant taxa, principles of classification and nomenclature. *Four weekend field trips required.*

BOT 3013* Biological Microtechnique. Lab 3. Prerequisite(s): 1404 or ZOOL 1604. Techniques for preparation of biological materials for microscopic examination.

BOT 3024* Plant Diversity. Lab 4. Prerequisite(s): 1404. Forms and life histories of selected plants with emphasis on some of the less familiar forms. The diversity of plant forms as well as basic similarities in life histories; importance of each form to man and his environment. *Field trips required.*

BOT 3114* Plant Taxonomy. Lab 4. Prerequisite(s): 1404 or equivalent. Vocabulary and concepts of plant taxonomy: terminology, keys, nomenclature, documentation, classification, and biosystematics. Emphasis on angiosperm flora of Oklahoma. *Field trips required.*

BOT 3233* Plant Anatomy. Lab 3. Prerequisite(s): 1404. Structure of cells, tissues and organs of plants. Consideration of structure as related to ontogeny, phylogeny and function.

BOT 3253 (N) Environment and Society. Prerequisite(s): BIOL 1114 or equivalent strongly recommended. The impact of human activities and population growth on the natural world. Analysis of the potential of technological and societal changes to have an impact on the environment. *For the non-biology major.*

BOT 3263 (N) Plants and People. Types of plants, form and function, history of uses of plants and plant products for food and beverages, fiber, medicinal purposes, and in people's surroundings. *For the non-biology major.*

BOT 3462 Plant Physiology Laboratory. Lab 4. Prerequisite(s): 3463 or concurrent enrollment. Skills in techniques for working with plants, experiments involving nutrition, respiration, photosynthesis, water relations, translocation, hormones, growth and development.

BOT 3463* Plant Physiology. Prerequisite(s): 1404. Plant subcellular structure, water relations, water absorption and ascent of sap, translocation, gaseous exchange, nutrition, enzymes, respiration, photosynthesis, growth, development, reproduction, tropisms, hormones, dormancy and seed germination.

BOT 3553 Fungi: Myths and More. Lab 2. Prerequisite(s): BIOL 1114. Explores the impact of fungi on beliefs, culture and society via the colorful folklore and myths on fungi and their role in the environment and human affairs, including diseases of plants, animals and humans exemplified by the Great Bengal famine of 1943, The Irish potato famine, 1840's and the Salem witch trials 1692. Laboratory instruction on use of microscopes, mushroom identification, mechanisms of dispersal, and genetic recombination. (Same course as PLP 3553)

BOT 4023 Community Ecology. Prerequisite(s): BIOL 3034 or equivalent. Plant and animal communities, community theory, the role of competition, predation, and demography in structuring plant and animal communities, succession, current controversies in ecology, with emphasis on the primary literature. *No credit for students with credit in 5023.*

BOT 4214 Ecology of Algae and Aquatic Plants. Lab 3. Prerequisite(s): Two of the following (or equivalents) recommended: BOT 3005, 3463, BIOL 3034. Ecology, physiology, evolution, and ecological roles of algae and vascular aquatic plants; problem algal blooms; ecological principles applied to algal biofuels. Laboratory includes basic identification of algae and aquatic plants. *Field trips required, with fee. No credit for students with credit in 5214.*

BOT 4400 Undergraduate Research. 1-3 credits, max 9. Prerequisite(s): Consent of instructor. Undergraduate research problems in botany.

BOT 4423 Plant Mineral Nutrition. Prerequisite(s): 3463 or equivalent. Uptake, translocation, metabolism, and biochemical function of mineral nutrients in higher plants. *No credit for students with credit in 5423.*

BOT 4993 Senior Honors Thesis. Prerequisite(s): Departmental invitation, senior standing, Honors Program participation. A research project under the direction of a faculty member resulting in a written report to be judged by a second faculty member as well. An oral presentation made at a departmental seminar. *Required for graduation with departmental honors in botany.*

BOT 5000* Master's Thesis. 1-6 credits, max 6. Thesis work for the MS degree.

BOT 5023* Community Ecology. Prerequisite(s): BIOL 3034 or equivalent. Plant and animal communities, community theory, the role of competition, predation, and demography in structuring plant and animal communities, succession, current controversies in ecology, with emphasis on the primary literature. *No credit for students with credit in 4023.*

BOT 5104* Mycology. Lab 2. Prerequisite(s): Graduate standing. A systematic study of the fungi, with emphasis on taxonomy, comparative morphology, and fungal biology. Taught in the Department of Entomology and Plant Pathology. (Same course as PLP 5104)

BOT 5110* Special Topics in Botany. 1-5 credits, max 24. Prerequisite(s): Consent of instructor. Special studies in any area of botany.

BOT 5210* Research in Botany. 1-6 credits, max 12. Prerequisite(s): Consent of instructor. Independent research in any area of botany or plant biology.

BOT 5214* Ecology of Algae and Aquatic Plants. Lab 3. Prerequisite(s): Two of the following (or equivalents) recommended: BOT 3005, 3463, BIOL 3034. Ecology, physiology, evolution, and ecological roles of algae and vascular aquatic plants; problem algal blooms; ecological principles applied to algal biofuels. Laboratory includes basic identification of algae and aquatic plants. *Field trips required, with fee. No credit for students with credit in 4214.*

BOT 5423* Plant Mineral Nutrition. Prerequisite(s): 3463 or equivalent. Uptake, translocation, metabolism, and biochemical function of mineral nutrients in higher plants. *No credit for students with credit in 4423.*

BOT 5533* Multivariate Methods in Community Ecology. Prerequisite(s): 5023 or BIOL 3034 or other equivalent course work in ecology recommended. Basic knowledge of statistics desirable. Methods used by ecologists to analyze community data and community patterns, including ordination and modern regression techniques. *One weekend field trip required.*

BOT 5553* Molecular Phylogenetic Analysis. Prerequisite(s): Undergraduate genetics strongly recommended. Covers the use of molecular sequence data to construct evolutionary trees. It integrates theory and computer applications to answer questions involving species relationships, gene evolution, molecular evolution and morphological change, co-evolution, and biogeographic relationships.

BOT 5563* Plant Ecological Genetics. Prerequisite(s): BIOL 3023, 3034, and/or ZOOL 4133 or equivalents. Basic concepts in plant population and quantitative genetics, focusing on techniques that reveal the genetic structure and the adaptive value of ecologically relevant traits.

BOT 5850* Botany Seminar. 1 credit, max 6. Weekly one-hour seminar series of invited and internal speakers. Botany MS and PhD Plant Sciences (Botany) students are required to present a minimum of two seminars, including one on an approved research proposal and one on thesis or dissertation results.

BOT 6000* Doctoral Research and Dissertation. 1-15 credits, max 60. Independent research for the doctoral dissertation.

Business Administration (BADM)

BADM 1103 (DS) Social and Behavioral Foundations of Business. Organizational management is about problem solving through modifying human behavior within a social and behavioral context. This course abstracts business concepts to provide a broad social and behavioral theoretical foundation for any specialized course of study. Through reading, observation, and decision-making, students enhance critical analysis and problem solving skills. Reflection and writing aid appreciation of business issues as human behavioral reaction and social interactions. *May not be used for degree credit with BADM 3101.*

BADM 1111 Business Freshman Orientation. Prerequisite(s): Freshman standing only and Spears School of Business or undeclared student. Required of all first semester freshmen in the Spears School of Business. An orientation to the SSB and OSU, survival skills, and a study of the career opportunities and curriculum in the various business departments.

BADM 2010 Special Topics. 1-6 credits, max 6. Prerequisite(s): Consent of instructor. Special topics and independent study in business.

BADM 2011 Personal Management I: Decision-Making Skills. Management concepts to help achieve success in students' personal lives, an examination of cognitive biases and decision-making strategies, recognizing traps and consumer rip-offs.

BADM 2021 Personal Management II: Influence Tactics. An evaluation of the science of persuasion, influence tactics and practical strategies for managing interpersonal conflict. Also covers personal branding, upward and downward influence, issue selling in corporations and becoming a corporate entrepreneur.

BADM 2093 (I) Study Abroad: Contemporary International Culture and Business Impacts. A study of a country and region that will provide an integrated approach to the rich cultural, commercial, historical, technological, political, economic, and religious issues. The country's role as a political and economic power will be examined. Comparisons of technology, policies, and economies will be made, as well as investigating hurdles and synergies to doing business between that country and the U.S.

BADM 3090 (I) Study Abroad. 1-18 credits, max 36. Prerequisite(s): Consent of the Study Abroad office and associate dean of the college. Participation in an OSU reciprocal exchange program.

BADM 3101 (D) Diversity Impacts on Business. Diversity issues within major business theories. Through reading, observation, discussion, and writing, students will have their own perceptions of others challenged to better understand perspectives from different diverse populations. *May not be used for degree credit with BADM 1103.*

BADM 3201 Career Planning and Job Search Strategies. Develop an understanding of the importance and relevance of the entire career planning process, express career objectives in a concise manner, acquire an understanding of the job market from the perspective of both a job seeker and an employer, prepare professional application materials, and analyze the advantages and disadvantages of various job search strategies.

BADM 4010 Business Projects. 1-6 credits, max 6. Prerequisite(s): Consent of instructor. Special advanced topics, projects and independent study in business.

BADM 4050* Business Colloquium. 3-9 credits, max 9. Prerequisite(s): Junior standing and consent of the instructor and the dean. Study of an interdepartmental and interdisciplinary nature of various important issues and aspects of the business and economic environment. Provides an intellectual challenge for the able student with a strong interest in scholarship.

BADM 4090 International Proficiency Field Experience for Business. A cohort experience and study of a country and region that will ground the rich cultural, commercial, historical, technological, political, economic, and religious issues which have been explored through directed language and general education study. The country's role as a political and economic power will be examined. Comparisons of technology, policies, and economies will be made, as well as investigating hurdles and synergies to doing business between that country and the U.S.

BADM 4093 (I) Study Abroad: Business Impacts of Contemporary International Culture. Prerequisite(s): Junior standing. A study of a country and region that will provide an integrated approach to the rich cultural, commercial, historical, technological, political, economic, and religious issues. The country's role as a political and economic power will be examined. Comparisons of technology, policies, and economies will be made, as well as investigating hurdles and synergies to doing business between that country and the U.S.

BADM 5013* Research Methods for Business. Prerequisite(s): STAT 2023, admission to MBA program or approval from MBA director. Role of Bayesian and inferential statistics in business research and management decision-making. Measurement, sealing, survey methods, and forecasting. Applications to marketing; managerial, human resource; financial and production planning; and other related business topics. Use of computers in statistical analysis.

BADM 5093* Study Abroad: Applied Business Studies. A study of a country and region that will provide an integrated approach to the rich cultural, commercial, historical, technological, political, economic, and religious issues. The country's role as a political and economic power will be examined. Comparisons of technology, policies, and economies will be made, as well as investigating hurdles and synergies to doing business between that country and the U.S.

BADM 5200* Selected Master of Business Administration Topics. 3-6 credits, max 6. Prerequisite(s): Admission to the MBA program. Selected topics dealing with business decision-making and contemporary business issues.

BADM 5513* Fundamentals of Business Analytics. Prerequisite(s): Graduate standing in the SSB or permission from the MBA/MSIS/MSTM director or assistant director, or instructor. Introduction to a set of analytic tools, including exploratory and graphical techniques, variable associations, simple regression, multiple regression, decision trees, logistic regression, segmentation, RFM, design of experiments, and forecasting techniques, and use of tools for better business decisions.

BADM 5613* The External Environment of Business. Prerequisite(s): Admission to a SSB graduate program or consent of MBA director. Social, ethical, regulatory and political forces as they impact on the organization. Attention to organizational response to these forces through management policies and strategies.

BADM 5713* Analysis of the Multinational Firm. Prerequisite(s): Admission to MBA program or consent of MBA director. Identification and analysis of the managerial, financial, and market problems facing the multinational firm. Focus is empirical and stressing application of ecological and quantitative tools to the study of the multidimensional nature of the international business environment.

BADM 6000* Research and Thesis. 1-9 credits, max 30. Prerequisite(s): Approval of advisory committee.

BADM 6100* Seminar in Business Administration. 3-6 credits, max 12. Prerequisite(s): Consent of instructor. Interdisciplinary in nature; focused on research methodology.

BADM 6343* Advanced Methods in MSIS Research. Prerequisite(s): Doctoral standing. Development of advanced methodological skills necessary to carry out research in the chosen area of study. Skills related to any one of the areas within the broad, interdisciplinary field of management science and information systems, such as management information systems, management science, telecommunications, and operations management. (Same course as MSIS 6343)

BADM 6353* Advanced Methods in Management Research. Prerequisite(s): Doctoral student standing and consent of instructor. Course examines issues in theory building and development, strategies for collecting behavioral research. At conclusion of course, student should be able to: develop research questions, develop appropriate measures for constructs to be tested, and design research study using various methodologies. (Same course as MGMT 6353)

BADM 6513* Org Science I: Micro Issues in Business. Prerequisite(s): Permission from the Director of the PhD option in Executive Research. Provides an overview of the topics and research in behavior primarily at the individual and team level from different domains in business such as consumer behavior in marketing, organizational behavior in management, and behavioral research in accounting.

BADM 6523* Org Science II: Macro Issues in Business. Prerequisite(s): Permission from the Director of the PhD option in Executive Research. Examines topics and research in business focusing particularly on the major theories applicable at the SBU, firm level and above. Topics include theories of globalizing business and national culture, agency theory, transaction cost theory, pricing theories, corporate governance and control, entry mode choice, and CEO compensation strategies. Each topic is introduced through a review of seminal theories which are then reinforced with current research that applies and/or tests these theories.

BADM 6533* Creativity, Innovation and Leadership. Prerequisite(s): Permission from the Director of the PhD option in Executive Research. Examines the creative process and the role of leadership in driving the creative process within organizations. Covers issues such as works of genius, everyday problem solving, the role of intelligence, innovative environments, creative analysis, creative leadership, consumer creativity, and co-creation. The foundation of each topic is theory-driven research with an occasional management practice perspective.

BADM 6713* Theory Building and Scientific Research in Business. Prerequisite(s): Doctoral student status and consent of instructor. Examination of theory building and research methods from a business perspective. Understanding of theory and methods relevant to research in the business disciplines.

BADM 6723* Dissertation Design. Prerequisite(s): Permission from the Director of the PhD option in Executive Research. Introduces doctoral candidates to the dissertation-writing process. Helps students get organized, prepare a dissertation timeline, develop effective writing strategies, choose or refine a dissertation topic, write a dissertation proposal, and successfully defend a completed dissertation.

BADM 6913 Mixed Methods in Management Research. Prerequisite(s): Permission from the Director of the PhD option in Executive Research. Introduces students to both quantitative and qualitative research methodologies, including designs for data collection and analysis. Addresses the integration of qualitative and quantitative design methodologies in studying organizational issues.

Business Communications (BCOM)

BCOM 3113 Written Communication. Prerequisite(s): 50 credit hours. Analysis of business communication problems in terms of generally accepted communication principles. Practice in neutral and positive, negative and persuasive written messages. Practice writing a short report, as well as preparation of employment documents. (Students may not take both BCOM 3113 and BCOM 3443 for degree credit).

BCOM 3223 Oral Communication. Prerequisite(s): 3113 or 3443. Prepares students for oral and written communication in the workplace. Emphasis on planning and presenting of ideas to audiences as an individual and as a member of a team. Grammar skills and principles of effective communication will be explored.

BCOM 3333 Business Report Writing. Prerequisite(s): 6 hours of English. Fundamentals of writing business reports, including coverage of mechanics, content, and structure of business reports. Practice in writing business reports as well as oral presentations of reports.

BCOM 3443 Business Communication for International Students. Prerequisite(s): 50 credit hours. Analysis of business communication problems in terms of generally accepted communication principles. Practice in written messages, employment documents and presentations. This course is specifically designed for students who learned English as a second language. (Students may not take both BCOM 3113 and BCOM 3443 for degree credit).

BCOM 5113* Seminar in Administrative Communication. Understanding and application of valid and relevant communication principles and theories. Designed to develop management-level personnel who can effectively and efficiently use oral and written communications as administrative tools to organizational functioning.

BCOM 5210* Business Communication Applications. 1-3 credits, max 3. Application of communication techniques to the business setting. Interpersonal communication skills necessary for the manager in a business organization. Problems and applications within the modern business setting.

Business Honors (BHON)

BHON 4053 Critical Issues in Global Business. Prerequisite(s): Junior standing, admission to the Honors Program. Current critical issues facing business in a global environment. Social, political, economic, and technological sectors of the environment. Framework of study on geographical and political regions.

BHON 4063 Topics in Contemporary Business. Prerequisite(s): Junior standing, admission to the Honors Program. Topics of interest in the contemporary business and economic environment. The social role of the corporation; U.S. competitiveness and business and environmental issues.

BHON 4073 Literature in Business. Prerequisite(s): Junior standing, admission to the Honors Program. Foundations of American business through selected literary masterpieces.

BHON 4990 Business Honors Thesis. 1-5 credits, max 5. Prerequisite(s): Honors Program participation, senior standing, college approval. A guided reading and research program ending with an honors thesis under the direction of a faculty member, with second faculty reader and oral examination. *Required for graduation with college honors in business.*

Career and Technical Education (CTED)

CTED 2000 Field Experience. 1-6 credits, max 6. Supervised work experience in student's proposed teaching area with special emphasis on occupational skill development. Written agreement between student, employer and department must be made prior to beginning of field experience program. *Graded on a pass-fail basis.*

CTED 3000 Occupational Experience. 1-24 credits, max 24. Credit to be determined by a special skill competency examination.

CTED 3203 Foundations of Career and Technical Education. Opportunities provided by career and technical education through the programmatic areas of trade and industrial, marketing, business and information technology, health occupations, and technology education. The relationship of CTED to other elements of the educational system, including legislative aspects, student guidance, and programs for students with special needs.

CTED 3903 Seminar in Professional Education. Procedures for completing certification and portfolio requirements and gaining admission to Professional Education and student teaching. Documentation of field experiences, professional development opportunities, and observations of at least 45 clock hours of master teachers in various school settings.

CTED 4010* Career and Technical Education Workshop. 1-6 credits, max 12. Professional workshops of various topics and lengths. Focus on a particular topic from such areas as the development, use and evaluation of instructional methods and materials.

CTED 4103* Instructional Procedures in Career and Technical Education. Methods and techniques for effective teaching and learning in career and technical classroom, laboratories, and technology-based environments.

CTED 4110* Career and Technical Information. 1-6 credits, max 12. New developments in scientific and technical information and knowledge that are relevant to current career, technical and trade practices.

CTED 4113 Career and Technical Education in American Society. Characteristics of career and technical education and its development, role and function in a changing American society. Economic and sociological considerations of career and technical programs. Exploration of the interrelationship of career and technical and academic subject strategies for teaching multicultural and special needs in career and technical and adult education.

CTED 4123* Coordinating Career and Technical Student Organizations and Activities. Student organizations and activities in career and technical education at local, state and national levels. Procedures for planning programs of work, incorporation of student organization activities into curriculum, adviser characteristics and responsibilities, fund-raising activities, and techniques for recognizing outstanding members and community supporters.

CTED 4213* Safety, Organization and Management of Learning Facilities. Techniques and procedures for organizing and managing career and technical laboratory facilities and learner activities to enhance the quality of instruction and improve efficiency of equipment and space utilization, including all safety rules and procedures.

CTED 4223* Program Planning and Development in Career and Technical Education. Planning and designing programs for the development of human resources. Program goals and objectives, curriculum, facilities, teaching-learning theories, materials development, program resources, and program and instructional evaluation.

CTED 4313 Computers and Multimedia in Career and Technology Education. Lab 2. Review of current hardware systems and software applications and their uses in career and technology education. Current and emerging issues facing career and technology instructors using technology in the classroom. A wide range of Internet and multimedia tools and techniques and their functions in career and technical teaching and learning. Instructional technology usage issues and computer-based materials suitable in professional settings.

CTED 4333 (I) International Career and Technical Education. Comparison and analysis of international career and technical education.

CTED 4343* Occupational Analysis and Curriculum Development. Analysis of occupational job activities; development of course objectives, course outlines, and specific instructional materials for occupational and technical courses.

CTED 4413 Career and Technical Education Practicum I. Prerequisite(s): Successful completion of 3903; full admission to Professional Education. Organized teaching experiences under the guidance of a university professional educator designed to broaden and enhance the candidate's preparation. Portfolio submission II included.

CTED 4470 Teaching Practicum in Career and Technical Education II. 1-12 credits, max 12. Prerequisite(s): Full admission to Professional Education; CTED 3903 and 4113. Organized teaching experiences under the guidance and direction of a local school cooperating professional and university professional educator. Participant assigned to a cooperating teacher with responsibility for planning, implementing, and evaluating the classroom, laboratory, or shop. Portfolio submission III included.

CTED 4673* Current Issues in Career and Technical Education. Defining current issues, conducting action research and proposing possible solutions to current issues in CTED. Debating opposing views and giving logic and reasoning for each view.

CTED 4683* Legal Issues in Career and Technical Education. Overview of the law and the legal system, including how to perform legal research using library and Internet resources, issues involving student organizations, intellectual property, and distance education.

Chemical Engineering (CHE)

CHE 2033 Introduction to Chemical Process Engineering. Prerequisite(s): CHEM 1515 and ENSC 2213. Concurrent enrollment in MATH 2233 or 3263, ENGR 1412. Application of mathematics and scientific principles to solving chemical engineering problems. Simple material and energy balances applied to process design. The nature and application of unit operations and unit processes to the development of chemical processes.

CHE 2581 Chemical Engineering Seminar 1. Prerequisite(s): CHE majors. Through guest lectures and home assignments, preparation and planning for a CHE career and success in the CHE curriculum. Professional growth topics oriented to students in the sophomore-level courses.

CHE 3013 Rate Operations I. Prerequisite(s): Admission to CHE Professional School. Development and application of phenomenological and empirical models to the design and analysis of fluid processing and heat transfer unit operations.

CHE 3113 Rate Operations II. Prerequisite(s): 3013, 3333, 3473, admission to CHE Professional School. Development and application of phenomenological and empirical models to the design and analysis of mass transfer and separations unit operations.

CHE 3123 Chemical Reaction Engineering. Prerequisite(s): 3333, 3473, and admission to CHE Professional School. Principles of chemical kinetics rate concepts and data treatment. Elements of reactor design principles for homogeneous systems; introduction to heterogeneous systems.

CHE 3333 Introduction to Transport Phenomena. Prerequisite(s): Admission to CHE Professional School. Molecular concepts of mass, momentum, and thermal energy diffusion. Theories and correlations for transport properties of viscosity, thermal conductivity, and diffusivity. Shell balance techniques to derive differential equations of change. Application of ODEs to simple transport phenomena problems. Turbulent flow analysis. Use of CFD software for analysis.

CHE 3473 Chemical Engineering Thermodynamics. Prerequisite(s): Admission to CHE Professional School. Application of thermodynamics to chemical process calculations. Behavior of fluids, including estimation of properties by generalized methods. Study of chemical thermodynamics, including heats of reaction, chemical reaction, and phase equilibria.

CHE 3581 Chemical Engineering Seminar 2. Prerequisite(s): Junior standing in the department. Through guest lectures and home assignments, preparation and planning for a ChE career and success in the ChE curriculum. Professional growth topics oriented to students in the junior-level CHE courses.

CHE 4002* Chemical Engineering Laboratory I. Lab 6. Prerequisite(s): 3013, 3333, 3473, admission to CHE Professional School. Application of CHE fundamentals and unit operation principles to the analysis of bench and pilot-scale equipment. Primarily fluid processing and heat exchange. Design of experiments on non-ideal units to generate credible data useful for validation of principles and for engineering decisions. Interpretation of experimental data and presentation of results.

CHE 4112* Chemical Engineering Laboratory II. Lab 6. Prerequisite(s): 3113, 3123, 4002, admission to CHE Professional School. A continuation of 4002. Primary reaction and mass transfer processes.

CHE 4124* Chemical Engineering Design I. Lab 2. Prerequisite(s): 3113, 3123, 4002, and admission to CHE Professional School. Economic analysis of process plants and systems of equipment; methods for estimating plant investment requirements and operating costs; economic evaluation and optimal design of chemical process systems; basic equipment and process design calculations.

CHE 4224* Chemical Engineering Design II. Lab 2. Prerequisite(s): 4124 and admission to CHE Professional School. A continuation of CHE 4124. Economic analysis of process plants and equipment. Design of chemical processing equipment and chemical plants. Application of computer techniques to chemical engineering design.

CHE 4283* Bioprocess Engineering. Prerequisite(s): Admission to CHE Professional School and CHE 3123 (or instructor consent). Application of fundamental engineering principles to biochemical and biological processes. Introduction to cellular processes, fermentation technology, biological mass transfer and kinetics, bioreactor design and scale-up and downstream processing. (Same course as BAE 4283)

CHE 4293 Biomedical Engineering. Prerequisite(s): ENSC 2213, 3233, MATH 2155. Introduction to engineering principles applied to biomedical applications. Biomaterials, drug delivery, artificial organs, transport in biological systems, tissue engineering and modeling of biological systems.

CHE 4343 Environmental Engineering. Prerequisite(s): 4123. Application of science and engineering principles to minimize the adverse effects of human activities on the environment. National and state environmental regulations. Predictive movement and fate of chemicals in the geospheres. Multi-media pollution assessment, analysis and control. Consideration of safety, health and environmental issues from a process standpoint.

CHE 4523 Introduction to Colloid Processing. Prerequisite(s): MATH 2153, CHEM 1515. The physics and chemistry governing the behavior of microscopic particles in dilute and concentrated suspensions. Interparticle interaction influence on viscosity, viscoelasticity, yield stress, and shear thinning. Practical application of colloids principles in industrial practice. *No credit for students with credit in 5523.*

CHE 4581* Chemical Engineering Seminar 3. Prerequisite(s): Senior standing in the department. Through guest lectures and home assignments, preparation and planning for a ChE career and success in the ChE curriculum. Professional growth topics oriented to students in the senior-level ChE courses.

CHE 4843* Chemical Process Instrumentation and Control. Prerequisite(s): 4124, admission to CHE Professional School. Process instrumentation for measurement and control. Process dynamics and modeling. Linearization. Classical control system analysis and design. Tuning. Communication through block diagrams and P&IDs.

CHE 4990 Special Problems. 1-5 credits, max 5, Lab 3-15. Prerequisite(s): Senior standing. Training in independent work, study of relevant literature, and experimental investigation of an assigned problem.

CHE 5000* Master's Thesis. 1-6 credits, max 6. Prerequisite(s): Approval of major professor. Methods used in research and thesis writing.

CHE 5030* Professional Practice. 2-6 credits, max 8. Prerequisite(s): Senior standing and consent of instructor. Application of chemical engineering principles to the solution of real-life engineering problems in an actual or simulated industrial environment. Includes application of design and testing procedures, economic evaluation and reporting on one or more assigned projects.

CHE 5110* Special Topics in Chemical Engineering. 2-3 credits, max 6, Lab 2-6. Prerequisite(s): Consent of instructor. Small group and individual projects in unit operations, unit procedures, chemical kinetics, computer applications, process modeling, or any of a wide range of chemical engineering topics. May be repeated for credit if subject matter varies.

CHE 5123* Advanced Chemical Reaction Engineering. Prerequisite(s): 4473. Advanced principles and applications of chemical kinetics in catalysis, heterogeneous systems, non-ideal reactions, polymerization, and biological reactions.

CHE 5213* Selected Diffusional Unit Operations. Mass transfer in fluids. Diffusion in liquids and gases. Equilibrium stage and transfer unit concepts. Mass transfer concepts of diffusional unit operations such as absorption, adsorption, crystallization, drying, humidification and liquid extraction.

CHE 5233* Bioseparations. Prerequisite(s): BAE 3013 or CHE 3013. Study of separations important in food and biochemical engineering such as leaching, extraction, expression, absorption, ion exchange, filtration, centrifugation, membrane separation, and chromatographic separations. Course available online only through AG*IDEA consortium.

CHE 5263* Advanced Biomaterials Science and Engineering. Prerequisite(s): Graduate standing or consent of instructor. Engineering issue that are implicit in understanding the interactions of living tissue and processed materials will be introduced. Emphasis is on identifying the processes in which cells interact with surfaces and particulate matter and the outcome of these interactions. Highlighted biological responses will include inflammation and coagulation. Also, biomaterial issues related to drug delivery and tissue engineering will be discussed. (Same course as MAE 5003)

CHE 5273* Basic Physiology and Physiological System Analysis for Engineers. Prerequisite(s): Graduate standing or consent of instructor. The goals of this class are: 1) to introduce the basic physiology concepts used widely in biomedical engineering research; 2) to introduce and develop engineering concepts and approaches for quantitative analysis of physiological systems. Engineering principles will be applied to study mechanical properties of various tissue and organ systems under normal and diseased conditions. Knowledge obtained from this class can help engineers to apply engineering principles to the design and development of medical devices for disease treatments. (Same course as MAE 5013)

CHE 5283* Advanced Bioprocess Engineering. Prerequisite(s): Consent of instructor. Application of fundamental engineering principles to biochemical and biological processes. Introduction to cellular processes, fermentation technology, biological mass transfer and kinetics, bioreactor design and scale-up, and downstream processing. (Same course as BAE 5283)

CHE 5293* Advanced Biomedical Engineering. Prerequisite(s): Consent of instructor. Principles and engineering analysis of biomedical processes. Artificial organs, biomaterials, tissue engineering, transport in biological systems, biomedical imaging and drug delivery systems. (Same course as MAE 5033*)

CHE 5343* Advanced Environmental Engineering. Prerequisite(s): Consent of instructor. Science and engineering principles to minimize the adverse effects of human activities on the environment. National and state regulations. Predictive movement and fate of chemicals in the geospheres. Multi-media pollution assessment, analysis, and control. Consideration of safety, health, and environment issues from a process standpoint. *Special project required. Credit not allowed if CHE 4343 was taken.*

CHE 5373* Process Simulation. Prerequisite(s): 5843 or concurrent enrollment or with professor's consent. Computer-aided process synthesis, simulation, analysis and optimization. Systematic tools for developing and screening potential chemical process flow sheets. Use of commercial process simulators to aid in evaluating process designs. Practical problems will be used as examples and case studies.

CHE 5523* Colloid Processing. Prerequisite(s): Graduate standing in engineering, physics, or chemistry or consent of instructor. The physics and chemistry governing the behavior of microscopic particles in dilute and concentrated suspensions. Interparticle interaction influence on viscosity, viscoelasticity, yield stress, and shear thinning. Practical application of colloids principles in industrial practice.

CHE 5633* Stagewise Operations. Stagewise separation in binary and multicomponent systems. Development of theoretical techniques with application to typical situations in vapor-liquid, liquid-liquid and solid-liquid systems. Use of digital and analog techniques.

CHE 5703* Optimization Applications. Prerequisite(s): Graduate standing. A survey of various methods of unconstrained and constrained linear and non-linear optimization. Applications of these methodologies using hand-worked examples and available software packages. *Intended for engineering and science students.* (Same course as ECEN 5703, IEM 5023 & MAE 5703)

CHE 5733* Neural Networks. Prerequisite(s): Graduate standing. Introduction to mathematical analysis of networks and learning rules and on the application of neural networks to certain engineering problems, image and signal processing and control systems. (Same course as ECEN 5733 & MAE 5733)

CHE 5743* Chemical Engineering Process Modeling. Chemical engineering systems and process models. Analytical and numerical methods of solution of resulting equations with computer methods in a chemical engineering context.

CHE 5843* Principles of Chemical Engineering Thermodynamics. Principles of thermodynamics. Properties of fluids and prediction of thermodynamic properties. Phase and chemical equilibrium. Thermodynamics in unit operations.

CHE 5850* Advanced Process Control Laboratory. 2-3 credits, max 6. Lab 6-8. Prerequisite(s): Graduate standing and permission of instructor. Instrumentation systems and control strategies on pilot-scale chemical processes. Calibration, filtering, dynamic modeling, tuning, advanced control, and method evaluation. Students will learn industrial practices and cope with many non-idealities.

CHE 5853* Advanced Chemical Process Control. Prerequisite(s): 4843 or equivalent. General concepts and approaches of model-based control. Studies in the application of process-model-based control and model-predictive control on multivariable, nonlinear, nonstationary, noisy processes.

CHE 5873* Air Pollution Control Engineering. Causes, effects and control of atmosphere pollution. (Same course as CIVE 5873*)

CHE 5990* Special Problems. 2-4 credits, max 9. Prerequisite(s): Consent of instructor. Individual report topics in chemical engineering involving operations, processes, equipment, experiments, literature search, theory, computer use or combinations of these.

CHE 6000* Doctoral Thesis. 2-15 credits, max 54. Prerequisite(s): Consent of major professor. The doctoral candidate registers for a minimum of 2 semester credit hours to a maximum of 15 semester credit hours in each semester during which laboratory work is in process. Methods used in research and thesis writing. An original investigation of a problem in chemical engineering and its report in a dissertation.

CHE 6010* Chemical Engineering Seminar. 1-3 credits, max 3. Advanced research and development topics.

CHE 6223* Advanced Chemical Engineering Thermodynamics. Prerequisite(s): 5843. Phase equilibrium in multicomponent systems. Irreversible processes. Properties of fluids and the prediction of properties by statistical methods. Application of thermodynamics to unit operations.

CHE 6440* Advanced Topics in Chemical Engineering. 3-6 credits, max 9. Topics in chemical engineering unit operations in design. Advanced mathematical techniques in chemical engineering problems. May be repeated for credit if subject matter varies.

CHE 6703* Research Methods in Chemical Engineering. Prerequisite(s): MS or PhD candidacy in chemical engineering or consent of instructor. Methods and skills required to successfully conduct chemical engineering research projects. Maintaining research records, experiment design, data validation, results presentation and research ethics.

Chemistry (CHEM)

CHEM 1014 (L,N) Chemistry in Civilization. Symbols, methods and contributions to society of the chemical sciences. Includes polymers, pollution, energy, consumer chemicals, drugs, nuclear science, and other topics. *May not be used for degree credit with 1215 or 1314.*

CHEM 1215 (L,N) General Chemistry. Lab 2. Prerequisite(s): MATH 0123 or high school equivalent. The beginning chemistry course recommended for students in the applied biological sciences. *May not be used for degree credit with 1014 or 1314.*

CHEM 1225 (L,N) General Chemistry. Lab 2. Prerequisite(s): 1215 with a grade of "C" or higher. A continuation of general chemistry, recommended for students in the applied biological sciences. *May not be used for degree credit with 1515.*

CHEM 1314 (L,N) General Chemistry. Lab 2. Prerequisite(s): MATH 1513 with grade of "C" or better or concurrent enrollment in a higher level math course. The beginning chemistry course recommended for students in basic biological sciences (including pre-medical science and pre-veterinary science), physical sciences and engineering. *May not be used for degree credit with 1014, 1215 or 1414.*

CHEM 1413 (L,N) Inquiry-Based Chemistry. Lab 3. Prerequisite(s): PHYS 1313 recommended. Directed inquiry and hands on study of chemical reactions. Recommended for elementary education majors as model course to learn and teach science.

CHEM 1414 (L,N) General Chemistry for Engineers. Lab 2. Prerequisite(s): One year of high school chemistry and a "C" or higher in MATH 1513 or concurrent enrollment in a higher level math course. Survey course for engineers needing only one semester of chemistry. Thermodynamics, atomic structure, solid state, materials, equilibria, acids and bases, and electrochemistry. *May not be used for degree credit with 1314.*

CHEM 1515 (L,N) General Chemistry. Lab 2. Prerequisite(s): a grade of "C" or better in CHEM 1314. A continuation of general chemistry. *May not be used for degree credit with 1225.*

CHEM 2113 Principles of Analytical Chemistry. Prerequisite(s): a grade of "C" or higher in CHEM 1515. Modern theories of solutions, separation techniques and methods of analysis.

CHEM 2122 Quantitative Analysis Laboratory. Lab 6. Prerequisite(s): 2113 or concurrent enrollment. Laboratory work related to material covered in CHEM 2113.

CHEM 2990 Special Problems in Chemistry. 1-3 credits, max 3. Prerequisite(s): 1515 or concurrent enrollment and consent of instructor. Independent training in chemistry.

CHEM 3013 The Chemistry of Organic Compounds. Prerequisite(s): 1215 and 1225 or equivalent. Terminal, one-semester non-majors course in organic chemistry covering the general principles of nomenclature, structures, bonding, methods of preparation, reactions and use of acyclic, cyclic, and aromatic compounds. *May not be used for degree credit with 3053 or 3112.*

CHEM 3015* The Chemistry of Organic Compounds. Lab 4. Prerequisite(s): a "C" or better in 1225 or 1414 or 1515. Terminal, one-semester non-majors course in organic chemistry covering the general principles of nomenclature, structures, bonding, methods of preparation, reactions and uses of acyclic, cyclic, and aromatic compounds. *May not be used for degree credit with 3053 or 3112.*

CHEM 3053 Organic Chemistry. Prerequisite(s): a "C" or higher in CHEM 1515. Hydrocarbons and their derivatives, including specific compounds of theoretical, biological or industrial importance. *May not be used for degree credit with 3015.*

CHEM 3112 Organic Chemistry Laboratory. Lab 6. Prerequisite(s): 3153 or concurrent enrollment. Laboratory exercises related to theoretical principles covered in CHEM 3053 and 3153. *May not be used for degree credit with 3015.*

CHEM 3153* Organic Chemistry. Prerequisite(s): A grade of "C" or higher in 3053. A continuation of 3053.

CHEM 3353 Descriptive Inorganic Chemistry. Prerequisite(s): A grade of "C" or higher in CHEM 1515. Structures and properties of the elements and their many compounds in the broadest sense which includes the modern technologically important materials, organometallics, and inorganic substances of biological significance.

CHEM 3433* Physical Chemistry I. Prerequisite(s): CHEM 2113 or concurrent enrollment and a "C" or higher in MATH 2163. Introductory theoretical analysis of molecular structure, chemical bonding and macroscopic chemical systems using quantum theory, classical and statistical thermodynamics, and kinetics. Students who are not chemistry majors may receive graduate credit.

CHEM 3532* Physico-Chemical Measurements. Lab 6. Prerequisite(s): a "C" or higher in CHEM 2122 and 3433. Apparatus, experimental methods, and calculations employed in physico-chemical investigations.

CHEM 3553* Physical Chemistry II. Prerequisite(s): a grade of "C" or higher in 3433. A continuation of 3433. Students who are not chemistry majors may receive graduate credit.

CHEM 4020* Modern Methods of Chemical Analysis. 1-5 credits, max 5. Prerequisite(s): a "C" or higher in 2122. Theoretical and laboratory study of modern techniques, reagents and instruments employed in analytical chemistry.

CHEM 4320* Chemical and Spectrometric Identification of Organic Compounds. 1-3 credits, max 3, Lab 1-2. Prerequisite(s): a "C" or higher in CHEM 3112 and 3153. Theory and practice in separating mixtures of organic compounds and some theory and practice in identifying organic compounds by spectroscopic methods.

CHEM 4990* Special Problems. 1-5 credits, max 6, Lab 3-15. Prerequisite(s): Junior or senior standing and instructor permission. Training in independent work, study of relevant literature and experimental investigation of an assigned problem culminating in a written and oral report.

CHEM 5000* Thesis. 1-6 credits, max 6. Investigations, chiefly experimental, with necessary conferences. Familiarizes the student with methods used in research in chemistry.

CHEM 5001* Introduction to Chemistry Research. Prerequisite(s): Graduate student standing. Introduction to chemical research topics of interest to the department. Special emphasis placed on ethics, plagiarism, codes of conduct, research notebooks, publishing, and presentations.

CHEM 5011* Graduate Seminar. Preparation and presentation of seminars usually on subjects of current interest taken from the literature. Completion of 1 credit hour required for MS degree.

CHEM 5103* Physical and Chemical Separations. Prerequisite(s): One year of physical chemistry. Principles of bulk and multi-stage separation methods: chromatography, liquid-liquid extraction, and zone melting.

CHEM 5113* Equilibrium and Kinetics in Analytical Chemistry. Prerequisite(s): One year of physical chemistry. Physical and chemical principles of equilibrium and kinetics as applied to analytical problems.

CHEM 5220* Modern Topics for Teachers. 1-9 credits, max 9. Prerequisite(s): Teaching experience. Designed to help elementary and secondary science teachers improve their subject matter competence in chemistry. Content varies depending on the needs of specific groups of teachers.

CHEM 5223* Chemistry of High Polymers. Prerequisite(s): 3153 and 3433 or equivalent. Preparation and polymerization of organic monomers; properties and uses of resulting high polymers; theories of polymerization; inorganic and natural organic polymers.

CHEM 5260* Inorganic Chemistry I. 1-3 credits, max 3. Prerequisite(s): 3353 or equivalent and 3 hours of physical chemistry. Bonding theory, molecular symmetry and structure, characterization of inorganic compounds, coordination chemistry, crystal field theory, solution chemistry, and mechanisms of inorganic reactions in solution.

CHEM 5283* Solid-State Chemistry. Prerequisite(s): 5260. Structure, bonding, and properties of crystalline and amorphous inorganic solids. Emphasis on the characterization of inorganic solids and phase transitions in inorganic solids.

CHEM 5323* Reactions of Organic Compounds. Prerequisite(s): 3153. Products and mechanisms of reactions of importance in organic synthesis.

CHEM 5373* Spectrometric Identification of Organic Compounds. Lab 3. Prerequisite(s): 4320. Lectures on ultraviolet, circular dichroism, infrared, nuclear magnetic resonance (NMR) and mass spectrometry (MS). More advanced techniques in NMR and MS stressed. Hands-on training and use of modern spectroscopic instrumentation in laboratory.

CHEM 5443* Mechanism and Structure in Organic Chemistry. Prerequisite(s): 3153 and 3553. Relationship of properties of organic compounds to their structure; mechanisms of organic reactions.

CHEM 5563* Chemical Thermodynamics I. Prerequisite(s): 3553. Statistical and classical thermodynamics applied to chemical systems.

CHEM 5623* Quantum Chemistry I. Prerequisite(s): 3553. Fundamentals of quantum mechanics, including classical mechanics, wave representation of matter, the Schroedinger equation, and atomic structure.

CHEM 5960* Inorganic Chemistry II. 1-3 credits, max 3. Prerequisite(s): 5260. Chemistry of main group and transition metal organometallic compounds, metal clusters, and catalysis by organometallic polymers, bioinorganic chemistry, and materials chemistry. (Same course as 6650*)

CHEM 6000* Doctoral Dissertation Research. 1-15 credits, max 60. Prerequisite(s): MS degree in chemistry or consent of instructor. Independent investigation under the direction and supervision of a major professor.

CHEM 6010* Research Seminar. 1 credit, max 8. Prerequisite(s): Consent of instructor. Presentations of current research. One credit hour per academic year required for MS and PhD candidates.

CHEM 6011* Advanced Seminar. Prerequisite(s): 5011 or MS degree. Preparation and oral presentation of critical reviews on chemical subjects. Usually related to the student's research area. Completion of one credit hour required for the PhD degree.

CHEM 6050* Special Topics in Analytical Chemistry. 1-6 credits, max 6. Supervised study of topics and fields not otherwise covered.

CHEM 6103* Electroanalytical Chemistry. Prerequisite(s): 4024. The theory, practice and instrumentation in various areas of modern electroanalytical chemistry.

CHEM 6113* Analytical Spectroscopy. Prerequisite(s): 4024. Survey of selected topics in analytical applications of spectroscopic techniques. Fundamental concepts as well as current trends in research, including instrumentation.

CHEM 6223* Physical Polymer Science. Prerequisite(s): 5223 or equivalent. A study of the physical properties of macromolecular systems including polymer solutions, gels, bulk polymers and rubbers. The characterization of polymers based on their thermal, spectroscopic, microstructure and molecular masses is also discussed.

CHEM 6420* Special Topics in Organic Chemistry. 1-9 credits, max 9. Prerequisite(s): 3153. Deals with topics not covered in other courses.

CHEM 6453* Chemical Kinetics. Prerequisite(s): 3553. The kinetics of chemical reactions and their theoretical interpretation.

CHEM 6553* Molecular Spectroscopy. Prerequisite(s): 5623. Spectra and structure of molecules.

CHEM 6650* Selected Topics in Advanced Physical and Inorganic Chemistry. 1-6 credits, max 12. Prerequisite(s): Consent of instructor. Supervised study of selected topics and fields not otherwise covered. (Same course as 5960*)

CHEM 6803* Photonics I: Advanced Optics. Lab 9. Prerequisite(s): ECEN 3813 or PHYS 3213, or consent of instructor. Advanced optics, including spectral and time characteristics of detectors, characteristics of lasers, time, spectral and spatial parameters of laser emission, interferometric techniques, and

nonlinear effects such as two-photon absorption and second and third harmonic generations. Ultra short laser pulses. (Same course as ECEN 6803 & PHYS 6803)

CHEM 6810* Photonics II: THz Photonics and THz-TDS. 1 credit, max 4, Lab 1. Prerequisite(s): 6803. THz photonics and THz time-domain spectroscopy (THz-TDS). Concepts and techniques of driving electronic circuitry with ultra short laser pulses to generate and detect freely propagating pulses of THz electromagnetic radiation using several operational research systems. (Same course as ECEN 6810 & PHYS 6810)

CHEM 6820* Photonics II: Spectroscopy II. 1 credit, max 4, Lab 1. Prerequisite(s): 6803. Operating principles and applications of laser spectroscopy of atoms, molecules, solids and complex fluids. Absorption, emission, photon correlation, coherence, time resolved Fourier transform. Raman spectroscopy and non-linear optical. (Same course as ECEN 6820 & PHYS 6820

CHEM 6830* Photonics II: Spectroscopy III. 1 credit, max 4, Lab 1. Prerequisite(s): 6803. Advanced spectroscopic instruments and methods used for investigation of semi-conductors and solid state material. Stimulated emission characterized both in wavelength and in time. Time-resolved fluorescence measurements. Multiphotonic excitations. Fast measuring techniques, including subnanosecond detectors, picosecond streak cameras, and ultra fast four-wave mixing and correlation techniques. Time-dependent photoconductivity measurements. (Same course as ECEN 6830 & PHYS 6830)

CHEM 6840* Photonics III: Microscopy I. 1 credit, max 4, Lab 1. Prerequisite(s): 3553 or consent of instructor. The structure and imaging of solid surfaces. Basics of scanning probe microscopy (SPM). Contact and noncontact atomic force microscopy (AFM). Scanning tunneling microscopy (STM) in air. (Same course as ECEN 6840 & PHYS 6840)

CHEM 6850* Photonics III: Microscopy II. 1 credit, max 4, Lab 1. Prerequisite(s): 3553 or consent of instructor. Advanced techniques of scanning probe microscopy (SPM). Magnetic force microscopy, Kelvin force microscopy, scanning tunneling microscopy (STM) in vacuum. Characterization of materials with SPM. Nanolithography with SPM. Device manufacturing and analysis. (Same course as ECEN 6850 & PHYS 6850)

CHEM 6860* Photonics III: Microscopy III and Image Processing. 1 credit, max 4, Lab 1. Prerequisite(s): ECEN 5793. Digital image processing, including projects. Image acquisition and display, image enhancement, geometric operations, linear and nonlinear filtering, image restoration, edge detection, image analysis, morphology, segmentation, recognition, and coding/compression. (Same course as ECEN 6860 & PHYS 6860)

CHEM 6870* Photonics IV: Synthesis and Devices I. 1 credit, max 4, Lab 1. Prerequisite(s): 6803 and 6840. Preparation of functional nanostructures and related optical and electronic devices. Physical and chemical methods of thin film deposition. Engineering of prototypes of light emitting diodes, sensors, optical limiting coatings, lithographic patterns. (Same course as ECEN 6870 & PHYS 6870)

CHEM 6880* Photonics IV: Semiconductor Devices, Testing and Characterization. 1 credit, max 4, Lab 1. Prerequisite(s): 6803. Test and characterization of semiconductor and optoelectronic devices. Hall Effect, four point probe, CV and IV measurements, optical pump-probe, photoluminescence and electro-optics sampling. (Same course as ECEN 6880 & PHYS 6880)

CHEM 6890* Photonics IV: Semiconductor Synthesis and Devices III. 1 credit, max 4, Lab 1. Prerequisite(s): 6803. Processing, fabrication and characterization of semiconductor optoelectronic devices in class 100/10000 clean rooms. Clean room operation, including general procedure for material processing and device fabrication. Device processing using a variety of processing such as mask aligner, vacuum evaporators and rapid thermal annealer. Testing using optical and electrical testing apparatus such as I-V, C-V, Hall and optical spectral measurement systems. (Same course as ECEN 6890 & PHYS 6890)

Chinese (CHIN)

CHIN 1115 Elementary Chinese I. Basic introduction to spoken Mandarin Chinese and Chinese characters. Training in pronunciation, conversation, grammar and reading. *Not for native speakers per University Academic Regulation 4.9.*

CHIN 1225 Elementary Chinese II. Prerequisite(s): 1115 or equivalent proficiency. Continuation of 1115. Mastery of the basic grammatical patterns and conversational principles, and increasing repertory of Chinese characters. *Not for native speakers per University Academic Regulation 4.9.*

CHIN 2115 Intermediate Chinese I. Prerequisite(s): 1225 or equivalent proficiency. A continuation of 1225. Emphasis on fluency in spoken Mandarin Chinese, structures of greater complexity, a greater repertory of characters and vocabulary items, and reading ability. *Not for native speakers per University Academic Regulation 4.9.*

CHIN 2225 Intermediate Chinese II. Prerequisite(s): 2115 or equivalent proficiency. Continuation of 2115. *Not for native speakers per University Academic Regulation 4.9.*

CHIN 3013 Chinese Conversation. Prerequisite(s): 2225 or equivalent proficiency. Development of general oral and aural proficiency.

CHIN 3133 Readings in Chinese. Prerequisite(s): 2225 or equivalent proficiency. Development of student competence in reading a wide variety of materials by contemporary Chinese writers.

CHIN 4113 Chinese Literature in Translation. Chinese literature from ancient times to the 20th century, with emphasis in major writers and movements and on cultural and political context.

Civil Engineering (CIVE)

CIVE 2041 Civil and Environmental Engineering Seminar. Prerequisite(s): Sophomore standing or department permission required. An introduction to the importance of communication, professional ethics, knowledge of contemporary issues, and the role these play in developing a broad education. Emphasis will be placed on understanding the impact of engineering solutions in a global and societal context. The various sub-disciplines within the fields of Civil and Environmental Engineering will also be presented.

CIVE 3413 Structural Analysis. Prerequisite(s): Minimum grade of "C" in ENSC 2143. Analysis of internal forces and deflections of structures subjected to static loading. Beams, trusses, and framed structures analyzed by appropriate classical methods. Classical methods and modern computer procedures for the analysis of statically indeterminate structures.

CIVE 3513 Structural Steel Design. Lab 2. Prerequisite(s): Admission to CIVE professional school required and CIVE 3413, or department permission required. Introduction to the design of structural steel members and connections in accordance with AISC specifications.

CIVE 3523 Reinforced Concrete Design. Lab 3. Prerequisite(s): Admission to CIVE professional school required and 3413, or department permission required. Introduction to the design of reinforced concrete elements in accordance with the strength design requirements of the ACI Building code.

CIVE 3614 Engineering Surveying. Lab 3. Prerequisite(s): Minimum grade of "C" required in MATH 1613 or 1715. Principles and techniques of vertical and horizontal measurements related to engineering and construction projects. Linear and angular measurements, differential leveling, traverses, topographic surveys, construction surveying, horizontal and vertical curves, earthwork quantities and design of route systems.

CIVE 3623 Engineering Materials Laboratory. Lab 3. Prerequisite(s): Admission to CIVE professional school required and 3714 or concurrent enrollment, or department permission required. Basic construction materials including Portland cement concrete, asphalt concrete, aggregates, and composite materials. Behavioral characteristics, use, and quality control of these materials. Basic statistical procedures used for material specifications. Laboratory sessions provide "hands on" experience in performing standard tests.

CIVE 3633 Transportation Engineering. Prerequisite(s): Admission to CIVE professional school required and 3614, or department permission required. Planning, design and operations of transportation facilities. Vehicle characteristics and human factors in design. Traffic stream variables and their measurement techniques. Basic traffic flow models. Highway and street intersection capacity and level of service. Traffic control concepts. Transportation systems management. Application of statistical analysis and operations research to analyze transportation problems.

CIVE 3714 Introduction to Geotechnical Engineering. Lab 3. Prerequisite(s): Minimum grade of "C" in ENSC 2143, or department permission required. Physical and mechanical properties of soils, including grain size analysis, plasticity, permeability, consolidation, and shear strength. Use of physical and mechanical properties to calculate stresses in a soil mass, lateral earth pressures and bearing capacity. Laboratory tests conducted to determine the physical and mechanical soil properties needed for application in geotechnical design.

CIVE 3813 Environmental Engineering Science. Prerequisite(s): CHEM 1414 or 1515, MATH 2144. Engineering aspects of the life support system; the carbon-oxygen cycle; cycling of nitrogen, sulfur and phosphorus; and the hydrologic cycle. Concepts of environmental pollution and degradation. Techniques for mitigation; water and wastewater treatment, solid and hazardous waste management, and air pollution abatement. Calculation of pollution potential and treatment system parameters.

CIVE 3833 Applied Hydraulics. Prerequisite(s): Admission to CIVE professional school required and minimum grade of "C" in CHEM 1414 or 1515 and ENSC 3233 and PHYS 2014, or department permission required. Basic hydraulic principles and their application in civil engineering problems. Analyses of water distribution networks, open channels, storm-water management and wastewater collection systems, water pumps, hydraulic models, hydraulic measurements, treatment plant hydraulics and hydraulic structures.

CIVE 3843 Hydrology I. Prerequisite(s): Admission to CIVE professional school required and minimum grade of "C" in CHEM 1414 or 1515 and ENSC 3233 and PHYS 2014, or department permission required. Basic hydraulic principles and their application in civil engineering problems. Analyses of water distribution networks, open channels, storm-water management and wastewater collection systems, water pumps, hydraulic models, hydraulic measurements, treatment plant hydraulics and hydraulic structures.

CIVE 3853 Environmental Engineering Laboratory. Lab 3. Prerequisite(s): Admission to CIVE professional school required and 3813, or department permission required. Performance of experiments with benchscale environmental engineering unit operations, review of chemical principles and analyses important to the evaluation of these and other environmental engineering applications. Emphasis on the development of experimental results that can be used in the design of full-scale units.

CIVE 4010* Civil Engineering Research. 1-4 credits, max 12. Prerequisite(s): Senior standing or consent of instructor. Research and investigation of civil engineering problems.

CIVE 4041 Engineering Practice. Prerequisite(s): Admission to professional school required and enrolled in last two semesters of CIVE degree, or department permission required. Topics relevant to the professional practice of civil and environmental engineering will be introduced, to include management principles, project management, and the laws that impact the practice of engineering, such as OSHA and ADA. Emphasis will be placed on written communication skills to include resumes, letters of introduction, and job interviews. The advantages of professional registration and technical/ professional society membership will be presented as well as discussions of professional ethics, income taxes, and investments.

CIVE 4043 Senior Design. Lab 3. Prerequisite(s): Admission to CIVE professional school required and enrolled in last two semesters of CIVE degree and 3513, 3523, 3713, or department permission required. Major comprehensive design experience using the team approach. Industry practitioners provide design projects and analyze and critique results. Extends the undergraduate experience and provides the student with opportunities to analyze and design complex structures.

CIVE 4143* Environmental Engineering Design. Lab 2. Prerequisite(s): Admission to CIVE professional school required and enrolled in last two semesters of CIVE degree and 3833, 3853 and 4833, or department permission required. Factors involved in the design of engineered environmental systems. Solving "real world" environmental engineering problems. Design experience using decision-making techniques, integrating and expanding upon current knowledge, and defending decisions made. Economic, environmental, social, and regulatory aspects of environmental engineering design.

CIVE 4273 Construction Engineering and Project Management. Lab 2. Prerequisite(s): Admission to CIVE professional school required or graduate standing. Principles and practice of construction engineering and project management. Project planning, development of cost estimates and project schedules, construction methods and fundamental terminology used in the engineering and construction industry.

CIVE 4711 Basic Soils Testing Laboratory. Lab 3. Prerequisite(s): Non CIVE majors only, ARCH 4143 for ARCH students. Laboratory measurements of the physical and mechanical properties of soils; grain size distribution, plasticity, permeability, compaction, compressibility, and shear strength.

CIVE 4823* Human Impact on the Environment. The activities of humans and how they affect the aqueous, terrestrial, and atmospheric environment.

CIVE 4833 Unit Operations in Environmental Engineering. Prerequisite(s): Admission to CIVE professional school required and 3813 and ENSC 3233 or department permission required. Fundamental principles of water and wastewater treatment, including basic theory and development of design parameters. Application of these to the design of unit operations and processes in various treatment plants.

CIVE 5000* Master's Thesis or Report. 1-6 credits, max 6. Prerequisite(s): Graduate standing. A student studying for a master's degree will enroll in this course for 2 credit hours if a report is to be written; 6 credits if a thesis is to be written.

CIVE 5010* Civil Engineering Seminar. 1-3 credits, max 6. Prerequisite(s): Graduate standing and approval of major professor, or undergrad in professional school. Review of literature of major fields of civil engineering.

CIVE 5013* Aquatic Chemistry. Prerequisite(s): Graduate standing or admission to CIVE professional school required and CIVE 5813 or concurrent enrollment and CHEM 1515 or equivalent, or department permission required. Application of chemical principles to environmental problems. Chemical kinetics, chemical equilibrium, acid-base chemistry, development of pc-pH diagrams, and coordination chemistry. Precipitation and dissolution reactions and oxidation-reduction reactions.

CIVE 5020* Civil Engineering Research. 1-6 credits, max 6. Prerequisite(s): Graduate standing and approval of major professor. Research and investigations other than thesis studies.

CIVE 5023* Public Health Engineering. Prerequisite(s): Graduate standing or admission to CIVE professional school required. Protection of public health through improved environment in urban, suburban, and rural communities. Practical examples, simple formulas, general rules and guidelines for application of public health principles. Intended for students in engineering, physical sciences and other technical disciplines.

CIVE 5030* Engineering Practice. 1-6 credits, max 9. Prerequisite(s): Approval of adviser. Professional supervised civil engineering practice involving authentic projects for which the student assumes a degree of professional responsibility. Activities must be approved in advance by the student's adviser and may consist of engineering experience on-campus or off-campus, or both. *Periodic reports, both oral and written, are required as specified by the adviser.*

CIVE 5080* Engineering Problems. 1-3 credits, max 6. Prerequisite(s): Graduate standing. Problems of particular interest to graduate students in the field of applied science.

CIVE 5103* Construction Simulation. Prerequisite(s): Graduate standing or admission to CIVE professional school required. This course introduces students to effective ways of modeling construction processes and technologies. It provides an investigation of quantitative methods used for the design and analysis of construction operations to maximize productivity and minimize resource idleness. It includes discussions on queueing theory, line-of-balance techniques, linear programming and simulation. Comprehensive group projects that involve modeling and analyzing actual construction operations will be integral parts of this course.

CIVE 5113* Construction Business Management. Prerequisite(s): Graduate standing or admission to CIVE professional school required. Fundamental theories and applied methods of financial management of construction companies. The spectrum of the present and future practice of business management at the construction company level. Basic construction business operations in the context of construction accounting, financial management, cash flow analysis, financial planning, and risk analysis.

CIVE 5123* The Legal and Regulatory Environment of Engineering. Prerequisite(s): Graduate standing or admission to CIVE professional school required. The U.S. and Oklahoma court systems. Tort law and labor law having an impact on engineering and construction. Union organization and activities. Government contracting and the laws governing it. Discussions of the Occupation Safety and Health Act and Americans with Disabilities Act. In-Depth look at environmental policy, laws, and regulations affecting engineering, including NEPA, CWA, SDWA, RCRA, CERCLA and CAA Water law.

CIVE 5133* Construction Contracts and Specifications. Prerequisite(s): Graduate standing or admission to CIVE professional school required. The nature of contracts. Contract documents. Master format. Principles of specification writing. Contract types. Bonds and insurance. Bidding. Subcontracting. Disputes and disputes resolution.

CIVE 5143* Project Engineering and Management. Prerequisite(s): Graduate standing or admission to CIVE professional school required. Management of the design and construction of civil engineering projects. Topics include owner's study, formation of project teams, design coordination, construction, and project closeout.

CIVE 5153* Contract Administration. Prerequisite(s): Graduate standing or consent of instructor. Methods and techniques of tracking and control of construction projects. Evaluation of current research findings to contract implementation.

CIVE 5163* Construction Equipment Management. Prerequisite(s): Graduate standing or admission to CIVE professional school required. Analysis of construction equipment. Performance under various operating conditions. Application of engineering fundamentals to construction methods. Selection and costs of equipment, prediction of equipment production rates, and unit costs of work in place.

CIVE 5173* Concrete Formwork Design. Prerequisite(s): Graduate standing or admission to CIVE professional school required. Design of formwork for concrete structures. Analysis of loads, deflections, and stresses of forming systems. Evaluation of economics of formwork designs.

CIVE 5183* Construction Estimating. Lab 2. Prerequisite(s): Graduate standing or admission to CIVE professional school required. The construction industry, its makeup, operation, estimating, and bidding procedures. Theory and practice of estimating materials, labor, equipment, and overhead costs for various types of construction. Emphasis on preliminary cost estimates during the conceptual design phase of a construction project.

CIVE 5203* Pavement Rehabilitation, Management and Safety. Prerequisite(s): Graduate standing or senior standing with instructor approval. Understand and perform pavement evaluations of function, structure, surface condition, and surface safety and learn various types of equipment for evaluating pavement function, structure, and surface condition and safety. Describe techniques for rehabilitation of flexible and rigid pavements, and overall objectives and major components of a pavement management system. Understand and explain the basic techniques of safety analysis based on pavement surface data.

CIVE 5243* Use and Design of Geosynthetics. Prerequisite(s): Graduate standing or admission to CIVE professional school required and 3714. Description of types of geosynthetics available for engineering uses. Pertinent engineering properties required to design for various functions, basic design methodology for geosynthetics for various functions, and construction and performance considerations.

CIVE 5253* Sensors and their Applications for Pavement. Prerequisite(s): Graduate standing or senior standing with instructor approval. Sensor Principles of Falling Weight Deflectometer (FWD), Rolling Weight Deflectometer (RWD) and Traffic Speed Deflectometer (TSD); 2D and 3D laser imaging as used in pavement surface condition survey; Laser rangers and accelerometers for pavement longitudinal profile; Friction and texture measurement of pavement surface; New software and mobile tools for presenting sensor data with HTML5; 3D visualization and database management with pavement sensor data; Inertial

navigation system and high-precision gyro for pavement data positioning; LIDAR and its usage for infrastructure management.

CIVE 5273* Concrete Durability. Prerequisite(s): CIVE 5673 Concrete Mixture Design and graduate standing or permission of instructor. This course investigates the mechanisms, test methods, and evaluation procedures for the primary mechanisms for durability issues in concrete. Emphasis is placed on providing a practical and theoretical overview of the topics. Special topics may be covered with the interest of the students.

CIVE 5303* Systems Analysis for Civil Engineers. Prerequisite(s): Graduate standing or admission to CIVE professional school required. Synthesis of systems modeling and simulation techniques, mathematical optimization procedures, and evaluation tools of multi-attributed systems including utility theory and decision analysis. Mathematical optimization techniques in the areas of resource allocation, transportation and water resources systems planning, structural design, construction management, and environmental and ecological problems.

CIVE 5313* Highway Traffic Operations. Prerequisite(s): Graduate standing or admission to CIVE professional school required and 3633. Level of service, capacity and service volume concepts. Operational characteristics of uninterrupted-flow and interrupted-flow traffic facilities. The 1985 HCM procedures for analyzing the capacity of freeways, multilane and two-lane rural highways, urban arterials, signalized and unsignalized street intersections, and transit and pedestrian facilities. Administrative and planning actions for congestion management. Design alternatives and improvement strategies for effective use of urban arterial street width.

CIVE 5343* Urban Transportation Planning. Prerequisite(s): Graduate standing or admission to CIVE professional school required and 3633. Determinants of demand for transportation and models for demand forecasting. Performance characteristics of transportation systems and models for performance. Quantitative analysis of multimodal transportation networks including prediction of flow patterns and service quality. Evaluation of social, environmental, and political impacts of transportation decisions. Application of systems analysis techniques to the generation, evaluation, and selection of alternative transportation systems.

CIVE 5363* Design and Planning of Airports. Prerequisite(s): Graduate standing, or admission to CIVE professional school required and 3633. Nature of civil aviation. Aircraft characteristics and performance related to airport planning and design. Air traffic control and navigation systems. Basics of airport planning and airport demand forecasting. Analysis of airport capacity and delays. Runway length requirements. Configuration and geometric design of runways, taxiways, holding aprons, and landing areas. Airport lighting, marking, and signing. Drainage and noise control.

CIVE 5373* Design of Traffic Control Systems. Prerequisite(s): Graduate standing or admission to CIVE professional school required and 3633. Traffic control systems design, available technological options, and range of agency needs. Design of vehicle detectors, controllers, communications links, signal display hardware, and wiring. Development of timing plans using computer simulation models. Freeway surveillance and control: ramp metering, incident detection, and motorist information systems. Preparation of contractual documents and construction supervision.

CIVE 5383* Geometric Design of Highways. Prerequisite(s): Graduate standing or admission to CIVE professional school required and 3633. Geometric, functional, and aesthetic aspects of roadway design. Alignment, sight distance, at-grade intersections, interchanges, and freeway systems. Design tools and techniques.

CIVE 5403* Advanced Strength of Materials. Prerequisite(s): Graduate standing or admission to CIVE professional school required and 3413. General states of stress and strain, theories of failure, energy principles, beam bending, shear center, torsion of prismatic shafts, beams on elastic foundations, plates and shells, elastic stability.

CIVE 5413* Classical and Matrix Methods of Structural Analysis. Prerequisite(s): Graduate standing or admission to CIVE professional school, and 3413. Advanced analysis of indeterminate frames, trusses and arches by classical, numerical, energy, and stiffness methods with emphasis on methods for hand computations and development of matrix analysis.

CIVE 5423* Matrix Analysis of Structures. Prerequisite(s): Graduate standing or admission to CIVE professional school required and 3413. Matrix analysis of two- and three-dimensional trusses and frames. Development of member stiffness matrices. Assemblage of structure matrices by direct stiffness method. Computer programs for structural analysis.

CIVE 5433* Energy Methods in Applied Mechanics. Prerequisite(s): Graduate standing or admission to CIVE professional school required and 3413 and MATH 2233 or MAE 3323. Advanced structural mechanics from the standpoint of virtual work; energy principles and variational calculus applied to the analysis of structures, mechanisms, dynamics, and vibrations.

CIVE 5473* Steel Plastic Design. Prerequisite(s): Graduate standing or CIVE 3413 Structural Analysis and instructor approval. This course is for incoming graduate students that are not familiar with LRFD AISC based steel design. Topics typically covered in the undergraduate course are covered with additional topics.

CIVE 5503* Computer-Aided Structural Analysis and Design. Prerequisite(s): Graduate standing or admission to CIVE professional school required and 3413, 3513, 3523 (or concurrent enrollment); or permission of instructor. Major comprehensive design experience. Promotion of a design office atmosphere in using a team approach. Industry practitioners provide design projects and critique results. Analysis and design of complex structures and preparation of contract documents and drawings. Emphasis on modern computer-based computation and presentation tools.

CIVE 5513* Advanced Reinforced Concrete Design. Prerequisite(s): Graduate standing or admission to CIVE professional school required and 3523. Advanced topics in reinforced concrete design with emphasis on frames, slabs, and earthquake-resistant structures.

CIVE 5523* Advanced Steel Structure Design. Prerequisite(s): Graduate standing or admission to CIVE professional school required and 3513. Advanced topics in steel design such as plastic design, plate girders, composite design, fatigue and fracture, stability, and bracing design.

CIVE 5533* Prestressed Concrete. Prerequisite(s): Graduate standing or admission to CIVE professional school required and 3523. Design of simple and continuous prestressed concrete beams. Behavior under overload. Calculation of prestress losses and deflections.

CIVE 5563* Structural Dynamics. Prerequisite(s): Graduate standing or admission to CIVE professional school required and ENSC 2123 and CIVE 3413. Analysis of linear, elastic damped and undamped systems with single and multiple degrees of freedom undergoing free and forced vibration. Lumped and distributed mass systems. Computational techniques to numerically integrate the equations of motion.

CIVE 5573* Timber Design. Prerequisite(s): Graduate standing or admission to CIVE professional school required and 3523 or 3513. Design of structural timber members, assemblies, and connections in accordance with ANSI/AF&PA, NDS specifications. Design, build, and test timber structure.

CIVE 5653* Asphalt Materials and Mix Design. Lab 1.5. Prerequisite(s): 3623 or consent of instructor. Principles of asphalt concrete mix design including material characteristics and performance. Evaluation of Hveem and Marshall mix design methods. Asphalt cements, rubberized asphalt polymer asphalts, emulsions, cutbacks, and aggregates. Laboratory sessions focused on the engineering properties of the materials discussed.

CIVE 5673* Concrete Materials and Mix Design. Lab 1.5. Prerequisite(s): Senior or graduate standing. Principles of concrete mix design, including material characteristics, strength and durability requirements, environmental effects and forensic analysis. ACI and PCA mix design procedures. Laboratory on theoretical and practical aspects of concrete technology.

CIVE 5693* Pavement Design and Analysis. Prerequisite(s): 3633 or consent of instructor. Principles of pavement design, including stress analyses, load and environmental effects, and material characteristics. AASHTO, PCA and AI methods of pavement design. Computer methods. Practical aspects of life cycle cost analyses and construction methods.

CIVE 5713* Soil Mechanics. Prerequisite(s): 3713 and 4711. Application of soil mechanics principles and concepts in geotechnical areas of permeability and seepage, settlement analysis, bearing capacity, lateral earth pressures and retaining walls, slope stability, and metastable soils.

CIVE 5723* Foundation Engineering. Prerequisite(s): 3713 and 4711. Types of structural foundations including footings, mats, rafts, piles and drilled shafts. Site characteristics, exploration programs, field data, test results and construction materials and methods as basis for selection of type of foundation and design. Geotechnical design procedures and considerations.

CIVE 5733* Rock Mechanics in Engineering Design and Construction. Prerequisite(s): Undergraduate courses in soils and geology. Stresses, strength variations, and deformational behavior of rock. Engineering classification of rock. Methods of field and laboratory measurement of the engineering properties of rock. Rock mechanics consideration in the design and construction of engineering works.

CIVE 5743* Soil-Structure Interaction. Prerequisite(s): 3713 and senior or graduate standing in civil engineering. The mechanical interaction effects between soils and structures using suitable engineering procedures such as finite differences and finite element methods. Civil engineering problems where interaction effects are most dominant including grade beams (beams on elastic foundation), axially- and laterally-loaded piles, cantilever, and anchored sheet pile walls.

CIVE 5753* Engineering Soil Stabilization. Prerequisite(s): 3713 and 4711. Theoretical and practical aspects of engineering soil stabilization as a method for improving and upgrading low quality and unstable soils for engineering purposes. Use of lime, fly ash, portland cement, asphalt, and other physical and chemical admixtures. Application of deep foundation stabilization methods such as preloading, deep compaction, injection and reinforcement.

CIVE 5803* Essentials of Environmental Engineering. Prerequisite(s): CHEM 1314 or 1515; MATH 2155. Engineering aspects of the life support system; the carbon-oxygen cycle; cycling of nitrogen, sulfur and phosphorus; and the hydrologic cycle. Concepts of environmental pollution and degradation. Techniques for mitigation; water and wastewater treatment, solid and hazardous waste management, and air pollution abatement. Calculation of pollution potential and treatment system parameters.

CIVE 5813* Environmental Laboratory Analysis. Lab 3. Prerequisite(s): Graduate standing or permission of instructor. Analytical procedures for water

and waste water contaminants. Emphasis on the chemical theory of procedures, analytical work and an understanding of the significance or need for such laboratory data for surface and groundwater management and water and wastewater treatment processes and design.

CIVE 5823* Environmental Risk Assessment and Management. Prerequisite(s): Graduate standing or permission of instructor. Environmental risk assessment and management. Applies elements of statistics, probability and environmental simulation to determine the public health and ecological risks from activities of humans.

CIVE 5833* Introduction to Environmental Modeling. Prerequisite(s): Graduate standing or permission of instructor. Intended as an introductory course for graduate and senior undergraduate students to the fundamentals of environmental modeling. Develops material necessary to construct models capable of identifying contaminant distributions at future times and space for water and air pollution applications. Advanced topics such as stochastic modeling, ecological risk assessment, neural modeling and spatial statistical analysis among others will be presented according to the backgrounds and interests of the enrolled students. In part, the course is designed as the "Physical Science" component for MS students in the Environmental Sciences program.

CIVE 5853* Bioremediation. Prerequisite(s): Graduate standing or admission to CIVE professional school required and 3813 or permission of instructor. Process selection and design of bioremediation systems for renovation of contaminated hazardous and industrial waste sites, soils, sludge. Site analysis emphasizing contaminant and environmental characteristics. Engineering factors to promote successful bioremediation. Design project required.

CIVE 5863* Advanced Unit Operations in Environmental Engineering. Prerequisite(s): Graduate standing or admission to CIVE professional school required and 4833 or permission of instructor. Theory and design of advanced physical-chemical water and wastewater treatment processes applied to municipal, industrial, and hazardous waste situations.

CIVE 5873* Air Pollution Control Engineering. Prerequisite(s): Graduate standing or admission to CIVE professional school required and 4833 or permission of instructor. Causes, effects, and control of atmospheric pollution. (Same course as CHE 5873*)

CIVE 5883* Residuals and Solid Waste Management. Prerequisite(s): Graduate standing or admission to CIVE professional school required or permission of instructor. Theory, design and operation of systems for handling, treatment, and disposal of process sludge (water treatment, wastewater treatment, industrial) and solid wastes. Potential material reclamation options.

CIVE 5913* Groundwater Hydrology. Prerequisite(s): Graduate standing or admission to CIVE professional school required and 3843 or permission of instructor. Theory of groundwater movement, storage, exploration and pumping tests. Design of groundwater recovery and recharge systems.

CIVE 5923* Water Resources Planning and Management. Prerequisite(s): Graduate standing or admission to CIVE professional school required or permission of instructor. Application of engineering economics and microeconomic theory to the planning and management of water resources projects, including flood control, hydroelectric, water supply, and urban storm water. Systems analysis approaches, primarily linear and dynamic programming, and their application in water resources.

CIVE 5933* Water Treatment. Prerequisite(s): Graduate standing or admission to CIVE professional school required and 4833 or permission of instructor. Theory, design, and operation of water treatment plants. Sizing of various unit processes. Water treatment plant control procedures.

CIVE 5953* Biological Waste Treatment. Prerequisite(s): Graduate standing or admission to CIVE professional school required and 4833 or permission of instructor. Fundamentals of microbial systems applied to waste treatment processes. Standard suspended-growth and fixed biofilm wastewater and sludge suspensions and treatment system design calculations.

CIVE 5963* Open Channel Flow. Prerequisite(s): Graduate standing or admission to CIVE professional school required and 3833 or permission of instructor. Open channel hydraulics, energy and momentum concepts, resistance, channel controls and transitions, flow routing, and sediment transport.

CIVE 5983* Groundwater Pollution Control. Prerequisite(s): Graduate standing or admission to CIVE professional school required or permission of instructor. Theory, design and operation of groundwater pollution control systems. Includes examples from site specific applications as well as regional or national focus.

CIVE 5993* Environmental Data Analysis and Modeling. Prerequisite(s): Graduate standing or admission to CIVE professional school required or permission of instructor. Identification and application of various methods to analyze environmental data. Includes statistical, mathematical, and neural modeling. Emphasis on application of geostatistics to spatial environmental problems; including construction modeling semivariogram, kriging, co-kriging, and indicator kriging problems. Deterministic and stochastic simulation methods addressed, including conditional and Monte Carlo simulation with discussions of the inverse problems. More conventional statistical evaluations of environmental monitoring data including trend analysis and sampling adequacy or redundancy.

CIVE 6000* PhD Research Dissertation. 1-16 credits, max 30. Independent research under the direction of a member of the graduate faculty by students working beyond the level of Master of Science degree.

CIVE 6010* Seminar. 1-6 credits, max 12. Prerequisite(s): Consent of instructor and approval of the student's advisory committee. Analytical studies with suitable reports on problems in one or more of the subfields in civil engineering by students working beyond the level of Master of Science degree.

CIVE 6403* Theory of Elasticity. Prerequisite(s): Graduate standing or admission to CIVE professional school required or permission of instructor. Stress, strain, and deformation analysis of two- and three-dimensional elastic continua. Propagation of stress waves through elastic continua.

CIVE 6413* Plate and Shell Structures. Prerequisite(s): Graduate standing or admission to CIVE professional school required and 5403 or permission of instructor. Bending of thin plate structures to include rectangular and circular plates. Analysis of orthotropic plates by classical and numerical methods. Introduction to shell bending theory.

CIVE 6434* Finite Element Analysis. Prerequisite(s): Graduate standing and permission of instructor. Finite elements: formulation techniques, weighted residuals, variational techniques, shape functions and element types, isoparametric elements, convergence criteria, error analysis, and programming techniques. Applications to solid mechanics, structures, fluid mechanics, and heat transfer are discussed.

CIVE 6553 Natural Hazards Engineering. Prerequisite(s): Graduate standing and 5563. Performance of structural systems exposed to extreme loadings from natural hazard events. The response, analysis, and design of structures exposed to earthquakes, wind, flood, and fire loadings are considered. Advanced analytical, computational, and experimental techniques. Current building code specifications.

CIVE 6843* Stochastic Methods in Hydrology. Prerequisite(s): Graduate standing and STAT 4073 or 4033. Stochastic and statistical hydrologic analyses of surface water and ground water systems. Analyses of urban and rural drainage and detention systems. (Same course as BAE 6313)

CIVE 6853* Modeling of Water Resources Systems. Prerequisite(s): Graduate standing and 5913. Application of finite-difference and finite-element methods to predict water flow and chemical and biological water quality in saturated-unsaturated ground waters, streams, lakes, urban areas, and watersheds.

CIVE 6923* Industrial Wastes Engineering. Prerequisite(s): Graduate standing or permission of instructor. Theory and methods of waste minimization, waste product reduction or reuse; process changes and treatment of residuals to reduce volume and toxicity of industrial wastes.

CIVE 6953* Advanced Biological Waste Treatment. Prerequisite(s): Graduate standing and 5953. Advanced biological treatment processes and new process developments. Nutrient management, anaerobic wastewater treatment, hazardous waste bioremediation, land treatment, and macrophyte systems. Use of kinetic models for system design.

Communication Sciences and Disorders (CDIS)

CDIS 2033 Sign Languages. Introduction to methods of sign language currently used among the U.S. deaf society, socially and educationally, including traditional American Sign Language (ASL), Manually Coded English (MCE, SEE), and fingerspelling. Linguistic components of sign and various sociological, psychological and adaptive communication issues having an impact on the deaf community. Two hours per week devoted to lecture and theory; one hour involved in a variety of interactive sign language skill work in smaller groups.

CDIS 3123 Audiology and Audiometry. Prerequisite(s): A grade of "C" or higher in 4213. Anatomy and physiology of the hearing mechanism and related physics of sound. Common etiologies of hearing disorders. Establishing hearing screening programs. Practical experience in pure tone audiometry and impedance screening.

CDIS 3213 Introduction to Communication Disorders. The normal development of speech, language and hearing. The characteristics, diagnosis and treatment of speech, language and hearing disorders among all age groups. Suggestions for related professions involved with people with communication disorders.

CDIS 3223 Speech and Language Development. Normal acquisition of phonology, morphology, semantics, syntax, and pragmatics in children. Biological and cognitive social bases of language acquisition. Description of dialect variations, second language acquisition, and atypical language development. The relationship between spoken and written language development.

CDIS 3313 Phonetics. The analysis and description of speech at the segmental and suprasegmental levels. Development of students' perceptual and analytical skills in speech sound production. Practice using the International Phonetic Alphabet for broad and narrow transcription. Overview of the speech production mechanism and process.

CDIS 3413 Introduction to Research. Prerequisite(s): A grade of "C" or higher in CDIS 3213, 3223, 3313, and 4213 and STAT 2013 or 2053. Introduction to

research process and evidence based practice in communication disorders, including how to locate and evaluate research articles, how to find possible research topics, issues related to conduction of experiment, and how to determine treatment effectiveness.

CDIS 4010 Clinic Practicum. 1-3 credits, max 3, Lab 2-6. Prerequisite(s): 4022, 4031, 4323 or 4413, senior standing, 3.25 GPA in the major and consent of adviser. Supervised clinical practicum in speech-language pathology and audiology.

CDIS 4013 Diagnostics. Prerequisite(s): A grade of "C" or higher in 3213 and 3223. This course addresses principles and methods of assessment and diagnostics for people with communication disorders. The course includes test construction and design, reliability, validity, and other issues related to criterion and norm-referenced testing. Issues regarding diagnostic criteria and classification systems of communication disorders are also addressed.

CDIS 4023 Clinical Methods and Issues. Lab 2. Prerequisite(s): A grade of "C" or higher in 3213, 3223, and 3313. Acceptance into pre-professional program via Declaration of Intent in CDIS. Fundamental process and procedures of clinical practicum, report writing, goal selection; production, assessment and recording of speech and language behaviors; development of interpersonal skills with clients, families, and other professionals; problem solving skills; professional organization and credentialing requirements and includes two hours per week of supervised clinical practicum.

CDIS 4113 Communication Disorders in Children. Prerequisite(s): A grade of "C" or higher in 3213 and 3223. This course will address a broad range of communication disorders in children. In compliance with the standards put forth by the American Speech-Language-Hearing Association, this course will cover the nature of speech, language, and communication disorders and differences in children, including the etiologies, characteristics, psychological, developmental, linguistic, and cultural correlates.

CDIS 4133 Aural Rehabilitation. Prerequisite(s): A grade of "C" or higher in 3123 and 4213. Clinical aspects of habilitation and rehabilitation programs for the deaf and the hard-of-hearing, including speech reading, auditory training, speech conservation, speech and language therapy, hearing aid orientation, and counseling. Study of amplification units including assistive listening devices.

CDIS 4213 Anatomy and Physiology of the Speech Mechanism. Prerequisite(s): A grade of "C" or higher in BIOL 1114. Structure and function of the respiratory, phonatory, articulatory, and neural systems involved in the oral communication processes.

CDIS 4253* Diagnostic Procedures in Communication Disorders. Prerequisite(s): 3224. Speech and language diagnostic testing and procedures, interpreting diagnostic information and deriving appropriate treatment goals.

CDIS 4313* Speech Science. Prerequisite(s): Acceptance into CDIS program and a grade of "C" or better in 3313, 4213 and PHYS 1014. Scientific bases of the acoustic parameters, the perceptual and productive processes of speech, and the interrelationships of those factors during speech communication.

CDIS 4423 Neural Bases of Speech and Language. Prerequisite(s): A grade of "C" or higher in 4213. Neuroanatomy and neuro-physiological processes related to speech and language. Including basic anatomy of the central and peripheral nervous systems and the physiological processes involved in neuromotor control and neuronal function related specifically to speech and language.

CDIS 4433 Communication Disorders in Adults. Prerequisite(s): A grade of "C" or higher in 4213 and 4423. A review of language disorders and changes occurring with both normal aging and common neurological diseases and traumas, with focus on cerebral vascular accidents. Neurophysiological bases and etiology are presented as well as evaluation and treatment of aphasia and right hemisphere disorders, dementia and traumatic brain injury.

CDIS 4900 Undergraduate Research. 1-3 credits, max 3. Prerequisite(s): Consent of instructor. Research in speech, language, and hearing sciences and disorders.

CDIS 4980 Independent Study in CDIS. 1-3 credits, max 9. Prerequisite(s): Junior standing and consent of instructor. Directed readings or research in communication sciences and disorders.

CDIS 4993 Senior Honors Thesis. Prerequisite(s): Departmental invitation, senior standing, Honors Program participation. A guided reading and research program ending with an honors thesis under the direction of a faculty member. Required for graduation with departmental honors in communication sciences and disorders.

CDIS 5000* Master's Research and Thesis. 1-3 credits, max 6. Prerequisite(s): Consent of graduate faculty. Research in speech, language and hearing sciences and disorders.

CDIS 5013* Research Methods in Communication Disorders. Prerequisite(s): A grade of "C" or higher in STAT 2013 or 2053. Disorders. Research methods with emphasis on methods used most frequently in communication sciences and disorders; experience devising, evaluating, and implementing research.

CDIS 5113* Advanced Language Disorders in Children. Prerequisite(s): A grade of "C" or higher in 3223 and 4023. Principles of language assessment and intervention based on linguistic, cognitive, and social learning theories. Critical analysis of current research. Design of assessment and intervention programs.

CDIS 5143* Phonological Disorders. Prerequisite(s): A grade of "C" or higher in 3313. Current issues in linguistic theories related to the assessment and treatment of phonological disorders in children. Critical analysis of current research.

CDIS 5153* Neurological Communication Disorders. Prerequisite(s): A grade of "B" or higher in 4213 and 4423 or consent of instructor. Communication changes occurring with aging and common neurological diseases and trauma. Neurophysiological bases and etiology. Evaluation and treatment of aphasia and right hemisphere disorders.

CDIS 5163* Dysphagia. Prerequisite(s): A grade of "B" or higher in 4213 and 4423 or consent of instructor. Anatomy and neurophysiology of the swallowing mechanism in relation to pediatric and adult dysphagia. Evaluation, diagnosis and treatment of swallowing problems in children and adults including videofluoroscopic training with case studies. The first two-thirds of the course focus on adult dysphagia and the latter one third on pediatric dysphagia.

CDIS 5183* Traumatic Brain Injury and Dementia. Nature, evaluation and treatment of acquired cognitive communication disorders secondary to traumatic injury or dementia.

CDIS 5193* Motor Speech Disorders. Prerequisite(s): A grade of "B" or higher in 4213 and 4423 or consent of instructor. Nature, evaluation and treatment of neurologically-based motor speech disorders such as dysarthria and apraxia.

CDIS 5210* Advanced Practicum. 1-6 credits, max 15. Prerequisite(s): Consent of instructor. Practical experience for the advanced student on or off campus.

CDIS 5243* Language Disorders in School-Age and Adolescence. Prerequisite(s): A grade of "C" or higher in 4023 and 5113. Nature of spoken and written language disorders in school-age children and adolescents. Impact of language disorders on academic achievement. Assessment and intervention strategies.

CDIS 5333* Voice Disorders. Prerequisite(s): A grade of "B" or higher in 4313, 4213 and 4423 or consent of instructor. The physiology of the vocal mechanism and factors which cause voice deviations. Recent research on diagnostic and intervention procedures in a variety of disorders. Independent study, observations in medical settings, and special demonstrations.

CDIS 5423* Augmentative/Alternative Communication. Prerequisite(s): Major in CDIS or consent of instructor. Evaluation and management of communication disorders in individuals requiring specially adapted educational intervention programs. Adaptive communication technologies.

CDIS 5433* Cleft Palate. Prerequisite(s): A grade of "B" or higher in 4213 and 4313 or consent of instructor. Recent research in the etiology, assessment and management of communicative disorders in individuals with cleft palate.

CDIS 5710* Special Topics in Communication Disorders. 1-4 credits, max 9. Prerequisite(s): Consent of instructor. Individual and group investigations of problems in communication sciences and disorders.

CDIS 5713* Fluency Disorders. Prerequisite(s): Graduate admission or consent. Current research regarding the nature of etiologies, evaluation and treatment of dysfluent speech in both children and adults.

CDIS 5720* Seminar in Communication Disorders. 1-3 credits, max 3. Prerequisite(s): Consent of instructor. Topics relevant to the evaluation and treatment of communication disorders presented on a rotating basis.

CDIS 5730* Independent Study in Communication Sciences and Disorders. 1-3 credits, max 3. Prerequisite(s): Graduate standing and consent of instructor. Directed readings or research in communication sciences and disorders.

CDIS 5760* Portfolio. 1-2 credits, max 3. Prerequisite(s): Graduate standing. Nature and preparation of professional portfolio with faculty guidance.

Computer Science (CS)

CS 1003 Computer Proficiency. For students with minimal personal computer skills. Use of Internet and productivity software such as word processing, spreadsheets, databases, and presentation software. The ability to log on to a personal computer, access the OSU network, and access OSU websites is assumed.

CS 1013 Computer Science Principles. Computing as a creative human activity, abstraction to reduce detail and focus on concepts relevant to understanding and solving problems, describing data and information to facilitate the creation of knowledge, discuss algorithms as tools for developing and expressing solutions to computational problems, use programming is a creative process that produces computational artifacts; and discuss digital devices, systems, and the networks that interconnect them.

CS 1103 Computer Programming. Lab 2. Prerequisite(s): MATH 1513 or equivalent. Introduction to computer programming using a high-level computer language, including subprograms and arrays. Principles of problem solving, debugging, documentation, and good programming practice. Elementary methods of searching and sorting. *Not intended for computer science majors.*

CS 1113 (A) Computer Science I. Lab 2. Prerequisite(s): MATH 1513 or equivalent. Introduction to computer science using a block-structured high-level

computer language, including subprograms, arrays, recursion, records, and abstract data types. Principles of problem solving, debugging, documentation, and good programming practice. Elementary methods of sorting and searching. Use of operating system commands and utilities.

CS 2133 Computer Science II. Prerequisite(s): 1113. Recursive algorithms. Intermediate methods of searching and sorting. Mathematical analysis of space and time complexity, worst case, and average case performance.

CS 2351 UNIX Programming. Lab 2. Prerequisite(s): CS 1113 or EET 2303. The UNIX programming system. The programming environment. The UNIX file system and the shell. Use of pipes and filters.

CS 2433 C/C++ Programming. Prerequisite(s): 1113. C/C++ programming language types, operators, expressions, control flow, functions, structures, pointers, arrays, UNIX interface. Basic object oriented programming using C++ and the related language syntax and functionality.

CS 2570 Special Problems in Computer Science. 1-3 credits, max 6. Prerequisite(s): Consent of instructor and freshman or sophomore standing. Current topics and applications of computer science. Existing and new topics to computer science. Allows lower-division students to study topics not provided in existing classes. Can be individual study or a class with a new subject.

CS 3030 Industrial Practice in Computer Science. 1-6 credits, max 9. Prerequisite(s): 3443, MATH 2144, junior standing, consent of departmental adviser. Applied computing in industry. Topics vary with cooperating employers. *Written reports will be specified by adviser.*

CS 3363 Organization of Programming Languages. Prerequisite(s): 2133, 3443. Programming language constructs. Run time behavior of programs. Language definition structure. Control structures and data flow programming paradigms.

CS 3443 Computer Systems. Prerequisite(s): 2133. Functional and register level description of computer systems, computer structures, addressing techniques, macros, linkage, input-output operations. Introduction to file processing operations and auxiliary storage devices. Programming assignments are implemented in assembly language.

CS 3513 Numerical Methods for Digital Computers. Prerequisite(s): MATH 2153; MATH 3013 or concurrent enrollment; or MATH 3263 and knowledge of programming. Errors, floating point numbers and operations, interpolation and approximation, solution of nonlinear equations and linear systems, condition and stability, acceleration methods, numerical differentiation and integration.

CS 3570 Special Problems in Computer Science. 1-6 credits, max 6. Prerequisite(s): Junior standing and consent of instructor. Current topics and applications of computer science. Existing and new topics to computer science. Allows lower-division students to study topics not provided in existing classes. Can be individual study or a class with a new subject.

CS 3613 Theoretical Foundations of Computing. Prerequisite(s): 2133, 3653. Introduction to the classical theory of computer science. Sequential machines and their applications to devices, processes, and programming. Models of computation: finite-state automata, push-down automata, Turing machines. The role of non-determinism. Limits of digital computation. Computability and unsolvability. The Church-Turing Thesis.

CS 3653 Discrete Mathematics for Computer Science. Prerequisite(s): MATH 2144. Theory and applications of discrete mathematical models fundamental to analysis of problems in computer science. Set theory, formal logic and proof techniques, relations and functions, combinatorics and probability, undirected and directed graphs, Boolean algebra, switching logic.

CS 4143* Computer Graphics. Prerequisite(s): MATH 2163 and prior programming experience. Interactive graphics programming; graphics hardware; geometrical transformation; data structures for graphic representations; viewing in three dimensions; representation of 3D shapes; hidden edge and hidden surface removal algorithms; shading models.

CS 4153* Mobile Applications Development. Prerequisite(s): 2133 or 2433. The history of mobile apps and their implication on computing in general. Survey of the various platforms and approaches used for mobile apps. Examine the differences between "conventional" programs and mobile apps. Learn tools and techniques to develop mobile apps, and demonstrate proficiency through development assignments.

CS 4173* Video Game Development. Prerequisite(s): 2133 and 2433 and MATH 2144. History of video games. A survey of various game platforms. Computer graphics, audio tools and techniques, and artificial intelligence for game development. Game engines. Game development tools and techniques. An overview of the video game industry from a development perspective.

CS 4183* Video Game Design. Prerequisite(s): 2133 and 3653. Theory and pragmatics of game design including game mechanics, storytelling, and types of game play. The relationship between human/computer interaction and the user experience. A survey of game genres. An overview of the video game industry from a design perspective.

CS 4243 Algorithms and Processes in Computer Security. Prerequisite(s): 3443. Overview of the components of computer and network security. Discussion of external processes required in secure systems, information assurance, backup, business resumption. Detailed analysis of security encryption, protocols, hashing, certification, and authentication. *No credit for students with credit in CS 5243.*

CS 4273* Software Engineering. Prerequisite(s): CS 2133 and 3443 or ECEN 3213 and CS 3653. Fundamental characteristics of the software life cycle. Tools, techniques, and management controls for development and maintenance of large software systems. Software metrics and models. Human factors and experimental design. (Same course as ECEN 4273)

CS 4283* Computer Networks. Prerequisite(s): CS 2133 and 3443 or ECEN 3213; UNIX knowledge. Computer networks, distributed systems and their systematic design. Introduction to the use, structure, and architecture of computer networks. Networking experiments to describe network topology. ISO reference model. (Same course as ECEN 4283)

CS 4323* Design and Implementation of Operating Systems I. Prerequisite(s): CS 2133; and CS 3443 or ECEN 3213; and CS 3653 and 4343. Process activation and process context block. Batch, multi-programmed, and timeshared operating system. Process management, memory management, and synchronization primitives. Deadlock prevention, avoidance, and detection.

CS 4343* Data Structures and Algorithm Analysis I. Prerequisite(s): 2133, 3653. Storage, structures, data and information structures, list processing, trees and tree processing, graphs and graph processing, searching, and sorting.

CS 4433 Introduction to Database Systems. Prerequisite(s): 2133. An overview of database management systems, entity-relationship model, relational model, structural query language, relational algebra, relational database design with normalization theorems, XML; basic file organization and storage management; elementary e-commerce web application development; database systems and the Internet.

CS 4513* Numerical Mathematics: Analysis. Prerequisite(s): MATH 2233, 3013, knowledge of programming or consent of instructor. Machine computing, algorithms, and analysis of errors applied to interpolation and approximation of functions solving equations and systems of equations; discrete variable methods for integrals and differential equations. (Same course as MATH 4513)

CS 4570* Special Topics in Computing. 1-3 credits, max 5. Prerequisite(s): Senior standing and consent of instructor. Advanced topics and applications of computer science. Typical topics include operating systems, multiprocessor systems, programming systems or various mathematical and statistical packages. Designed to allow students to study topics not provided in existing courses.

CS 4793* Artificial Intelligence I. Prerequisite(s): 2133, 3653. Broad coverage of core artificial intelligence (AI) topics, including search-oriented problem solving, knowledge representation, logical inference, AI languages, history and philosophy of AI.

CS 4883 Social Issues in Computing. Prerequisite(s): Senior standing and ENGL 3323 or BCOM 3113 or BCOM 3223. The history and evolution of computing systems, providing the background for the analysis of the social impact of computers. The social implications of computer use and or misuse with emphasis on the effects on the individual, society, and other human institutions. Social responsibilities of people involved in using or applying computers.

CS 4993 Senior Honors Project. Prerequisite(s): Departmental invitation, senior standing, Honors Program participation. A guided reading and research program ending with an honors project under the direction of a faculty member, with a second faculty reader and an oral examination. Required for graduation with departmental honors in computing and information science.

CS 5000* Master's Thesis. 1-6 credits, max 6. Prerequisite(s): Consent of major professor. A student studying for a master's degree who elects to write a thesis or a report must enroll in this course.

CS 5030* Professional Practice. 1-9 credits, max 9. Prerequisite(s): Graduate standing in computer science, consent of the department head. Experience in the application of computer science principles to problems encountered in industry and government. Participation in problem solving in the role of junior computer scientist, junior software engineer, or computer science intern. All problem solutions documented. *Required written report to the major professor.*

CS 5033* Parallel Algorithms and Programming. Prerequisite(s): 4343 or consent of instructor. Models of parallel computation, design and analysis of parallel algorithms: fundamental parallel algorithms for selected sorting, arithmetic, and matrix, and graph problems, and applications in science and engineering, message-passing programming, and shared-memory programming.

CS 5070* Seminar and Special Problems. 1-6 credits, max 6. Prerequisite(s): Consent of instructor. Designed to allow students to study advanced topics not provided in existing courses.

CS 5113* Computer Organization and Architecture. Prerequisite(s): 3443. Computer architecture, computer control, microprogrammed control, addressing structures, memory hierarchies, hardware description languages, specific architectures, hardware simulation, and emulation.

CS 5123* Distributed Systems. Prerequisite(s): 3443 and 4343. Distributed system architectures, models, design principles, and performance evaluation metrics. Distributed programming paradigms and service-oriented architectures. Design and analysis of distributed algorithms. Grid computing, cloud computing, peer-to-peer computing, and data-intensive computing paradigms. Programming multicore and manycore systems.

CS 5173* Video Game Production. Prerequisite(s): 4173, 4183. The various aspects of video game production and the video game industry will be covered,

including technical production and testing, roles and responsibilities of team members, project management, and legal concerns related to video game production. Professionals from the video game industry will be invited to make presentations.

CS 5243* Algorithms and Processes in Computer Security. Prerequisite(s): 3443. Overview of the components of computer and network security. Discussion of external processes required in secure systems, information assurance, backup, business resumption. Detailed analysis of security encryption, protocols, hashing, certification, and authentication. *No credit for students with credit in 4243.*

CS 5253* Digital Computer Design. Prerequisite(s): ECEN 3223. Analysis and design of digital computers. Arithmetic algorithms and the design of the arithmetic/logic unit (ALU). Serial and parallel data processing; control and timing systems; microprogramming; memory organization alternatives; input/output interfaces. (Same course as ECEN 5253)

CS 5263* Quantum Computing. Prerequisite(s): Graduate standing. The main theory of quantum information science and its applications to communications, computing and cryptography. Topics include introduction to quantum mechanics, quantum gates, circuits, entropy, cryptographic schemes, and implementations. Current technology in support of quantum processing will be reviewed.

CS 5273* Advanced Software Engineering. Prerequisite(s): 4273. Continuation of 4273. Formal methods for software design and development. Static analysis. Emerging design and development approaches. Model checking and model-based software reuse. Component-based software engineering and software repositories. (Same course as ECEN 5273)

CS 5283* Computer Network Programming. Prerequisite(s): 4283. Detailed technical concepts related to Internet and multimedia, high speed LANS, high speed transport protocols, MPLS, multicasting, Int. serv/Diff serv, Router Buffer management, self-similar traffic, and socket programming.

CS 5313* Formal Language Theory. Prerequisite(s): 3613. Formal language theory applied to procedure oriented languages. Application of finite state algorithms to lexical analysis. Chomsky hierarchy of languages. Generation, recognition, and closure properties of languages.

CS 5323* Design and Implementation of Operating Systems II. Prerequisite(s): 4323. Task systems and concurrent programming, synchronization, and inter process communication. Theoretical investigation of resource sharing and deadlock, memory management, strategies, and scheduling algorithms, queuing theory, distributed operating systems. System accounting, user services and utilities.

CS 5363* Advanced Organizations of Programming Languages. Prerequisite(s): 3363. Continuation of 3363, mathematical theory of computer language organization functional programming. Parallelism in languages. Mathematics of control structures and data structures. Applicative languages. Symbolic languages.

CS 5373* Advanced Object-Oriented Programming for Windowing Environments. Prerequisite(s): For CS students, 2133, 2433. For TCOM students, CS 4343 and a working knowledge of C++. Applying the object-oriented computing model to the design and development of software for windowing environments. Effective use of Graphical User Interfaces (GUIs), the Internet, data interchange principles and related topics. *No credit for students with credit in 3373.* (Same course as 3373)

CS 5413* Data Structures and Algorithm Analysis II. Prerequisite(s): 4154 or 4343. Data structures and their application in recursive and iterative algorithms. Static and dynamic data structure representations and processing algorithms. Dynamic and virtual storage management.

CS 5423* Principles of Database Systems. Prerequisite(s): 4343, 4433 or equivalent. An overview of database management systems, entity-relationship model, relational model, structural query language, relational algebra, relational database design with normalization theorems, database integrity constraints, and principles of database systems with the Internet.

CS 5433* Distributed Database Systems. Prerequisite(s): 5423, 4283 or 5283. Overview of relational database management systems (DBMS), distributed DBMS architecture, distributed database design, overview of query processing, introduction to transaction management, distributed concurrency control, and SQL server.

CS 5513* Numerical Computation. Prerequisite(s): MATH 2233 and MATH 3013 or MATH 3263 or equivalent courses; CS 3513 or MATH 4513 or an equivalent course; a knowledge of computer programming. Errors in machine computation; condition of problems and stability of algorithms; interpolation and approximation; nonlinear equations; linear and nonlinear systems; differentiation and integration; applications to modeling, simulation, and/or optimization.

CS 5653* Automata and Finite State Machines. Prerequisite(s): 5313. Sequential machines and automata. Hierarchy of recognizers. Decision problems and closure properties. Finite and infinite state machines. Cellular and stochastic automata. Coverings of automata.

CS 5663* Computability and Decidability. Prerequisite(s): 5313. Primitive and partial recursive functions. Equivalence of models of computation. The Halting problem and undecidability. Reducing one problem to another or representation change. Tractability and the P-NP problem. Complexity hierarchies.

CS 5793* Artificial Intelligence II. Prerequisite(s): 4793. Advance knowledge representation and expert system building, including reasoning under uncertainty. Applications to planning, intelligent agents, natural language processing, robotics, and machine learning.

CS 5813* Principles of Wireless Networks. Prerequisite(s): 4283 or ECEN 4283. Wireless network operation, planning, mobility management, cellular and mobile data networks based on CDMA, TDMA, GSM, IEEE 802-11 WLANS, Adhoc networks, Bluetooth, power management, wireless geolocation and indoor positioning techniques. (Same course as ECEN 5563)

CS 5823* Network Algorithmics. Prerequisite(s): 4283 and 4323. Discusses principles of efficient network implementation-router architecture, end node architecture, data copying, timer maintenance, demultiplexing, forwarding table, lookups, switching, scheduling, IP traceback.

CS 6000* Doctoral Dissertation. 2-15 credits, max 40. Prerequisite(s): Graduate standing and approval of advisory committee. Independent research under the direction of a member of the graduate faculty. *For students working toward a PhD degree.*

CS 6210* Advanced Topics in Parallel and Distributed Systems. 2-6 credits, max 12. Prerequisite(s): 5113. The state-of-the-art of parallel and distributed systems. Design, implementation, and analysis of parallel and distributed system architectures, protocols, and algorithms. Resource management, scheduling, and coordination. Internet-scale systems, middleware and services, virtualization, and distributed operating systems. Parallel and distributed programming paradigms: message-passing, shared memory, data-intensive, high performance, high throughput.

CS 6240* Advanced Topics in Computer Organization. 2-6 credits, max 12. Prerequisite(s): 5113 and 5253. Structure and organization of advanced computer systems, parallel and pipeline computers, methods of computation, alignment networks, conflict-free memories, and bounds on computation time.

CS 6253* Advanced Topics in Computer Architecture. Prerequisite(s): 5253 or ECEN 5253. Innovations in the architecture and organization of computers, with an emphasis on parallelism. Topics may include pipelining, multiprocessors, data flow, and reduction machines. (Same course as ECEN 6253)

CS 6300* Advanced Topics in Programming Languages. 2-6 credits, max 12. Prerequisite(s): 5313. Interpreter models of programming language semantics, Vienna definition language, lambda calculus, LISP definition; Knuth semantic systems and their formulation, translational and denotational semantics. *May be repeated with change of topics.*

CS 6350* Advanced Topics in Operating Systems. 2-6 credits, max 12. Prerequisite(s): 5323. Design and analysis of operating systems. Concurrent processes, server scheduling, models of auxiliary storage, memory management, virtual systems, and performance algorithms. *May be repeated with a change in topics.*

CS 6400* Advanced Topics in Information Systems. 2-6 credits, max 12. Prerequisite(s): 5413, 5423. Principles of distributed database systems. Overview of relational database management systems (DBMS) and computer networks, distributed DBMS architecture, distributed database design, distributed concurrency control, query processing and distributed DBMS reliability.

CS 6500* Advanced Topics in Numerical Analysis. 2-6 credits, max 12. Prerequisite(s): MATH 5513 or 4513 or MATH 4513 and consent of instructor. Systems of nonlinear equations, nonlinear least squares problems, iterative methods for large systems of linear equations, finite element methods, solution of partial differential equations. *May be repeated with change of topics.*

CS 6600* Advanced Topics in Analysis of Algorithms. 2-6 credits, max 12. Prerequisite(s): 5413. Analysis of various algorithms. Sorting, searching, computational complexity, lower bounds for algorithms; NP-hard and NP-complete problems; parallel algorithms; proof of correctness of algorithms. *May be repeated with change of topics.*

CS 6620* Advanced Topics in Applied Algorithms. 3 credits, max 12. Prerequisite(s): 4343 or consent of instructor. Recent advances in the design and analysis of data structures and algorithms for real-world applications in diverse problem domains. Problem domain designated for the course will differ in each offering and with instructor's interests. Core topics include mathematical modeling of complex applied problems, and studies of relevant fundamental algorithmic techniques and their experimental analysis on real datasets.

CS 6623* Algebraic Structures of Formal Grammars. Prerequisite(s): 5313, 5653. Context-free languages, Kleene languages, Dyck languages, context-sensitive languages; use of algebraic systems to define languages; linear bounded automata.

CS 6700* Advanced Topics in Artificial Intelligence. 2-6 credits, max 12. Prerequisite(s): 5793 or consent of instructor. Machine learning; computer perception and robotics; logic programming; natural language understanding; intelligent agents; medical informatics. *May be repeated with change of topics.*

CS 6800* Advanced Topics in Computing Networks. 2-12 credits, max 12. Prerequisite(s): 5283; Graduate standing in Computer Science; consent of instructor. Large scale embedded networks, deep-space networking, ubiquitous computing, optical networking, Next Generation Internet. *May be repeated with change of topics.*

Construction Management Technology (CMT)

CMT 1214 Introduction to Construction. Lab 2. Overview of the construction industry with emphasis on construction materials, methods, and systems.

CMT 2203 Construction Drawings (for non-majors). (Online course for non-CMT majors) Principles of graphic communication are applied to reading and drawing construction plans, with emphasis to fire protection systems. Does not meet CMT degree requirements.

CMT 2253 Construction Drawings. Principles of graphic communication are applied to reading and drawing construction plans. Techniques for measuring items of construction work from plans and specifications are also covered.

CMT 2263 Estimating I. Prerequisite(s): Grade of "C" or better in 1214 and 2253. Quantity take-off with emphasis on excavation, formwork and concrete, masonry, rough carpentry and miscellaneous specialty items.

CMT 2343 Concrete Technology. Lab 2. Prerequisite(s): Grade of "C" or better in 1214 and 2253 or permission of instructor. Fundamentals of concrete and concrete making materials including admixtures. Proportioning concrete mixtures. Batching, mixing, conveying, placing, finishing, and curing concrete. Hot and cold weather concreting, jointing, volume change and crack control.

CMT 3273 Scheduling Construction Projects. Prerequisite(s): Acceptance to the CMT upper-division or permission of department; grade of "C" or better in 2263. Scheduling basics, including bar charts and critical-path methods; manual and computer techniques using current software; emphasis on using schedules for construction project management.

CMT 3331 Construction Practicum I. Prerequisite(s): Grade of "C" or better in 1214 or 2253. Supervised field experience in construction; 400 hours minimum documented time required.

CMT 3323 Strength of Materials for Construction Managers. Prerequisite(s): Acceptance to the CMT upper division or permission of department; MATH 2123 and grade of "C" or higher in GENT 2323. Stress and strain and their relationship to loads in buildings. Axial and bending loads on beams and columns. Applications in building and construction emphasized.

CMT 3332 Construction Practicum II. Prerequisite(s): Grade of "C" or better in 2263, 3331 and CIVE 3614 or permission of department. Supervised temporary, full-time employment in construction, emphasizing field and office engineering and a variety of project management functions; *400 hours minimum documented time required.*

CMT 3364 Structures I. Lab 2. Prerequisite(s): Grade of "C" or better in 2343 and GENT 3323 and acceptance to the CMT Upper Division. Methods of structural analysis applicable to construction; design of timber structures and forms for concrete structures.

CMT 3433 Principles of Site Development. Lab 2. Prerequisite(s): Grade of "C" or better in CIVE 3614 and GENT 3323 and acceptance to the CMT Upper Division. Site layout, vertical and horizontal control, surveying instrument adjustments, site investigations, excavations, site drainage and geotechnical considerations.

CMT 3463 Environmental Building Systems. Lab 2. Prerequisite(s): Grade of "C" or better in PHYS 1214 and acceptance to the CMT Upper Division. Plumbing, heating, air-conditioning, electrical and lighting systems as applied to residences and commercial buildings.

CMT 3554 Structures II. Lab 2. Prerequisite(s): Grade of "C" or better in 3364 and acceptance to the CMT Upper Division. Analysis and design of elements in steel and reinforced concrete structures; review of shop drawings for both types of construction.

CMT 3633 CAD and BIM for Construction Managers. Prerequisite(s): grade of "C" or higher in 1214 and 2253. Interpretation and production of construction drawings using computer aided drafting. Theory and use of Building Information Modeling software builds upon computer aided drafting skills.

CMT 4050 Advanced Construction Management Problems. 1-6 credits, max 6. Prerequisite(s): Junior standing and consent of instructor. Special problems in construction management.

CMT 4263 Estimating II. Prerequisite(s): Acceptance to the CMT upper division or permission of department; grade of "C" or better in 2263. Extensive use of actual contract documents for quantity take-off, pricing and assembling the bid for several projects. Use of computers in estimating.

CMT 4273 Computer Estimating. Lab 6. Prerequisite(s): Grade of "C" or better in 4263 and acceptance to the CMT Upper Division. Various software programs applied to estimating for building construction. Automated take off (Digitizer) systems.

CMT 4283 Business Practices for Construction. Prerequisite(s): Acceptance to the CMT Upper Division; grade of "C" or better in ACCT 2103, CMT 3273 and 4563; or permission of department. Principles of management applied to construction contracting; organizing office and field staff; bonding, liens, financial management practices; introduction to the construction manager concept; schedule of values; construction billings.

CMT 4293 Construction Manager Concepts. Prerequisite(s): Grade of "C" or better in 3332, 4283 and 3364 and acceptance to the CMT Upper Division or permission of department. Capstone course utilizing skills and knowledge of estimating, scheduling, bidding, construction management, CAD, TQM, partnering and safety; includes topics in leadership, motivation and the use of current project management software.

CMT 4333 Equipment Management for Constructors. Prerequisite(s): Grade of "C" or higher in 2263 and ACCT 2103 and acceptance to the CMT Upper Division or permission of department. Selection and use of equipment, estimating equipment costs, estimating equipment production rates for all types of equipment used in building construction and heavy/highway construction.

CMT 4443 Construction Safety and Loss Control. Prerequisite(s): Must be accepted to the CMT Upper Division or obtain department permission. A detailed study of OSHA Part 1926 - Construction Safety and Health Compliance and related safety topics; all elements of the OSHA 30-hour training course; students completing the course are OSHA Certified Competent Persons; concepts and methods of loss control.

CMT 4533 Heavy and Highway Estimating. Prerequisite(s): Grade of "C" or better in 4263 and 4333 and acceptance to the CMT Upper Division or permission of department. CMT 4333 may be taken concurrently. Theory and application of contractor estimating and bidding procedures used in heavy and highway construction projects.

CMT 4563 Construction Law and Insurance. Prerequisite(s): Acceptance to the CMT Upper Division or permission of department. Legal and insurance problems as they pertain to the construction industry.

Counseling Psychology (CPSY)

CPSY 1112 World of Work. Assists students in exploring career options through increased understanding of self and expanded knowledge of occupational information. Includes a study of the decision-making process and a look at the present and future changing world of work.

CPSY 3003 Introduction to Counseling and Related Professions. Professions related to counseling such as career counseling, school counseling, and substance abuse counseling are examined. Counseling theories and basic counseling skills are presented to prepare students for a possible graduate degree in counseling or counseling psychology.

CPSY 4443 (D) Cultural Diversity in Professional Life. Knowledge, awareness and skills regarding cultural diversity in one's professional life.

CPSY 5000* Master's Thesis. 1-6 credits, max 6. Prerequisite(s): Consent of advisory committee chairperson. Report of research conducted by a student in the master's program in counseling. Credit given and grade assigned upon completion and acceptance of the thesis.

CPSY 5173* Gerontological Counseling. An examination of mental health treatment modalities and approaches to counseling with older adults. An experiential component is included.

CPSY 5320* Seminar in Counseling Psychology. 3-9 credits, max 9. Prerequisite(s): Graduate standing. In-depth exploration of contemporary topics in counseling psychology.

CPSY 5413* Critical Issues in School Counseling. Counseling and guidance activities to enhance school climate and promote development of student academic, career, and personal/social competencies. Knowledge of the school counselor's role in advocating for students with special needs.

CPSY 5453* Vocational and Career Information. Local, state and national sources of occupational information about jobs and sociological factors related to career planning and worker effectiveness.

CPSY 5473* Introduction to Counseling Practice. Prerequisite(s): Graduate standing. Orientation to counseling practice through observation and participation. The supervised experiences permit the student and the counselor education staff to evaluate the student's strengths and weaknesses as a potential counselor or student personnel administrator.

CPSY 5483* Community Counseling and Resource Development. Prerequisite(s): Graduate standing. Application of educational, preventive, and crisis interventions in a variety of human service settings, including the development and evaluation of community helping resources.

CPSY 5493* Professional and Ethical Issues in Counseling. Prerequisite(s): Admission to community counseling, elementary or secondary school counseling graduate program or consent of instructor. Principles and issues of professionalism and ethics. Seminar format with special emphasis on student's thorough preparation for, and active participation in, class discussions.

CPSY 5503* Multicultural Counseling. Emphasis on effective communication skills in cross-cultural counseling or helping relationships and the integration of theoretical knowledge with experimental learning. Psycho-social factors, life styles, etc. of various cultural and ethnic groups and their influence on the helping relationship.

CPSY 5513* Comprehensive School Counseling Programs. Foundations of school counseling focusing on the knowledge and skills required to develop, implement, coordinate, and manage a comprehensive, developmental school counseling program.

CPSY 5523* Individual Appraisal. Methods of developing a framework for understanding individuals and techniques for data collection, assessment, and interpretation such as interviews, testing, and case study. The study of individual

differences including ethnic, cultural and gender factors.

CPSY 5533* Developmental Interventions. Lab 2. Counseling theories and techniques for working with children, adolescents, and their parents in individual and group counseling and consulting. Laboratory portion translates theory to practice.

CPSY 5543* Career Development Theories. Historical and contemporary viewpoints advanced by Ginsberg, Super, Holland, Roe, etc. Counselors are assisted in developing the theoretical and applied basis for developing school-based career education programs and for assisting individuals in career planning.

CPSY 5553* Principles of Counseling. A comprehensive foundation for counseling practice and the application of contemporary theories to further knowledge of counseling as a communication process.

CPSY 5563* Conceptualization and Diagnosis in Counseling. Prerequisite(s): 5473 and 5553 or consent of instructor. Foundation in skills necessary to conceptualize and diagnose clients presentation of problems in counseling. Intake interviewing and report writing skills, case conceptualization skills, and differential diagnostic skills using the DSM system.

CPSY 5583* Group Process. Group dynamics, theory and techniques applicable to working with people of all ages in various school and non-school settings. Group member competencies are stressed during the laboratory period.

CPSY 5593* Counseling Practicum. Prerequisite(s): Grade of "B" or better in 5473 and 5553; admission to program or instructor consent. Supervised experience in human interaction processes of counseling and consulting with the major goal of facilitating positive growth processes through individual supervision. May be conducted in a variety of settings with a wide range of developmental levels.

CPSY 5663* Counseling and Sexuality. Prerequisite(s): Permission of instructor. Current trends in counseling clients with sexual problems, as well as clients with varying sexual orientations and identities.

CPSY 5673* Substance Abuse Counseling. Prerequisite(s): Permission of instructor. Current therapeutic trends, strategies, and modalities used in the treatment of addictions, as well as relapse prevention strategies and treatment of special populations.

CPSY 5683* Internship in Counseling I. Prerequisite(s): Grade of "B" or better in 5593 and admission to counseling program. Supervised experience working and studying in a counseling agency or setting.

CPSY 5693* Internship in Counseling II. Prerequisite(s): Grade of "B" or better in 5683 and admission to counseling program. Supervised experience working and studying in a counseling agency or setting.

CPSY 5720* Workshop. 1-9 credits, max 9. Professional workshops on various topics. Designed to meet unique or special needs of professionals in various mental health fields.

CPSY 6000* Doctoral Dissertation. 1-25 credits, max 25. Prerequisite(s): Consent of advisory committee chairperson. Report of research conducted by a student in the doctoral program in counseling psychology. Credit given and grade assigned upon completion and acceptance of the doctoral dissertation.

CPSY 6053* Ethical and Legal Issues in Professional Psychology. Prerequisite(s): Consent of instructor. Ethical and legal standards applied to the professional practice of psychology.

CPSY 6083* Principles of Counseling Psychology. Prerequisite(s): Admission to the doctoral program in counseling psychology. Development, theoretical foundations and applications of therapeutic models of counseling and psychology.

CPSY 6123* Adult Personality Assessment. Prerequisite(s): Admission to counseling, school, or clinical psychology program. Administration and interpretation of adult personality assessment instruments such as Rorschach, TAT and DAP.

CPSY 6153* Personality Theories. Prerequisite(s): Graduate standing. An in-depth analysis of personality theories and personality disorders.

CPSY 6223* Beck's Cognitive Therapy. Prerequisite(s): Graduate standing in counseling, counseling psychology, school psychology, or clinical psychology; or consent of instructor. The theory and practice of Aaron T. Beck's cognitive therapy approach. Cognitive restructuring, problem-solving, imagery work, and cognitive case conceptualization skills to help clients with a variety of presenting problems.

CPSY 6310* Advanced Practicum and Supervision. 3-12 credits, max 12. Prerequisite(s): Admission to counseling psychology program. For prospective counseling psychologists, counselor educators and supervisors, and practicing counselors. Supervised assistance in development of counseling, consulting, and supervising competencies.

CPSY 6313* Advanced Group Interventions. Lab 1. Prerequisite(s): Admission to counseling psychology program or consent of instructor. Discussion and exploration of various aspects of group development and treatment. Theory and application of theory. Various factors associated with group psychotherapy cohesion, dynamics and screening.

CPSY 6323* Psychological Consultation. Prerequisite(s): Admission to graduate program in the SAHEP or psychology program. Models and strategies for the delivery of special services in the schools and other agencies that focus on serving the mental health needs of children, adolescents and adults. The use of consultation as a problem-solving alternative to the assessment/label approach. Students can receive credit in only one of the courses. (Same course as EPSY 6323*)

CPSY 6413* Counseling Psychology Practicum I. Prerequisite(s): Admission to the doctoral program in counseling psychology. For prospective counseling psychologists. Individual and group supervision and didactic experiences to facilitate the development of counseling psychology competencies with clients at practicum sites. Establishing therapeutic conditions conducive to growth and change.

CPSY 6423* Counseling Psychology Practicum II. Prerequisite(s): Grade of "B" or better in 6413. For prospective counseling psychologists. Individual and group supervision and didactic experiences to facilitate the development of counseling psychology competencies with clients at practicum sites. Integrating theory and research into the practice of counseling psychology.

CPSY 6433* Counseling Psychology Practicum III. Prerequisite(s): Grade of "B" or better in 6423. For prospective counseling psychologists. Individual and group supervision and didactic experiences to facilitate the development of counseling psychology competencies with clients at practicum sites. Integrating theory and psychological assessment skills into the practice of counseling psychology.

CPSY 6443* Counseling Psychology Practicum IV. Prerequisite(s): Grade of "B" or better in 6433. For prospective counseling psychologists. Individual and group supervision and didactic experiences to facilitate the development of counseling psychology competencies with clients at practicum sites. Building integrating consultation skills into the practice of counseling psychology.

CPSY 6543* Clinical Supervision. Prerequisite(s): Admission to clinical, counseling or school psychology doctoral program, or consent of instructor. Building the doctoral psychology student's knowledge base in theory and research of clinical supervision in psychology, and development and refinement of the student's supervision skills. Current theory and research in supervision, including a practical component.

CPSY 6553* Advanced Practice in Marital and Family Treatment. Prerequisite(s): Admission to counseling, school or clinical psychology program. Advanced methods in assessment, diagnosis, and treatment of marital and family problems. Skill development, professionalism, ethics and case management. Dynamics of co-therapy and conjoint treatment. Case consultation format.

CPSY 6560* Advanced Internship in Counseling. 1-3 credits, max 6. Prerequisite(s): Admission to the doctoral program in psychology. Designed to facilitate counseling effectiveness and to set the stage for a productive life of professional practice.

CPSY 6850* Directed Reading. 1-6 credits, max 6. Prerequisite(s): Consent of instructor. Directed reading for students with advanced graduate standing.

Curriculum and Instruction Education (CIED)

CIED 1230 Reading and Study Skills for College Students. 1-4 credits, max 4, Lab 1-4. Instruction and laboratory experience for the improvement of reading rate, vocabulary, comprehension, and study skills. *Graded on pass-fail basis.*

CIED 2450 Early Lab and Clinical Experience in Elementary Education I. 1-2 credits, max 2, Lab 3-6. Prerequisite(s): Declaration of intention to pursue a program in Professional Education. The initial pre-professional clinical experience in schools, kindergarten through grade eight. Required for full admission to Professional Education. *Graded on a pass-fail basis.*

CIED 3005 Foundations of Literacy. Lab 0-2. Prerequisite(s): ENGL 1113, 1213, 2413. Survey of evaluation, selection and utilization of literature of childhood; introduces cognitive and linguistics foundations of literacy; language conventions needed to compose and comprehend oral and written texts. Work in school setting.

CIED 3133 Children's Literature Across the Curriculum. Critical, analytical and instructional skills for teaching with culturally diverse literature for elementary and middle school learners. Integration of literature across the curriculum to develop critical thinking, social literacy, and inquiry skills.

CIED 3153 Teaching Mathematics at the Primary Level. Lab 2. Prerequisite(s): Grade of "C" or better in MATH 3403 or 3603; six hours of math; consent of instructor. Developmental levels in selection and organization of content and procedures for primary mathematics education.

CIED 3253 Teaching Language Arts in the Elementary and Middle School. Prerequisite(s): ENGL 1113 and 1213 and 2413. Learning theory, content, and methods related to teaching spoken, written, and visual forms of communication. Focus is on listening, speaking, writing and on teaching knowledge, skills and strategies inherent in those processes. Stresses integration of central literacy components (reading, writing, speaking, listening to, and viewing a wide range of texts in a variety of forms) and across the curriculum, teaching diverse learners and perspectives, inquiry, and critical literacy.

CIED 3293 Teaching Reading in the Elementary and Middle School. Prerequisite(s): ENGL 1113 and 1213 and 2413. Learning theory, content and methods specifically related to teaching children to read a wide range of texts for a wide range of purposes. Understandings of central reading components such as print awareness, phonological/phonemic awareness, phonics, fluency, vocabulary, comprehension, and critical literacy. Best practices for teaching reading effectively for diverse learners with varied needs and interests. Includes program phonics exam.

CIED 3313 Field Experience in the Secondary Schools. Lab 2. Prerequisite(s): Consent of instructor, 2.50 GPA, and passing scores on the Oklahoma General Education Test. Seminars, directed observation and participation in a particular subject area of the secondary/K-12 school. Experience in meeting the mental, social, physical, and cultural needs among children.

CIED 3430 Early Lab and Clinical Experience in Elementary Education II. 1-2 credits, max 3, Lab 3-6. Prerequisite(s): Full admission to Professional Education. Directed observation and participation in classrooms, kindergarten through grade eight. Concurrent seminar exploring multicultural education and integrated programs. *Graded on a pass-fail basis.*

CIED 3622 Middle Level Education. Lab 0-2. Overview of the nature and needs of early adolescents as well as an examination of the curriculum, instruction, and organization of middle grade schools. Also includes a field-based experience in a middle school.

CIED 4000 Field Studies in Education. 1-4 credits, max 4. Independent study and/or field experiences, such as spending a semester in an experimental program working with handicapped children in schools, in-depth studies in research projects, internships with school personnel. *Graded on a pass-fail basis.*

CIED 4003* Teaching Fundamental Concepts of Mathematics. Prerequisite(s): Full admission to Professional Education. Teaching of the basic skill areas. Study and comparison of contemporary basic mathematics textbooks. *Recommended to be taken concurrently with public school practicum experiences.*

CIED 4005 Literacy Assessment and Instruction. Lab 0-2. Prerequisite(s): 3005 or HDFS 3213. Provides a comprehensive survey of teaching strategies, formal and informal assessment, curriculum materials, theory, and research pertaining to reading, writing, spelling and oral language development at the primary and elementary school levels. *Practical experiences required.*

CIED 4012 Integration of Literacy Across the Curriculum. Prerequisite(s): 4005; full admission to Professional Education. Integration of reading, writing, and oral language; integration of literacy instruction into the content areas in elementary school curriculum.

CIED 4041 Interdisciplinary Curriculum Design and Development. Lab 2. Prerequisite(s): Full admission to Professional Education and concurrent enrollment in 3430, 4012, 4153, 4323,4353, and 4362. Planning and development of interdisciplinary teaching units for the elementary school classroom. Pedagogical approaches and materials for teaching integrated themes, as well as research on effective integrated teaching practices.

CIED 4053* Teaching Geometry in the Secondary School. Prerequisite(s): Full admission to Professional Education. Overview of the present secondary geometry curricula and future trends. Axiomatic development of Euclidean geometry, proofs and transformational geometry from the perspective of the secondary mathematics teachers. Study and comparison of contemporary basic mathematics textbooks. *Recommended to be taken concurrently with 3710 and MATH 4043.*

CIED 4073* Elementary School Curriculum Design and Development. Prerequisite(s): Full admission to Professional Education. Students will understand and learn to apply the foundations of elementary curriculum, the processes of designing curriculum for elementary classrooms, the analysis of instructional practices, and the data driven decision making to improve student learning.

CIED 4093 Teaching Grammar in the Secondary Schools. Prerequisite(s): ENGL 4013 (or concurrent enrollment) or instructor permission is required. Inductive teaching of grammar and usage for writing and oral communication. Lessons include learning to teach literary devices, poetic nomenclature, etymology of idiomatic expressions, and such linguistic elements as homonyms, synonyms, and antonyms.

CIED 4153 Teaching Mathematics at the Intermediate Level. Lab 1. Prerequisite(s): 3153 and MATH 3403 and 3603 and full admission to Professional Education. Selection and organization of content, procedures for instruction, and evaluation of outcomes in teaching the mathematics of the intermediate grades. Some attention to instruction in upper grades of the elementary school.

CIED 4193 Teaching Writing in the Secondary Schools. Prerequisite(s): ENGL 1113, 1213, 3203 with "B" or better or instructor permission is required. Teaching writing inductively in order to build their future students' reasoning skills ultimately leading to cogent, cohesive, audience appropriate writing.

CIED 4213 Introduction to the Visual Arts in the Curriculum. Lab 4. Provides an understanding of the theoretical basis for the use of art activities in developing sensory perception and aesthetic sensitivity as an integral part of the curriculum. Includes a wide range of opportunities for student involvement in experimentation and exploration with a variety of two- and three-dimensional art media. Emphasis on both creative expression and appreciation of the visual arts in the home, school and community as a vital aspect of instruction in the school, preschool level through grade eight.

CIED 4233 Literacy Assessment and Instruction. Prerequisite(s): 3253. Selection, administration, and interpretation of a variety of formal and informal literacy assessments. Use of assessment results to plan, evaluate, and revise effective instruction for diverse learners within an assessment/evaluation/instruction cycle. Tutoring practicum required.

CIED 4263* Teaching and Learning Foreign Languages in the Elementary Schools (Grades 1-8). Purpose, selection and organization of foreign language curriculum content, teaching and learning theories, and procedure and evaluation of outcome for diverse students. Teaching techniques and materials for grades 1-8.

CIED 4313* Young Adult Literature. Prerequisite(s): Senior or Graduate level standing. Survey of print and non-print materials, including multicultural and multi-ethnic materials for young adults from middle school through high school. History, criticism, selection, and evaluation of young adult literature and exploration of its relation to the needs and interests of young people.

CIED 4323* Social Studies in the Elementary School Curriculum. Prerequisite(s): Full admission to Professional Education. Purposes, selection and organization of content, teaching and learning procedures, and evaluation of outcomes in elementary social studies.

CIED 4353 Science in the Elementary School Curriculum. Lab 2. Prerequisite(s): Completion of 12 hours with a grade of "C" or better in required science courses and be fully admitted to Professional Education. The purposes, selection and organization of content, teaching and learning procedures and evaluation of outcomes in elementary school science.

CIED 4362 Design and Management of the Elementary School Classroom. Prerequisite(s): Full admission to Professional Education. Introduction to the design and management of the physical, social, intellectual aspects of the elementary classroom. Overview of the purposes, selection and organization of classroom management systems and teaching approaches.

CIED 4450 Internship in Elementary Education. 1-12 credits, max 12, Lab 3-36. Prerequisite(s): Concurrent enrollment in 4453 or 4730 and 4720 and full admission to Professional Education. Advanced clinical experience as associate (student) teacher in schools, kindergarten through grade eight. *Graded on a pass-fail basis.*

CIED 4453 Senior Seminar in Elementary Education. Prerequisite(s): Concurrent enrollment in 4450 and full admission to Professional Education. Legal and ethical issues, forms of assessment, including standardized testing, working with colleagues and other professionals, integration of performing arts including music and drama, and completion of a professional portfolio. *Taken concurrently with student teaching in the final semester of the elementary education program.*

CIED 4463 Senior Seminar: Learning and Teaching in Diverse School Cultures. Prerequisite(s): Senior classification; full admission to Professional Education and concurrent enrollment in 4450. Designing elementary classroom environments and curriculum that meet the needs of diverse populations.

CIED 4473 Reading for the Secondary Teacher. Prerequisite(s): Full admission to Professional Education and consent of instructor. Materials and procedures in the teaching of reading in secondary schools for content area teachers.

CIED 4560* Environmental Education. 1-4 credits, max 4, Lab 1. Development of (teacher/leader) competencies in the content, methods, philosophy, and historical perspective of contemporary environmental education curricula using both indoor and outdoor settings as a multidisciplinary learning laboratory. (Same course as 5730)

CIED 4613* Teaching the Nature of Science Through an Inquiry Approach. Prerequisite(s): Full admission to professional education. This course is designed to assist pre-service science teachers in developing skills to teach science through an inquiry approach. Guided readings, discussions, group activities, and classroom field experiences, will focus on strengthening views on the nature of science.

CIED 4713* Teaching and Learning in the Secondary School. Prerequisite(s): Full admission to Professional Education and consent of instructor. Purposes, selection and organization of curriculum content, teaching and learning theories and procedures, and evaluation of outcomes for diverse students. Teaching techniques and materials for art, English, foreign languages, science, and the social studies. This course MUST be taken the semester prior to student teaching/internship.

CIED 4720 Internship in the Secondary Schools. 1-12 credits, max 12, Lab 3-36. Prerequisite(s): Concurrent enrollment in 4730 or 4724 or 4734 and full admission to Professional Education. Supervised observation and student teaching in fields in which the student intends to qualify for teaching certification. Development of awareness of and experience with mental, social, physical and cultural differences among adolescents. *Graded on a pass-fail basis.*

CIED 4724 Planning and Management in the Multicultural Secondary Classroom. Prerequisite(s): 4713; full admission to Professional Education or 4003 and 4053. Taken concurrently with the student teaching internship. Includes student teaching seminar (one hour). Based on curriculum and teaching theory in 4713, planning and organizing for the secondary classroom in a diverse society, grades 7-12. Classroom management and discipline approaches as well as teacher research, parental involvement, school climate and community relations. Available in discipline-specialized sections: English/language arts, mathematics, science and social studies.

CIED 4730 Planning and Management in the Multicultural Art Classroom K-12. 1-4 credits, max 4. Prerequisite(s): 4713 and full admission to Professional Education. Taken concurrently with the student teaching internship. Student teaching seminar (one hour) included. Based on curriculum and teaching theory, planning and organizing for the art classroom in a diverse society, grades K-12. Classroom management and discipline approaches as well as teacher research, parental involvement, school climate and community relations. *Required for art education students.*

CIED 4734 Planning and Management in the Multicultural Foreign Language Classroom K-12. Prerequisite(s): 4713 and full admission to Professional Education. Taken concurrently with the student teaching internship. Student teaching seminar (one hour) included. Based on curriculum and teaching theory, planning and organizing for the foreign language classroom in a diverse society, grades K-12. Classroom management and discipline approaches as well as teacher research, parental involvement, school climate and community relations. *Required for foreign language education students.*

CIED 5000* Master's Report or Thesis. 1-6 credits, max 6. Prerequisite(s): Consent of adviser. Students studying for a master's degree enroll in this course for a total of 2 credit hours if they write a report or 6 hours if they write a thesis.

CIED 5013* Mathematics Education: Theory and Practice (Grades 1-8). Curriculum, materials, methods, and procedures related to the theory and practices of teaching mathematics in grades 1-8.

CIED 5033* Teaching Foreign Languages in the Schools K-12. Curriculum, materials, methods and procedures related to foreign languages (grades K-12).

CIED 5043* Issues in Teaching. Current issues and trends in teaching theory, practice and research with emphasis on teacher reflection.

CIED 5050* Seminar in Integrated Mathematics and Science Applications. 1-6 credits, max 6. Seminar topics may differ depending upon the nature of current interests and topics in mathematics and science education.

CIED 5053* Curriculum Issues. A study of curriculum that includes philosophy, history, decision-making, major concepts and terms.

CIED 5073* Pedagogical Research. Theory and application of pedagogical inquiry with emphasis on teacher as researcher, pedagogical question posing, and techniques of pedagogical inquiry, including narrative, autobiography, case writing, action research, and artifactual documentation of teacher performance.

CIED 5083* Teaching Science in the Elementary School (Grades 1-8). Curriculum, materials, methods, and procedures related to the theory and practice of science teaching in grades 1-8.

CIED 5123* Curriculum in the Secondary School. Contemporary curricular issues, philosophies, and points of view in secondary school education.

CIED 5143* Language Arts in the Curriculum. Content and current issues in the language arts. Materials and methods for teaching the communication skills.

CIED 5153* Advanced Studies in Children's Literature. Study of children's literature within the prevailing political, economic and social factors influencing cultural patterns and values. The tools of research in children's literature and the nature and direction of contemporary children's book publishing.

CIED 5163* Middle School Curriculum. Theory of planning and developing learning experiences appropriate to the needs and interests of early adolescents.

CIED 5173* Kindergarten-Primary Curriculum. Study of kindergarten-primary curriculum, including philosophy, history, current practice, and issues. For administrators, teachers and students in curriculum and early childhood education.

CIED 5183* Media Literacy Across the Curriculum. Examination of the history of media literacy. Major topics and issues in the field of media literacy and curriculum in media literacy across subject areas.

CIED 5193* Inquiry and Problem-Based Learning in Science Education. Prerequisite(s): Completion of Bachelor's degree. Different aspects of teaching science through inquiry methods. Using current research as a guide, students will define scientific inquiry teaching and learning, explore assessing inquiry, and evaluate the roles of students, teachers, and discourse in the science classroom.

CIED 5203* Foundations of Literacy Education 1-8. Major literacy theories, content, and pedagogy with a required 45 hour field experience. For graduate students seeking initial certification in elementary education.

CIED 5223* Teaching Science in the Schools. Materials, methods and classroom procedures related to science in grades K-12.

CIED 5243* Environmental Education in the Curriculum. Integration of environmental concepts in the total school curriculum. Review of K-12 environmental education curricula and methods of teaching environmental education in formal and nonformal settings.

CIED 5253* Rational Number Concepts, Proportional Reasoning, and Classroom Interactions at the Elementary Level (PK-6) Prerequisite(s): completion of a Bachelor's degree. Focus on teaching rational number concepts and developing proportional reasoning skills for PK-6 classrooms; attention is also given to learning methods which facilitate appropriate classroom interactions.

CIED 5263* Assessment and Evaluation in School Mathematics. Lab 2. Focus on classroom assessment to help teachers identify what students know about critical mathematics concepts, skills, procedures, and facts. Emphasis would be on using that information to inform their instructional decisions and enhance student learning.

CIED 5270* Practicum in School Mathematics. 1-3 credits, max 6, Lab 2-6. Diagnostic and therapeutic procedures in mathematics with students of all ages. Laboratory classes provide for clinical experiences in evaluation and instruction with children experiencing difficulty in mathematics.

CIED 5273* Number Concepts and Assessment at the Elementary Level (PK-6). Analysis and construction of effective mathematical tasks in teaching number systems and operations at the PK-6 level; attention is also given to the expansion of content knowledge and issues related to assessment.

CIED 5280* Workshop in Science Education. 1-4 credits, max 4. Develops and/or implements elementary and secondary science programs.

CIED 5283* Problem-Centered Learning in Mathematics. Focus on the different aspects of a problem-centered learning environment. Using current research as a guide, students will examine tasks, collaborative work, and the roles of students, teachers and discourse.

CIED 5293* Teaching and Learning Mathematics in Technology. The focus of this course is on research and methods of teaching and learning with technology in the mathematics classroom. Topics will include philosophical, social, developmental and theoretical issues associated with the development and use of technology and school reform. Activities and applications will be explored as they relate to the potential for providing a technology-rich learning environment conducive to student construction of mathematical knowledge.

CIED 5313* Curriculum of the Elementary School. Contemporary trends, philosophies and points of view in elementary school education.

CIED 5323* Teaching Social Studies in the Schools. Curriculum, materials, methods, and procedures related to social studies.

CIED 5350* The Visual Arts in the Curriculum. 1-3 credits, max 6, Lab 2. Creative approaches to the use of two- and three-dimensional media as they relate to various aspects of education. Opportunities available for periodic group and individual evaluation in order to give direction and significance to future growth.

CIED 5353* Literature for Children, Adolescents and Adults. Exploration of the elements and characteristics of quality literature for readers of all ages, addressing evaluation, selection, and utilization. Research component requiring learners to design and conduct relevant research into literature learning and engagement with selected populations.

CIED 5423* Literacy Instruction in Primary Grades. Analysis of growth in literacy from the preschool level through early elementary years. Examination of literacy learning processes and instructional procedures.

CIED 5433* Reading and Writing in the Content Areas. Study of the development and use of reading and writing across the content areas.

CIED 5463* Reading Assessment and Instruction. Lab 0-2. Prerequisite(s): 5423 or 5433 or consent of instructor. Development of knowledge of reading assessment and instruction for children and adults who find reading difficult. Laboratory experience for authentic assessment and tutoring in reading.

CIED 5473* Reading and Writing Difficulties. Study of research and formal assessment tools related to reading and writing difficulties in children and adults.

CIED 5483* Literacy and Technology Across the Curriculum. The characteristics of computer-facilitated learning relating to broad definitions of literacy. Use of a variety of computer and literacy tools across the curriculum.

CIED 5523* Practicum in Reading Instruction. Lab 0-2. Evaluation and instruction in reading and writing for children who experience difficulty learning to read. Collaboration among teachers, learners, and resource personnel.

CIED 5553* Literacy Leadership and Coaching. Prerequisite(s): 5463. Develops skills and knowledge for school literacy program design and leadership, and for coaching other teaching professionals in literacy teaching.

CIED 5613* Effective Teaching of Mathematics in the Secondary School. Prerequisite(s): Consent of instructor. Directed advanced practicum in secondary school mathematical education. Includes study of current research findings in mathematical education, teaching strategies, materials and evaluation procedures in the secondary school. For experienced classroom teachers, superintendents, principals and supervisors.

CIED 5623* Multicultural and Diversity Issues in Curriculum. Understanding of the historical and contemporary perspectives toward cultural diversity. Development of an awareness of diverse culture and language communities; understanding of critical issues of race, class, gender, and

ethnicity in education; perennial issues of multiculturalism in public education and in global society; a comprehensive overview of principles and current research on bilingual and multicultural education.

CIED 5640* Special Topics in Literacy Education. 1-6 credits, max 6. Topics vary to address special topics in literacy education.

CIED 5643* Integrating Teaching at the Elementary Level. Study and analysis of theories related to children's learning and implications for integrating teaching at the elementary level. Examination of teachers, own practices through reflection and research, study diverse populations, share teaching approaches and materials across the curriculum, and explore outreach to school, family and community.

CIED 5663* Integrating Teaching in the Secondary School. In-service for middle to secondary teachers especially with professional development in their own school settings and in further graduate work. Examination of own practices through reflection and research, study of diverse adolescents, sharing of teaching approaches and materials across the curriculum, and exploration of outreach to school, family and community. Teacher leadership.

CIED 5720* Education Workshop. 1-8 credits, max 8. For teachers, principals, superintendents and supervisors who need advanced curriculum and instruction course work related to K-12 subject areas and pedagogy, in the areas of instruction and administration. Students must register for the full number of credit hours for which the workshop is scheduled for a particular term.

CIED 5723* Gender and Curriculum. An overview of gender issues in curriculum theory and practice. Understanding of historical and contemporary perspectives on gender in the context of schooling, pedagogy, and education.

CIED 5730* Seminar in Education. 1-6 credits, max 6. Seminar topics may differ depending upon the nature of current interests and topics in American education. (Same course as 4560*)

CIED 5733* History of Reading. Prerequisite(s): Graduate standing with the Graduate College. This course provides an examination of the historical landscape of reading education paradigms, research, theory development, instruction, and policy in the U.S. Key research pioneers in reading/literacy education and their work, from a variety of "camps" (e.g. psychological or information processing, phonics, behaviorist, constructivist, reading and writing process, sociocultural, etc.), will also be examined.

CIED 5750* Seminar in Mathematics Education. 1-6 credits, max 6, Lab 0-6. Prerequisite(s): Consent of instructor. Problems, issues and trends in mathematics education.

CIED 5813* Educational Advocacy and Leadership. Preparation of teachers as advocates and leaders in educational policy and practice at various levels. Skills in action research, policy analysis, and coalition building leading to advocacy.

CIED 5850* Directed Study. 1-6 credits, max 6, Lab 1-6. Prerequisite(s): Consent of instructor. Directed study for master's level students.

CIED 5913* Geometry, Spatial Visualization, and Learning Trajectories at the Elementary Level (PK-6). Prerequisite(s): Completion of a Bachelor's degree. Focus on geometric concept development at the PK-6 level and an understanding of spatial visualization. Attention will be given to the understanding of learning trajectories for elementary grades mathematics learning.

CIED 5923* Algebra and Mathematical Tasks at the Elementary Level (PK-6) Prerequisite(s): Completion of a Bachelor's degree. Focus on early algebra concepts of functional thinking and generalized arithmetic. Attention will be given to the analysis and construction of effective mathematical tasks in the teaching of algebra.

CIED 5933* Teaching Measurement and Data at the Elementary Level (PK-6) Prerequisite(s): Completion of a Bachelor's degree. Focus on statistical literacy of elementary teachers and the teaching of data analysis and measurement to PK-6 students; emphasis on the use of instructional technology to enhance student learning.

CIED 5943* Mathematics Leadership and Coaching Prerequisite(s): Completion of a Bachelor's degree and 12 hours from CIED 5253, 5273, 5913, 5923, and 5933. Develops skills and knowledge for school mathematics program design and leadership, and for coaching other teaching professionals in mathematics teaching.

CIED 6000* Doctoral Dissertation. 1-25 credits, max 25. Required of all candidates for the Doctor of Philosophy degree. Credit is given upon completion of the dissertation.

CIED 6013* Assessment in Science Education. Prerequisite(s): Completion of a bachelor's degree. Guided readings, discussions, and group activities focus on strengthening students' understanding of state and national assessments in science education.

CIED 6030* Contemporary Issues in Curriculum Studies. 1-6 credits, max 6. Examination of selected contemporary topics in curriculum studies.

CIED 6033* Analysis of Teaching. Advanced study of multiple forms of analysis of teaching such as behavioral, phenomenological, and constructivist with emphasis on major research on teacher reflection and teacher narrative.

CIED 6043* Curriculum Leadership. A study of curriculum leadership and implications for schooling; focus on what it means to be a curriculum leader in times of major societal change and educational reform.

CIED 6053* Advanced Curriculum Studies. In-depth examination of key concepts, topics, trends, and the interdisciplinary nature of curriculum studies. Critical analysis of contemporary curriculum discourses.

CIED 6060* Advanced Special Topics in Literacy Education. 1-6 credits, max 6. Topics vary to address special topics in literacy education at the doctoral level.

CIED 6063* Curriculum History. Examines in-depth the history of various movements in U.S. curriculum thinking and the individuals who promoted them, with attention to the cultural and institutional contexts within which they worked. Emphasis is give to primary sources and the position of curriculum thinking within evolving educational thinking.

CIED 6070* Seminar in Arts and Humanities Education. Prerequisite(s): graduate standing or instructor permission is required. Topics, research trends, theories, themes, and/or problems of interest and use in research, theorizing, publishing, and teaching. Particular focus on the skill of writing a theoretical lens and analyzing texts through that lens.

CIED 6073* Advanced Pedagogical Research. Advanced theory and application of pedagogical research with emphasis on teacher as researcher, teacher research as professional development and education reform, techniques of pedagogical research and pedagogical question posing.

CIED 6083* Seminar in Writing Pedagogy. Prerequisite(s): Graduate standing with Graduate College. Seminal works in theory and research related to the teaching of writing in K-16 settings are examined. Students will examine the scholarship on genre theories, writing process theory, and writing pedagogy, considering the practical classroom implications and applications for this work. This course relies on reading, discussion, synthesis of key concepts, and individual inquiry as central learning processes.

CIED 6090* Readings in Arts and Humanities Education. Prerequisite(s): graduate standing or instructor permission is required. In-depth readings specific to research and theorizing in arts and humanities education. Focusing on analysis, students examine primary texts and related secondary texts.

CIED 6123* Teaching the Nature of Science in Secondary Science Education. Prerequisite(s): Successful completion of a bachelor's degree. Guided readings, discussions, and group activities focus on strengthening views on the nature of science.

CIED 6133* Theory to Practice in Education. A culminating seminar demonstrating the application of theory from several disciplines to the practical problems of education: curriculum development, organization, teaching strategies and evaluations.

CIED 6143* School Reform. Current issues in school reform with an emphasis on U.S. education; focus on what it means to engage in reform from dual points of view: curriculum leader and recipient of reform mandate.

CIED 6163* Advanced Research Strategies in Curriculum. Prerequisite(s): SCFD 6113. Exploration of designs and methods within qualitative and quantitative research as applied to the field of curriculum. Articulation on how to ensure that both qualitative and quantitative studies meet their respective standards of rigor.

CIED 6183* Advanced Media Literacy Across the Curriculum. This course examines the interdisciplinary area of media literacy across the curriculum. Major themes such as issues of hegemony and strategies of media literacy in diverse classrooms will be explored. Students will analyze and evaluate various curriculum theories as applied to media literacy as well as research in the field. Finally, the future of media literacy and debates in the field will be considered.

CIED 6223* Instruction and Learning in Science and Mathematics Education. Prerequisite(s): Acceptance into a doctoral program. Focus on learning and teaching in science and mathematics education contexts. Students will analyze and synthesize research in science and mathematics education that are related to the learning sciences.

CIED 6253* Designing and Conducting Mixed Methods Research. Prerequisite(s): REMS 5953 (or equivalent) and SCFD 5913 (or equivalent); admittance to a doctoral level program. Participants will examine the history, philosophical foundations, and methodological issues of mixed methods research.

CIED 6433* Seminar in Literacy. Research of issues in literacy education using knowledge gained through both research and classroom practice.

CIED 6503* Doctoral Seminar. In-depth investigation into the doctoral experience and the professoriate including research and writing for the dissertation and for publication; grant writing; professionalism and ethics; professional service; and teaching in higher education. Primarily for students in the PhD program in Curriculum Studies and Professional Education Studies.

CIED 6513* Staff Development in Literacy Education. Design and delivery of research related to staff development experiences in literacy.

CIED 6683* Language, Literacy and Culture. The social-cultural perspectives related to the role of language in mediating literate behaviors, cognition and action in learning contexts. Aspects of language use within various learning contexts (situated cognition) and its academic, technical and everyday discourse in understanding the interrelationships among teaching, learning, knowledge and culture.

CIED 6750* Research in Mathematics and Science Education. 1-6 credits, max 6. The examination of current research in mathematics and science learning and teaching research designs, employed, and the generation of new hypotheses.

CIED 6850* Directed Reading. 1-6 credits, max 6. Prerequisite(s): Consent of instructor. Directed reading for students with advanced graduate standing to enhance students' understanding in areas where they wish additional knowledge.

CIED 6853* Improvement of Instruction in Reading. Problems and issues related to reading instruction. The roles of various school personnel in changing curriculum and methods.

CIED 6880* Internship in Education. 1-8 credits, max 8, Lab 3-24. Prerequisite(s): Consent of instructor. Directed off-campus experiences designed to relate ideas and concepts to problems encountered in the management of the school program.

CIED 6910* Practicum. 1-6 credits, max 6. Prerequisite(s): Consent of adviser. Helps the student carry out an acceptable research problem (practicum) in his/her local school situation. Credit given upon completion of the written report.

Design, Housing and Merchandising (DHM)

DHM 1003 Design Theory and Processes for Design and Merchandising. Lab 4. Prerequisite(s): DHM majors only. Design elements, principles and processes applied to design and merchandising.

DHM 1103 Basic Apparel Assembly. Lab 4. Basic apparel assembly techniques. Problems including basic fit, spreading and cutting methods and equipment, and use and application of sewing equipment, including lock, chain, and overedge.

DHM 1123 Graphics for Interior Design I. Lab 4. Prerequisite(s): DHM majors only. Drafting and visual communication techniques related to interiors.

DHM 1433 Innovation and Marketing of Fashion Products. The process of fashion innovation; variables of fashion affecting production and distribution of consumer goods; development of present structure in the apparel, interiors and related industries.

DHM 1993 Communications and Presentation Techniques for Apparel Design. Lab 6. Prerequisite(s): 1003. Creative communication methods and techniques, including a variety of media for two- and three-dimensional presentations in apparel design.

DHM 2003 Problem Solving Strategies. Participatory problem solving in design and merchandising; critique of proposed solutions as a positive process of evaluation.

DHM 2073 Computer-Aided Design for Interior Design. Lab 4. Prerequisite(s): 1123 and pass proficiency review. Computer-aided design and drafting for two-dimensional and three-dimensional interior systems.

DHM 2103 Interior Design Studio I: Residential. Lab 4. Prerequisite(s): Pass proficiency review. Studio course utilizing the design process in the analysis and planning of residential environments using computer-aided and hand drafting techniques.

DHM 2203 Intermediate Apparel Assembly. Lab 4. Prerequisite(s): 1103. Development of skill in apparel assembly. Intermediate problems in fit, spreading, cutting, and sequencing of apparel assembly operations for lined garments, plaids, other special fabrics and closures.

DHM 2212 Heritage of Dress I. Prerequisite(s): 3 credit hours of history. Survey of ancient to Baroque European modes of dress, as that clothing reflects the environment and cultural life of a people.

DHM 2233 Graphics for Interior Design II. Lab 4. Prerequisite(s): 1123. Applied creative solutions to visual communication formats and media; free-hand sketching, informational graphics, rendering techniques for product and material illustrations, floor plans, elevations and 3-D room interiors/architectural detailing.

DHM 2263 Interior Design Studio II: Small Scale Contract. Lab 4. Prerequisite(s): 2073 and 2103. Analysis and planning of small office, hospitality and retail environments with emphasis on materials, lighting, codes and accessibility using computer-aided 2D drafting and 3D modeling techniques.

DHM 2301 Supervised Field Experience. Prerequisite(s): 2263 or consent of instructor. Field experience in specialized residential, commercial and institutional design with both historic and contemporary elements.

DHM 2403 Research Methods. Prerequisite(s): Math 1483 or 1523. Qualitative and quantitative data collection methodologies for the fields of Apparel, Interior Design and Merchandising. Basic understanding of data analysis and use of data to guide managerial decision making.

DHM 2423 Technology and Visual Communication for Merchandisers. Lab 4. Prerequisite(s): 1003 and 1433. The development of visual communication skills for marketing, promotional, and merchandising applications as well as personal branding utilizing industry-relevant technological practice.

DHM 2444 Draping. Lab 6. Prerequisite(s): DHM 2203 with "C" or higher and pass proficiency review. Interpretation of garment design developed through the medium of draping on dress forms.

DHM 2573 (L,N) Textiles. Lab 2. Science principles as the basis for understanding fibers, the basic structure of yarns and fabrics. Relationships between the chemical composition of fibers and properties such as tensile strength, flammability, elasticity, moisture absorption, and dye affinity. Understanding science principles in relation to textile properties for evaluation of textile products. Recommended for education majors seeking knowledge to be used for innovative teaching of science principles in grades K-12. *Required for all DHM majors*.

DHM 2913 Sewn Product Quality Analysis. Prerequisite(s): 1433, 2573. Sewn product manufacturing process with emphasis on evaluating product quality and its relationship to performance. Examined from the retailers', manufacturers', and consumers' perspectives.

DHM 3013 Flat Pattern Design. Lab 6. Prerequisite(s): 2444 and pass proficiency review and MATH 1483 or 1513. Interpretation of dress design developed through the medium of flat pattern; introduction to pattern drafting.

DHM 3023 Computer-Aided Flat Pattern Design. Lab 6. Prerequisite(s): 3013 and pass proficiency review. Advanced apparel design problems using flat pattern and computer-aided design (CAD) techniques.

DHM 3033 Material Culture. Prerequisite(s): completion of 30 credit hours. An exploration of a variety of theoretical approaches toward understanding what objects mean. Psychological, sociological, economic, and other approaches are examined using culture theory models.

DHM 3053 Quality Analysis for Apparel Design. Prerequisite(s): DHM majors only and 1433, 2203, 2573 or consent of instructor. Evaluation of product quality relating to target market, materials, and construction.

DHM 3103 Anthropometry and Ergonomics in Design. Prerequisite(s): DHM 2403. Methods and principles for representing body size, fit, accommodation, proxemics, ease and product specific functionality to apparel, merchandising and built environment design.

DHM 3123 Advanced Technology for Apparel Design. Lab 4. Prerequisite(s): DHM majors only and 1993 and 3023. Building on CAD skills using software as applied to apparel design and production. Development of technical packages and specification materials.

DHM 3203 Functional Clothing Design. Prerequisite(s): 2573, 3013, 4 credit hours of chemistry. Problem solving approach to functional clothing design for specialized market segments (athletic, sportswear, clothing for the handicapped) including performance evaluation of selected materials using standard methods of textile testing.

DHM 3213 (H) Heritage of Dress II. Prerequisite(s): 3 credit hours of history. Survey of historic modes of dress from the 18th to the 21st centuries, as that clothing reflects the environment and cultural life of a people, and change within the fashion industry.

DHM 3233 (H) Heritage of Interior Design I. Religious, civic, commercial, and domestic architecture and furnishings prior to and including the 18th Century with emphasis on the periods which have greatly influenced housing and interior design.

DHM 3303 Materials and Finishes for Interior Design. Prerequisite(s): 2263 (Interior Design students) or 1123 and 2573 (Merchandising students). An overview and examination of interior materials and finishes.

DHM 3343 Interior Design Studio III: Interior Components and Construction Documents. Lab 4. Prerequisite(s): 2263. Studio course exploring the design, materials, construction and production of interior design components for small scale commercial projects using computer-aided and hand drafted documents and renderings for visualization of design solutions.

DHM 3433 Retailing of Apparel, Interiors and Related Products. Prerequisite(s): DHM majors or minors only, or by permission of instructor, and 1433 and ACCT 2103 with minimum grade of "C", and ECON 1113 or 2103. Marketing structures at retail level; job descriptions and responsibilities at management level; financial and control functions.

DHM 3453 Interior Design Studio IV: Environmental Design. Lab 4. Prerequisite(s): 3343. Exploration of the design factors and human performance criteria for lighting, acoustics, and thermal/atmospheric comfort and their applications in studio projects using computer-aided and hand drafted techniques.

DHM 3533 Textile Surface Design. Lab 4. Prerequisite (s): DHM 1003 and 2573. Traditional and contemporary dyeing, printing, stitching, and other textile surface manipulation techniques are practiced in a portfolio of individual projects. Exercises in color theory and production inform textile design work. Aesthetic, methodological, and environmental tradeoffs are considered in relation to designing textile surfaces.

DHM 3553 Profitable Merchandising Analysis. Prerequisite(s): 3433, ACCT 2103, MATH 1483, 1513 or 2103. Relationship analysis of profit and loss statement. Retail mathematical calculations necessary to plan and control merchandising results, open-to-buy, mark-up, mark-down, turn-over, stock-sales ratio. Initial development of a six-month buying plan.

DHM 3563 Merchandise Acquisition and Allocation. Prerequisite(s): 3433, 3553. In-depth study of buying and distributing merchandise.

DHM 3643 Apparel and Accessories for Special Markets. Prerequisite(s): 1433, PSYC 1113, and completion of 60 credit hours. An analysis of the apparel and accessory needs of specialized market segments and the products designed to meet those needs, with consideration given to both product design and merchandising.

DHM 3823 Professional Practices for Interior Design. Prerequisite(s): 2263. Specific terminology, procedures, relationships and ethics pertaining to the organization and conduct of interior design practice in the United States.

DHM 3853 Visual Merchandising. Lab 2. Prerequisite(s): 1003, 1433, 2423 and completion of 60 credit hours. Study and application of principles and practices in merchandise presentation for commercial purposes.

DHM 3881 Interior Design Pre-Internship Seminar. Prerequisite(s): DHM majors only, 2073, 3343, 3823, SPCH 2713, and HS 1112 or 3112 (or concurrent). Preparation for obtaining and completing a directed practical experience in a work situation in the interior design field.

DHM 3991 Pre-Internship Seminar. Prerequisite(s): DHM majors and 2.5 major GPA and 1003 and 2003 and 2573 and HS 1112 or HS 3112 (or concurrent) and SPCH 2713 and (merchandising students) 3433 or (ADP students) 3123. Skills requisite to a directed practical experience in an approved work situation related to the fashion industry.

DHM 3994 Professional Internship in Merchandising or Apparel Design and Production. Prerequisite(s): DHM majors only and 3991 and (merchandising students) 3553 and 3853 or (apparel design and production students) 3023 and 3123; and HS 1112 or 3112. Directed practical experience in an approved work situation related to the fashion industry.

DHM 4001 Design and Merchandising Speakers Colloquium. Seminars presented by distinguished industry professionals. Current issues and implications for the future of apparel and interiors.

DHM 4011 Post-Internship Seminar. Prerequisite(s): DHM majors only, 3994. Study and comparison of student work experiences. Individual student conferences, review of merchant supervisor reactions.

DHM 4143* Design for Special Needs. Problems and alternative solutions for apparel and interiors for special groups, e.g., the aging, children, the handicapped, special markets. Includes field study or design problem.

DHM 4153 Mass Production of Apparel and Related Products. Lab 4. Prerequisite(s): DHM majors only and 3023 and 3123. Understanding and applying mass production strategies for apparel related products. Includes design for production, production operations including CAD marker making and material utilization, production simulation, modeling and costing.

DHM 4163 Housing in Other Cultures. Housing and interior design and expressions of cultural beliefs, attitudes, family patterns and environmental influences.

DHM 4264* Interior Design Studio V: Large Scale Commercial. Lab 6. Prerequisite(s): 3453, 4373, and 4824. Analysis of large scale office planning and institution design including systems and specifications and emphasizing computer-aided design techniques for construction documents and presentations.

DHM 4294* Interior Design Studio VI - Capstone. Lab 6. Prerequisite(s): 4264. Studio course utilizing the design process in the analysis and planning of hospitality design and/or institutional design such as health care and education. Approaches includes the consideration of the impact on facility management.

DHM 4323 (I) Heritage of Interior Design II. Exploration of the architecture, interiors and furnishings of a variety of structures. Residential, commercial, governmental, institutional, and recreational buildings of different cultures of the 19th and 20th centuries.

DHM 4373* Advanced Computer-Aided Design for Interior Design. Lab 4. Prerequisite(s): 2073 and 3453. Advanced computer-aided design and visualization for three-dimensional interior systems.

DHM 4403* Advanced Apparel Design. Lab 6. Prerequisite(s): 2444 and 3023. Application of design and pattern-making principles and apparel assembly processes in the development of original designs.

DHM 4423* Heritage III: Designing for Progress. A thematic survey of movements affecting the design of the built environment after 1900. Social and political developments as generators of new building types, construction techniques, materials and stylistic directions.

DHM 4433* Facility Management and Design. Survey of nine competency areas of facility management and design, ensuring functionality of the built environment by integrating people, places, processes and technology.

DHM 4453* Entrepreneurship and Product Development for Apparel and Interiors. Prerequisite(s): ECON 1113 or 2103 and completion of 90 credit hours. In-depth study of entrepreneurship concepts as applied to manufacturers and retailers of apparel and interior products including product development, accounting and control, merchandising and buying, operation and management, advertising and promotion.

DHM 4503* Couture Techniques. Lab 4. Prerequisite(s): 2443. Advanced clothing construction techniques using couture methods.

DHM 4523 Critical Issues in Design and Merchandising. Prerequisite(s): Senior standing in major. Capstone course examining professional issues in design and merchandising in the context of central themes from general education.

DHM 4533 (D) Diversity Issues in Facility Management and Design. In-depth study of facility management and design issues focused on diversity in a variety of workplace types including: office, retail stores, hotels, restaurants, government, educational and cultural institutions.

DHM 4573* Sustainable Design for Apparel and Interiors. Prerequisite(s): CHEM 1014 or equivalent, and DHM 2573, 3033 and completed 90 hours. Non-DHM majors: no prerequisite. A brief review of contemporary environmental, social and economic issues associated with industry practice; a broad exploration of sustainable design theories which may be applied in the apparel and interiors fields, from eco-efficiency to socially-driven changes.

DHM 4810* Problems in Design, Housing and Merchandising. 1-6 credits, max 6. Prerequisite(s): Consent of instructor. Selected areas of study in design, housing and merchandising.

DHM 4824 Professional Internship in Interior Design. Prerequisite(s): DHM majors only, 3453, 3881, 4373. A supervised internship experience that simulates the responsibilities and duties of a practicing professional in interior design.

DHM 4850* Special Unit Course in Design, Housing and Merchandising. 1-6 credits, max 6. In-depth study of specific areas of design, housing and merchandising.

DHM 4893* Fundamentals of Medical Smart Garment. Prerequisite(s): completion of 90 credit hours or Graduate standing. Students will gain elementary knowledge in focus areas of health science, biomedical sensing and analysis, and apparel design necessary to undertake the development of wearable electronic sensing systems. Lecture and laboratory systems. *May not be used for degree credit with BIOM 6933, IEM 4893 or IEM 5893.*

DHM 4900 Honors Creative Component. 1-3 credits, max 3. Prerequisite(s): College of Human Sciences Honors Program participation, senior standing. Guided creative component for students completing requirements for College Honors in the College of Human Sciences. Thesis, creative project or report under the direction of a faculty member in the major area, with second faculty reader and oral exam.

DHM 4993 Textiles, Apparel, Interiors and Related Products in the International Economy. Prerequisite(s): 3 credit hours of ECON and 90 credit hours. Broad multi-disciplinary study of textiles, apparel, interiors and related products in the international economy.

DHM 5000* Master's Thesis. 1-6 credits, max 6. Prerequisite(s): Graduate standing and consent of major professor. Research related directly to design, housing and merchandising for the master's thesis.

DHM 5001* Orientation to Graduate Studies in Design, Housing and Merchandising. Process of developing a graduate plan of study in the Department of Design, Housing and Merchandising. Fundamental skills needed for successful completion of a DHM graduate degree.

DHM 5003* Theoretical Perspectives for Design, Housing and Merchandising. Prerequisite(s): 5013. A study of terminologies associated with theory. Exploration of key theories and their application to practice and research in design, housing and merchandising.

DHM 5010* Thesis Equivalency for Doctoral Students. 1-6 credits, max 6. Prerequisite(s): Doctoral student standing and consent of supervising instructor and DHM 5013 and STAT 5013, or equivalent courses. Research related directly to design, housing or merchandising, conducted for the purpose of removing a master's degree research thesis deficiency.

DHM 5013* Research Developments in Design, Housing and Merchandising. Current methods and needs in research for design, housing and merchandising including the application and integration of research into design, housing and merchandising practice.

DHM 5112* Research Planning and Proposal Writing. Prerequisite(s): 5001, 5013. Fundamentals of planning and completing qualitative and quantitative research projects, including writing the proposal.

DHM 5113* Theories of Creative Process in Design and Merchandising. A study of the creative processes used in art, science, business and hybrid disciplines, with application to design and merchandising.

DHM 5163* Housing in Different Cultures. Prerequisite(s): Graduate student status. Housing and life style as an expression of cultural aesthetics, beliefs, attitudes and environmental influences.

DHM 5213* Product Design, Production and Promotional Strategies for Apparel and Interior Design Industries. Lab 2. Prerequisite(s): 5113. An overview of product design and production techniques for apparel and interior design markets using an industry approach. Promotional strategies needed for successful advertising campaigns.

DHM 5233* Design Evaluation. Prerequisite(s): Consent of instructor. Theoretical perspectives on evaluation of applied design; examination and evaluation of historic and contemporary designers, their philosophies and their work.

DHM 5240* Master's Creative Component. 1-6 credits, max 6. Prerequisite(s): Consent of major professor and department head. An in-depth design

application of theoretical design models and philosophies. *A maximum of six hours to be used by graduate students following Plan III for the master's degree.*

DHM 5273* Interpretative Theories of Material Culture. A theoretical analysis of the influences of cultural values and characteristics upon the design, acquisition and use of apparel, furnishing and building products, and the cultural diffusion of those material goods.

DHM 5303* Sociological, Psychological and Economic Aspects of Consumer Behavior. Analysis and integration of social, psychological and economic theories related to consumer acquisition of products. Application and testing of these theories as appropriate to apparel and interior consumption processes.

DHM 5343* Constructed Environment and Human Behavior. Prerequisite(s): 5013, 5273, PSYC 1113, SOC 1113. An exploration and evaluation of the physical attributes of the constructed environment and the interrelationships with the social and psychological aspects of human behavior.

DHM 5353* Graduate Interior Design Studio. Prerequisite(s): Consent of instructor. Studio course exploring alternative, research-based design solutions for selected interior environments.

DHM 5360* Advanced Studies in Design, Housing and Merchandising. 1-6 credits, max 6. Investigation into special areas in the fields of design, housing and merchandising.

DHM 5363* Color Theories and Applications for Apparel and Interiors. Prerequisite(s): Nine hours in DHM graduate courses or consent of instructor. Survey of color theories as they apply to the physical, psychological, and aesthetic aspects of apparel and interiors.

DHM 5440* Career Internship. 1-6 credits, max 6. Prerequisite(s): Consent of instructor and department head. An individualized career-oriented internship. Selected learning experiences in approved work situations in industry, government, education or research institutions related to design, housing or merchandising.

DHM 5503* Housing and Real Estate for Family Financial Planning. Overview of the role of housing and real estate in financial planning process from a theoretical perspective. Taxation, legal aspects, mortgages, and financial calculations related to home ownership and real estate investments. New and emerging issues in the context of housing and real estate. Role of ethics in financial planning including housing and real estate.

DHM 5533* Theory and Design of Functional Apparel. Lab 2. Prerequisite(s): 2573, 3013, 5013, or consent of instructor. A holistic approach to the study of apparel design with an emphasis on integrating knowledge of the needs and functions of the individual, the structural properties of textiles and apparel design.

DHM 5543* Textile Arts and Design. Lab 6. Prerequisite(s): Permission of instructor/adviser. Interpretation of designs developed through experimental studies in textile surface design and manipulation resulting in portfolio/competition quality designs/artwork and written documentation for submissions to a "juror selection" format exhibition.

DHM 5603* Historical and Contemporary Issues in Trade. The examination of fiber, textile, and apparel industries in a global context. The historical development of the global and U.S. textile and apparel industries and how the global environment (economic, political, and social systems) affects the textile and apparel production and trade. *Web-based instruction.*

DHM 5613* Merchandising Research Methods. Prerequisite(s): 5303, 5623, 5633, 5643, 5653 and graduate course in Statistics. An overview of the research process used in social science, including a survey and analysis of research methodologies. A review of current merchandising literature with implications for future research. *Web-based instruction.*

DHM 5623* Professional Advancement in Merchandising. Analysis of leadership and how it affects organizational culture and change through a prism of past and current experiences. Various leadership styles examined and a personal leadership philosophy developed for professional advancement in merchandising. *Web-based instruction.*

DHM 5633* Product Design, Development and Evaluation. Advanced study of issues and management strategies necessary to design and produce a competitively priced product. Examination of the role of globalization and rapidly changing technology on the development of a successful product. *Web-based instruction.*

DHM 5643* Promotional Strategies in Merchandising. Examination of integrated marketing communications (i.e., promotional strategies and techniques) while fostering cultural and global awareness, social responsibility and ethical decision-making in the field of promotion. *Web-based instruction.*

DHM 5653* Merchandising Trends, Practices and Theories in Apparel and Interior Industries. Prerequisite(s): Nine credit hours in marketing, merchandising or management. Current trends in merchandising; theories, concepts and processes related to management level problems.

DHM 5663* International Merchandising Management. Prerequisite(s): Merchandising or business courses or consent of the instructor. Comprehensive understanding of theory, practices, and trends in international merchandising management. An analysis of global retail systems and the way goods are distributed to consumers in various countries.

DHM 5673* Financial Merchandising Implications. Advanced study of financial trends in the merchandising industries; implications related to sole proprietors, partnerships, franchises, S corporations, and C corporations. Foci will be on the financial implications of recent advances in the field that assist graduate students as they embark on careers in academic and/or the merchandising industries. *Web-based instruction.*

DHM 5683* Strategic Planning for the Merchandising Executive. Examination of the merchandising executive planning process utilized to develop successful corporate strategies. Emphasis on the importance of a market orientation for building customer value and sustaining a competitive advantage. *Web-based instruction.*

DHM 5810* Problems in Design, Housing and Merchandising. 1-3 credits, max 6. Prerequisite(s): Consent of instructor and department head. Individual and group investigations and discussions of special problems in the various phases of design, housing and merchandising.

DHM 5963* Case Studies in Medical Smart Garment. 1-3 credits. Prerequisite(s): 4893 or consent of instructor. Advanced training course designed to activate critical thinking skills needed for problem solving in wearable sensing system development. *(Same course as BIOM 5963).*

DHM 5984* Capstone in Medical Smart Garment Engineering. 1-3 credits. Prerequisite(s): 4893 or 5893 and DHM 5963 or consent of instructor. Project-based course where interdisciplinary teams identify a wearable sensing application and collaborate to engineer a prototype that addresses a defined need. Industry collaboration encouraged. *(Same course as BIOM 5984).*

DHM 6000* Doctoral Dissertation. 1-12 credits, max 30. Prerequisite(s): Completion of a master's research thesis or thesis equivalency and consent of major instructor. Research in design, housing and merchandising for the PhD degree.

DHM 6133* Research Methods in Design, Housing and Merchandising. Prerequisite(s): 5112 and 5013 or equivalent and six credit hours of graduate level statistics. Survey and discussion of research methods, experiences in research design and analysis of data.

DHM 6363* Anthropometrics in Product Design. Prerequisite(s): Graduate standing and 6133 or equivalent. Variability of human body measurements and their relationships (body shape) as determinants for product design. Theory and practice of anthropometry and ergonomics (human factors) as applied to apparel and/or interior design. Comfort, performance, health, and safety issues in product design for men, women, children, and special populations.

DHM 6383* Design, Housing and Merchandising in Higher Education. Prerequisite(s): Nine credit hours in design, housing and merchandising. Development and organization of curricula and teaching methods for design, housing and merchandising.

DHM 6403* Merchandising Theory Application and Strategy Implementation. Prerequisite(s): 5653. Integration of marketing, merchandising, and management theories, strategies, models, and frameworks. Application of theories and implementation of strategies relevant to apparel and interior industries.

DHM 6410* Independent Study in Design, Housing and Merchandising. 1-3 credits, max 6. Prerequisite(s): Consent of instructor. Selected areas of design, housing and merchandising for advanced graduate students working toward the doctorate degree.

DHM 6413* International Consumer Behavior. Prerequisite(s): 5303. A critical understanding of theoretical and methodological issues with an emphasis on consumer behavior from a cross-cultural perspective and applications of this knowledge to international consumer research and strategy development in international markets.

DHM 6463* Project Management. Analysis of project management strategies and techniques used by architecture, interior design, and construction management firms relating to budget, schedule and personnel, with emphasis on leadership, quality assurance, and risk management issues.

DHM 6810* Advanced Problems in Design, Housing and Merchandising. 1-6 credits, max 6. Prerequisite(s): Consent of instructor and department head. Intensive individual or small-group study of problems in various areas of design, housing and merchandising for advanced graduate students who are working toward doctorate degrees.

DHM 6830* Design, Housing and Merchandising Seminar. 1-3 credits, max 6. Prerequisite(s): Consent of instructor. Problems and recent developments in design, housing and merchandising.

Diversity (DIVR)

DIVR 2003 (D,S) Inclusion Leadership. Focus on developing and refining leadership skills in order to prepare for success in personal and professional lives. Variety of leadership theoretical perspectives to broaden perspectives; develop inclusive leadership skills; increase knowledge regarding global networking; and clear a pathway to successful living within a global society.

DIVR 2213 (D,S) Minorities in Science and Technology: Contributions Past, Present and Future. Women, racial and ethnic minorities are underrepresented

in science and technology in America. STEM (science, technology, engineering, and mathematics) fields are traditionally perceived as unwelcoming for these groups. This course examines this idea by focusing on the notion of a "Chilly Climate" for minorities in technical fields. The contributions of prominent women and minority scientists and engineers in America will be explored, as well the struggles they overcame to achieve. This course also explores current issues and why inclusiveness matters today and in the future.

DIVR 2323 (D,S) Diversity and Inclusion in 21st Century America. This course is designed to increase awareness and understanding of diversity and inclusion in the United States. It focuses on the complex and often controversial issues of race, sex, gender, sexual orientation, social class, and disability by assessing the effects these categories have on society. This course will examine the historical context and how the United States has reached current categories of difference.

Economics (ECON)

ECON 1113 (S) The Economics of Social Issues. Issues-oriented approach. Basic economic principles introduced and developed through study of important social issues: for example, inflation, unemployment, poverty, discrimination, crime, population growth and environmental quality. Develops the economist's approach to social problems, and evaluates the contribution of economics to their solution. *May not be used for degree credit with ECON 2103. No general education credit for students also taking ECON 2103 or AGEC 1113.*

ECON 2103 (S) Introduction to Microeconomics. Goals, incentives and outcomes of economic behavior with applications and illustrations from current social issues: operation of markets for goods, services and factors of production; the behavior of firms and industries in different types of competition; income distribution; and international exchange. *May not be used for degree credit with ECON 1113. No general education credit for students also taking ECON 1113 or AGEC 1113.*

ECON 2203 Introduction to Macroeconomics. Prerequisite(s): 2103 or AGEC 1113. The functioning and current problems of the aggregate economy: determination and analysis of national income, employment, inflation and stabilization; monetary and fiscal policy; and aspects of international interdependence.

ECON 3010 Special Topics in Economics. 1-3 credits, max 9. Prerequisite(s): 2203, prior approval of instructor. Analysis of a contemporary topic in economics. Course content will vary to reflect changing social issues and trends in applied economics.

ECON 3023 Managerial Economics. Prerequisite(s): 2103. Application of economic theory and methodology to decision problems of private industry, nonprofit institutions and government agencies; demand and cost analysis, forecasting, pricing and investment.

ECON 3033 Economics of Entrepreneurship and Innovation. Prerequisite(s): 3 credit hours in Economics. Explores the process of economic innovation and entrepreneurship from both microeconomic and macroeconomic perspectives. Key topics include risk and uncertainty, the psychology of innovation, institutional change, product versus process innovation, the externality of innovation, innovation profit, innovation life cycle, innovation diffusion, and business cycle instability.

ECON 3113 Intermediate Microeconomics. Prerequisite(s): 2103 and either MATH 2103 or MATH 2144. How the market system organizes economic activity and an evaluation of its performance. Principles of price theory developed and applied to the interactions of consumers, producers and resource owners in markets characterized by different degrees of competition.

ECON 3123 Intermediate Macroeconomics. Prerequisite(s): 2203 and either MATH 2103 or MATH 2144. Development of a theoretical framework for studying the determinants of national income, employment and general price level. National income accounting, consumption, investment, government spending and taxation, the supply of and demand for money. Monetary, fiscal and incomes policies considered with regard to unemployment, inflation and economic growth.

ECON 3213 Game Theory and Experimental Economics. Prerequisite(s): Three credit hours in economics. The fundamentals of strategic actions presented in a game theory context and the validation of these ideas with economic experiments.

ECON 3313 Money and Banking. Prerequisite(s): 2203. The economics of money and banking. Operations of commercial banks and structure and competition of the banking industry. Organization and operation of the Federal Reserve System and its effects on interest rates, employment and prices. An introduction to monetary economics and international banking concludes the course.

ECON 3423 Public Finance. Prerequisite(s): Three credit hours in economics. The economics of the government sector. Scope of government activity, efficiency in government expenditures, federal budget, fiscal and debt management policy. Principles of taxation. Major tax sources, tax distribution, tax issues. Current public finance problems such as revenue sharing, negative income tax, urban transport systems and national health insurance.

ECON 3513 Labor Economics. Prerequisite(s): Three credit hours in economics. The economic analysis of labor markets. Topics include labor supply and demand, the impact of education and training, labor migration, the structure of wages, discrimination and labor unions.

ECON 3523 Economics of Health Care and Social Security. Prerequisite(s): Three credit hours in economics. Examination of the long-run budget problems created by an aging society and evaluation of policies designed to solve them, with a focus on Medicare, Medicaid, and Social Security.

ECON 3613 (S) International Economic Relations. Prerequisite(s): Three credit hours in economics. International trade and finance; international economic organizations; the foreign economic policy of the U.S.

ECON 3713 (S) Government and Business. Prerequisite(s): Three credit hours in economics. Methods of measuring the extent of monopoly power in American industries and ways of evaluating the effects of this power on consumer welfare. U.S. antitrust laws, their enforcement and landmark court decisions under these laws.

ECON 3723 The Economics of Sport. Prerequisite(s): 2103. Using economic analysis to understand the world of professional and amateur sport. Emphasis will be on economic decision-making relevant to the teams, leagues and institutions in the world of sport.

ECON 3823 (S) American Economic History. Economic development and economic forces in American history; emphasis upon industrialization and its impact upon our economic society since the Civil War. (Same course as HIST 4513)

ECON 3903 Economics of the Environment. Prerequisite(s): 2103. Economic and political factors that influence the formation and implementation of environmental policy. Environmental policy instruments such as pollution taxes, standards and marketable pollution permits are discussed. Measurement of environmental damages and risk are also considered.

ECON 3913 State and Local Economic Development. Prerequisite(s): Three hours of economics. The process of local economic growth and development; innovation, technology, and government policy.

ECON 4113 Energy Economics: Traditional and Renewable Energy Markets. Prerequisite(s): 2103 and either MATH 2103 or MATH 2144. This course examines economic theory, empirical perspectives, and the political economy of energy supply and demand. It discusses aspects of local, national, and global markets for oil, natural gas, coal, electricity, nuclear power, and renewable energy. In the course, we will examine public policies affecting energy markets including taxes, price regulation, energy efficiency, and control of emissions.

ECON 4213 Econometric Methods. Prerequisite(s): 2203 and three credit hours in statistics. Basic quantitative methods used in economic analysis emphasizing applications to economic problems and interpretation of empirical results. Statistical analyses, regression and forecasting techniques using computer programs.

ECON 4223* Business and Economic Forecasting. Prerequisite(s): 2203 and three credit hours in statistics. Forecasting business and economic variables. Regression models and time series models such as exponential smoothing models, seasonal models, and Box-Jenkins models. Evaluation of methods and forecasting accuracy. Application of methods using computer programs.

ECON 4643 (I,S) International Economic Development. Prerequisite(s): Three credit hours in economics. Problems of underdeveloped economics related to the world economy; obstacles to economic growth and policies for promoting growth.

ECON 4723* Economics Analysis of Law. Prerequisite(s): Three credit hours in economics. Use of economic analysis to explain why certain laws exist and to evaluate the effects of various alternative rules of law on economic efficiency and behavior. Emphasis on the economics of the common law areas of property, contracts, and torts. Also, products liability, crime and punishment, distributive justice, and discrimination.

ECON 4913* Urban and Regional Economics. Prerequisite(s): Three credit hours in economics. Theoretical, historical, and empirical examination of the economic forces that shape growth, development, land use, and location decisions in towns, cities and regions. Presents economic explanation for several urban problems such as sprawl, segregation, crime, pollution, traffic congestion, and inadequate housing and education. The role of state and local governments in addressing these problems is discussed.

ECON 4993 Economics Honors Thesis. Prerequisite(s): Departmental invitation, senior standing, Honors Program participation. A guided reading and research program ending with an honors thesis under the direction of a faculty member, with second faculty reader and oral examination. *Required for graduation with departmental honors in economics.*

ECON 5000* Research and Thesis. 1-6 credits, max 6. Workshop for the exploration and development of research topics. Research leading to the master's thesis.

ECON 5003* Research Report. Prerequisite(s): Consent of committee chairperson. Supervised research for MS report.

ECON 5010* Research and Independent Studies. 1-3 credits, max 10. Prerequisite(s): Consent of departmental committee under a workshop arrangement or supervised independent studies.

ECON 5013* Contemporary Environmental Policy. Economic, social and political factors that influence the formation and implementation of environmental

policy. Environmental policy instruments (including pollution taxes, standards and marketable pollution permits), measurement of environmental damages and risk. Risk comparison, regulatory issues, health risk assessment, and risk communication. Political-economic considerations.

ECON 5033* Macroeconomic Analysis. Prerequisite(s): Three hours of economics or consent of instructor. Study of the determinants of aggregate output, employment, price level, and interest rates, including international aspects. Monetary, fiscal, and exchange rate policies and impact on the macroeconomy and business environment. *No credit for PhD students in economics.*

ECON 5043* Microeconomic Analysis. Prerequisite(s): 3113 and MATH 2144 or consent of instructor. A calculus-based microeconomics course developing basic consumer, producer, and equilibrium models.

ECON 5053* Impact Evaluation of Public Policies. Prerequisite(s): Introductory econometrics or instructor consent. The primary goal of this course is to familiarize students with evaluation methodology and tools commonly used to assess publicly funded policies. Students will become familiar with the concepts, methods and applications of impact evaluation; learn how to read evaluation research critically; understand how to use evaluation results to anticipate or improve public policies; and be able to propose an appropriate evaluation plan to assess the implementation and effectiveness of a public policy.

ECON 5113* Managerial Economics. Prerequisite(s): Admission to a SSB graduate program or consent of MBA director. Economic theory applied to business decision-making. Concepts of microeconomics and macroeconomics related to understanding the economic system, analysis of policy, forecasting, and international economics. *No credit for PhD students in economics.*

ECON 5123* Microeconomic Theory I. Prerequisite(s): 3113. Contemporary price and allocation theory with emphasis on comparative statics.

ECON 5133* Macroeconomic Theory I. Prerequisite(s): 3123. National income, employment and the price level from the point of view of comparative statics.

ECON 5173* Energy Economics. Prerequisite(s): ECON 5113 or 2103 or equivalent. Develop tools necessary to examine energy markets from an economics perspective and discuss aspects of local, national and global markets for oil, natural gas, coal, electricity, and renewable energy. The course examines public policies affecting energy markets including taxes, regulation, energy efficiency and control of emissions.

ECON 5213* Introduction to Econometrics. Prerequisite(s): STAT 3013 or equivalent; consent of instructor. Introductory course in econometric regression analysis for first year graduate students in economics, business and agricultural economics. A review of basic probability and statistics, linear regression with one or more explanatory variables, binary dependent variables regression, instrumental variables regression, the use of panel data, and program evaluation. Assessment of the internal validity of estimated models.

ECON 5223* Mathematical Economics I. Prerequisite(s): 3113 and MATH 2163 or equivalent. Mathematical concepts of single variable and multivariate calculus, topological properties of Euclidean space, convergence, linear algebra, optimization theory and the Kuhn-Tucker Theorem with applications from economic theory.

ECON 5243* Econometrics I. Prerequisite(s): 4213 or STAT 4043. Theory and application of econometrics to economic problems. Topics include OLS, GLS, distributed lags, serial correlation, heteroske-dasticity, and simultaneous equations.

ECON 5263* Introduction to Econometrics II. Prerequisite(s): 5213 or equivalent; consent of instructor. This is a continuation of 5213. Introductory course in econometric regression analysis for first year graduate students in economics, business and agricultural economics. Topics include microeconometric applications using panel data, qualitative choice and limited dependent variable models. Also, includes applications in macroeconomics and financial economics using regression analysis.

ECON 5413* Economics of the Public Sector I. Allocation and distribution effects as well as incidence of governmental budget policies.

ECON 5433* Economics of the Public Sector II. Fiscal policy as a means of promoting economic stabilization and growth.

ECON 5543* Labor and Personnel Economics. An economic examination of labor markets and the relationship between the firm and the worker. Topics include screening, hiring, and sorting workers, worker signaling and job search, employee motivation and compensation schemes and shared investment in worker training. The course also considers issues related to labor supply and demand, discrimination, job search and unemployment.

ECON 5603* Global Economics. This courses presents an introduction to economic issues from a global perspective for the non-specialist. It emphasizes the problems and challenges the process of globalization poses to national economies. The first part of the course presents the main theories of international trade and their relevance to explaining current global trade patterns. The second part of the course examines the foreign exchange market and the process of exchange rate determination. It covers various international financial issues such as global current account imbalances, the role of the dollar in international financial markets and international currency crises.

ECON 5613* International Finance. Prerequisite(s): Permission of instructor. Open economy macro-economics and the role of devaluation, fiscal and monetary policy in the open economy, monetary approach to the balance of payments, portfolio balance and asset market approaches to the determination of exchange rates.

ECON 5623* Economic Development I. Prerequisite(s): Permission of instructor. Characteristics and problems of less-developed countries. Criteria of growth and development with emphasis on strategies for development. The role of capital, labor, technological progress and entrepreneurship. Growth models.

ECON 5633* International Trade. Prerequisite(s): Permission of instructor. International trade and commercial policy. Comparative advantage, general equilibrium and modern trade theories; welfare implications of international resource allocation models; the theory of protection and international interdependence.

ECON 5643* Economic Development II. Prerequisite(s): Permission of instructor. Major problems of development policy. Inflation and mobilization of capital, investment criteria, agriculture, foreign trade, population and manpower, planning and programming methods.

ECON 5703* The Economics of Organization and Competitive Advantage. Prerequisite(s): 3113 or 5113 or consent of instructor. An analysis of organizational architecture (the assignment of decision-making rights, performance evaluation, and reward systems within an organization). An appropriate architecture to give an organization a competitive advantage and to help an organization develop prowess in innovation and reputation, providing other sources of competitive advantage.

ECON 5713* Industrial Organization I. Organization and operation of the enterprise sector of a free enterprise economy; interrelations of market structure, conduct and performance; public policies affecting these elements.

ECON 5723* Industrial Organization II. Alternative market structures and their relationships to market performance; the empirical evidence concerning these. Public policies toward business, including emphasis on U.S. antitrust laws and economic analysis of their enforcement; theories of public utility regulation.

ECON 5733* Energy Economics: Traditional and Renewable Energy Markets. Prerequisite(s): Permission of instructor. This course is an applied course in energy economics. The focus is on empirical studies of energy markets, environmental regulation, and the political economy of energy supply and demand. It discusses aspects of local, national, and global markets for oil, natural gas, coal, electricity, nuclear power, and renewable energy. The goal of this course is to provide students interested in energy topics the tools necessary to begin conducting their own research.

ECON 5903* Regional Economic Analysis and Policy. Prerequisite(s): Permission of instructor. Selected topics in location theory, regional economic growth and policies toward regional development in the U.S.

ECON 5913* Urban Economics. Prerequisite(s): Permission of instructor. The urban area as an economic system. Problems of economic policy in urban environment.

ECON 6000* Research and Thesis. 1-12 credits, max 30. Prerequisite(s): Approval of advisory committee. Workshop for the exploration and development of research topics. Research leading to the PhD dissertation.

ECON 6010* Seminar in Economic Policy. 1-3 credits, max 6. Intensive analysis of selected problems in economic policy. Individual research, seminar reports and group discussion of reports.

ECON 6113* Seminar in Economic Theory. Microeconomics.

ECON 6123* Seminar in Economic Theory. Macroeconomics.

ECON 6133* Microeconomic Theory II. Prerequisite(s): 5123. Contemporary price and allocation theory with emphasis on general equilibrium analysis. Welfare economics.

ECON 6143* Macroeconomic Theory II. Prerequisite(s): 5133. National income, employment and the price level from the point of view of dynamics. Growth models.

ECON 6233* Time Series Econometrics. Prerequisite(s): 5243 or equivalent. Advanced topics and fundamental elements in economic as well as financial time series models. Recently developed techniques with stationary and nonstationary time series, including Box-Jenkins and forecast methods, unit root, cointegration, error correction model, and VAR.

ECON 6243* Econometrics II. Prerequisite(s): 5243. Advanced econometric theory covering single and simultaneous equations models, seemingly unrelated regressions, limited dependent variable models, causality, and pooled models.

Education (EDUC)

EDUC 1111 Orientation to Education. Lab 1. Designed to aid in the transition from high school to university, and to increase student success at Oklahoma State University and the College of Education. Student will explore topics and resources related to the academic and social development of OSU students. In addition, students are encouraged to reflect on their own personal characteristics, values, and attitudes and relate these to their chosen major and ultimately their profession.

EDUC 2000 Special Topics in Education. 1-3 credits, max 3. Specialized readings in education.

EDUC 2510 Innovative Education Studies. 1-3 credits, max 6. Designed to meet unique or special needs of individuals involved in education. Topics include contemporary approaches to meeting educational challenges on the professional as well as the personal classroom experience. *Graded on a pass-fail basis.*

EDUC 3080 International Experience. 1-18 credits, max 36. Prerequisite(s): Consent of the associate dean of the college. Participation in a formal or informal educational experience outside of the USA.

EDUC 3090 (I) Study Abroad. 1-18 credits, max 18. Prerequisite(s): Participation in an OSU reciprocal exchange program, consent of the Study Abroad office, and associate dean of the college. Participation in a formal study abroad program in which a semester or year is spent in full-enrollment at a university outside the U.S.

EDUC 3110 Honors Directed Study. 1-3 credits, max 3. Prerequisite(s): Admission to the College of Education's Honor Program. Individualized directed study approved by a sponsoring professor or Honors coordinator.

EDUC 4050 Honors Colloquium. 1-9 credits, max 9. Prerequisite(s): Consent of instructor or honors coordinator. Study of an interdepartmental and interdisciplinary nature of various important issues and aspects as related to the field of education. Provides an intellectual challenge for the able student with a strong dedication to scholarship.

EDUC 4110 Professional Education Seminar. 1-6 credits, max 6. Problems, trends, and pertinent education issues. May include simulation, small-group instruction and field-based experiences. For the pre-service or in-service level.

EDUC 5110* Contemporary Educational Issues. 1-6 credits, max 6. Contemporary topics and issues in the broad field of education. May include television interaction, small group discussion and outreach and field experiences. *Written reports required. Graded on a pass-fail basis.*

EDUC 5910* Educational Field Experiences. 1-6 credits, max 6. Prerequisite(s): Consent of instructor. Guided field experience appropriate to a specific program of study. Field experience preceded and followed by appropriate on-campus seminars, readings and reports.

EDUC 5993* Instructional Effectiveness in Higher Education. Prerequisite(s): Graduate standing or consent of instructor. For teaching assistants in all areas. The many aspects of teaching in higher education. Both theory, e.g., traditional instructional design and practical applications, e.g., how to create a lecture. Issues related to instructional design, development of classroom climate, understanding and assessment of students, classroom practices, materials creation for teaching and development of support systems.

Educational Leadership (EDLE)

EDLE 2513 Foundations of Ethical Leadership. Prerequisite(s): 24 hours in good standing; admission into the UGLC or consent of instructor. Introduces students to a variety of theoretical views of ethics and leadership studies through the identification of contemporary ethical challenges and the development of foundational leadership skills to meet those challenges. (Same course as EPSY 2513)

EDLE 4513 Ethical Leadership for the Common Good. Prerequisite(s): 2513 or EPSY 2513. Builds on foundational knowledge of ethical theory and leadership studies through application of ethical theory and leadership skills to specific contexts and evaluation of their results. (Same course as EPSY 4503)

EDLE 5000* Thesis or Report. 1-10 credits, max 10. Prerequisite(s): Consent of instructor. Master's students may earn up to two hours of credit for a report or six hours of credit for a thesis. Students working on a specialist's report may earn a maximum of 10 hours of credit.

EDLE 5203* Foundations of Adult and Continuing Education. Societal trends, issues and institutions which have influenced the development and current status of adult and continuing education. Analyses and critiques of contemporary adult and continuing education activities, materials and clientele groups served, and their implications for new and existing programs in the field.

EDLE 5253* The Principalship. Prerequisite(s): 5000-level course in school administration or equivalent. Strategies, techniques and solutions used by the principal in the administration and leadership of a public school.

EDLE 5313* Characteristics of Adult Learners. Learning patterns, interests and participation patterns among adults in a variety of educational settings. Theories of learning and behavior modification for adults, with implications for adult and continuing education programs. Particular attention given to learners in occupational, adult basic, community junior college, extension and proprietary program settings.

EDLE 5323* School Finance. Development of conceptual bases in economics of education, taxation, distribution systems, policy analysis; application to Oklahoma school finance; and introduction to budget development.

EDLE 5353* Instructional Strategies for Adults. An analysis and application of the various techniques and materials available to facilitate the learning process for adults. Concentration on the process of designing effective learning experiences for adults and developing competencies of the facilitators of group and self-directed learning.

EDLE 5473* Supervision of Instruction. Application of modern approaches to instructional supervision through practice in recording and analyzing teacher behavior in actual classroom settings. Clinical and group methods for improving instruction.

EDLE 5720* Education Workshop. 1-4 credits, max 8. Analysis of organizational, administrative, and instructional problems by common schools and higher education personnel.

EDLE 5723* Education Law. Study of the legal framework of education (constitutional law, case law, and Oklahoma law) with emphases on church-state issues, tort liability, teachers' rights, and student rights.

EDLE 5813* Leadership Theory and Ethical Decision-Making. Developing understanding of leadership theory and issues related to decision-making in educational settings. Exploring leadership and decision-making within an ethical context.

EDLE 5883* Field Studies Internship I. Lab 3. Prerequisite(s): Consent of instructor. Directed internship experiences designed to relate ideas and concepts to problems encountered in education by faculty and administrators.

EDLE 5893* Field Studies Internship II. Lab 3. Prerequisite(s): Consent of instructor. Directed advance internship experiences designed to relate ideas and concepts to problems encountered in educational organizations by faculty and administrators.

EDLE 5953* Developing Educational Organizations. Prerequisite(s): 5813. Understanding and critically analyzing conventional and novel approaches to the climate and governance of schools and higher education.

EDLE 5973* Foundations of Higher Education. Overview of the historical background and philosophical foundations of American higher education.

EDLE 5983* Administrative Issues in Higher Education. Overview of the organization and administration operations and analyses of social, political and legal influences on colleges and universities.

EDLE 6000* Doctoral Dissertation. 1-15 credits, max 15. Required of all candidates for the Doctor of Education degree. Credit given upon completion of the thesis.

EDLE 6003* Educational Ideas. Decision-making processes used in educational systems and use of modern technologies for curricular enhancement and professional development.

EDLE 6143* Resources for the Study of Educational Leadership. Introduction to research traditions, tools and processes that are integral to the study of educational leadership.

EDLE 6233* Critical Issues in Higher Education. Issues that have shaped and are shaping higher education in American society.

EDLE 6243* Connecting Theory and Practice in Administering Schools. Application of research findings and theoretical concepts to best practice in administering educational organizations.

EDLE 6343* Problem Solving in School Administration. Identifying and analyzing administrative problems, individually and collectively, in school settings.

EDLE 6353* The Superintendency. Integration of theory and practice through examination of roles and responsibilities of the superintendent. Particular emphasis on leadership, communications, and the changing nature of public education.

EDLE 6363* Special Topics in School Finance Policy. Prerequisite(s): Admission to the Graduate College and EDLE 5323 or equivalent. Investigation of problems in education finance policy within the interconnected concepts of liberty, equity, equality, adequacy and efficiency.

EDLE 6393* The Human Factor in Administering Schools. Analysis and critique of current issues in school personnel administration such as recruitment, selection, promotion, morale, salary, staff relations and teacher assessment.

EDLE 6423* The Politics of Education. Activities of schools as they relate to the political environment, e.g., voter behavior, change strategies and community power structures.

EDLE 6453* Special Topics in Education Law. Analysis and critique of selected topics in school law relating to public school administration.

EDLE 6463* Higher Education Law. National and state constitutional provisions, laws, and court cases concerning higher education. Considerable legal research required.

EDLE 6483* School Leadership, Culture and Ethics. Prerequisite(s): Admission to the School Administration doctoral program. Ethical dilemmas and leadership are explored. Personal ethics are studied in terms of integrity in leadership roles.

EDLE 6493* School Improvement/Reform. Prerequisite(s): Admission to the School Administration doctoral program. Focus on the theory and practice of school improvement/reform, especially addressing conditions of underachievement and performance gaps among diverse populations. Knowledge and skill related to understanding evaluating, and implementing school improvement/reform practices. Addresses Oklahoma licensure standards related to the provision of effective instructional practices.

EDLE 6583* The Impact of College of Students and on Society. The psychological and sociological impact that attending four-year colleges and universities has on undergraduates from their freshman year until they graduate.

EDLE 6603* Organizational Theory in Education. Selected organizational typologies, conceptualizations and theoretical frameworks as they relate to organizational behavior and behavior of personnel in organizations.

EDLE 6633* School Leadership and Community Collaboration. Promoting student success, school mission and goals through collaborating with faculty and community members, responding to diverse community interests and needs, and mobilizing community resources.

EDLE 6650* Problems in Educational Administration. 1-4 credits, max 8. Special administrative problem in common schools or higher education, e.g., school plant, school/community relations, administration and the instructional programs, attrition and finance.

EDLE 6683* The Community Junior College. The American two-year college including historical and philosophical development, curricula, students and the learning process, faculty and instruction, administration and governance, support and control. Principles, practices and problems of community colleges in America.

EDLE 6703* Finance in Higher Education. Problems and prospects of financing American education, with in-depth discussion of selected topics, e.g., social capital, federal aid, faculty salaries and state support.

EDLE 6710* Special Problems. 1-4 credits, max 8. Assists administrators with either recurrent or unique problems arising in common schools or in higher education. Emphasizes evaluation and planning related especially to staff, programs and faculty needs.

EDLE 6713* Effective Teaching in College and Universities. Relevant research and practice about effective college teaching, role of faculty in higher education settings, and development of teaching strategies and lessons for application in college classrooms.

EDLE 6733* Planning and Educational Change. Organizational and environmental parameters, sources of change, barriers to change, and strategies for planning and implementing organizational change.

EDLE 6753* Historical Development of Higher Education. History and development of higher education, studies of objectives and functions of institutional types and of students and faculty.

EDLE 6803* Administration in Higher Education. Functions and principles of administration in higher education from historical and contemporary points of view. Both internal and external forces acting on the institution treated.

EDLE 6823* Educational Leadership. Leadership and the implications of leadership across contexts, cultures and time.

EDLE 6833* College and University Presidency. The role and function of the presidency. For those who anticipate a career in college and university administration or a related management position.

EDLE 6843* The Academic Department. Organization and administration in higher education emphasizing an analysis of the academic department and its leader, the department head.

EDLE 6850* Directed Reading. 1-4 credits, max 6. Directed reading for students with graduate standing.

EDLE 6853* Research Traditions in Educational Leadership. Exploration of advanced integrated research strategies and the development of designs and methods supporting the field of educational leadership.

EDLE 6863* University and College Campus Culture. This course examines the concept of institutional and collegiate culture as a lens to understanding higher education institutions and their various stakeholders.

EDLE 6870* Seminar. 1-3 credits, max 9. Topical issues related to administration and/or higher education, including research techniques available to analyze such topics.

EDLE 6883* Internship in Education I. Lab 3. Prerequisite(s): Consent of instructor. Directed internship experiences designed to relate ideas and concepts to problems encountered in education by faculty and administrators.

EDLE 6893* Internship in Education II. Lab 3. Prerequisite(s): Consent of instructor. Field experiences in a variety of educational work settings.

EDLE 6910* Practicum. 1-5 credits, max 9. Prerequisite(s): Consent of instructor. Required of all candidates for the Specialist in Education degree. Designed to help the student carry out an acceptable field study or research problem. Credit given upon completion of the written report.

Educational Psychology (EPSY)

EPSY 1003 Learning to Learn. Learning effective strategies to succeed through online individualized assessment, positive attitude development, habit change, development and self-efficacy and self-regulation. Learning tools include goal setting, developing information skills, questioning, transformational learning, presentation and information use skills. Analyzing class materials, problem solving, creativity, teacher analysis, reflection, developing classroom motivation and appropriate classroom behavior to lead to classroom success.

EPSY 1013 Emotional Skills in Learning Success. Striving for academic excellence through self awareness and growth in areas of social and emotional development. Interpersonal and intrapersonal skills, leadership skills, and self-management skills in the context of emotional intelligence theories.

EPSY 2513 Foundations of Ethical Leadership. Prerequisite(s): 24 hours in good standing; admission into the UGLC or consent of instructor. Introduces students to a variety of theoretical views of ethics and leadership studies through the identification of contemporary ethical challenges and the development of foundational leadership skills to meet those challenges. (Same course as EDLE 2513)

EPSY 3063 Creative Processes and Problem Solving. Interrelationships of multiple creative processes to find, probe, and solve problems in learning, teaching, and advancing a diverse society.

EPSY 3110 Educational Psychology Seminar. 1-3 credits, max 3. Problems, trends, contemporary topics, and pertinent issues in educational psychology. Concentrated study of selected areas not usually addressed in the undergraduate curriculum.

EPSY 3113 Psychological Foundations of Childhood. The child from conception to puberty with focus on educational implications of development in cognitive, affective and psychomotor domains.

EPSY 3213 Psychology of Adolescence. The adolescent from pubescence to adulthood with focus on educational implications of development in cognitive, affective and psychomotor domain.

EPSY 3413 Child and Adolescent Development. The person from conception through adolescence with focus on education implications of development in cognitive, affective, social, and physical domains.

EPSY 3513 Behavior Management for Teachers of Diverse Learners. Comprehensive and practical introduction to classroom management for diverse learners. Avoidance of behavioral problems through planning, organization and class management; group management procedures to promote positive learning environments, individualized management for specific behavior problems are addressed.

EPSY 3523 Response to Intervention (RtI): Responding to At-Risk Learners. Focus on innovative practices, assessments, treatments, and prevention of academic and behavioral skill deficits. Students will develop skills in the areas of academic assessment, differentiated instructional techniques, intervention/treatment of learning problems, and the use of data to drive instructional decisions for enhancing student outcomes.

EPSY 3533 Motivating Learners. Current practices in learner motivation, school age through adult. Developing positive attitudes and building community in classrooms to stimulate motivation of all learners.

EPSY 4063* Exploration of the Creative Experience. The creative experience in art (visual to performing), articulation (oratory to literature), thought (philosophy to psychology), business (practices to products), leisure (procreation to recreation). Western and Eastern viewpoints. Personal creative development fostered by modeling and by investigation of proven techniques. A wide range of creative endeavor with an experiential approach. Future-oriented applications.

EPSY 4223 Human Learning in Educational Psychology. Instructional psychology focusing on the study of teaching and learning theory as part of an instructional program to deal with individual, cultural, and environmental differences. Case studies and group discussion emphasizing motivation, planning, evaluation, classroom problems and management.

EPSY 4503 Ethical Leadership for the Common Good. Prerequisite(s): EPSY or EDLE 2513. Builds on foundational model of ethical theory and leadership studies through application of ethical theory and leadership skills to specific contexts and evaluation of their results. (Same course as EDLE 4513)

EPSY 4513* Prevention and Intervention for Violent Incidents and Emergencies in School Settings. The literature and best practices for prevention and intervention for violent incidents and emergencies in school settings.

EPSY 4533 Competency Motivation. Development of competence through the application of research strategies in achievement motivation. Examines intellectual ability, motives, goals, attributions, competence perceptions and values as they relate to developmental issues, demographics, contextual influences, culture, and self-regulation.

EPSY 5000* Master's Thesis. 1-6 credits, max 6. Prerequisite(s): Consent of advisory committee chairperson. Report of research conducted by a student in the master's program in school and educational psychology. Credit given and grade assigned upon completion and acceptance of the thesis.

EPSY 5023* Introduction to School Psychological Service. Prerequisite(s): Admission to school psychometry or school psychology program or consent of instructor. History, role and function, and issues and problems of the school psychological service worker.

EPSY 5063* Introduction to Gifted and Talented Education. Concepts, techniques and strategies for providing differentiated educational programs and experiences for the gifted and talented. State and Federal legislation; development of gifts and talents; program types; identification systems; program development; materials development; teaching techniques and methodologies.

EPSY 5103* Human Development in Psychology. Introduction to basic research and theories of cognitive, emotional and social development. Applications to educational and family settings.

EPSY 5113* Child Psychopathology. Prerequisite(s): 5103 or equivalent; enrolled in school psychology, counseling psychology or clinical psychology program or consent of instructor. Survey of theoretical and conceptual issues related to etiology, assessment and treatment of childhood psychopathology. Educational, empirical and clinical taxonomic systems compared and contrasted.

EPSY 5163* Counseling Techniques for Teachers of Gifted and Talented Students. Techniques for dealing with the conflicts experienced by gifted and talented students. Strategies for consulting with teachers, peers, and parents regarding optimal development of gifts. Peer counseling techniques, dealing with self-concept, social and emotional concerns, problem solving and decision-making, referral procedures and self analysis for teachers related to learning and teaching philosophy and style.

EPSY 5183* Theories of Social Psychology. Prerequisite(s): Permission of instructor. History, theories, and empirical findings regarding the interactions between individual and group functioning.

EPSY 5210* Introductory Practicum in School Psychometry. 2-6 credits, max 6. Prerequisite(s): Admission to school psychology program and consent of instructor. Various roles and functions of school psychologists; supervised experience with and shadowing of psychological service delivery activities, introduction to science-based child learner success orientation and professional identify as school psychologists.

EPSY 5213* Advanced Educational Psychology. Learning and its effect upon coping and adjustment. How learning, environmental and personality factors interact to change human behavior.

EPSY 5310* Practicum in Child and Adolescent Therapy. 1-6 credits, max 12. Prerequisite(s): 6033 and/or permission of instructor. Practicum offers supervised therapy experience with children, adolescents, and their parents for students in School Psychology.

EPSY 5320* Seminar in Educational and School Psychology. 3-9 credits, max 9. In-depth exploration of contemporary topics in educational and school psychology.

EPSY 5363* Differentiated Curriculum Techniques and Materials for Gifted and Talented. Development of curriculum content for horizontal and vertical enrichment and acceleration. Commercial and teacher-prepared materials in imagination; imagery; analogy; metaphor; inductive, deductive and abductive thinking; science; philosophy; psychology; logic systems; problem solving; concept learning; creativity; creative dramatics, etc. Conceptual approaches to the use of the preceding in various interest-based and non-interest-based formats.

EPSY 5403* Issues in Adolescent Development. Current issues in adolescent development in an educational context and culture, including self, family, peers, school and work relationships. Gender differences within culture, race and class examined. Current dilemmas explored using critical theory and action research.

EPSY 5463* Psychology of Learning. Application to education of the principles and theories of the psychology of learning.

EPSY 5473* Psychology of Adult Learning. Analysis of the psychological foundation of adult learning both in and out of learning programs across the lifespan. Differentiates among adults of all ages in terms of practice and performance in a variety of settings, including classroom, community, and work environments. Examines the intellectual, social, cultural, emotional, motivational, and performance components of the psychology of adult learning.

EPSY 5503* Crisis Intervention and Emergency Action in School Settings. Current models for crisis intervention and emergency actions plans in school settings. Preparation for crisis intervention and experience in evaluating crisis and emergency action plans in schools.

EPSY 5510* Practicum in School Psychology. 2-6 credits, max 6. Prerequisite(s): Admission to school psychology program and consent of instructor. Supervised experience in the schools of psychological service delivery. Assessment, consultation, direct interventions and development of professional practice for school psychologists within school settings. Science-based child-success model. Two-three semester sequence.

EPSY 5603* Developmental Issues in Instruction. Prerequisite(s): Three hours in developmental psychology, educational psychology or consent of instructor. Developmental issues in instruction at all levels from early childhood through adulthood. Specific impacts of developmental stages on the acquisition and retention of cognitive, affective and psychomotor development at various levels and contexts will be examined and applications to instruction will be provided.

EPSY 5620* Practicum with Exceptional Learners. 1-8 credits, max 8, Lab 1-8. Prerequisite(s): Consent of instructor. Supervised individual and group experience with exceptional learners. The particular experience (learning disability, mental retardation, gifted, etc.) is determined by the student's field of specialization.

EPSY 5663* Creativity for Teachers. Theoretical origins of creativity and their concomitant applications in the learning environment. Blocks to creative thinking, imagination, imagery, creativity testing, developing ideas and innovations, creative problem solving and teaching techniques and methods to maximize creative potential in all kinds and types of students.

EPSY 5713* Transpersonal Human Development. Human development in terms of individual consciousness, focusing on the implications of such extraordinary states of consciousness as those associated with hallucinogenic drugs and mystical religious experience. Integration of psychological and religious interpretations of development. Applications to practical problems in education and psychology.

EPSY 5720* Educational and School Psychology Workshop. 1-9 credits, max 9. Workshop on various topics related to educational and school psychology.

EPSY 5753* Psychoeducational Assessment of Pre-Schoolers. Relevant issues and challenges associated with the intellectual, social and behavioral assessment of preschool children, from the vantage point of recent research, discourse and policy initiatives. The link between assessment and intervention.

EPSY 5763* Teaching Methods and Techniques for the Gifted and Talented. Subject and skill-related learning facilitation that is process-oriented and doing-centered. The role of the teacher as facilitator, counselor and non-directive change agent. Individualized educational plans, involving independent study, tutoring, correspondence, clustering, mentors, learning centers, resource centers.

EPSY 5783* Psycho-Educational Testing of Exceptional Individuals. Intensive practice in the selection, administration and interpretation of individual tests, appropriate for exceptional individuals.

EPSY 5793* Individual Intellectual Assessment of Children and Youth. Prerequisite(s): 5783 or consent of instructor. Intensive study of the Wechsler Scales, the Stanford-Binet, and other selected tests of mental ability. Emphasis and practice in administration, scoring, interpretation. Issues related to report writing and non-discriminatory assessment.

EPSY 5803* Advanced Intellectual Assessment. Contemporary Theories and Assessment of Intelligence and Cognitive Abilities. Prerequisite(s): 5783 or equivalent; good standing in school, counseling, or clinical psychology program, or consent of instructor. Examination of contemporary theories of intelligence and cognitive abilities and intelligence to new assessment technology. Appropriate for school, counseling, or clinical psychology students who are already familiar with tests such as the Wechsler Series and the Stanford Binet IV.

EPSY 5813* Parent and Family Interventions in School Psychology. Prerequisite(s): By consent of instructor only. Empirically-supported, parent-implemented interventions for children and adolescents addressing a variety of home and school problems within the discipline of school psychology.

EPSY 5853* Applied Behavior Analysis. Intensive study of behavior and analytical principles as they relate to the functional assessment and intervention development with an emphasis on developmental issues. Fundamental theoretical and philosophical issues, procedures and findings within applied behavior analysis in educational and related psychology specialties.

EPSY 5863* Developing Programs for the Gifted and Talented. Programs based on various philosophies and structural concepts of gifted and talented education, e.g., mainstreaming, self-contained, pullouts, magnet schools, time blocking, acceleration and enrichment. Programs designed for general and specific academic ability; however, exposure will be provided to creative and productive thinking programs, leadership programs, and visual and performing arts programs. Specific models included.

EPSY 5963* Developing Resources to Support Educational Programs. Development, management and evaluation of programs in intra- and extra-class settings. Program types include parent, volunteer, mentor, tutor, group sponsors in technology, business involvement, curricular enhancement and service learning. Developing community and business interest through public relations, financial development, grantsmanship or resource information sources. Developing Internet resources to support learners.

EPSY 5993* Identification and Behavior Characteristics of the Gifted and Talented. Cognitive, affective, and behavioral characteristics of the gifted and talented. Selection of tests and interest inventories. Selection and/or developing of nomination/recommendation forms/models, inventories, checklists, rating scales, sociograms as well as data abstraction from cumulative and anecdotal records. Functions of gifted/talented identification committees.

EPSY 6000* Doctoral Dissertation. 1-25 credits, max 25. Prerequisite(s): Consent of advisory committee chairperson. Report of research conducted by a student in the doctoral program in educational school psychology. Credit given and grade assigned upon completion and acceptance of the doctoral thesis.

EPSY 6030* Doctoral Seminar in School Psychology. 3-6 credits, max 6. Prerequisite(s): Admission to school psychology doctoral program. Research in school psychology in areas such as philosophy of science, major areas of emphasis, research design, ethical concerns, solving problems in schools, and publication. Scientific and professional ethics and standards of psychologists.

EPSY 6033* Introduction to Psychotherapy with Children and Adolescents. 3 credits. Prerequisite(s): 5113. Development of individual and group skills in therapy with children and adolescents. Applications of theories of psychotherapy to a variety of disorders and coping skills, crisis intervention and adaptive social skills training.

EPSY 6043* Adult Development. Theory and research concerning human development during the adult years. Practical applications for serving adult populations in education and education-related settings.

EPSY 6063* Research Applications with Q Methodology. Research applications using qualitative, quantitative and Q methodology. Subjectivity and abductive reasoning explored with a limited research project. Professional research skills, including ethics, process, team research and manuscript development.

EPSY 6110* Seminar in School Psychology. 1-3 credits, max 6. An assessment of psychological techniques applied to problems encountered in the internship.

EPSY 6113* Child Personality Assessment. Prerequisite(s): Admission to school psychology or counseling psychology program, or consent of instructor. The personal and social assessment of children using objective and projective techniques.

EPSY 6133* History and Systems of Psychology. History and systems of psychology related to contemporary applied psychology.

EPSY 6143* Introduction to Developmental Psychopharmacology. Prerequisite(s): Graduate student in School of Applied Health and Educational Psychology, or psychology; or 5103, or equivalent, or consent of instructor. Introduction to biological basis of behavior and behavior disorders. Review of the biological systems associated with psychopharmacological treatments. Major drug classes and their role in the treatment of developmental psychopathology.

EPSY 6153* Advanced Research in Educational Psychology. Prerequisite(s): Admission to doctoral program in Educational Psychology (School, Educational, Counseling, REMS Options). Research in educational psychology in areas such as philosophy of science, issues in basic and applied research in psychology, research ethics, advanced quantitative and qualitative research design. Preparation of the dissertation and grant proposals and dissemination of research.

EPSY 6163* Emotion and Cognition. The relationship between emotion and cognition as it relates to knowing and learning. History, wisdom and the interdependence of affect and cognition, the effects of mood on memory, emotion in feminist epistemology, the role of feeling in the writing process, intuition, and narrative thought. Exploration of potential research.

EPSY 6210* Internship in School Psychology. 3-6 credits, max 12. Prerequisite(s): Admission to school psychology program; completion of all course work; completed readiness for internship form and approval of school psychology faculty. Supervised field experience of non-doctoral school psychologists by certified school psychologists for a maximum of 1200 hours over the course of an academic year, or half-time for two years.

EPSY 6310* Doctoral Practicum in School Psychology. 1-6 credits, max 6. Prerequisite(s): 5510 and consent of instructor. Advanced practica for doctoral students in school psychology. Supervised experiences in assessment, consultation, intervention and supervision activities in a non-school setting.

EPSY 6323* Psychological Consultation. Prerequisite(s): Admission to graduate program in the SAHEP or psychology program. Models and strategies for the delivery of special services in the schools and other agencies that focus on serving the mental health needs of children, adolescents and adults. The use of consultation as a problem solving alternative to the assessment/label approach. (Same course as CPSY 6323, students can receive credit in only one of the courses)

EPSY 6333* Instructional Assessment and Consultation. Prerequisite(s): Admission to College of Education or psychology program; or consent of instructor. Development of skills in consulting with educational and agency personnel and families regarding academic and educational functioning. Systematic curriculum-based assessment and measurement techniques as well as planning, implementing and evaluating instructional interventions. Evaluation of the instructional environment.

EPSY 6343* Behavioral Assessment and Consultation. Prerequisite(s): 5113 or equivalent; admission to school psychology, clinical psychology or counseling psychology program; or consent of instructor. Development of psychological skills in systematic behavioral assessment and consultation with application to school, agency and home settings. Systematic behavioral observation, data collection and intervention design, implementation and evaluation.

EPSY 6443* Theories and Problems in Educational Psychology. Prerequisite(s): Admission to the doctoral program in educational psychology or consent of instructor. Theoretical foundations and nature of the problems studied in educational psychology; current issues and historical overview.

EPSY 6460* Internship in Educational Psychology. 1-9 credits, max 9. Prerequisite(s): Consent of instructor. Supervision and guidance of teaching and service in educational psychology. May be repeated for credit when work assignment varies. Required of all teaching assistants in educational psychology during the first semester of each new teaching assignment. Includes cooperative planning and evaluation.

EPSY 6533* Human Motivation. A theoretically-oriented approach to the concept of motivation; essential precursors to human behavior and applications to the solution of real and hypothetical problems.

EPSY 6610* Doctoral Internship in School Psychology. 3-6 credits, max 6. Prerequisite(s): Admission to school psychology doctoral program, completion of all course work; readiness for internship form, approved by school psychology faculty. Supervised experience of doctoral school psychologists for final preparation to enter the profession of school psychology. Designed to fulfill requirements of APA and State Board of Examiners of Psychologists.

EPSY 6613* Instructional Systems Design. A practically-oriented coverage of analyzing, defining, sequencing and validating instructional systems. Developing educational objectives, course development, matching instruction to individual differences and evaluation of systems. Techniques of developing and validating instructional components.

EPSY 6850* Directed Readings in Educational and School Psychology. 1-6 credits, max 6. Prerequisite(s): Consent of instructor. Directed reading for students with advanced graduate standing in educational and school psychology.

EPSY 6880* Internship in Education. 1-8 credits, max 8, Lab 3-24. Prerequisite(s): Admission to advanced graduate program and consent of area coordinator. Directed off-campus experiences designed to relate ideas and concepts to problems encountered in the management of the school program.

Educational Technology (EDTC)

EDTC 3123 Applications of Educational Technologies. Introduction to the design and development of instruction using educational media and technology. Materials development, contemporary applications of computers and other electronic systems to instruction. Integration of instructional design, instructional media, and instructional computing. *May not be used for degree credit with EDTC 4113.*

EDTC 4113 Applications of Media and Technology. Introduction to the application of media and technology to formal and informal learning situations. Intended for non-professional education majors. *May not be used for degree credit with EDTC 3123.*

EDTC 5000* Master's Report or Thesis. 1-6 credits, max 6. Prerequisite(s): Consent of instructor. Students studying for a master's degree enroll in this course for a total of 2 credit hours if they write a report or 6 hours if they write a thesis.

EDTC 5103* Advanced Computing Applications in Education. In-depth exploration of advanced technology use in teaching and learning environments. Examination of current issues of technology use in instructional settings.

EDTC 5113* Digital Media Production for Instruction. Introduction to the production of digital media for instruction. Topics covered: Instructional design for digital media, message design, use of graphics, multimedia development tools. Current research, trends, tools and issues in media production will also be addressed.

EDTC 5153* Computer-Based Instructional Development. Examinations of curriculum strategies, related research issues, and techniques for developing computer-based instruction. Students will develop and evaluate computer-based instruction with case studies.

EDTC 5203* Foundations of Educational Technologies. A general introduction to the field of Educational Technology. Define, describe, and critically evaluate the foundations, issues and careers in educational technology.

EDTC 5303* Digital Games and Simulations in the Classroom. Introduces students to the philosophies, theories, processes, and practices of integrating digital games and simulations into the classroom.

EDTC 5403* Creativity and Innovation in Educational Technology. In-depth examination of a variety of innovation technologies and engagement in pedagogies and technologies associated with creativity, innovation and invention.

EDTC 5503* Facilitating Online Learning. Apply knowledge of pedagogy, standards for online teaching, online community building, and teaching with technology to design and facilitate online learning environments.

EDTC 5720* Education Workshop. 1-8 credits, max 8. For teachers, principals, superintendents and supervisors who have definite problems in instruction or administration. Students must register for the full number of credit hours for which the workshop is scheduled for a particular term.

EDTC 5753* Introduction to Instructional Design. Introduction to the systematic design of instruction. Topics covered: Analysis, design, development, implementation, and evaluation of instructional materials in a variety of educational settings. Current research, trends and issues in instructional design will be addressed.

EDTC 5773* Instructional Systems Management. Principles of management relevant to instructional systems, including, but not limited to: project, resource, quality, change, financial, information technology, human resource, program evaluation, product, knowledge and performance management.

EDTC 5850* Directed Study. 1-3 credits, max 3. Prerequisite(s): Consent of instructor. Directed study for master's level students.

EDTC 6000* Doctoral Dissertation. 1-15 credits, max 15. Required of all candidates to the Doctor of Education degree. Credit is given upon completion of the thesis.

EDTC 6153* Advanced Computer-Based Instructional Development. Prerequisite(s): 5153 or consent of instructor. Design of user-friendly instructional interfaces and computer-based learning management systems.

EDTC 6283* Performance Improvement Technology. Overview of performance improvement, as defined within the field of Educational Technology. Training and non-training interventions to improve performance in learning situations. Sample topics may include needs assessment, motivation systems, compensation systems, job aids, or electronic performance support systems.

EDTC 6333* Human Computer Interaction. Prerequisite(s): 5153 or consent of instructor. Human cognitive architecture, information processing, and design of effective educational, computer-based interfaces.

EDTC 6423* Trends and Issues in Educational Technology. Selected problems, issues and trends in educational technology.

EDTC 6850* Directed Reading. 1-6 credits, max 6. Prerequisite(s): Consent of instructor. Directed reading for students with advanced graduate standing to enhance students' understanding in areas where they wish additional knowledge.

EDTC 6880* Internship in Education. 1-8 credits, max 8. Prerequisite(s): Consent of instructor. Directed off campus experiences designed to relate ideas and concepts to problems encountered in the management of the school program.

EDTC 6910* Practicum. 1-6 credits, max 6. Prerequisite(s): Consent of instructor. Helps the student carry out an acceptable research problem (practicum) in a local school situation. *Credit given upon completion of the written report.*

Electrical and Computer Engineering (ECEN)

ECEN 2011 Experimental Methods I. Lab 3. Prerequisite(s): PHYS 2114; Co-requisite(s): ENSC 2613. Basic electrical measurements and instrumentation techniques and devices. Use of voltmeters, ammeters, oscilloscopes, impedance bridges to study resistive, inductive, and capacitive circuit elements in steady state and transient operation. Reinforces ENSC 2613 and introduces design of instrumentation networks. *Serves as introduction for non-majors.*

ECEN 3020 Supervised Research Project. 1-3 credits, max 3. Prerequisite(s): Consent of instructor and ECEN department head. Supervised research project for qualified students. *May be repeated no more than three times for a total of three credit hours.*

ECEN 3113 Energy, Environment and Economics. Prerequisite(s): 3513 and admission to Professional School. Topics relevant to understanding the close relationship between energy use, its impact on the environment, and overall economic implications. Green energy technologies (wind, solar, hydro) will be considered along with conventional techniques. Both conventional and non-conventional energy technologies will be discussed.

ECEN 3233 Digital Logic Design. Lab 2. Boolean algebra, optimization of logic networks. Design using SSI, and MSI, LSI components. ROM and PLA applications. Analysis and design of clock sequential logic networks. Flip-flops, counters, registers. Asynchronos circuit design and analysis. Laboratory experience in implementing combinational and sequential logic devices.

ECEN 3314 Electronic Devices and Applications. Lab 2. Prerequisite(s): 2011, 3714; degree program requires admission to Professional School prior to enrollment. Semiconductor electronic components including MOSFETs, BJTs, JFETs, and OpAmps. Emphasis on device models and use of solid state electronic devices to analyze, synthesize and design amplifiers and switching circuits. SPICE simulations are extensively utilized. Basic building blocks for analog and digital applications. Theoretical concepts and methods are demonstrated and reinforced through laboratory exercises.

ECEN 3513 Signal Analysis. Prerequisite(s): 3021, 3713 or 3714; degree program requires admission to Professional School prior to enrollment. Deterministic signals. Fourier series and Fourier transforms. Impulse response, convolution and correlation. Sampling theorem. Analog modulation techniques.

ECEN 3613 Electromagnetic Fields. Prerequisite(s): ENSC 2613, MATH 2163 and MATH 2233. Time-harmonic and transient response of transmission lines. Maxwells equations and their applications to engineering problems in electrostatics, magnetostatics, time-harmonic fields and plane wave propagation.

ECEN 3623 Mathematical Foundations of Electromagnetics and Photonics. Lab 2. Prerequisite(s): 3613; degree program requires admission to Professional School prior to enrollment. Mathematical and computational treatment of fundamental electromagnetic theory, with applications to microwave engineering, photonics and semiconductor design. Energy and power; Laplace and Poisson equations; wave equation, including reflection, refraction, and diffraction; and classical electromagnetic radiation at macroscopic and microscopic levels.

ECEN 3714 Network Analysis. Lab 2. Prerequisite(s): 2011, ENSC 2613, MATH 2233. Laplace transform, transfer functions, magnetically coupled circuits and two-port networks. Theoretical concepts and methods are demonstrated and reinforced through laboratory exercises.

ECEN 3723 Systems I. Prerequisite(s): ENSC 2113, 2613, MATH 2233. Physical and mathematical modeling of electrical and mechanical dynamic systems. Transient response of first and second order systems. Laplace transform techniques for solving differential equations, transfer functions, frequency response and resonance.

ECEN 3903 Introduction to Semiconductor Devices. Prerequisite(s): PHYS 2114 or equivalent. Crystal structure, the quantum theory of solids. The physics of semiconductor materials and the projunction, with an emphasis on applications to semiconductor devices. (Same course as PHYS 3313)

ECEN 3913 Solid State Electronic Devices. Prerequisite(s): PHYS 3313 or ECEN 3903. Solid state physics basis of modern electronic devices. Introductory quantum mechanics. Energy bands in solids. Electronic properties of semiconductors. Junction diodes. Bipolar transistors. Field effect transistor.

ECEN 4010* Technical Problems and Engineering Design. 1-12 credits, max 12. Prerequisite(s): Consent of instructor. Individual independent study projects selected in consultation with the instructor; analysis or design problems, literature searches and computer simulations may be involved.

ECEN 4013 Design of Engineering Systems. Lab 4. Prerequisite(s): 2011, 3714, 3314, 3233 and ENSC 3323 and ENGL 3323 as a co-requisite. Complete design cycle for several small design projects, each including establishing objectives, synthesis, analysis, construction, testing and evaluation. Use of modern lab equipment and fabrication techniques. Development of communication skills.

ECEN 4024 Capstone Design. Lab 2. Prerequisite(s): ECEN 4013; degree program requires admission to Professional School prior to enrollment. Continuation of ECEN 4013. Student project teams design, build, test and present results for realistic projects from university and industrial sponsors. Formulation of specifications, consideration of alternative solutions, feasibility considerations, detailed system descriptions, economic factors, safety, reliability, aesthetics, ethics and social impact.

ECEN 4030 Undergraduate Professional Practice. 1-8 credits, max 8. Prerequisite(s): Approval of ECEN department head. Experience in application of electrical engineering principles to typical problems encountered in industry. Solutions to the problems by student participation in the role of engineer or engineering intern.

ECEN 4133* Power Electronics. Prerequisite(s): Degree program requires admission to Professional School prior to enrollment. Power electronic devices, components, and their characteristics; DC to AC conversion; fundamentals of inverters and waveshaping devices; application aspects; control aspects; characteristics and state-of-the-art of advanced power inverter and power conditioning topologies.

ECEN 4153* Power System Analysis and Design. Prerequisite(s): Degree program requires admission to Professional School prior to enrollment. Power system component models from circuit theory. Formulation and design of the load flow model and the optimum economic generator allocation problem utilizing computer methods.

ECEN 4213* Embedded Computer Systems Design. Lab 2. Prerequisite(s): ENSC 3213 and CS 1113. Degree program requires admission to Professional School prior to enrollment. Design of microprocessor-based systems through proper integration of hardware and software. Serial and parallel communications, sensor interfacing, computer control of external devices, and color graphics hardware. Design of PASCAL and assembly language modules for optimum real-time system performance.

ECEN 4233* High Speed Computer Arithmetic. Prerequisite(s): 3233; degree program requires admission to Professional School prior to enrollment. Course covers computer arithmetic as applied to general purpose and application-specific processors. Focus is on developing high-speed arithmetic algorithms and understanding their implementation in VLSI technology at the gate level.

ECEN 4243* Computer Architecture. Lab 2. Prerequisite(s): 3233 and ENSC 3213. Degree program requires admission to Professional School prior to enrollment. Functional organization and hardware design of digital computer systems with emphasis on microprocessor-based systems. CPU organization, features of microprocessors including advanced 32-bit CPU's, memory system design including cache, virtual memory, error detection and correction, I/O operations, including direct memory access and peripheral interface design.

ECEN 4273* Software Engineering. Prerequisite(s): ENSC 3213 or CS 1113, CS 3443. Degree program requires admission to Professional School prior to enrollment. Functional organization and hardware design of digital computer systems with emphasis on microprocessor-based systems. CPU organization, features of microprocessors including advanced 32 bit CPU's memory system design including cache, virtual memory, error detection and correction, I/O operations, including direct memory access and peripheral interface design. (Same course as CS 4273)

ECEN 4283* Computer Networks. Prerequisite(s): ENSC 3213 or CS 3443; UNIX knowledge; degree program requires admission to Professional School prior to enrollment. Computer networks, distributed systems and their systematic design. Introduction to the use, structure, and architecture of computer networks. Networking experiments to describe network topology. ISO reference model. (Same course as CS 4283)

ECEN 4303* Digital Integrated Circuit Design. Prerequisite(s): 3233 and 3314; degree program requires admission to Professional School prior to enrollment. Theory of digital and electronics circuits. Digital logic families TTL, IIL, ECL, NMOS, CMOS, GaAs. Large signal models for transistors. Implementation at RAM and ROM. Circuit design for LSI and VLSI.

ECEN 4313* Linear Electronics Circuit Design. Prerequisite(s): 3314; degree

program requires admission to Professional School prior to enrollment. Class A and B small-signal, push-pull power, complementary symmetry, differential and operational amplifiers, utilizing field-effect transistors, bipolar transistors, tunnel diodes and integrated circuits. Emphasis on amplification in electronic devices, design and analysis of wide-band amplifier circuitry.

ECEN 4353* Communication Electronics. Prerequisite(s): 3314; degree program requires admission to Professional School prior to enrollment. Design of tuned voltage and power amplifiers, oscillators and mixers, modulation and detection, and parametric amplifiers.

ECEN 4413* Automatic Control Systems. Prerequisite(s): 3723 or MAE 3723; degree program requires admission to Professional School prior to enrollment. Properties of feedback control systems, mathematical models of basic components, state-variable models of feedback systems, time-domain analysis, stability, transform analysis, frequency domain techniques, root-locus design of single input single output systems and simple compensation techniques. (Same course as MAE 4053)

ECEN 4503* Random Signals and Noise. Prerequisite(s): 3513, 3714; degree program requires admission to Professional School prior to enrollment. Analysis of electrical systems using elementary concepts of probability, random variables and random processes. Frequency and time domain response of linear systems driven by random inputs. Statistical properties of electrical noise. Analysis and design of optimum linear systems.

ECEN 4523* Communication Theory. Prerequisite(s): 3513; degree program requires admission to Professional School prior to enrollment. Noise in modulation systems. Digital data transmission. Design of optimal receivers. Introduction to information theory.

ECEN 4533* Data Communications. Prerequisite(s): 4503; degree program requires admission to Professional School prior to enrollment. Signal detection in noise. Tradeoffs between bandwidth signal-to-noise ratio and rate of information transfer. Transmission multiplexing and error handling. Elements of computer network design. Data link protocols.

ECEN 4613* Microwave Engineering. Prerequisite(s): 3613; degree program requires admission to Professional School prior to enrollment. Aspects of propagation, transmission, and radiation of microwave energy. Plane wave propagation; lossless and lossy media, reflection, refraction, and polarization. Transmission line theory; lumped element model, characteristic impedance, impedance matching, and transient response. Theory of waveguides and cavity resonators. Microwave network theory and S-parameters. Introduction to radiating systems.

ECEN 4703* Active Filter Design. Prerequisite(s): 3613; degree program requires admission to Professional School prior to enrollment. Introduction to passive filters; operational amplifiers as network elements; filter specifications; design of active filters. Laboratory design projects and computer simulations.

ECEN 4743* Introduction to Biomedical Engineering Modeling and Systems. Prerequisite(s): 3714, 4763; degree program requires admission to Professional School prior to enrollment. An overview of the field of biomedical engineering and an introduction of the modeling approaches implemented in biomedical engineering. Topics include bio-electronics, biomechanics, compartmental modeling, bio-signal processing, biomedical optics, etc. The course will demonstrate a few of major fields of activity in which biomedical engineers are engaged and modeling approaches are implemented.

ECEN 4763* Introduction to Digital Signal Processing. Prerequisite(s): 3513; degree program requires admission to Professional School prior to enrollment. Introduction to discrete linear systems using difference equations and z-transforms. Discrete Fourier analysis. Design of digital filters. Sampling theorem. Applications of digital signal processing.

ECEN 4773* Real Time Digital Signal Processing. Prerequisite(s): 4763 or equivalent; degree program requires admission to Professional School prior to enrollment. DSP Processor architectures and programming. A/D, D/A, polled and interrupt-driven I/O. Realtime implementation of FIR/IIR filters, the FFT, and other DSP algorithms on special purpose DSP hardware from Motorola, Texas Instruments and others. Link between DSP theory and practical implementation.

ECEN 4823* Design of Optical Systems. Lab 2. Prerequisite(s): PHYS 2114; degree program requires admission to Professional School prior to enrollment. Introduction to optics through the design, construction, and characterization of optical systems. Emphasis on geometrical optics and spectroscopy.

ECEN 4843* Design of Lasers and Systems. Lab 2. Prerequisite(s): 3613; degree program requires admission to Professional School prior to enrollment. Introduction of the design of lasers and optical systems based on lasers including the design, construction, and characterization of lasers. Gaussian beams and optics, laser gain materials, laser cavities, advanced topics.

ECEN 5000* Thesis or Report. 1-6 credits, max 6. Prerequisite(s): Approval of major professor. A student studying for the master's degree will enroll in this course for a maximum of six credit hours.

ECEN 5030* Professional Practice. 1-8 credits, max 8. Experience in application of electrical engineering principles to typical problems encountered in industry and government engineering design and development projects. Solutions to the problems require participation by the student in the role of junior engineer or engineer-intern. Problem solutions involve economics and ecological considerations as well as technology and must be adequately documented.

ECEN 5060* Special Topics. 1-6 credits, max 30. Prerequisite(s): Consent of instructor. Engineering topics not normally included in existing courses. Repeat credit may be earned with different course subtitles assigned.

ECEN 5070* Directed Studies. 1-6 credits, max 6. Prerequisite(s): Consent of instructor. Investigation outside of the classroom of topics not normally covered in lecture courses.

ECEN 5113* Power Systems Analysis by Computer Methods. Quasi-static control of power systems and analysis of power systems under abnormal operating conditions. Transient stability studies. Models formulated and solutions outlined for implementation on the computer.

ECEN 5123* Engineering Systems Reliability Evaluation. Techniques and concepts needed for evaluating the long-term and short-term reliability of a system. Topics include static and spinning generation capacity; transmission, composite, interconnected, and dc system reliability evaluations; and power system security. Applications to systems other than power systems included. For students with little or no background in probability or statistics.

ECEN 5153* Direct Energy Conversion. Energy conversion techniques and applications; thermo-electrics, thermionics, fuel cells, MHD and other processes involving electrical, mechanical and thermal energies. State-of-the-art developments in direct energy conversion using selected papers from journals and other publications. Gives the student a proper perspective of the possibilities and problems associated with satisfying future energy requirements.

ECEN 5193* Power Economics and Regulation. Prerequisite(s): Vector calculus, familiarity with complex numbers. Natural monopoly, regulated monopolities. Power pricing. Deregulation and the Energy Policy Act of 1992. Bulk power markets, transmission access and wheeling. Economic dispatch and system operations. Security and reliability. Environmental externalities and Clean Air Act compliance. Procurement of new capacity and integrated resource planning. Co-generators and independent power producers.

ECEN 5223* Digital Systems Testing. Prerequisite(s): 3233. Testing of combinational and sequential circuits. Test generation techniques. Design of reliable and testable circuits and systems. Testing for LSI and VLSI.

ECEN 5233* Embedded Sensor Networks. Prerequisite(s): Graduate standing or consent of instructor. Analysis and design of wireless networks, including the integration of sensing, computation, and wireless communication within an embedded system. Mobile sensor networks and body sensor networks. Real world application and new innovations.

ECEN 5253* Digital Computer Design. Prerequisite(s): 4243 or graduate standing. Analysis and design of digital computers. Arithmetic algorithms and the design of the arithmetic/logic unit (ALU). Serial and parallel data processing; control and timing systems; microprogramming; memory organization alternatives; input/output interfaces. (Same course as CS 5253)

ECEN 5263* VLSI Digital Systems Design. Prerequisite(s): 4303; 5253 recommended or graduate standing. Design of very large-scale digital systems on a single chip. Review of MOS technology. Design rules imposed by fabrication techniques. Systematic structures for control and data flow; system timing; highly concurrent systems. Experimental opportunities available.

ECEN 5283* Computer Vision. The development of machine vision and advanced image understanding techniques for robotics, automated inspection, biomedicine. Object recognition, motion analysis, object tracking, segmentation, representation, and 3-D analysis.

ECEN 5313* Solid-State Electronics I. An advanced study of electronic networks. Application of solid-state devices to the medium- and low-frequency regions. Integrated networks as replacements for discrete-component networks. Discrete and integrated operational amplifiers. Broad-band and tuned amplifiers.

ECEN 5333* Semiconductor Devices. Prerequisite(s): 3314 and PHYS 3313 or equivalent. Semiconductor crystal structure and device fabrication, carrier distribution and transport, pn junction and diode, metal-semiconductor heterojunction, MOSFET, BJT and optoelectronic devices.

ECEN 5353* Advanced Power Electronics. Prerequisite(s): 4133. Characteristics of high power semiconductor devices and the application of such devices to power conditioning, inversion and wave shaping at high power levels.

ECEN 5363* CMOS Analog Integrated Circuit Design. Prerequisite(s): 4313. Advanced study of solid state CMOS linear integrated circuits. Topics include: Op Amps, comparators, multipliers, D/A and A/D converters and Op Amp building blocks. Op Amp building blocks include, differential pairs, current mirrors, gain, output stages, and references. VLSI layout and circuit simulation using SPICE.

ECEN 5373* RF Microwave Circuit Design. Prerequisite(s): 3314 , 4613 and 5333 or equivalent. Smith chart, single- and multi-port network, filter design, RF/microwave components and modeling, matching and biasing network, amplifier, oscillators and mixers.

ECEN 5413* Optimal Control. Prerequisite(s): 5713 or MAE 5713. Optimal control theory for modern systems design. Specification of optimum performance indices. Dynamic programming, calculus of variations and Pontryagin's minimum principle. Iterative numerical techniques for trajectory optimization. (Same course as MAE 5413)

ECEN 5423* Control of Hybrid Systems. Prerequisite(s): 5713 Linear Systems or consent of instructor. Introduction and definitions. Modeling of hybrid systems. Analysis of hybrid systems. Stability analysis. Switched control systems. Hybrid

control design. Applications in power systems, robotics, transportation and multivehicle systems.

ECEN 5433* Robotics Kinematics, Dynamics and Control. Prerequisite(s): 4413 or MAE 4053 or consent of instructor. Kinematic and dynamic analysis of robot manipulators. Inverse kinematics, motion planning and trajectory generation. Industrial practice in robot servo control. Dynamics and control in the presence of constraints. Actuators and sensors. Force sensors and vision systems. Robotic force control and its applications in industry. Passivity-based control algorithms. Advanced control techniques for motion and force control. (Same course as MAE 5433)

ECEN 5463* Nonlinear System Analysis and Control. Prerequisite(s): 4413 or MAE 4053. Failure of superposition of effects; phase-plane analysis; limit-cycles; Lyapunov stability; hyperstability and input-output stability; controllability and observability of nonlinear systems; feedback linearization; robust nonlinear control system design. (Same course as MAE 5463)

ECEN 5473* Digital Control Systems. Prerequisite(s): 4413 or MAE 4053. Input-output and state-space representation of linear discrete-time systems. Approximate methods in discrete-time representation. Stability methods. Controllability, observability, state estimation, and parameter identification. Design and analysis of feedback control system using frequency-domain and state-space methods. Introduction to optimal control. (Same course as MAE 5473)

ECEN 5483* Advanced Mechatronics Design. Prerequisite(s): MAE 4733 or similar course and consent of instructor. Optimizing C programming code for microcontrollers using the assembly language instruction set. RS-232 microcontroller communication protocol. Controller Area Network (CAN) communication protocol plus hands-on CAN bus development boards, advanced topics which could include but are not limited to sensor design, real time operating systems, and advanced communication protocols. *Same course as MAE 5483.*

ECEN 5493* Software Design for Real-Time Distributed Systems. Prerequisite(s): 5483 or MAE 5483 or consent of the instructor. Fundamental concepts associated with the design of software for implementation on distributed computer systems using real-time operating systems. Parallel computing in a real-time environment and control algorithm design. State-of-the-art boards including analog-to-digital and digital-to-analog equipment and newest computer-aided software engineering tools.

ECEN 5513* Stochastic Systems. Prerequisite(s): 3513 and 4503 or STAT 4033. Theory and applications involving probability, random variables, functions of random variables, and stochastic processes, including Gaussian and Markov processes. Correlation, power spectral density, and non-stationary random processes. Response of linear systems to stochastic processes. State-space formulation and covariance analysis. (Same course as MAE 5513)

ECEN 5523* Estimation Theory. Prerequisite(s): 5513 or MAE 5513. Stochastic model development, parameter estimation and state estimation. The linear model, model order determination, least squares estimation, maximum likelihood estimation, Bayesian estimation. Gaussian random vectors, estimation in linear and Gaussian models, state estimation, the Kalman filter, prediction and smoothing. (Same course as MAE 5523)

ECEN 5533* Modern Communication Theory. Prerequisite(s): 5513. Noise as a random process, analog and digital signal detection in the presence of noise, optimum receiver design using signal space concepts and introduction to information theory. Trade-offs between bandwidth, signal-to-noise ratio and the rate of information transfer. Example system designs include earth satellite, deep space and terrestrial communication systems and computer communication networks.

ECEN 5543* Data Transportation and Protection. Data and its representation; finite field matrices, pseudorandom sequences; information protection; space division networks; synchronization; and channel and error control.

ECEN 5553* Telecommunications Systems. Prerequisite(s): Graduate standing or consent of instructor. Surveys the ways and means that voice, data and video are moved long distances. Covers computer networks (Ethernet LAN's, Internet WAN's); telephone systems (PSTN, VoIP and cellular telephony); video (MPEG, H.323, and IPTV); and last mile delivery systems.

ECEN 5563* Principles of Wireless Networks. Prerequisite(s): 4283 or CS 4283. Wireless network operation, planning, mobility management, cellular and mobile data networks based on CDMA, TDMA, GSM; IEEE 802-11 WLANS, Adhoc networks, Bluetooth, power management, wireless geolocation and indoor positioning technique. (Same course as CS 5813)

ECEN 5613* Electromagnetic Theory. Prerequisite(s): 3613. First graduate level treatment of classical electromagnetic theory. Wave equation, potential theory, boundary conditions. Rectangular, cylindrical and spherical wave functions. Conducting and dielectric guiding structures. Scattering and radiation. Introduction to numerical techniques.

ECEN 5623* Antenna Theory. Prerequisite(s): 3613. Fundamental antenna parameters, including directivity, efficiency, radiation resistance, and pattern. Analysis of dipole, loop, aperture, broad- band, and traveling wave antennas. Array theory. Introduction to numerical techniques used in modern antenna design.

ECEN 5633* Radar Theory. Prerequisite(s): 3613; 4503 or 5513. Theoretical treatment of radar principles. Overview of radar systems and techniques, radar equation, integration of signals. Radar cross-section of single and multiple targets. Waveform design, resolution, ambiguities and accuracy. Range, speed and angular measurements. Detection of targets in noise. Statistical description of clutter. Signal processing techniques.

ECEN 5643* Antennas and Propagation for Wireless Communications. Prerequisite(s): 3613, 4503. Aspects of radiowave propagation for fixed and mobile communication systems. Review of Maxwell's equations and plane wave propagation, antenna principles. Reflection, refraction, diffraction, fading and scintillation, attenuation, ducting, diversity. Propagation in a cellular environment. Satellite communications.

ECEN 5703* Optimization Applications. Prerequisite(s): Graduate standing. A survey of various methods of unconstrained and constrained linear and non-linear optimization. Applications of these methodologies using hand-worked examples and available software packages. *This applications oriented course is intended for engineering and science students.* (Same course as CHE 5703, IEM 5023 & MAE 5703)

ECEN 5713* Linear Systems. Prerequisite(s): Graduate standing or consent of instructor. Introduction to the fundamental theory of finite-dimensional linear systems with emphasis on the state-space representation. Mathematical representations of systems; linear dynamic solutions; controllability, observability, and stability; linearization and realization theory; and state feedback and state observer. (Same course as MAE 5713)

ECEN 5733* Neural Networks. Prerequisite(s): Graduate standing. Introduction to mathematical analysis of networks and learning rules, and on the application of neural networks to certain engineering problems in image and signal processing and control systems. (Same course as CHE 5733 & MAE 5733)

ECEN 5753* Digital Processing of Speech Signals. Prerequisite(s): 4763 or 5763. Digital signal processing; speech production; digital modeling of speech; short time analysis and synthesis; the short time Fourier transform, linear predictive coding and solution of the normal equations; vocal tract spectrum calculation; speech coding; homomorphic processing; applications of speech processing. Introduction to more advanced topics as time permits.

ECEN 5763* Digital Signal Processing. Introduction to discrete linear systems; frequency-domain design of digital filters; quantization effects in digital filters; digital filter hardware, discrete Fourier transforms; high-speed convolution and correlation with application to digital filtering; introduction to Walsh-Fourier theory.

ECEN 5773* Intelligent Systems. Prerequisite(s): 5733. Introduction to the state-of-the art intelligent control and system successfully deployed to industrial and defense applications. Emerging intelligent algorithms (e.g., NN, FS, GA, EP, DES); intelligent control architecture (e.g., bottom-up, top-down, seminotics); reinforcement learning and hybrid systems; and case studies and design projects. (Same course as MAE 5773)

ECEN 5783* Medical Imaging. Prerequisite(s): 3513, 4743, or consent of instructor. A comprehensive introduction to the standard medical imaging modalities used today. Topics include radiation, radiation-interaction with matter, X-ray radiography, ultrasound, computer topography, image reconstruction and analysis, MRI, nuclear medicine, and radiation therapy. The fundamental mathematics underlying each imaging modality is reviewed and the hardware needed to implement each system is examined.

ECEN 5793* Digital Image Processing. Prerequisite(s): 4763 or 5763. Digital image processing including image acquisition and characterization, transforms, coding and compression, enhancement, restoration and segmentation. Use of modern image processing software on Sun and IBM work stations.

ECEN 5803* Geometrical Optics. Prerequisite(s): PHYS 3213 or consent of instructor. Foundations of geometrical optics, geometrical theory of optical imaging, geometrical theory aberrations, image forming instruments. (Same course as PHYS 5123*)

ECEN 5823* Physical Optics. Prerequisite(s): PHYS 3213 or consent of instructor. Multiple beam interference, diffractions, imaging, near field optical probes of matter, surface plasmons, light scattering from random media, optical coherence tomography- biomedical applications, negative materials, perfect lenses and super resolution. (Same course as PHYS 5303)

ECEN 5833* Fiber-Optic Communication Systems. Prerequisite(s): Graduate standing or consent of instructor. Five generations of fiber-optic communication systems described in detail. Technical advances and increased capability of each system. Historical framework of how technical capability at the time forced technical decisions. A systems engineering point of view, emphasizing optimization of all components of the optical fiber link.

ECEN 5843* Microelectronic Fabrication. Lab 1. Prerequisite(s): 3314. Contamination control and clean-room, vacuum systems, wafer manufacturing. Photolithography and alternative lithographic techniques. Physical and chemical vapor deposition, oxidation, etching, doping, packaging, formation of semiconductor devices and circuits. A series of Fabrication lab projects is conducted starting from bare silicon wafers to fabricate Optoelectronic circuits.

ECEN 5853* Ultrafast Optoelectronics. Prerequisite(s): Graduate standing or consent of instructor. Combining ultra fast laser pulses with electronic circuitry. Increased device performance. Optoelectronic/electrical pulses as short as 0.2

psec. High performance areas illustrating the power of advanced techniques in applications.

ECEN 5923* Introduction to MEMS. Prerequisite(s): 5843 or consent of instructor. Fundamentals of Microsystems. Topics include: energy transduction mechanisms, energy dissipation modeling, energy methods, mechanics of small scale, fabrication process design, micromachining, electronic interface.

ECEN 6000* Research. 1-16 credits, max 36. Prerequisite(s): Consent of major professor. Independent research for students continuing graduate study beyond the level of the MS degree.

ECEN 6001* PhD Seminar Series. Prerequisite(s): Approval of ECEN department head. Seminar series for PhD studies and research.

ECEN 6050 Preliminary PhD Research and Proposal. 3 credits, max 3. Prerequisite(s): Consent of adviser. Independent research and report of an advanced electrical engineering problem. Work performed serves as foundation of the oral PhD preliminary exam.

ECEN 6060* Advanced Special Topics. 1-6 credits, max 30. Prerequisite(s): Consent of instructor. Advanced engineering topics not normally included in existing courses. Repeat credit may be earned with different course subtitles assigned.

ECEN 6070* Advanced Directed Studies. 1-6 credits, max 12. Prerequisite(s): Admission into PhD program and consent of instructor. Investigation outside of the classroom of topics not normally covered in lecture courses.

ECEN 6123* Special Topics in Power Systems. Prerequisite(s): 5113. Selected relevant current topics related to power system operation and planning.

ECEN 6253* Advanced Topics in Computer Architecture. Prerequisite(s): 5253 or CS 5253. Innovations in the architecture and organization of computers, with an emphasis on parallelism. Topics may include pipelining, multiprocessors, data flow, and reduction machines. (Same course as CS 6253)

ECEN 6263* Advanced VLSI Design and Applications. Prerequisite(s): 5223 and 5263. System timing. Designing testable integrated circuits. Specialized parallel processing architectures. Application examples.

ECEN 6363* Analog VLSI for Signal Processing. Lab 2. Prerequisite(s): 4273. Continuation of 5363. Advanced theory and practice of analog VLSI design methodology. Very large scale design and implementation of signal processing solutions, including over sampled A/Ds, neural networks and filters.

ECEN 6423* System Identification. Prerequisite(s): 5473 or 5713 or MAE 5473 or MAE 5713. Linear and nonlinear system modeling of random systems. Models of linear time-invariant systems, nonparametric methods and preliminary model development, parameter estimation methods, convergence and consistency, asymptotic distributions of parameter estimates. Nonlinear modeling. (Same course as MAE 6423)

ECEN 6453* Adaptive Control. Prerequisite(s): 5473 or 5713 or MAE 5473 or MAE 5713. Analysis and design of control techniques that modify their performance to adapt to changes in system operation. Review of systems analysis techniques, including state variable representations, linearization, discretization, covariance analysis, stability, and linear quadratic Gaussian design. On-line parameter estimation, model reference adaptive systems, self-tuning regulators, stable adaptive systems. (Same course as MAE 6453)

ECEN 6483* Robust Multivariate Control Systems. Prerequisite(s): 5713 or MAE 5713. Introduction to multivariable systems: SISO robustness vs. MIMO robustness; multivariable system poles and zeros; MIMO transfer functions; multivariable frequency response analysis; multivariable Nyquist theorem; performance specifications; stability of feedback systems; linear fractional transformations (LFT's); parameterization of all stabilizing controllers; structured singular value; algebraic ricatti equations; H2 optimal control; H-infinity controller design. (Same course as MAE 6483)

ECEN 6523* Information Theory. Prerequisite(s): 5513 or consent of instructor. Mathematical theory of information (Shannon theory) including information measure and transmission rates and capacities. Source coding theory including algebraic and error-correcting codes. Design of waiver-forms for noise immunity. Information transfer in learning systems.

ECEN 6803* Photonics I: Advanced Optics. Lab 9. Prerequisite(s): 3813 or PHYS 3213 or consent of instructor. Advanced optics including spectral and time characteristics of detectors, characteristics of lasers, time, spectral and spatial parameters of laser emission, interferometric techniques, and nonlinear effects such as two-photon absorption and second and third harmonic generations. Emphasis on ultrashort laser pulses. (Same course as CHEM 6803 & PHYS 6803)

ECEN 6810* Photonics II: THz Photonics and THz-TD. 1 credit, max 4, Lab 3. Prerequisite(s): 6803. THz photonics and THz time-domain spectroscopy (THz-TDS). Concepts and techniques of driving electronic circuitry with ultra short laser pulses to generate and detect freely propagating pulses of THz electromagnetic radiation using several operational research systems. (Same course as CHEM 6810 & PHYS 6810)

ECEN 6820* Photonics II: Spectroscopy II. 1 credit, max 4, Lab 3. Prerequisite(s): 6803. Operating principles and applications of laser spectroscopy of atoms, molecules, solids and complex fluids. Absorption, emission, photon correlation, coherence, time resolved Fourier transform. Raman spectroscopy and non-linear optical. (Same course as CHEM 6820 & PHYS 6820)

ECEN 6823* Advanced Optical Techniques. Prerequisite(s): 5853. State-of-the-art optical devices and research methodologies. Investigation and discussion of contemporary developments in non-linear optical devices and laser applications. Includes both analytical and experimental techniques.

ECEN 6830* Photonics II: Spectroscopy III. 1 credit, max 4, Lab 3. Prerequisite(s): 6803. Advanced spectroscopic instruments and methods used for investigation of semi-conductors and solid state material. Stimulated emission characterized both in wavelength and in time. Time-resolved fluorescence measurements. Multiphotonic excitations. Fast measuring techniques, including subnanosecond detectors, picosecond streak cameras, and ultra fast four-wave mixing and correlation techniques. Time-dependent photoconductivity measurements. (Same course as CHEM 6830 & PHYS 6830)

ECEN 6840* Photonics III: Microscopy I. 1 credit, max 4, Lab 3. Prerequisite(s): CHEM 3553 or consent of instructor. The structure and imaging of solid surfaces. Basics of scanning probe microscopy (SPM). Contact and non-contact atomic force microscopy (AFM). Scanning tunneling microscopy (STM) in air. (Same course as CHEM 6840 & PHYS 6840)

ECEN 6843* Advanced Microelectronic Fabrication. Prerequisite(s): 5843. Photolithography, wet and dry etching, thermal and electron beam evaporation, photomask design using L-Edit, silicon devices processing, quartz devices processing, silicon-on-sapphire devices processing. GaAs devices processing and MEMS devices processing.

ECEN 6850* Photonics III: Microscopy II. 1 credit, max 4, Lab 3. Prerequisite(s): CHEM 3553 or consent of instructor. Advanced techniques of scanning probe microscopy (SPM). Magnetic force microscopy, Kelvin force microscopy, scanning probe microscopy (STM) in vacuum. Characterization of materials with SPM. Nanolithography with SPM. Device manufacturing and analysis. (Same course as CHEM 6850 & PHYS 6850)

ECEN 6860* Photonics III: Microscopy III and Image Processing. 1 credit, max 4, Lab 3. Prerequisite(s): 5793. Digital image processing, including projects. Image acquisition and display, image enhancement, geometric operations, linear and nonlinear filtering, image restoration, edge detection, image analysis, morphology, segmentation, recognition, and coding/compression. (Same course as CHEM 6860 & PHYS 6860)

ECEN 6870* Photonics IV: Synthesis and Devices I. 1 credit, max 4, Lab 3. Prerequisite(s): 6803 and 6840. Preparation of functional nanostructures and related optical/electronic devices. Physical and chemical methods of thin film deposition. Engineering of prototypes of light emitting diodes, sensors, optical limiting coatings, lithographic patterns. (Same course as CHEM 6870 & PHYS 6870)

ECEN 6880* Photonics IV: Semiconductor Devices, Testing and Characterization. 1 credit, max 4, Lab 3. Prerequisite(s): 6803, 6840. Test and characterization of semiconductor and optoelectronic devices. Hall effect, four point probe, CV and IV measurements, optical pump-probe, photoluminescence and electro-optics sampling. (Same course as CHEM 6880 & PHYS 6880)

ECEN 6890* Photonics IV: Semiconductor Synthesis and Devices III. 1 credit, max 4, Lab 3. Prerequisite(s): 6803. Processing, fabrication and characterization of semiconductor optoelectronic devices in class 100/10000 cleanrooms. Cleanroom operation including general procedure for material processing and device fabrication. Device processing using a variety of processing such as mask aligner, vacuum evaporators and rapid thermal annealer. Testing using optical and electrical testing apparatus such as I-V, C-V, Hall, and optical spectral measurement systems. (Same course as CHEM 6890 & PHYS 6890)

Electrical Engineering Technology (EET)

EET 1003 Introduction to Microcomputer Programming. Lab 2. Co-requisite(s): MATH 1513. Programming a microcomputer using a spreadsheet and in BASIC. Application of algorithms to solve defined problems and an introduction to the numerical limitations of small machines.

EET 1104 Fundamentals of Electricity. Lab 3. Prerequisite(s): MATH 1513 and consent of department. Elementary principles of electricity covering basic electric units. Ohm's law, Kirchoff's law, circuit solutions, network solutions, magnetism, inductance and capacitance.

EET 1244 Circuit Analysis I. Lab 3. Prerequisite(s): 1104. Co-requisite(s): MATH 1613. Analysis of AC electric circuits. The use of network theorems and phasors, coupled circuits, resonance, filters, and power.

EET 2303 Technical Programming. Lab 3. Prerequisite(s): 1104, MATH 1513 or completion of comparable engineering science courses. Introduction to machine programming using industrial standard languages, emphasis on problems from science and technology.

EET 2544 Pulse and Digital Techniques. Lab 3. Prerequisite(s): 1104. Electronic circuits used in digital control and computation. Pulse generation, Boolean algebra and logic circuits.

EET 2635 Solid State Devices and Circuits. Lab 3. Prerequisite(s): 1244, MATH 1613. Diodes, transistors, LSI linear devices; their operation and applications in electronic circuits.

EET 3005 Electronics Analysis I. Prerequisite(s): 1104, 1244, 2544, 2635, MATH 1513, 1613, or evaluated equivalent. Co-requisite(s): MATH 2123. Extensive use of mathematics in analyzing discrete, linear device, linear systems

and non-linear circuits. Development of the analytic skills necessary for upper-division work. The use of basic calculus in circuit analysis. *Must obtain a "C" or better before admission to other 3000 level EET courses. Intended for transfer and returning students. Enrollment by adviser consent.*

EET 3104 Elements of Electricity and Electronics. Lab 3. Prerequisite(s): MATH 1513. Essentials of electricity, controls, and electronics for non-majors. *No credit for EET majors.*

EET 3113 Circuit Analysis II. Prerequisite(s): 2635 and MATH 2133. Application of elementary switching functions and LaPlace transforms to electronic circuit analysis. Circuit analysis in the S-plane, transfer functions, and the application of circuit analysis software.

EET 3124 Project Design and Fabrication. Lab 3. Prerequisite(s): 1244, 2544, 2635. Methods of designing, analyzing and fabricating electronic circuits using standard software packages. Heat transfer characteristics and problem solutions are included.

EET 3254 Microprocessors I. Lab 3. Prerequisite(s): 2544. An introduction to microcontrollers and their uses in embedded applications. Topics include system architecture, assembly language, structured programming, memory systems, user I/O, timers, peripherals, etc.

EET 3264 Microprocessors II. Lab 3. Prerequisite(s): 2544, 3254. A continuation of EET 3254. Programming and interfacing of microcontrollers in embedded application, including interrupts, EEPROM, serial programming, interfacing, power management, algorithms, stepper motor control.

EET 3354 Communication and Signal Processing. Lab 3. Prerequisite(s): 1244, 2635, MATH 2133, GENT 3123; Co-requisite(s): EET 3113. Bandpass signaling principles and circuits. The Fourier transform; AM, SSB, FM, and PM signaling; binary modulated bandpass signaling (FSK and PSK); superheterodyne receiver; phase locked loop (PLL); modulators and mixers; frequency multiplication; special purpose IC's.

EET 3363 Data Acquisition. Lab 3. Prerequisite(s): 2544 and 2635. Methods used to convert physical variables to digital signals and vice versa. Signal conditioning, digital-to-analog converters, analog-to-digital converters, sample-and-hold circuits, sensors, and transducers. The use of computers in data acquisition and signal processing.

EET 3524 Advanced Logic Circuits. Lab 3. Prerequisite(s): 2544. Computer-based design, simulation and implementation of digital systems using programmable logic, field programmable gate arrays.

EET 3533 Introduction to Telecommunications. Lab 3. Prerequisite(s): 2544, 2635, 3254. Introductory course to the field of telecommunications. Study of the various technologies and how the application of these technologies work together to form functioning systems and networks.

EET 3713 Introduction to Electric Power Technology I. Prerequisite(s): 1244 or 3104, PHYS 1214, MATH 2123 and MATH 2133. Concurrent enrollment in MATH 2133 or equivalent course work is acceptable. Physical principles of electromagnetic and electromechanical energy conversion devices and their application to conventional transformers and rotating machines.

EET 3723 Introduction to Electric Power Technology II. Lab 3. Prerequisite(s): 1244 or 3104, PHYS 1214, MATH 2123 and 2133. Concurrent enrollment in MATH 2133 or equivalent course. Physical principles of electromagnetic and electromechanical energy conversion devices and their application to conventional transformers and rotating machines. Electrical energy generation, transmission and distribution.

EET 4050 Advanced Electronic Problems. 1-4 credits, max 4. Prerequisite(s): Junior standing and consent of head of department. Special problems in the electronic area.

EET 4314 Elements of Control. Lab 3. Prerequisite(s): 3113 and 3363 and GENT 3123. Principles of analog and digital control, with emphasis on the analysis of feedback control systems in their various conceptual configurations. Application of feedback control theory to the analysis and design of present day circuits and systems. Use of circuit analysis software.

EET 4363 Digital Signal Processing. Prerequisite(s): 3354, 3363. Introduction to Digital Signal Process. Theoretical development of Fourier transforms, IIR and FIR filters. Significant Design and programming projects.

EET 4514 Advanced Telecommunication Topics. Lab 1. Prerequisite(s): 3533. Study of data transmission techniques between digital electronic devices.

EET 4654 Microwave Techniques. Lab 3. Prerequisite(s): 2635, 3354. Study of topics pertaining to VHF behavior of circuits and systems. Transmission line theory: wave equations, SWR, impedance calculations and transformations, and lossy lines. Extensive use of the Smith chart to solve transmission line problems. Introduction to Maxwell's equations, with emphasis on steady state. Wave propagation in rectangular waveguides. Introduction to antennas. Modeling of transistors at VHF, UHF, and microwave frequencies. Design and analysis of transistor amplifiers at VHF using y and s parameters. Designing LC impedance matching networks.

EET 4833 Industrial Project Design I. Lab 6. Prerequisite(s): 20 credit hours of upper-division electronics courses or consent of instructor. Course mirrors the design process in industry. Topics covered are Design Team formation, Identify Objectives, define design specifications, write specifications, create a state of work and Gantt chart, create a project budget, perform a Preliminary Design Review, Design Prototype.

EET 4843 Industrial Project Design II. Lab 6. Prerequisite(s): 4833. Student continues in the project steps of Change Board Review, Critical Design Review, Developing & Writing Test Specs., Product Fabrication and Testing, Formal Technical Report Submission and Outcomes Assessment Exam.

Engineering (ENGR)

ENGR 1111 Introduction to Engineering. An introduction to the study and practice of engineering. Skills for students in CEAT; expected engineering student behavior; tools needed by CEAT students; and the role of engineers in society. An introduction to engineering ethics; safety issues; and the relationship of engineering to social, global and contemporary issues. Student enrichment opportunities in the CEAT. *May not be used for degree credit with ENGR 1113.*

ENGR 1113 Introduction to Engineering Mathematics. Prerequisite(s): High school algebra or MATH 0123 or equivalent. This course focuses on applications of engineering mathematics to analysis and design problems across disciplines of engineering. Application of algebra, trigonometry, linear systems of equations, and basic calculus are illustrated through hands-on laboratory experiments and design projects. *May not be used for degree credit with ENGR 1111.*

ENGR 1322 Engineering Design with CAD. Lab 2. Introduction to engineering design using modern design methodologies and computer-aided tools. Design, construction and testing through participation in a multidisciplinary team-based design project contest.

ENGR 1332 Engineering Design with CAD for MAE. Lab 2. Introduction to engineering design using modern design methodologies and computer-aided tools appropriate for mechanical and aerospace engineering. Design, construction and testing through participation in a multidisciplinary team based design project contest.

ENGR 1342 Engineering Design with CAD for ECEN. Lab 2. Introduction to engineering design using modern design methodologies and computer-aided tools appropriate for electrical and computer engineering. Design, construction and testing through participation in a multidisciplinary team-based design project contest.

ENGR 1352 Engineering Design with CAD for CHE. Lab 2. Introduction to engineering design using modern design methodologies and computer-aided tools appropriate for chemical engineering. Design, construction and testing through participation in a multidisciplinary team-based design project contest.

ENGR 1412 Introductory Engineering Computer Programming. Lab 2. Programming to solve problems typical of practice in engineering. Techniques and methods.

ENGR 2030 Co-op Industrial Practice I. 1-3 credits, max 6. Prerequisite(s): Sophomore standing and permission of Co-op coordinator. Pre-engineering industrial practice. *Written reports as specified by adviser. Application of credit to meet degree requirements varies with level and department.*

ENGR 2100 Orientation Projects. 1-3 credits, max 3, Lab 2-6. Prerequisite(s): Pre-engineering standing. Enrollment in independent study or small groups. Projects to assist students with special needs to adjust to engineering curriculum.

ENGR 3030 Co-op Industrial Practice II. 1-3 credits, max 6. Prerequisite(s): Junior standing and permission of Co-op coordinator. Pre-engineering industrial practice. *Written reports as specified by adviser. Application of credit to meet degree requirements varies with level and department.*

ENGR 3061 Domestic Scholars Experience. Prerequisite(s): Consent of the coordinator of CEAT Student Services. Participation in the domestic scholars experience.

ENGR 3080 International Experience. 1-18 credits, max 36. Prerequisite(s): Consent of the associate dean of the college. Participation in a formal or informal educational experience outside of the USA.

ENGR 3090 (I) Study Abroad. 1-18 credits, max 36. Prerequisite(s): Consent of the Study Abroad office and associate dean of the college. Participation in an OSU reciprocal exchange program.

ENGR 4010 Engineering Problems and Design. 0-6 credits, max 6. Prerequisite(s): Permission of the instructor. Special projects and independent study.

ENGR 4030 Co-op Industrial Practice III. 1-3 credits, max 6. Prerequisite(s): Senior standing and permission of Co-op coordinator. Pre-engineering industrial practice. Written reports as specified by adviser. Application of credit to meet degree requirements varies with level and department.

ENGR 4043* (I) International Engineering Service Learning I. Prerequisite(s): Approval of instructor. International engineering service learning experience. Project design, construction, implementation and training to provide permanent answer to clients' needs. Emphasis on the development of culturally acceptable engineering designs. Includes classroom lectures, hands-on design, writing assignments and travel to foreign country. For both engineering and non-engineering majors.

ENGR 4053* (I) International Engineering Service Learning II. Prerequisite(s): ENGR 4043 and approval of instructor. A continuation of ENGR 4043. International engineering service learning experience. Project

design, construction, implementation and training to provide permanent answer to clients' needs. Emphasis on the development of culturally acceptable engineering designs. Includes classroom lectures, hands-on design, writing assignments and travel to foreign country. For both engineering and non-engineering majors.

ENGR 4060* Topics in Technology and Society. 1-3 credits, max 6. Problems of society relating to technology and added problems stemming from their solution. Minimal reliance on mathematics; *for engineering and non-engineering students.*

ENGR 4061 CEAT Scholars Study Abroad. Prerequisite(s): Permission of instructor. Comparison of technologies, history, culture and economic systems between the U.S. and another country or countries. Includes both classroom and travel for on-site study.

ENGR 4073* (I) Technology and Culture of Italy. Prerequisite(s): Approval of instructor. Examination of the technology, history and culture of Italy, with an emphasis on the development of cultural competency. Analysis of similarities and differences in professional practices. Includes classroom lectures, writing assignments and travel to Italy. Minimal reliance on mathematics. For both engineering and non-engineering majors.

ENGR 4083* (I) Technology and Culture of Brazil. Prerequisite(s): Approval of instructor. Examination of the technology, history and culture of Brazil, with an emphasis on the development of cultural competency. Analysis of similarities and differences in professional practices. Includes classroom lectures, writing assignments and travel to Brazil. Minimal reliance on mathematics. For both engineering and non-engineering majors.

ENGR 4093* (I) Technology and Culture of France. Prerequisite(s): Approval of instructor. Examination of the technology, history and culture of France, with an emphasis on the development of cultural competency. Analysis of similarities and differences in professional practices. Includes classroom lectures, writing assignments and travel to France. Minimal reliance on mathematics. For both engineering and non-engineering majors.

ENGR 4103* Impact of Law on Engineering Practice. Prerequisite(s): Junior standing or consent of instructor. Principles and impact of U.S. and international laws and regulations on technical professionals, including the impact of environmental regulations, intellectual property laws, tort claims, and product liability on the design, research and oversight of technologies.

ENGR 4113 (S) Intellectual Property Law for Technical Professionals. Prerequisite(s): Junior standing or consent of instructor. Law and regulations of patents and other intellectual property protection methods. Impact of statutory and common law on the practice of technical professionals and how they can exploit intellectual property in their daily work.

ENGR 4123 (S) Tort and Products Liability Law for Technical Professionals. Prerequisite(s): Junior standing or consent of instructor. Legal liability of the work product and duties of technical professionals to the public. Relevant statutory, regulatory and common law relating to torts, specifically products liability.

ENGR 4133 (S) Environmental Regulation for Technical Professionals. Prerequisite(s): Junior standing or consent of instructor. Environmental laws and regulations are omnipresent in the practice of engineering, science and architecture. Survey of the environmental laws and regulations affecting the practice of these professions.

ENGR 4201 Principles of Nuclear Engineering. The nuclear enterprise, radiation, biological effects of ionizing radiation, nuclear reactor power plants, radioactive waste disposal, the fission process, food irradiation activities, applications of nuclear power in space, approaches to radiation detection, thermonuclear fusion, and nuclear weapons and proliferation.

ENGR 4203 Nuclear Technologies in Society: Fulfilling Madame Curie's Dream. Introduction to applications of nuclear science and technology and the radiation principles governing these applications. Problem-based learning environment. *Class assignments are web-based and include reference materials and modules to be completed by students.*

ENGR 4211 Introduction to Nuclear and Radiation Engineering Concepts. Aspects and applications of nuclear and radiation engineering/physics. History of nuclear development, basic concepts of radiation and radioactivity, radioactive waste management, global warming and the impact of nuclear power plants, industrial applications, health physics, nuclear medicine, job opportunities at power plants, graduate school and national labs.

ENGR 4213* Elements of Nuclear Engineering. Prerequisite(s): 4201, 4211 or 4203 and MATH 2163, PHYS 2114. Nuclear engineering concepts and applications, including nuclear reactions, radioactivity, radiation interaction with matter, reactor physics, risk and dose assessment, applications in medicine, industry, agriculture and research.

ENGR 4223 Nuclear Reactor Engineering. Prerequisite(s): 4213 and MATH 2233. Physics governing nuclear reactors and the design principles for commercial nuclear power plants. Reactor designs currently operating in the power industry. Generation III and Generation IV reactor designs are also discussed.

ENGR 4233* Energy Systems and Resources. Prerequisite(s): 4213. Energy systems, renewable and non-renewable energy sources, and advances in energy applications.

ENGR 4243* Radiation Protection and Shielding. Prerequisite(s): 4213 and MATH 2233. Radiation protection, doses, associated risks, and exposure limits; properties of natural and other radiation sources, and evaluation of internal and external doses; and techniques for shield design including ray, point kernal, and transport theories for both neutrons and gamma rays.

ENGR 4253 Nuclear Reactor Analysis. Prerequisite(s): 4213 and MATH 2233. Fundamental physical principles, concepts and modeling techniques for analysis and design of nuclear reactors. Prepares students to analyze nuclear reactors including aspects of performance, dynamics and safety and to either develop new designs or to assess existing or proposed designs based upon fundamental understanding of reactor physics.

ENGR 4263* Nuclear Reactor Theory. Prerequisite(s): 4243. Introduction to neutron diffusion theory, neutron moderation, neutron thermalization, and criticality conditions of nuclear reactors. *Distance education only.*

ENGR 4273 Probabilistic Risk Assessment. Prerequisite(s): 4213. This course is a detailed introduction to neutron diffusion theory, neutron moderation, neutron thermalization, and criticality conditions of nuclear reactors.

ENGR 4303 Physical and Chemical Behavior of Petroleum Fluids. Prerequisite(s): 1412, CHEM 1414 or CHEM 1515, ENSC 2213 or permission of instructor. Topics include principles of organic chemistry; properties of hydrocarbon liquids and gases; multicomponent mixtures; phase behavior; surface separation, and gas-liquid equilibria.

ENGR 4313 Drilling Engineering. Prerequisite(s): Consent of instructor. Introduction to drilling systems; wellbore hydraulics; casing design; identification and solution drilling problems; well cementing; drilling of directional and horizontal wells; wellbore surveying; abnormal pore pressure; fracture gradients; well control; offshore drilling; under balanced drilling. *Offered through distance education only.*

ENGR 4333 Production Engineering. Prerequisite(s): Consent of instructor. Fundamental production engineering design, evaluation, and optimization for oil and gas wells, including well deliverability, formation damage and skin analysis, completion performance, and technologies that improve oil and gas well performance. *Offered through distance education only.*

ENGR 4343 Reservoir Engineering. Prerequisite(s): Consent of instructor. Reservoir description techniques using petrophysical and fluid properties; engineering methods to determine fluids in place, identify production-drive mechanisms, and forecast reservoir performance; implementation of pressure-maintenance schemes and secondary recovery. *Offered through distance education only.*

ENGR 4363 Deterministic Petroleum Economics and Reserves. Prerequisite(s): Consent of instructor. Deterministic evaluation techniques for oil and gas properties focusing on economic analyses, reserves classifications and decision making. *Offered through distance education only.*

ENGR 5010* Engineering Problems and Design. 1-6 credits, max 6. Prerequisite(s): Permission of instructor. Special projects and independent study.

ENGR 5103* Advanced Impact of Law on Engineering Practice. Prerequisite(s): Graduate standing. Principles and impact of U.S. and international laws and regulations on technical professionals, including the impact of environmental regulations, intellectual property laws, tort claims, and product liability on the design, research and oversight of technologies.

ENGR 5113* Advanced Intellectual Property Law for Technical Professionals. Prerequisite(s): Graduate standing. Law and regulations of patents and other IP protection methods. Impact of statutory and common law has made on the practice of technical professionals and how they can exploit IP in their daily work.

ENGR 5123* Advanced Tort and Products Liability Law for Technical Professionals. Prerequisite(s): Graduate standing. Legal liability of the work product and duties of technical professionals to the public. Relevant statutory, regulatory and common law relating to torts, specifically products liability.

ENGR 5133* Advanced Environmental Law for Technical Professionals. Prerequisite(s): Graduate standing. Environmental laws and regulations are omnipresent in the practice of engineering, science, and architecture. This course will survey the environmental laws and regulations affecting the practice of these professions.

ENGR 5313* Drilling Engineering. Prerequisite(s): Consent of instructor. Introduction to drilling systems; wellbore hydraulics; casing design; identification and solution drilling problems; well cementing; drilling of directional and horizontal wells; wellbore surveying; abnormal pore pressure; fracture gradients; well control; offshore drilling; underbalanced drilling. *Offered through distance education only. No credit with credit in 4213.*

ENGR 5333* Production Engineering. Prerequisite(s): Consent of instructor. Fundamental production engineering design, evaluation, and optimization for oil and gas wells, including well deliverability, formation damage and skin analysis, completion performance, and technologies that improve oil and gas well performance. *Offered through distance education only. No credit with credit in 4333.*

ENGR 5343* Reservoir Engineering. Prerequisite(s): Consent of instructor. Reservoir description techniques using petrophysical and fluid properties; engineering methods to determine fluids in place, identify production-drive mechanisms, and forecast reservoir performance; implementation of pressure-maintenance schemes and secondary recovery. *Offered through distance education only. No credit with credit in 4343.*

ENGR 5363* Deterministic Petroleum Economics and Reserves. Prerequisite(s): Consent of instructor. Deterministic evaluation techniques for oil and gas properties focusing on economic analyses, reserves classifications and decision making. *Offered through distance education only. No credit with credit in 4363.*

Engineering Science (ENSC)

ENSC 2113 Statics. Prerequisite(s): MATH 2144 and either PHYS 1114 or 2014. Resultants of force systems, static equilibrium of rigid bodies, statics of structures, and fluid statics. Shear and moment diagrams.

ENSC 2123 Elementary Dynamics. Prerequisite(s): 2113. Kinematics and kinetics of particles, systems of particles, and rigid bodies from a Newtonian viewpoint using vector algebra and calculus. Work-energy and impulse-momentum principles. Planar and three-dimensional kinetics and kinematics of rigid bodies.

ENSC 2143 Strength of Materials. Prerequisite(s): 2113. Bending moments, deformation and displacement in elastic and plastic deformable bodies. Axial, torsional and shear loads. Buckling stress transformations and combined loads.

ENSC 2213 Thermodynamics. Prerequisite(s): CHEM 1314, 1414 or 1515, MATH 2144, PHYS 2014. Properties of substances and principles governing changes in form of energy. First and second laws.

ENSC 2613 Introduction to Electrical Science. Prerequisite(s): MATH 2153 and PHYS 2114. Elements of electrical engineering; AC and DC circuits, mesh and node formulation of network equations, steady-state response to sinusoids, energy, power and power factor.

ENSC 3213 Computer Based Systems in Engineering. Prerequisite(s): CS 1113 or ENGR 1412 and sophomore or higher standing. A comprehensive introduction to technology and application of microprocessors, concepts of computer and computation, interfacing and communication, data acquisition and representation. Applications of general-purpose and embedded processors in various disciplines of engineering and engineering problem solving.

ENSC 3233 Fluid Mechanics. Prerequisite(s): 2113, MATH 2153. The study of fluid properties, statics, conservation equations, dimensional analysis and similitude, viscous flow in ducts, inviscid flow, boundary layer theory, open channel flow, turbomachinery and fluid measurement techniques.

ENSC 3313 Materials Science. Prerequisite(s): CHEM 1314 or 1414 or 1515. Introductory level. Relationship between structure and properties of materials and engineering applications. Atomic, microscopic and macroscopic properties.

Engineering and Technology Management (ETM)

ETM 5110* Seminar. 1-6 credits, max 6. Prerequisite(s): Admission to the master's program or consent of instructor. Guided study in a topic area selected to enhance a student's program.

ETM 5111* Introduction to Strategy, Technology and Integration. Prerequisite(s): Admission to the MSETM program or consent of instructor. Introduces students to the discipline of engineering and technology management, emphasizing the importance of strategy, technology, and integration, where timing of products and services are keys to market success.

ETM 5133* Capstone to Strategy, Technology and Integration. Prerequisite(s): Enrolled in last semester of MSETM program or consent of adviser. Independent analysis of a business problem. Student prepares a proposal and report that makes substantive use of MSETM material, and is a notable and relevant contribution to the student's organization. Readings and discussions.

ETM 5211* Enterprise Integration. Prerequisite(s): Admission to the MS in ETM program or consent of instructor. Conceptualizing, designing and operating advanced manufacturing systems within an integrated enterprise-wide framework. Recent developments in computer and communication technologies and conceptual breakthroughs regarding the nature and behavior of integrated enterprises.

ETM 5231* Benchmarking. Prerequisite(s): Admission to the MS in ETM program or consent of instructor. Benchmarking as an effective approach to study and adopt or adapt methodologies representing best specific practices from any industry; or identify and assess performance based on equivalent and common measures, usually from those in the same or similar industries, including competitors.

ETM 5241* Strategic Project Management. Prerequisite(s): Admission to the MS in ETM program or consent of instructor. Overview of traditional project management concepts and techniques (i.e., Gantt charts, PERT, CPT) along with several technical issues related to their effective use. Fundamental nature of the problems associated with several technical issues related to their effective use. Fundamental nature of the problems associated with effectively managing and coordination of multiple discrete projects within an overall systems integration initiative. A framework for addressing these problems.

ETM 5253* Engineering Problem Solving and Decision-Making. Prerequisite(s): Admission to the MSETM program or consent of instructor. Processes and tools for problem solving and decision making in technical organizations. Focus on issues involving both quantitative and qualitative factors, where the quantitative factors are the result of an engineering analysis. Risk and systems analysis tools provide a fundamental background to understanding the context in which technical decisions are made. Concentration on general systems theory as developed by Ludwig von Bertalaffy.

ETM 5271* Technology Forecasting and Assessment. Prerequisite(s): Admission to the MS in ETM program or consent of instructor. A framework and analytical tools for developing technological foresight. Technology monitoring, forecasting and assessment in the context of a family of emerging technologies.

ETM 5282* Strategic Planning. Prerequisite(s): Admission to the MSETM program or consent of instructor. Continuous and systematic process of thought about the future, resulting in a plan or specific course of action for communicating, coordinating and controlling activities. Strategic, long-range, tactical, operational, contingency and performance planning.

ETM 5291* Failure Mode and Effects Analysis in Design. Prerequisite(s): Admission to the MS in ETM program or consent of instructor. A design technique for reducing risk and improving reliability of a system, design or process. Potential failures in any of these studied methodically during design. The concepts, tools and techniques applicable to any product or process.

ETM 5311* Value Engineering. Prerequisite(s): Admission to the ETM program or consent of instructor. The application of Value Engineering (also known as Value Analysis, Value Methodology) to improve customer value for a project, process, or product during or after engineering design. The development of VE, its objectives, definitions and methodologies, the use of the VE system, and its range of application. VE's use for improving performance reducing life cycle cost.

ETM 5341* Leadership Strategies for Technical Professionals. Prerequisite(s): Admission to the ETM program or consent of instructor. Leadership strategies, principles, styles and dynamics that must be understood by technical professionals engaged in the creation of products, processes, and services in technology-based organizations.

ETM 5351* Planning Technical Projects. Prerequisite(s): Admission to the MSETM program or consent of instructor. Techniques and tools for project definition, staffing, scheduling, resource allocation, and time estimation. Behavioral and quantitative dimensions of project management. Performance measures of project progress and completion.

ETM 5361* Managing Virtual Project Teams. Prerequisite(s): Admission to the MSETM program or consent of instructor. The management and group issues inherent in the application and implementation of effective teamwork in virtual work- spaces. The appropriate use of virtual team issues and challenges associated with effective teamwork; virtual team structures, process, and technology facilitation skills; group dynamics; and team motivation.

ETM 5371* Ethics for Practicing Engineers. Prerequisite(s): Admission to the MSETM program or consent of instructor. A values-based approach to professional ethics and its application to the decision-making in a technology-intensive environment. Ethical concerns related to the expectations of stakeholders.

ETM 5391* New Product Introduction and Commercialization. Prerequisite(s): Admission to the MSETM program or consent of instructor. Elements of the new product introduction (NPI) process and its impact or business strategy and planning. Organizational resources required for NPI and tools for determining commercial viability.

ETM 5411* Engineering Economic Analysis. Prerequisite(s): Admission to the MSETM program or consent of instructor. Quantitative evaluation of investment alternatives. Basis for comparison of alternatives, including present worth, annual worth, rate of return and payout period methods. Decision-making among capital constrained and unequal-life projects. Benefit-cost and cost effectiveness analysis.

ETM 5461* Intellectual Property Management. Prerequisite(s): Admission to MS in ETM program or consent of instructor. Overview of intellectual property law and management of intellectual property. Exploration of ways to manage intellectual property from conception through production and licensing. Types of intellectual property and associated legal issues and management processes.

ETM 5471* Introduction to System Safety. Prerequisite(s): Admission to the MSETM program or consent of instructor. System safety as a discipline in research, development and acquisition of systems, sub-systems and components. The history and methodologies of mishap prevention including the development of system safety management and engineering processes.

ETM 5481* Sustainable Enterprise Strategies. Prerequisite(s): Admission to the MSETM program or consent of instructor. The principles of sustainability in the context of industrial enterprises. The implications of sustainability in design of products, industrial systems and infrastructure. The importance of life cycle cost analysis as a key engineering economy tool.

ETM 5491* ISO 9000. Prerequisite(s): Admission to the MSETM program or departmental permission. A detailed look at the requirements of ISO 9001:2008 from a systems perspective. The relationship between ISO 9001, ISO 9000, ISO 9004 and industry-related standards. Implementation and improvement of quality management systems (both high quality and typical methods).

ETM 5511* Capstone Preparation. Prerequisite(s): Admission to the MSETM program and at least 17 hours earned toward MSETM degree or departmental permission. Introduction to the requirements for the ETM Capstone Project, including problem statements, strategic implications, management systems, and problem metrics. Emphasis is placed on persuasive technical communication.

ETM 5521* Quick Response Manufacturing. Prerequisite(s): Admission to the MSETM program or departmental permission. Introduction to QRM, an enterprise-wide strategy for lead-time reduction. Discussion of the four core concepts of QRM - realizing the power of time, rethinking organizational structure, understanding and exploiting system dynamics, and implementing a unified strategy enterprise-wide. Definitions of manufacturing critical-path time (MCT) map. Focused target market segment (FTMS), and material control strategy POLCA. Case studies and MPX software.

ETM 5943* Lean Sigma Implementation. Prerequisite(s): IEM 5113, admission to the MSETM program or departmental permission. Introduction to the implementation skills necessary to successfully apply lean manufacturing and six sigma concepts and manage continuous improvement within a small to mid-sized firm. Successfully combining leadership, organizational dynamics and skills in meeting customer expectations. Planning, applying and monitoring these learned skills.

Engineering Technology

(See specific technology programs listed alphabetically)

English (ENGL)

ENGL 0003 Academic English for Graduate Students. Study and practice of English listening, reading and speaking skills required for graduate study. *Graded on satisfactory-unsatisfactory basis.*

ENGL 1010 Studies in English Composition. 1-2 credits, max 2. Special study in composition to allow transfer students to fulfill general education requirements as established by Regent's policy.

ENGL 1113 Composition I. The fundamentals of expository writing with emphasis on structure, development and style.

ENGL 1123 International Freshman Composition I. Restricted to students whose native language is not English. Expository writing with emphasis on structure and development. Special attention to problems of English as a second language. *This course may be substituted for 1113.*

ENGL 1213 Composition II. Prerequisite(s): 1113 or 1123 or 1313. Expository composition with emphasis on technique and style through intensive and extensive readings.

ENGL 1223 International Freshman Composition II. Prerequisite(s): 1113 or 1123. Restricted to students whose native language is not English. Expository composition with emphasis on technique and style in writing research papers. *May be substituted for 1213.*

ENGL 1313 Critical Analysis and Writing I. Expository writing forms, including summary, critique, and synthesis. Writing assignments based on readings from across the curriculum. May be substituted for 1113 for gifted writers who seek a more challenging course.

ENGL 1413 Critical Analysis and Writing II. Critical thinking, research, and writing skills necessary for success in courses across the curriculum. Some sections available for honors credit. *May be substituted for 1213 for gifted writers who seek a more challenging course.*

ENGL 1923 (H) Great Works of Literature. Readings in the great works of the most important writers of Britain and America, such as Shakespeare, Dickens, Twain, Faulkner, and others.

ENGL 2233 (H) Writing as a Profession. An overview of genres and styles of writing in professional contexts, including organizations, science and industry.

ENGL 2243 (H,I) Language, Text and Culture. Investigation of how human language relates to culture.

ENGL 2413 (D,H) Introduction to Literature. Fiction, drama/film and poetry that introduces students to the elements of all genres and focuses on the diversity of underrepresented and socially constructed segments of American society. Written critical exercises and discussion.

ENGL 2443 (I) Languages of the World. A comprehensive survey of world languages. The essential structural and historical organization of languages. The process of languages as a basic human function. (Same course as FLL 2443)

ENGL 2453 (H) Introduction to Film and Television. Introduction to the formal analysis of moving images - film, television, and new media - in aesthetic, cultural, and political contexts. Students discuss and write about films and other moving images screened in class.

ENGL 2513 (H) Introduction to Creative Writing. Literary composition with emphasis on techniques and style through readings and writings in fiction, poetry and creative nonfiction.

ENGL 2543 Survey of British Literature I. The beginnings through the Neo-Classic Period.

ENGL 2653 Survey of British Literature II. The Romantic Period to the present.

ENGL 2773 (D) Survey of American Literature I. The Puritans through the Romantic Period.

ENGL 2883 (D) Survey of American Literature II. The Romantic Period to the present.

ENGL 3030 Fiction Writing. 3 credits, max 6. Prerequisite(s): 2513. Directed readings and practice in writing fiction with special attention to techniques.

ENGL 3040 Poetry Writing. 3 credits, max 6. Prerequisite(s): 2513. Directed readings and practice in writing poetry with special attention to techniques.

ENGL 3050 Screenwriting. 3 credits, max 6. Prerequisite(s): 2453. The reading and discussion of screenplays in the Hollywood style, including exercises on three-act structure, conflict-building, and characterization. Students write and revise a 30-page fictional screenplay as their term project and supply weekly critiques of their peers' work.

ENGL 3060 Creative Nonfiction Writing. Prerequisite(s): 2513. Directed readings and practice in writing nonfiction with special attention to techniques.

ENGL 3123 (H) Mythology. Myths, their cultural context, and their place in world literature.

ENGL 3153 (D,H) Readings in Literature by Women. The collection of literature written by women in England and America, classical and modern figures.

ENGL 3163 (H) World Literature I. Selected literary masterpieces exemplifying ideals and values in Western cultures.

ENGL 3170 Readings in Literature and Other Disciplines. 3 credits, max 6. A study of literature and its historical or thematic connections to one or more of the fine arts or disciplines in the humanities or social sciences.

ENGL 3173 (H,I) World Literature II. Selected literary masterpieces exemplifying ideals and values in non-Western cultures. Emphasis on the study of non-Western literature available in English.

ENGL 3183 (D,H) Native American Literature. Origins and development of a literary tradition in its historical and cultural context.

ENGL 3190 Readings in Postcolonial and Multiethnic Literature. 3 credits, max 6. Principal literary and critical texts written in English either by writers from parts of the world once colonized by the West or by American writers of different ethnic origins whose work bridges cultures.

ENGL 3193 (D,H) African-American Literature. Origins and development of a literary tradition in its historical and cultural context.

ENGL 3200 Special Problems in Language and Literature. 1-3 credits, max 3. Prerequisite(s): 9 credit hours of English. Specialized readings and independent study.

ENGL 3203 Advanced Composition. Prerequisite(s): 9 hours of English. An advanced writing course based on contemporary theories of composition.

ENGL 3223 Professional Writing Theory. Major theories, issues, and methodologies in professional writing.

ENGL 3243 Literary Theory and Criticism. Study of the major works of critical theory and literary criticism.

ENGL 3263 Screen Theory. Lab 2. An inquiry into the major concepts and debates of mass-media theory. Issues addressed include the nature of the relation between images and reality; the psychological and cultural significance of style in film, television, and new media representations; and the role that mass-media play in the organization of social and political relations.

ENGL 3323 Technical Writing. Prerequisite(s): 1113 or 1213 or 1313 and junior standing. Applied writing in areas of specialization. Intensive practice in professional/technical writing genres, styles, research techniques and editing for specialized audiences. *This course may be substituted for 1213 with an "A'' or "B'' in 1113 and consent of the student's college.*

ENGL 3333 (H) Short Story. Origins, development, theory and craft of the short story.

ENGL 3343 Readings in Poetry. Poetry as a genre. The historical development of poetry in English, its major figures, its definitions, its key elements.

ENGL 3353 (H) Film and Literature. Lab 2. The theory and practice of the relationship between verbal and visual texts, including adaptation of literary works for the screen.

ENGL 3363 (H) Readings in Drama. Close study of representative plays of various periods (for example, Classical, Renaissance, Restoration, Modern, and others) and of the main formal categories (tragedy, comedy).

ENGL 3373 Readings in Nonfiction. Theory and practice of creative nonfiction in English, including autobiography, travel writing, literary journalism, correspondence and the essay.

ENGL 3383 Readings in Narrative. Readings in narrative of different periods and different genres.

ENGL 3410 Popular Fiction. 3 credits, max 6. Study of certain popular genres of fiction including science fiction, detective fiction, Western fiction, horror and the grotesque, the romance, American humor. Course content varies by

semester. Exploration of the characteristics and evolution of the genre while developing skills in reading, writing and thinking critically.

ENGL 3433 (H) Introduction to Television Studies. Lab 2. A focused examination of one aspect of television culture, technology, history and/or style. While the particular topics to be considered vary, and include everything from TV genres to TV theories, in each instance the course gives students an in-depth understanding of how television shapes the social and political world in which we live.

ENGL 3443 (H) Studies in Film Genre. Lab 2. A comparative study of types of films both inside the Hollywood system and in other national cinemas. The western, the film noir and the musical, as well as genres from such countries as France, Germany and Japan. Focused knowledge of selected genres, a sense of the economic imperatives that necessitate generic "contracts" between film producers and viewers and knowledge of the history of specific genres.

ENGL 3453 (H) History of American Film. Lab 2. Examines the history of cinema in the U.S. from its beginnings until the present, addressing such issues as: the origins of cinema, the coming of sound, American film genres, the Hollywood studio system, censorship, the challenge of television, the new American cinema of the 1970s, the politics of independent film production, and the rise of computer-generated imagery.

ENGL 3463 (H,I) History of International Film. Lab 2. Introduction to the history of international cinema and the principal eras in film history, focusing on the moments when different national cinemas flourished.

ENGL 3473 (D) Race, Gender, and Ethnicity in American Film. Lab 2. A survey of race, gender, and ethnicity as they have been represented in American films. (Same course as AMST 3473)

ENGL 3503 (D,H) Television and American Society. Examination of television within the social and cultural context of the U.S. Looks at the aesthetic and industrial practices that shape representation on TV and the effects of those practices, particularly for socially disempowered groups. (Same course as AMST 3503)

ENGL 3813 (D,H) Readings in the American Experience. Life in the New World from the colonial to the postmodern era using a multiplicity of interdisciplinary texts that demonstrate the emergence and ongoing evolution of distinctive American identities. (Same course as AMST 3813)

ENGL 3903 Writing Center Theory and Practice. Lab 4. Prerequisite(s): six hours English or consent of instructor. Writing center research with practical applications in writing instruction.

ENGL 3933 (H) Shakespeare. Recurring themes and their variations in Shakespeare's work. Nature of these genres in the period and Shakespeare's innovations. The structure and language of the plays, occasional examination of historical documents and contexts, modern performances, and critical essays.

ENGL 4003* History of the English Language. The growth of the English language.

ENGL 4013* English Grammar. The traditional terminology and concepts of English grammar leading or evolving into the several current systems of description.

ENGL 4033* Discourse Analysis. Introduction to the analysis of the language used in spoken and written discourse contexts in a variety of genres.

ENGL 4043 Teaching English to Speakers of Other Languages. Designed to develop the skills and techniques needed in teaching English to speakers of other languages (TESOL). Examines the theoretical issues behind the practice and methodologies and classroom techniques, including the testing of English and the selection and preparation of teaching materials.

ENGL 4063* Introduction to Descriptive Linguistics. The methodology of linguistic analysis.

ENGL 4073* Introduction to Sociolinguistics. The study of how languages and varieties vary in social contexts and how they are regarded.

ENGL 4080* Studies in Linguistics. 3 credits, max 6. Study of a topic in linguistics, chosen at the instructor's discretion.

ENGL 4083* Applied Linguistics. Introduction to the applied study of language in use, including aspects of discourse, power, identity, and language choice among other topics.

ENGL 4093* Language in America. Historical development of American English. Regional, social and cultural language differences.

ENGL 4100 Studies in Medieval British Literature. 3 credits, max 6. Special topics encompassing the many different ethnic traditions and genres found in medieval British literature.

ENGL 4110 Studies in 16th Century British Literature. 3 credits, max 6. Literature themes of the English Renaissance focusing on related authors and topics. Authors include Shakespeare, Spenser, Sidney, Marlowe, Raleigh, Wyatt, and Surrey.

ENGL 4120 Studies in 17th Century British Literature. 3 credits, max 6. Obtaining an understanding of 17th century British literature while developing skills as a critical thinker, a reader of literary texts and a writer of expository prose.

ENGL 4130 Studies in 18th Century British Literature. 3 credits, max 6. Selected topics in British literature from 1660-1800. Various writers and their works and themes and literary developments of the period. Topics vary by semester.

ENGL 4160 Studies in 19th Century British Literature. 3 credits, max 6. Exploration of the literary culture of nineteenth-century Britain. Topics might range from romantic poetry to the Victorian novel.

ENGL 4170 Studies in 20th Century British Literature. 3 credits, max 6. Various topics focusing on the literature and culture of Britain and Ireland, such as 20th century British and Irish fiction, poetry, or drama; The City; The Irish Renaissance.

ENGL 4200 Studies in Early American Literature. 3 credits, max 6. Readings and topics in early American literature and culture.

ENGL 4210 Studies in 19th Century American Literature. 3 credits, max 6. Themes in 19th century American literature with attention to social and cultural contexts.

ENGL 4220 Studies in 20th Century American Literature. 3 credits, max 6. Topics focusing on the literature and culture of the United States, such as 20th century American fiction, poetry, or drama; alienation and activism; the impact of science and technology.

ENGL 4223* Introduction to Old English. The basics of pronunciation, vocabulary, and grammar, enabling students to read short works in prose and poetry.

ENGL 4263 (H) Moving Image Aesthetics. Lab 2. A historical and theoretical examination of the stylistic and affective dimension of moving images, including questions of beauty and ugliness, cuteness and the graphic, enjoyment and disgust, high and low culture. Screenings will vary from semester to semester, but may include examples of realism, lo-fi production, prestige pictures, documentary, music videos and cult cinema, and will include material from both American and international contexts.

ENGL 4300 Studies in Romanticism. 3 credits, max 6. Principle works of Romanticism, reflecting the cultural, social, and political developments.

ENGL 4310 Studies in Modernism. 3 credits, max 6. Selected topics in literature of the early twentieth century. Texts and themes will vary by semester.

ENGL 4320 Studies in Postmodernism. 3 credits, max 6. Approaches to the exploration of postmodernism in literature, other art forms, and culture. The analysis of representative postmodern texts from various genres such as fiction, poetry, drama, film and mass media.

ENGL 4350* Contemporary International Cinema. 3 credits. Lab 2. Examines major trends in contemporary international cinema of the last fifteen years. National cinema may include France, Germany, Italy, Spain, Sweden, China, Taiwan, India, South Korea, and Russia, amongst others.

ENGL 4400 Studies in Regional Literature. 3 credits, max 6. Literature of a nation such as Ireland or Canada, or of a region such as the American Southwest. Topic varies by semester.

ENGL 4450 Culture and the Moving Image. 3 credits, max 9, Lab 2. Prerequisite(s): 2453. An advanced class that examines in-depth the relation between moving images and a particular cultural phenomenon, including mass media and the production of violence, the moving image as common culture, television and the construction of domestic life, to name only a few possibilities.

ENGL 4520* Problems in English. 1-3 credits, max 6. Prerequisite(s): 12 credit hours of English. Specialized readings and independent studies.

ENGL 4523* Professional Writing Internship. Prerequisite(s): 4543 and 4553 or permission of instructor. Supervised work-and-learning experience in writing, editing, document design, and research in the workplace.

ENGL 4530* Studies in Professional Writing. 3 credits, max 9. Prerequisite(s): Six credit hours of English, including 3323.Selected topics in professional writing, focusing on a particular theme, issue or theoretical approach.

ENGL 4543* Style and Editing. Prerequisite(s): 4013. An intensive study of writing style and editing from the sentence level (including diction and grammatical arrangement) to the levels of genres of communication. Writing assignments on style for different audiences.

ENGL 4553* Visual Rhetoric and Design. Prerequisite(s): 3223. Major theories, issues, and methodologies in visual rhetoric and design. Practice of theory through guided composing work.

ENGL 4563* Scientific and Technical Literature. The study of writings about science and technology.

ENGL 4600 Studies in Chaucer or Milton. 3 credits, max 6. Various topics focusing on the works of Chaucer or Milton.

ENGL 4620* Advanced Creative Nonfiction Writing. 3 credits, max 6. Prerequisite(s): 3030 or 3040. Intensive practice in creative nonfiction writing.

ENGL 4630* Advanced Fiction Writing. 3 credits, max 6. Prerequisite(s): 3030. Intensive practice in fiction writing.

ENGL 4640* Advanced Poetry Writing. 3 credits, max 6. Prerequisite(s): 3040. Intensive practice in poetry writing.

ENGL 4650* Advanced Screenwriting. 3 credits, max 6. Prerequisite(s): 3050.

Discussion of professional screenplays and critiquing peers' work; completion of exercises on structure, visualization, and characterization; and writing a fictional screenplay.

ENGL 4700 Single Author or Work Pre-1800. 3 credits, max 6. Study of a single author or work prior to 1800 along with supporting literature. Chosen at the instructor's discretion.

ENGL 4710 Single Author or Work Post-1800. 3 credits, max 6. Study of a single author or work after 1800 along with supporting literature. Chosen at the instructor's discretion.

ENGL 4723 (H) Studies in Shakespeare. Focus on advanced topics in major plays and selected criticism.

ENGL 4893* Research Writing for International Graduate Students. Prerequisite(s): Graduate standing or permission of the instructor. Analysis and practice in the grammar and rhetorical structures specific to writing research papers in the disciplines.

ENGL 4993 Senior Honors Thesis. Prerequisite(s): Admission to Arts and Sciences Honors Program and 3.50 cumulative GPA. For Honors students in their final semester. Thesis written on a topic of student's choice and directed by a faculty member. Final approval of thesis requires oral defense.

ENGL 5000* Master's Thesis. 1-9 credits, max 12. Master's Thesis.

ENGL 5013* Introduction to Graduate Studies. Principles and procedures in scholarly research.

ENGL 5063* Seminar in Shakespeare. Intensive study of a limited number of plays. Assignment of problems to individual students.

ENGL 5093* Seminar in Milton. Poetry, major prose and criticism.

ENGL 5120* Studies in Teaching English as a Second Language. 1-3 credits, max 6. Selected topics in teaching English as a second language; e.g. cross-cultural communication, materials preparation, bilingual education.

ENGL 5123* Approaches to Language Acquisition. An overview of theories of first and second language acquisition.

ENGL 5130* Studies in English Grammar. 3 credits, max 6. Selected study of current topics in grammatical theory as it applies to the teaching of English.

ENGL 5133* Phonetics and Phonology. Exploration of fundamental aspects of the use of sound in human language.

ENGL 5140* Seminar in Linguistics. 3 credits, max 6. Selective study of current topics in linguistics.

ENGL 5143* Descriptive Linguistics. An introduction to phonology, morphology, syntax and semantics.

ENGL 5153* Syntax. The study of the principles and rules for constructing phrases and sentences in natural languages.

ENGL 5163* Middle English Literature. Major works in Middle English.

ENGL 5173* Sociolinguistics. Introduction to linguistic change and variation in speech communities, focusing on the methods of data collection and analysis.

ENGL 5183* Acoustic Phonetics. Prerequisite(s): 5143 or 5133 or PDP. An introduction to acoustic phonetics. Students will learn basic principles of the acoustics of speech sounds, develop practical skills in instrumental measurement, and learn how acoustic data can answer questions about sounds and sound patterns in language.

ENGL 5201* Writing Center Theory and Pedagogy. The study of writing center theory and practice with the goal of application to one-to-one pedagogy.

ENGL 5210* Seminar or Directed Study. 1-6 credits, max 9. Specialized readings or independent studies.

ENGL 5213* Composition Theory and Pedagogy. The study of methods and materials for effective one-to-one and one-to-many teaching.

ENGL 5223* Professional Writing Theory and Pedagogy. The study of the needs of students in technical and professional writing service courses, major approaches to teaching professional writing, and the genres often taught in professional writing service courses.

ENGL 5243* Teaching English as a Second Language. Materials and methods of second language instruction.

ENGL 5313* Internship, Teaching English as a Second Language. Supervised teaching of beginning through advanced English as a second language courses.

ENGL 5333* Seminar in TESL: Testing. Standardized testing for teaching English as a second language.

ENGL 5340* Studies in Discourse Analysis. 3 credits, max 9. Selected topics in the study of language in use in spoken or written contexts.

ENGL 5353* Studies in the History of Rhetoric. An exploration of selected topics and texts in the history of Western and non-Western rhetoric from the classical period to the present.

ENGL 5360* Seminar in Screen Studies. 3 credits, max 9. The exploration of key aesthetic issues of analysis and evaluation as they pertain to film criticism.

ENGL 5363* Critical Approaches to Screen Studies: Theory and History. Designed to provide students with an overview of fundamental theoretical and historical scholarship in film and television studies.

ENGL 5370* Studies in Television and New Media. 3 credits, max 9. Exploration of aesthetic, cultural, and ideological aspects of television and new media in the United States and abroad.

ENGL 5410* Seminar in British Literature of the 16th Century. 3 credits, max 9. Selected writers and their works, themes and literary developments of the 16th century.

ENGL 5420* Seminar in British Literature of the 17th Century. 3 credits, max 9. Selected writers and their works, themes and literary developments of the 17th century.

ENGL 5440* Seminar in British Literature of the 18th Century. 3 credits, max 9. Selected writers and their works, themes and literary developments of the 18th century.

ENGL 5460* Seminar in British Literature of the 19th Century. 3 credits, max 9. Selected writers and their works, themes and literary developments of the 19th century.

ENGL 5480* Seminar in Modern Literature. 3 credits, max 9. Selected writers and their works, themes and literary developments of modern literature.

ENGL 5520* Internship in Professional Writing. 3 credits, max 6. Prerequisite(s): permission of department. Supervised work-and-learning experience in writing, editing, document design, and research in the workplace.

ENGL 5523* Genres in Professional Writing. The study of the current status of genre in professional writing theories and its crucial role in professional writing practices.

ENGL 5553* Studies in Visual Rhetoric and Design. Advanced study of design and visual rhetorical theory. Practice of theory through guided composing work.

ENGL 5560* Seminar in Professional Writing. 3-9 credits, max 9. Advanced study of selected theories, themes, methods, debates, and developments in professional writing.

ENGL 5583* Environmental Writing. Consideration of the historical, political, cultural, and ethical contexts of modern environmentalism and examination of the rhetorical strategies in several types of environmental discourse. Major writing project tailored to individual research interests and career goals.

ENGL 5593* Seminar in Style and Editing. An advanced study of writing style and editing from the sentence level (including diction and grammatical arrangement) to the levels of genres of communication. Writing assignments on style for different audiences.

ENGL 5630* Seminar in Early American Literature. 3 credits, max 9. Selected writers and their works, themes and literary developments of the 17th and 18th centuries.

ENGL 5660* Seminar in American Literature of the 19th Century. 3 credits, max 9. Selected writers and their works, themes and literary developments of the 19th century.

ENGL 5680* Seminar in Contemporary Literature. 3 credits, max 9. Selected writers and their works, themes and literary developments in contemporary literature.

ENGL 5720* Seminar in Creative Nonfiction. Prerequisite(s): Admission to MFA or PhD in Creative Writing or consent of instructor. Writing creative nonfiction at the professional level.

ENGL 5723* Craft and Forms of Poetry. Prerequisite(s): Admission to MFA or PhD in Creative Writing or consent of instructor. Theory and practice of the poetic forms.

ENGL 5730* Seminar in Fiction Writing. 3 credits, max 9. Prerequisite(s): Admission to MFA or PhD in Creative Writing or consent of instructor. Writing fiction at the professional level.

ENGL 5740* Seminar in Poetry Writing. 3 credits, max 9. Prerequisite(s): Admission to MFA or PhD in Creative Writing or consent of instructor. Writing poetry at the professional level.

ENGL 5750* Seminar in Scriptwriting. 3 credits, max 6. Scriptwriting at the professional level.

ENGL 5763* Craft and Forms of Prose. Prerequisite(s): Admission to MFA or PhD in Creative Writing or consent of instructor. Theory and practice of prose forms.

ENGL 5990* Special Problems. 1-3 credits, max 6. Investigation into a designated area of English leading to material for creative component option (MA). *Graded on a pass-fail basis.*

ENGL 6000* Doctoral Dissertation. 1-9 credits, max 30. Doctoral dissertation.

ENGL 6130* Studies in Fiction Writing. 3 credits, max 9. Prerequisite(s): Admission to MFA or PhD in Creative Writing or consent of instructor. Individual projects in fiction.

ENGL 6140* Studies in Poetry Writing. 3 credits, max 9. Prerequisite(s): Admission to MFA or PhD in Creative Writing or consent of instructor. Individual projects in poetry.

ENGL 6160* Studies in Creative Nonfiction. 3 credits, max 9. Prerequisite(s): Admission to MFA or PhD in Creative Writing or consent of instructor. Individual projects in creative nonfiction.

ENGL 6210* Seminar or Directed Study. 1-6 credits, max 9. Specialized readings or independent studies.

ENGL 6220* Seminar in Genre. 3 credits, max 9. The development, traditions, concerns or characteristics of genre in selected texts. Major genres and subgenres considered.

ENGL 6240* Studies in Literature. 3 credits, max 9. Advanced topics in literature and literary research.

ENGL 6250* Seminar in Race and Ethnicity. 3 credits, max 9. Study of the complex representation of race and ethnicity in literature.

ENGL 6260* Studies in Literary Criticism. 3 credits, max 9. Selected work in literary criticism, for example ancient and neo-classical, 19th century, 20th century.

ENGL 6270* Seminar in Region. 3 credits, max 9. Study of regional literature or language variation.

ENGL 6280* Seminar in Gender. 3 credits, max 9. Examination of gender as an analytical category in the study of literature, discourse and society.

ENGL 6350* Topics in Rhetorical Theory. 3 credits, max 9. Study of advanced topics in rhetorical theory and research, focusing on an important scholar in the field, a specific theme, or some combination of the two.

ENGL 6360* Seminar in Film and Society. 3 credits, max 9. Social conduct and value systems as they affect the role of media in culture.

ENGL 6410* Topics in Linguistics. 3 credits, max 9. Prerequisite(s): 5143. Study of advanced topics in linguistic theory and research.

ENGL 6420* Topics in Second Language Acquisition. 3 credits, max 9. Prerequisite(s): 5243. Study of topics in second language theory and research.

ENGL 6500* Topics in Professional Writing. 3 credits, max 9. In-depth study of selected topics in professional writing.

Entomology (ENTO)

ENTO 2003 (N) Insects and Society. Influence of insects and related arthropods on human society. Current issues involving insects, society and the environment. View of insects in folklore and mythology. Basic biology and behavior of insects and use of insects as model systems for biological studies. A course for both majors and non-majors.

ENTO 2143 Global Issues in Agricultural Biosecurity and Forensics. Biosecurity, biosafety, bioterrorism, microbial forensics, emerging organisms, invasive species, quarantine, response, surveillance, detection, diagnostics, and how all system components integrate to science, and to agricultural specialties, economics and defense. (Same course as PLP 2143)

ENTO 2223 (N) Insects in Global Public Health. Biology of diseases carried by arthropods, including their historical and societal impacts focusing on the intersection of arthropod and human biology.

ENTO 2993 (L,N) Introduction to Entomology. Basic biology and classification of insects and closely related animals. Overview of the ecological roles of insects in both natural and managed ecosystems.

ENTO 3003 Livestock Entomology. Economic importance, biology and control of pests affecting domestic animals. Biology of diseases carried by arthropods, including their impacts focusing on the intersection of arthropod and animal biology.

ENTO 3021 Postharvest, Structural and Urban Arthropod Pests. Lab 2. Prerequisite(s): 2993. The biology and management of insect pests of bulk-stored grains, flour, feed, dried fruits and nuts within food processing plants, warehouses, wholesale and retail distribution systems. Common structural and urban arthropod pests found in and around man-made buildings and their identification, biology and standard management practices.

ENTO 3044 Insect Physiology. Lab 2. Prerequisite(s): 2993 and one course in organic chemistry and nine credit hours of biology. Functions of organ systems and demonstration of selected techniques for study of insect physiology. *Offered in combination with 5044. No credit for both 3044 and 5044.*

ENTO 3331 Insect Pests of Agronomic Crops. Lab 2. Prerequisite(s): 2993 or concurrent enrollment. A survey of important arthropods of agronomic crops commonly grown in Oklahoma. Coverage includes identification of pests and beneficial insects, recognition of damage symptoms, discussion of sampling strategies and decision-making processes for management, and integrated pest management tactics.

ENTO 3421 Horticultural Insects. Lab 2. Prerequisite(s): 2993 or concurrent enrollment. Identification, biology and control of pests attacking horticultural crops. Emphasis on pests injurious to vegetables, fruits, pecans, greenhouse plants, turf and ornamental trees and shrubs.

ENTO 3461 Insects in Forest Ecosystems. Lab 2. Prerequisite(s): 2993 or concurrent enrollment. Identification and seasonal life history of insect pests and beneficial insects on shade trees in urban settings, in commercial forests, and in forest products.

ENTO 3501 Entomology for Educators. Lab 2. Hands-on laboratory course designed to provide high school science teachers, FFA or 4H leaders with all of the resources and background information needed to use insects as a model to teach scientific concepts. Curriculum and resources are provided at the level of 7-12th grade and may be adapted to other levels as needed.

ENTO 3644 Insect Morphology. Lab 4. Prerequisite(s): 2993 or equivalent. Insect development and comparative morphology. *Offered in combination with 5644. No credit for both 3644 and 5644.*

ENTO 3663 Turfgrass Integrated Pest Management. Lab 2. Prerequisite(s): PLP 3343 or ENTO 2993. The biology, ecology, and identification of fungal, nematode, and insect turfgrass pests. Contemporary concepts and applications of integrated control practices available for managing turfgrass pests along with decision-making tools for use in turfgrass pest management programs. (Same course as PLP 3663)

ENTO 4223* Ecological Methodology. Lab 2. Prerequisite(s): One course in either ecology or general biology. Use of insects and other invertebrates for describing and evaluating interactions of individuals and populations with their environments. Coverage of behavioral and physiological ecology on consequences to individuals; population and community ecology considered in dynamics of groups of organisms in ecosystems.

ENTO 4400 Special Topics. 1-3 credits, max 3. Prerequisite(s): Consent of instructor. Special topics in plant pathology, entomology or related fields. (Same course as PLP 4400)

ENTO 4464 Insect Biology and Classification. Lab 4. Prerequisite(s): 2993 or equivalent or consent of instructor. Insect phylogeny, taxonomy, behavior, morphology and physiology in the context of ecosystem function. Major roles of insects in shaping ecosystem diversity, as indicators of environmental integrity, and as vectors of plant and animal pathogens and parasites.

ENTO 4484 Aquatic Entomology. Lab 4. Prerequisite(s): 2993 or ZOOL 1604 or consent of instructor. Biology, taxonomy and ecology of insects and other invertebrates, inhabiting freshwater environments. Emphasis is placed on identification and biology of individual taxa. Roles of insects in aquatic ecology as a forage base, and as indicators of biotic integrity of aquatic systems. Linkages between aquatic systems and terrestrial systems are also examined. *No credit for students with credit in ENTO 5484 or ZOOL 5484.* (Same course as ZOOL 4484)

ENTO 4733 Insect Behavior and Chemical Ecology. Prerequisite(s): 2993 and CHEM 3015 or equivalent. Behavioral biology of insects. Ecological interactions among organisms mediated by naturally produced chemicals. An interface of ecology, behavior, physiology and chemistry with examples from animals, plants and microorganisms. Origin, function, significance and utilization of semiochemicals such as pheromones and allelochemicals. *No credit for students with credit in ENTO 5733.*

ENTO 4800 Entomology Practicum. 1-6 credits, max 6. Prerequisite(s): Consent of practicum coordinator and adviser. Supervised research or extension experience with faculty in the Entomology/Plant Pathology Dept. or with approved governmental agencies or private employers. Written report required at close of practicum.

ENTO 4854 Medical and Veterinary Entomology. Lab 4. Prerequisite(s): 2993 or consent of instructor. Biology and control of arthropod vectors of disease and the diseases carried by arthropods. Course includes emphasis on scientific writing skills. *No credit for students with credit in 5854.*

ENTO 4923* Applications of Biotechnology in Pest Management. Prerequisite(s): BIOL 1114 and CHEM 1215 or equivalents. Applications of biotechnology in managing arthropod pests of plants, animals, plant pathogens, and weeds. Introduction to underlying technology, products being developed and deployed, effectiveness and associated problems or concerns resulting from their use. (Same course as PLP 4923 and PLNT 4923)

ENTO 5000* Master's Research and Thesis. 1-6 credits, max 6. Research in entomology.

ENTO 5003* Insect Biochemistry. Prerequisite(s): Consent of instructor. Biochemical processes in insects and closely related arthropods with emphasis on metabolic pathways unique to this group. Biochemical aspects of arthropod host interactions.

ENTO 5020* Special Problems. 1-8 credits, max 8. Prerequisite(s): Graduate standing. Selected studies in the area of entomology, acarology or araneology.

ENTO 5044* Insect Physiology. Lab 2. Prerequisite(s): 2993 or equivalent and one course in organic chemistry and nine credit hours in biology. Functions of the organ systems and demonstration of selected techniques for study of insect physiology. *Offered in combination with 3044. No credit for both 3044 and 5044.*

ENTO 5464* Insect Biology and Classification. Prerequisite(s): 2993 or equivalent or consent of instructor. Insect phylogeny, taxonomy, behavior, morphology and physiology in the context of ecosystem function. Major roles of insects in shaping ecosystem diversity, as indicators of environmental integrity, and as vectors of plant and animal pathogens and parasites. *No credit for students with credit in ENTO 4464.*

ENTO 5484* Aquatic Entomology. Lab 4. Prerequisite(s): 2993 or ZOOL 1604 or consent of instructor. Biology, taxonomy and ecology of insects and other invertebrates, inhabiting freshwater environments. Emphasis is placed on identification and biology of individual taxa. Roles of insects in aquatic ecology as a forage base, and as indicators of biotic integrity of aquatic systems. Graduate students will have extra collection requirements and biotic integrity analyses. *No credit for students with credit in ZOOL 5484, ENTO 4484 or ZOOL*

4484. (Same course as ZOOL 5484)

ENTO 5501* Entomology for Educators. Lab 2. Hands-on laboratory course designed to provide educators (teachers, FFA or 4H leaders, etc.) with all of the resources and background information needed to use insects as a model to teach scientific concepts. *No credit given for students who have taken ENTO 3501.*

ENTO 5513* Biological Control. Lab 2. Prerequisite(s): 2993 or equivalent or consent of instructor. The ecological principles and applied practices of biological control of insects, weeds and plant pathogens. Epizootiology including the scientific basis of biological control; natural enemies and their biology; biological control methods; and biological control in integrated pest management programs.

ENTO 5524* Integrated Management of Insect Pests and Pathogens. Lab 4. Prerequisite(s): 2993 and PLP 3344 or equivalent or consent of instructor. Modern theory and practices for management of insect pests and pathogens in plant production systems, emphasizing an ecologically-based, integrated approach. Basic concepts of pest management, decision-making, cost/benefit analysis and risk/benefit analysis. (Same course as PLP 5524)

ENTO 5550* Advanced Agronomic Entomology. 1-5 credits, max 5. Prerequisite(s): 4523. Special problems in advanced agronomic entomology.

ENTO 5613* Host Plant Resistance. Lab 2. Prerequisite(s): 2993 and PLP 3343 or equivalent and a general genetics course; or consent of instructor. Interactions of plants and the herbivorous insects and pathogenic micro-organisms that attack them. Development and deployment of multiple-pest resistant cultivars in crop management systems. (Same course as PLP 5613)

ENTO 5623* Advanced Biotechnology Methods. Lab 3. Prerequisite(s): BIOC 3653, BIOL 3023 or equivalent or consent of instructor. Overview of current theory and principles of biotechnology and laboratory experience with contemporary techniques and experimental methods used in biotechnology, including genome analysis, gene transfer, identification and isolation of genes and their products and regulation of gene expression in plants and arthropods. (Same course as PLP 5623)

ENTO 5644* Insect Morphology. Lab 4. Prerequisite(s): 2993 or equivalent. Insect development and comparative morphology. *Offered in combination with 3644. No credit for both 3644 and 5644.*

ENTO 5700* Teaching Practicum in Entomology. 1-6 credits, max 6. Prerequisite(s): Graduate student standing. Variable credit offering for graduate students who wish to develop skills in teaching, assessment and curriculum development working in conjunction with a primary instructor.

ENTO 5710* Advanced Medical and Veterinary Entomology. 1-5 credits, max 5. Prerequisite(s): 4854. Special problems in methods of disease transmission, animal parasite control and the relationships existing between parasite and host.

ENTO 5733* Insect Behavior and Chemical Ecology. Prerequisite(s): 2993 and CHEM 3015 or equivalent. Behavioral biology of insects. Ecological interactions among organisms mediated by naturally produced chemicals. An interface of ecology, behavior, physiology and chemistry with examples from animals, plants and microorganisms. Origin, function, significance and utilization of semiochemicals such as pheromones and allelochemicals. *No credit for students with credit in 4733.*

ENTO 5753* Insecticide Toxicology. Prerequisite(s): Organic chemistry or 15 credit hours biology. Properties and mode of action of the major insecticidal materials. Assessment of their impact on the environment.

ENTO 5833* Insect Molecular Biology. Prerequisite(s): 2993 and BIOL 3024 or equivalent or consent of instructor. Concepts and methods in molecular biology with emphasis on genetics of insects. Application of molecular techniques in insect biology.

ENTO 5850* Epidemiology of Arthropod-Borne Diseases. 1-4 credits, max 4, Lab to be arranged. Prerequisite(s): 4854 or equivalent. The relationships existing between the hosts, arthropod vectors and causal agents of disease and the principles of disease prevention or suppression by the intelligent use of biological principles.

ENTO 5870* Scientific Presentations. 1 credit. Prerequisite(s): Consent of instructor. Preparation and delivery of scientific presentations including 50-minute seminars, 10-minute talks, and posters. (Same course as PLP 5870)

ENTO 5992* Career Skills and Professionalism for Scientists. Prerequisite(s): Graduate standing. For graduate students majoring in science-based fields, especially those nearing graduation. Skills needed for effective job application and interviewing, career development and advancement, communication with professional colleagues and the public, and personal professional development. (Same course as PLP 5992)

ENTO 6000* Doctoral Research and Dissertation. 1-10 credits, max 30. Prerequisite(s): MS in entomology or consent of major professor. Independent investigation under the direction and supervision of a major professor.

ENTO 6100* Advanced Insect Physiology. 1-5 credits, max 5. Prerequisite(s): 3044 or 5044 or equivalent. Special problems in advanced insect physiology.

Entrepreneurship and Emerging Enterprise (EEE)

EEE 1010 Creativity, Innovation and Entrepreneurship. 1-3 credits, max 6. Examination of the creative process. Exploration of underlying premises of creativity, exposure to basic frameworks and concepts, and examination of obstacles to creativity. Emphasis on practical applications. Intended for students in Creativity, Innovation and Entrepreneurship Learning Community.

EEE 1020 Creativity, Innovation and Entrepreneurship II. 1-3 credits, max 6. Examination of the underpinnings of entrepreneurship and innovation as each relates to the creative process. An applied perspective is adopted in exploring the interfaces between creativity, innovation and entrepreneurship. Intended for students in Creativity, Innovation and Entrepreneurship Learning Community.

EEE 2023 Introduction to Entrepreneurship. Lab 1. Focuses on both the entrepreneurial mindset and the process of launching and growing a new business. Reviews opportunities, innovation, new value creation, business context, existing firms and any area of business or life that pertains to entrepreneurship.

EEE 3020 Business Plan Laboratory. 1-3 credits, max 3. Provides any student regardless of background with a fundamental understanding of the logic and structure of a business plan and a knowledge of basic tools and concepts for putting together a great business plan for an original idea or concept. Applies to for-profit and non-profit ventures.

EEE 3023 Introduction to Entrepreneurial Thinking and Behavior. Prerequisite(s): Sophomore standing. Overview of entrepreneurial thinking and behavior and its role in our lives. Examination of what it takes to start and sustain new concepts and ventures. Central focus is on the issues surrounding effective implementation of the entrepreneurial process across a variety of contexts.

EEE 3033 (D) Women and Minority Entrepreneurship. The course covers race, gender, and ethnicity as factors that impact entrepreneurship. Students look at the theoretical underpinnings of minority and women's entrepreneurship and their opportunities, challenges, and strategies when creating ventures.

EEE 3123 Entrepreneurship and The Arts. Introduces entrepreneurship as a way of thinking and acting within the arts, including fine art, theatre, music and design. Key entrepreneurial competencies are explored, including opportunity recognition, risk management, resource leveraging, and innovation. *No credit for students with credit in 5123.*

EEE 3263 Entrepreneurial Marketing. Prerequisite(s): 3023, MKTG 3213 and completion of business core classes or instructor permission. Examination of the roles of marketing in entrepreneurial ventures and entrepreneurship in the marketing efforts of any organization. Emphasis on marketing as it relates to risk management, resource leveraging and guerrilla approaches. *No credit for students with credit in EEE 5223 or MKTG 5223.* (Same course as MKTG 3263)

EEE 3403 Social Entrepreneurship. An examination of the application of entrepreneurship concepts and principles in addressing vexing social needs such as hunger, homelessness, environmental degradation, disease, domestic violence and inadequate access to education. Exploration of unique challenges in and approaches for developing and implementing viable business models for social ventures. *Students may not take both EEE 3403 and EEE 5403* for credit.*

EEE 3513 Growing Small and Family Ventures. Prerequisite(s): 3023 or instructor permission. Exploration of unique challenges involved when growing small and family-owned ventures. The life stages of emerging enterprises are examined. Issues addressed include resource needs, skill requirements, functional area development, and work-life balance.

EEE 3663 Imagination in Entrepreneurship. Prerequisite(s): 3023 or instructor permission. Exploration of creativity and ideation as they relate to entrepreneurship. Perspectives on opportunity discovery and assessment are examined. Theoretical and conceptual foundations for the application of creativity to business problem solving are investigated. *No credit for students with credit in 5663.*

EEE 3713 Native American Entrepreneurship. Understanding the impact entrepreneurship thinking and behavior can have for Native Americans. Strategies and tactics to increase the number of new business ventures launched by Native Americans. No credit for students with degree credit in EEE 5713.

EEE 4010 Special Topics in Entrepreneurship. 1-6 credits, max 6. Examination of entrepreneurship issues. Specific topics vary from semester to semester.

EEE 4113 Dilemmas and Debates in Entrepreneurship. Designed around a series of critical dilemmas confronted by entrepreneurs when creating and growing a venture. Entrepreneurs explore with students the issues surrounding these dilemmas in a structured format.

EEE 4263 Corporate Entrepreneurship. Prerequisite(s): 3023 or instructor permission. Examination of the application of entrepreneurship concepts and behaviors within established organizations, assessment of factors contributing to a company's entrepreneurial orientation, and identification of ways to foster high levels of entrepreneurship within firms. *No credit for students with credit in 5263.*

EEE 4313 Emerging Enterprise Consulting. Prerequisite(s): 3023 and junior standing. Students nearing the end of their studies work in teams in addressing problems and opportunities within existing entrepreneurial ventures. Using an

established methodology, teams work with local entrepreneurs in establishing priorities and producing tangible deliverables that solve business needs. *No credit for students with credit in 5313.*

EEE 4483 Entrepreneurship and New Technologies. Prerequisite(s): 3023 or instructor permission. Assessment of technologies and their marketplace potential. Issues in technology commercialization are examined from an entrepreneurial perspective. Students work on implementation issues surrounding actual emerging technologies originating at the university and in the surrounding community.

EEE 4513 Strategic Entrepreneurial Management. Prerequisite(s): Senior standing. The capstone integrative experience required of all business students, culminating in the development of a comprehensive plan for a new business or nonprofit venture. All students compete in the Capstone Competition at the end of the semester.

EEE 4603 (I) Entrepreneurship Empowerment in South Africa. Prerequisite(s): Instructor permission required. Introduction to the supporting emerging enterprises assessment model. Includes focused attention on consulting within all the functional areas of an emerging enterprise operating under conditions of adversity. Periodic guest lectures by subject matter experts. Exposure to the local customs, business environment, and culture of entrepreneurs in a South African context. *No credit for students with credit in 5603.*

EEE 4610 Entrepreneurship Practicum. 1-6 credits, max 6. Prerequisite(s): 3023 and instructor permission. Transfer of knowledge from entrepreneurship course work into practice through hands-on experiences, such as business development consulting projects, management of a venture capital fund and creation of a student-owned business.

EEE 4653 Venture Capital. Prerequisite(s): 3023 or instructor permission. Approaches to raising and managing working capital in emerging enterprises. Examination of the many sources of financing for start-up and early stage ventures. Attention devoted to determining financial needs of new ventures and formulating, determining valuations and formulating deal structures.

EEE 5113* Entrepreneurship and Venture Management. Prerequisite(s): Admission to MBA program or instructor permission. Enterprise creation and problems faced by entrepreneurs in early growth stages of business ventures. An interdisciplinary problem-solving approach with emphasis on case studies and plans for new business ventures.

EEE 5123* Entrepreneurship and The Arts. Explores entrepreneurship as a way of thinking and acting within the arts, including fine art, theatre, music and design. The application of entrepreneurial framework competencies within the arts is examined. Attention is devoted to opportunity recognition, innovation, creative problem-solving, risk assessment and management, resource leveraging and related entrepreneurial capabilities. *No credit for credit in 3123.*

EEE 5133* Dilemmas and Debates in Entrepreneurship. Prerequisite(s): Graduate standing. Designed around a series of critical dilemmas confronted by entrepreneurs when creating and growing a venture. Entrepreneurs explore with students the issues surrounding these dilemmas in a structured format.

EEE 5200* Special Topics in Entrepreneurship. 1-6 credits, max 6. Prerequisite(s): Graduate standing. Examination of entrepreneurship issues. Specific topics vary from semester to semester.

EEE 5213* Entrepreneurship in Science and Technology. Assessment of technologies and their marketplace potential. Issues in technology commercialization are examined from an entrepreneurial perspective. Students work on implementation issues surrounding actual emerging technologies originating at the university and in the surrounding community. Students in science and engineering are especially encouraged to enroll.

EEE 5223* Entrepreneurial Marketing. Prerequisite(s): Admission to MBA program or instructor permission. Interplay of entrepreneurship concepts and marketing concepts, including the role of marketing in entrepreneurial ventures, and the role of entrepreneurship in a firm's marketing efforts. Emphasis is placed on how to address the significant changes taking place in markets and the modern marketing function. (Same course as MKTG 5223)

EEE 5263* Corporate Entrepreneurship. Prerequisite(s): Admission to MBA program or instructor permission. Examination of the application of entrepreneurship concepts and behaviors within established organizations, assessment of factors contributing to a company's entrepreneurial orientation, and identification of ways to foster higher levels of entrepreneurship within firms.

EEE 5313* Emerging Enterprise Consulting. Prerequisite(s): Admission to the MBA program or instructor permission. Using an established methodology, student teams work with local entrepreneurs in establishing consulting priorities within their ventures and producing tangible deliverables that solve business challenges. All facets of business are addressed.

EEE 5333* Launching a Business: The First 100 Days. Addresses operational challenges in launching a new venture in its very formative stage. Attention is devoted to business formation, risk management, record keeping, go-to-market strategy, contracts, facilities, dealing with suppliers, and intellectual property, among other issues.

EEE 5403* Social Entrepreneurship. Advanced level examination of entrepreneurship in the social or non-profit sector. Investigation of issues surrounding creation and operation of new ventures that address vexing social needs and opportunities. Explores the application of entrepreneurship concepts and principles in a social context. *Students may not take both EEE 3403 and EEE 5403* for credit.*

EEE 5493* Entrepreneurship and Architecture. Prerequisite(s): Admission to a graduate program. Introduction to entrepreneurship within the context of architecture, with direct application to architectural services, activities and products. Emphasis on implementing the entrepreneurial process in starting and sustaining new ventures that significantly shape the building environment. (Same course as ARCH 5493)

EEE 5513* Growing Small and Family Ventures. Prerequisite(s): 3023 or instructor permission. Exploration of unique challenges involved when growing small and family-owned ventures. The life stages of emerging enterprises are examined. Issues addressed include resource needs, skill requirements, functional area development, and work-life balance. *No credit for credit in 3513.*

EEE 5603* Entrepreneurship Empowerment in South Africa. Prerequisite(s): Instructor permission required. Introduction to the supporting emerging enterprises assessment model. Includes focused attention on consulting within all the functional areas of an emerging enterprise operating under conditions of adversity. Periodic guest lectures by subject matter experts. Exposure to the local customs, business environment, and culture of entrepreneurs in a South African context. *No credit for students with credit in 4603.*

EEE 5610* Advanced Entrepreneurship Practicum. 1-6 credits, max 6. Prerequisite(s): 5113. Transfer of knowledge from entrepreneurship course work into practice through hands-on experiences, such as business development consulting projects, management of a venture capital fund, and creation of student-owned business.

EEE 5653* Venture Capital. Prerequisite(s): 5113, admission to MBA program or instructor permission. Venture capital investing and the business development process. Exploration of how startups and early stage firms determine money needs, obtain financing and structure deals. *No credit for students with credit in 4653.*

EEE 5663* Imagination in Entrepreneurship. Prerequisite(s): Graduate standing. Exploration of creativity and ideation as they relate to the entrepreneurial process. Perspectives on opportunity discovery and assessment are examined. Theoretical and conceptual foundations for the application of creativity to business problem solving are investigated.

EEE 5713* Native American Entrepreneurship. Understanding the impact entrepreneurship thinking and behavior can have for Native Americans. Strategies and tactics to increase the number of new business ventures launched by Native Americans. No credit for students with degree credit in EEE 3713.

EEE 5993* Preparing Effective Business Plans. Prerequisite(s): ACCT 5183, 5283, FIN 5013, MGMT 5113, EEE 5113, 5663 and 5333. The critical issues involved with developing a business venture, through the process of developing a comprehensive business plan including feasibility analysis, actual development of the plan, and preparing to present the plan to investors.

EEE 6200* Entrepreneurship Research Project. Prerequisite(s): Admission to doctoral program and instructor permission. Directed research projects for doctoral students. Students conduct publishable research on leading issues in entrepreneurship.

EEE 6213* Entrepreneurship: Cross-Disciplinary Interfaces. Prerequisite(s): Doctoral student standing and consent of instructor. Survey of the existing conceptual, theoretical, and practical links between entrepreneurship and other disciplines. Exploration of opportunities for cutting edge research on the boundaries of entrepreneurship and other disciplines.

EEE 6263* Theoretical Foundations in Entrepreneurship. Prerequisite(s): Doctoral student standing and consent of instructor. Broad survey of major topics in the field of entrepreneurship. The primary theoretical underpinnings of the field are covered as well as some of the common and/or promising methodological approaches to the study of entrepreneurial phenomena.

EEE 6343* Entrepreneurship Processes. Prerequisite(s): Doctoral student standing and consent of instructor. Current research that addresses important entrepreneurial questions and assesses "gaps" in those literatures. Strategies will be proposed to address these gaps. Focuses on refining students' skills in "mapping out" and writing research papers.

EEE 6353* Contemporary Research Topics in Entrepreneurship. Survey of the existing conceptual, theoretical, and practical links between entrepreneurship and other disciplines. Exploration of opportunities for cutting edge research on the boundaries of entrepreneurship and other disciplines.

EEE 6363* Individual Theories in Entrepreneurship Research. Prerequisite(s): Admission to doctoral program. Analysis of research and theories related to the individual entrepreneur.

Environmental Science (ENVR)

ENVR 1113 Elements of Environmental Science. Application of biology, chemistry, ecology, economics, geology, hydrology, mathematics, physics, and other agricultural sciences to environmental issues. Addressing environmental problems from the standpoint of ethics, risk, and scientific and social feasibility. Emphasis on agricultural systems and natural resources.

ENVR 3113 Sampling and Analyses for Solving Environmental Problems. Lab 3. Prerequisite(s): 1113 and CHEM 1215 or CHEM 1314 and BIOL 1114. Provide multiple examples for evaluating the evidence which documents environmental problems. Develop sampling skills required to obtain biological and physical data needed in the evaluation of environmental problems. Analyze biological and physical data using basic statistical methods and determine the 1) severity of water, soil, and air pollution, and 2) degree of ecosystem degradation. Present findings as written reports which emphasize the use of comparative graphs, tables, and figures.

ENVR 4010 Internships in Environmental Science. 1-6 credits, max 6. Prerequisite(s): Junior standing in environmental science or consent of instructor. Supervised internships with business, industry, or governmental agencies in environmental assessment and remediation.

ENVR 4112 Land Measurement and Site Analysis. Lab 2. Prerequisite(s): MATH 1513 or equivalent. Methods and techniques used to locate sites and evaluate physical conditions with the goal of collecting the required information for an environmental impact report; includes Public Land Survey System (PLSS), equipment selection and use, Global Positioning System (GPS), data collection and analysis, and mapping. (Same course as MCAG 4112)

ENVR 4363 Environmental Soil Science. Prerequisite(s): BIOL 1114 and SOIL 2124. Re-emphasis of soil science concepts vital in the understanding of processes that are within the realms of the ecological regulator function of the soil; discussions on the role of soil as the foundation of forest, rangeland/pastureland, agricultural, urban and suburban, as well as wetland ecosystems; impact of soil processes on global environmental concerns; soil as the ultimate recipient of waste; impact of soil processes on groundwater and surface water quality (Same course as SOIL 4363*)

ENVR 4500 Environmental Science Problems. 1-6 credits, max 6. Prerequisite(s): Upper-division standing, GPA of 2.50 or better, and consent of instructor. Individual or small group study of selected problems in environmental science. Course may be used twice for up to six credit hours to meet degree requirements.

ENVR 4512 Environmental Impact Analysis. Outline of the National Environmental Policy Act (NEPA) documentation of potential environmental impacts for decision makers. Development of environmental assessment, environmental impact statements, and categorical exclusion documents that result from the NEPA processes. *Graded on a pass/fail basis.*

ENVR 4811 Professional and Capstone Planning. Prerequisite(s): Senior standing. Preparation to work and communicate with environmental professionals and develop a written proposal to solve an environmental application or problem.

ENVR 4813 Environmental Science Applications and Problem Solving. Lab 4. Prerequisite(s): 4811 or consent of instructor. Team work on environmental problems, to develop solutions and communicate recommendations to professionals as part of a senior capstone project. Results are presented by oral and written reports directly to professionals.

ENVR 4893 Soil Chemistry and Environmental Quality. Prerequisite(s): SOIL 2124 and CHEM 1225. Chemical and colloidal properties of clays and organic matter in soil systems, including ion exchange, retention, and precipitation; soil acidity and salinity; minerals weathering and formation; oxidation-reduction reactions; trace and toxic elements, water quality, land application of wastes, and soil remediation. (Same course as SOIL 4893*)

ENVR 4913 Animal Waste Management. Prerequisite(s): SOIL 2124. Aspects of animal waste management related to animal nutrition, system design, land application, socioeconomic issues and environmental impacts. (Same course as ANSI 4913* and SOIL 4913*)

ENVR 5000* Master's Thesis. 1-3 credits, max 6. Prerequisite(s): Approval of advisory committee and departmental steering committee. Research leading to master's thesis or report.

ENVR 5050* Readings in Environmental Science Topics. 1-3 credits, max 9. Prerequisite(s): Consent of the instructor. This course provides an avenue for masters students to extend their knowledge of Environmental Science topics not covered in other courses. *This course is not available for doctoral students.*

ENVR 5123* Environmental Problem Analysis. Prerequisite(s): 5303. This course reviews the process of environmental problem analysis using current practical examples. This course draws on theories from various disciplines and applies appropriate techniques of analysis.

ENVR 5200* Special Topics in Environmental Science. 1-4 credits, max 10. Prerequisite(s): Graduate standing. Topics and issues in the broad field of environmental science. Group discussions and projects not covered by existing courses such as ecological risk assessment, water chemistry and environmental law.

ENVR 5210* Seminar in Environmental Science. 1-3 credits, max 6. Prerequisite(s): Consent of the instructor. This seminar is offered as a special topics course for masters students. The theme of the seminar will vary in accordance with recent advances in environmental science and the interests of the faculty instructor.

ENVR 5303* Issues in Environmental Sustainability. Prerequisite(s): 3000 or 4000 level ecology course. The course reviews human-nature relationships and how they affect the ability of future generations to sustainably improve their quality of life. The course also considers methods of environmental stewardship that can contribute to sustainability. In-class and/or online discussions of issues, guest presentations by outside experts, and reports on selected topics are included.

ENVR 5313* Clean Air Act: Regulation, Compliance and Reporting. This course will present an overview of the Federal Clean Air Act including regulatory history and framework, key concepts such as technology forcing, enforceability and adequate margin of safety. This course addresses the preparation of emissions calculations for reporting and permitting, discussion of emissions monitoring and control technologies, and review of reporting requirements and legal standards for compliance. Course will focus on U.S. Federal and State application.

ENVR 5353* Environmental Outreach and Education. Techniques for environmental education and outreach programs for adults and children in the classroom and in the public arena.

ENVR 5443* Hazardous Waste Regulations for Environmental Managers. Covers air, water and waste permitting and plans as well as DOT transportation of hazardous materials and several OSHA standards.

ENVR 5453* Bioremediation for Environmental Managers. Teaches the fundamental biological mechanisms that allow microorganisms and plants to degrade and/or remove contaminants from the environment.

ENVR 5503* Environmental Management Practicum. Prerequisite(s): 18 credit hours, which must include one environmental compliance course (POLS 5633 or CIVE 5123), and one environmental risk course (POLS 5643, POLS 5653, or CIVE 5823); OR comparable courses as approved by the instructor. This course explores methods of analyzing sustainable solutions to complex environmental, safety and health problems using an integrated team approach. This approach combines technical, legal, economic, and sociopolitical information into a coherent analytical framework. *Required for masters students pursuing a plan of study in environmental management.*

ENVR 5510* Environmental Management Internship. 3 credits, max 6. Prerequisite(s): 5503 and consent of program director. The student must identify and solve an environmental problem under the supervision of a competent professional environmental manager, and submit and defend a formal report presenting the problem, solution analysis methodologies, and recommended solution. The internship must involve at least 240 contact hours with the manager. *The course is required of all masters students pursuing a plan of study in environmental management.*

ENVR 5523* Industrial Ecology for Environmental Scientists. Prerequisite(s): General biology. Provides students with an overview and broad understanding of ecology principles as applied to an industrial setting. The course begins with an overview of general ecological principles such as ecosystem components and structures, biogeochemical cycles, energy flows, and properties of populations. The course concludes with a consideration of industrial ecology principles such as sustainability, pollution prevention, life cycle assessment and waste minimization.

ENVR 5543* Environmental Management Systems. Prerequisite(s): 5303 or equivalent knowledge with consent of instructor. This course introduces strategies for the design and operation of environmental management systems that reduce environmental impacts in conformance with ISO 14000 standards. Topics include aspect identification, impact assessment, impact reduction strategies, and management oversight. Other topics such as training, internal and external auditing, and integration with other management programs will also be addressed.

ENVR 5573* Applied Standards for Environmental Managers. Foundational understanding of the complex regulatory framework related to waste management.

ENVR 5633* Physical Geology for Environmental Managers. Overview of the physical and chemical nature of the solid and fluid earth. Focuses on how these physical attributes and processes influence interactions between humans and the earth's environment.

ENVR 5703* Chemical Aspects of Environmental Science I. Prerequisite(s): CHEM 1225, MATH 2155. For non-chemists with a basic understanding of industrial environmental chemistry. For the environmental professional student in the calculations required for permitting, such as the Clean Air Act, the Clean Water Act, release reporting (CERCLA), RCRA and Industrial Hygiene. The chemical interpretation of MSDS sheets and review of basic chemistry for individuals sitting for professional examinations. Fundamental scientific basis required for dealing with any environmental area.

ENVR 5713* Chemical Aspects of Environmental Science II. Prerequisite(s): 5703. A continuation of 5703. Applications of statistical methods for environmental monitoring, environmental sampling, chemical wastewater treatment, fugacity (air emission calculations) and environmental chemical analysis.

ENVR 5733* Environmental Site Assessment. This course introduces concepts associated with conducting environmental site assessments (ESAs) and contaminant remediation. Topics include review of federal regulations regarding site assessments, an overview of Phase I and Phase II ESA methodologies, proper soil/water sampling techniques, soil/geology/hydrogeology principles relating to environmental assessments, and various

remediation strategies. The course includes field exercises simulating Phase I and Phase II ESA investigations, interpretation of historical aerial photos, and wetland identification.

ENVR 5743* Environmental Impact Assessment. The course teaches students how to understand and apply the National Environmental Policy Act to evaluate and document potential environmental impacts for decision makers. The course reviews the development of environmental assessment, environmental impact statement and categorical exclusion documents that result from the NEPA process. Emphasis is placed on the development of an environmental assessment program.

ENVR 5753* Environmental Site Remediation. Introduction to concepts associated with environmental site remediation. Emphasis will be placed on the application and assessment of site clean-up.

ENVR 5823* Watershed Management. This course provides an overview of watershed management that integrates law, politics, economics, watershed science, engineering, education, social marketing, and conflict resolution. Students will also learn how to critically evaluate watershed management programs. *Field trips to watersheds are included.*

ENVR 5853* Field Stream Assessment. Techniques for evaluating the health of streams. Laboratory techniques for fish and aquatic insect collection, habitat assessments, chemical water quality analysis, and stream discharge measurement.

ENVR 6000* Doctoral Research for Dissertation. 1-12 credits, max 24. Prerequisite(s): Approval of advisory committee. Research leading to the PhD dissertation.

ENVR 6011* Survey of Environmental Science. This course introduces newly admitted environmental science students to environmental research conducted by faculty at OSU. The course also helps students prepare interdisciplinary plans of study that support their professional and research goals. It is required of all ES doctoral students during their first year of enrollment. *The course may also be taken by ES masters students, but is not required.*

ENVR 6023* Research Methodologies in Environmental Science. Prerequisite(s): Permission of student's research adviser. Introduction to research techniques and literature in environmental science for doctoral students.

ENVR 6031* Interdisciplinary Research Report Preparation. Prerequisite(s): 6023 or AGED 5983 and permission of the student's research adviser. This course teaches students how to prepare and defend interdisciplinary dissertations. Students will learn how to interpret results, articulate findings, justify conclusions, and identify implications. They will also learn how to deliver professional conference presentations and write professional papers. The course requires permission of the student's research adviser. The course is required of all ES doctoral students just before they intend to prepare and defend their dissertations. ES master's students who want to learn more about preparing and defending a thesis may also enroll.

ENVR 6050* Advanced Readings in Environmental Science. 1-3 credits, max 9. Prerequisite(s): Consent of the instructor. This course provides an avenue for doctoral students to extend their knowledge of environmental science topics not covered in other courses.

ENVR 6210* Advanced Seminar in Environmental Science. 1-3 credits, max 9. Prerequisite(s): Consent of the instructor. This course is offered as a special topics course for doctoral students. The theme of the course will vary in accordance with recent advances in environmental science and the interests of the faculty instructor. *No masters student may enroll in this course.*

ENVR 6310* Advanced Topics in Environmental Science. 1-3 credits, max 6. Prerequisites: 24 credit hours of graduate credit and permission of instructor. This course covers current topics and issues in environmental science. Though the topics will vary, each course will typically include environmental assessment, environmental sustainability and environmental policy. Group discussions and team projects may be required.

ENVR 6503* Advanced Environmental Management Practicum. Prerequisite(s): 30 credit hours, which must include one environmental compliance course (POLS 5633 or CIVE 5123), and one environmental risk course (POLS 5643, PLS 5653, or CIVE 5823); OR comparable courses as approved by the instructor. This course discusses and compares advanced methods of analyzing sustainable solutions to complex environmental, safety and health problems. A framework for integrating technical, legal, economic, and sociopolitical analysis into a risk-based model will be developed and applied to a real-world case study. *Required for doctoral students pursuing a plan of study in environmental management.*

ENVR 6516* Advanced Environmental Management Internship. 6 credits. Prerequisite(s): 6503 and consent of program director. The student must identify and solve an environmental problem in collaboration with a competent professional environmental manager, and submit and defend a formal report presenting the problem, problem and solution analysis methodologies, and recommended solution. The internship must involve at least 480 contact hours with the manager. The course is an experience for all ES doctoral students pursuing a plan of study in environmental management.

ENVR 6623* Social Aspects of Environmental Planning. This course develops students' theoretical and practical understanding of social aspects of environmental planning. The course addresses topics such as social impact assessment, the role of public involvement, environmental justice, and other social considerations in the implementation of environmental programs. It will also demonstrate the application of social science techniques in environmental planning and prepare students for the application of social perspectives in environmental decision-making - in both the public and private sectors.

Finance (FIN)

FIN 2123 Personal Finance. A first course in the management of the individual's financial affairs. Budgeting, use of credit, mortgage financing, investment and estate planning.

FIN 3113 Finance. Prerequisite(s): STAT 2023 and ACCT 2203 or concurrent enrollment; and ECON 2203 or concurrent enrollment. Operational and strategic financial problems including allocation of funds, asset management, financial information systems, financial structure, policy determination and analysis of the financial environment.

FIN 3613 General Insurance. Prerequisite(s): 3113. Introduction to the theory and general principles of insurance. A broad analysis of the elements and operation of property, casualty, health and life insurance.

FIN 3713 Real Estate Investment and Finance. Prerequisite(s): 3113. An introductory course in real estate investment and finance. Financing real estate, financial leverage and financial planning, the institutional structure of mortgage lending, managing risks, investment strategies and decisions.

FIN 4063 Applied Financial Studies. Prerequisite(s): Consent of the instructor. Structured internship or field project with supporting academic study.

FIN 4113 Financial Markets and Institutions. Prerequisite(s): 3113, and ECON 3313 or concurrent enrollment in ECON 3313. Money and capital markets, flow-of-funds, commercial banks and other financial intermediaries.

FIN 4213 International Financial Management. Prerequisite(s): 3113 or consent of instructor. Financial management topics unique to business firms operating in an international environment. Topics include global economic and business environments, international monetary system, foreign exchange markets, foreign exchange risk and management, foreign direct investment, and trade finance. Recent and current international financial events.

FIN 4223 Investments. Prerequisite(s): 3113. Various approaches to selecting and timing investment opportunities, e.g., common stocks, bonds, commodities and options. Modern concepts of portfolio theory.

FIN 4333 Financial Management. Prerequisite(s): 3113 or consent of instructor. Theories and practice applicable to the financial administration of a firm. A variety of teaching methods used in conjunction with readings and cases to illustrate financial problems and techniques of solution.

FIN 4363 Energy Finance. Prerequisite(s): 3113. Introduction to basic terminology, industry structure, and supply and demand outlook in the oil, gas and power industries. A broad analysis of applications in the energy industry including financial statement analysis, valuation, risk analysis in capital budgeting, risk management, alternative energy topics and energy specific case studies.

FIN 4443 Banking Strategies and Policies. Prerequisite(s): 3113, and ECON 3313 or concurrent enrollment in ECON 3313. Theories and practices of bank asset management; banking markets and competition.

FIN 4453 Bank Decision Simulation and Analysis. Prerequisite(s): 3113 and 4443. Student teams assume the roles of senior bank officers, making decisions regarding bank assets, funding, product pricing, financial leverage, profit enhancement, risk management, and staffing. Decisions implemented through computer simulation, incorporating the decisions into an environment where the decisions of competing management teams and the local economy determine bank profitability and shareholder value. Evaluation of students' abilities to create shareholder value and effectively communicate planning and analysis through written and spoken reports.

FIN 4550 Selected Topics in Finance. 1-6 credits, max 6. Prerequisite(s): 3113 or consent of instructor. Advanced topics in finance. Topics are updated each semester.

FIN 4653 Bond Markets. Prerequisite(s): 3113 and 4113. Provides a broad introduction to treasury, corporate, municipal, mortgage backed, and asset backed bond markets. The analytical techniques for valuing bonds, quantifying their exposure to changes in interest rate and credit risk exposures and investment decision-making are explored. Concepts are applied through case studies and projects.

FIN 4763 Financial Futures and Options Markets. Prerequisite(s): 3113 and 4223. Foundation in financial futures and options markets. A balance of institutional detail necessary to understand the structure of these markets and the theoretical developments necessary to apply the contracts to various uses. The use of financial futures and options to manage price risk.

FIN 4813 Portfolio Management. Prerequisite(s): 3113 and 4223 with a grade of "C" or better and consent of instructor. Overview of portfolio management from the point of view of a trust officer, mutual fund manager, pension fund manager, or other manager of securities. Emphasizes the need of financial managers for an understanding of problems, trends, and theory of portfolio management.

FIN 4843 Risk Management. Prerequisite(s): 3113 and 4223. Introduction to

relevant analytical tools necessary for the effective management of risk.

FIN 4913 Advanced Risk Management. Prerequisite(s): 3113, 4223, 4763, and 4843 (with a grade of "C" or better). Applications of risk management concepts and skills for the development of programs to manage risk exposures.

FIN 5000* Master's Research and Thesis. 1-6 credits, max 6. Prerequisite(s): Good standing in Master of Science in quantitative financial economics program and consent of program coordinator. Research and thesis for master's students.

FIN 5010* Finance Projects and Independent Studies. 1-6 credits, max 6. Prerequisite(s): Good standing in graduate program and consent of project adviser and consent of department head. Graduate projects and independent study in finance.

FIN 5013* Business Finance. Prerequisite(s): Admission to a SSB graduate program and ACCT 5183 or equivalent, or consent of MBA director or instructor. Introduction to the major areas of business finance: the financial environment in which business decisions are made and the institutions found therein, the financial management practices of a firm securing financing and allocating resources among competing alternatives, and the valuation of financial assets to the firm and individuals.

FIN 5053* Theory and Practice of Financial Management. Prerequisite(s): Admission to a SSB graduate program and FIN 5013 or equivalent and ACCT 5183 or equivalent or consent of the MBA director or instructor. Concepts and theories applicable to the financial administration of a firm. Cases, problems and readings to illustrate various financial problems and techniques of solution.

FIN 5153* Corporate Financial Strategy. Prerequisite(s): Admission to a SSB graduate program and FIN 5013 or equivalent and ACCT 5183 or equivalent or the consent of the MBA director or instructor. Strategic financial decisions and their implementation, including capital structure policy, capital budgeting, risk assessment and management, corporate restructuring, management performance assessment, cost of capital, financial resource planning, dividend policy, and capital raising. Familiarity with basic financial tools and techniques including time value of money, asset pricing and security valuation, and financial statement analysis.

FIN 5213* International Business Finance. Prerequisite(s): 5013. Theories and financial management practices unique to business firms which operate in, or are influenced by, an increasingly global economy.

FIN 5223* Investment Theory and Strategy. Prerequisite(s): Admission to a SSB graduate program, 5013 or the consent of MBA director or the instructor. Selected investment topics and advanced portfolio management techniques.

FIN 5243* Financial Markets. Prerequisite(s): 5013. An analysis of the structure of financial markets, the determination and behavior of interest rates, the functioning of and the flow of funds.

FIN 5333* Corporate Governance. Prerequisite(s): 5013. The theoretical and applied analysis of the governance structure of a corporation. The interconnections of the board of directors, CEO, management and shareholders. Case problems and readings address the advantages and disadvantages of various corporate governance practices.

FIN 5550* Special Topics in Finance. 1-6 credits, max 12. Prerequisite(s): Consent of instructor. Theoretical and applied aspects of specialized financial areas. Evaluation of models, current trends and problems.

FIN 5763* Derivative Securities and the Management of Financial Price Risk. Prerequisite(s): 5013 or consent of instructor. Differing amounts of financial price risk for individuals and corporations in volatile financial environment. The development of arbitrage-based models for the pricing of derivative securities, and the use of a full range of derivative securities to manage exposure to financial price risk.

FIN 5773* Financial Engineering. Prerequisite(s): MATH 4513 and FIN 5763 or consent of instructor. Techniques for the design, development and implementation of innovative financial instruments and processes to the formulation of creative solutions of problems in finance.

FIN 5883* Quantitative Financial Applications. Prerequisite(s): 5223 and consent of the head of the department. Application of financial solution techniques through directed case work in appropriate business and public sector settings. Simulation, small group instruction and field-based experiences.

FIN 6053* Financial Theory and Corporate Policy. Prerequisite(s): Consent of the instructor. Theoretical and empirical underpinnings of modern corporate finance.

FIN 6660* Seminar in Finance. 3-6 credits, max 12. Prerequisite(s): Consent of instructor. Advanced research with emphasis on theoretical problems and solutions. Selected topics covered.

Fire Protection and Safety Technology (FPST)

FPST 1213 Fire Safety Hazards Recognition. "The Fire Problem'' Physical, chemical and electrical hazards and their relationship to loss of property and/or life. Safe storage, transportation and handling practices to eliminate or control the risk of fire in the home, business and industry.

FPST 1373 Fire Suppression and Detection Systems. Lab 3. The design, installation, maintenance and utilization of portable fire-extinguishing appliances and pre-engineered systems. Operational capabilities and utilization requirements of fire detection and signaling systems. Fire detection and suppression applied in practical laboratory problems.

FPST 2023 Introduction to Occupational Safety Techniques. Lab 3. Occupational facilities, equipment and operations and their inherent hazards. Directed toward worker, machine and environmental control.

FPST 2050 Studies in Loss Control. 1-4 credits, max 6. Prerequisite(s): Consent of instructor and adviser. Problems in applied fire protection technology, occupational safety, industrial hygiene or hazardous materials management of particular interest to the loss control specialist.

FPST 2153 Fire Protection Management. Applied human relations, technical knowledge and skills for achieving optimum effectiveness from a fire protection organization.

FPST 2243 Design and Analysis of Sprinkler Systems. Lab 3. Prerequisite(s): 1373, 2483, ENGR 1322 or GENT 1153. Detailed current standards for selection, design, installation, operation and maintenance of automatic fire suppression systems. Laboratory problems on applicable technological principles.

FPST 2344 Elements of Industrial Hygiene. Lab 3. Prerequisite(s): CHEM 1225. Toxic or irritating substances, physical, biological, ergonomic and other occupational stress factors causing employee illness or discomfort. Environmental pollution sources and controls.

FPST 2483 Fire Protection Hydraulics and Water Supply Analysis. Lab 3. Prerequisite(s): 1373 and MATH 1513. Fluid flow through hoses, pipes, pumps and fire protection appliances. Water supply and distribution analysis using hydraulic calculations. Testing techniques to detect anomalies in design or performance capabilities.

FPST 2650 Technical Problems and Projects. 1-4 credits, max 4. Special problems or projects assigned by advisers with the approval of the department head. A comprehensive written report or equivalent creative effort.

FPST 3013 Safety Management. Understanding and implementing techniques for a safer work environment. Recognition, evaluation and control of occupational health and safety hazards. Accident prevention, accident analysis, training techniques, workman's compensation insurance, guarding and personal protective equipment.

FPST 3113 Advanced Extinguishing Systems Design and Analysis. Prerequisite(s): 2483, 2243. Automatic fixed fire-extinguishing systems and water supply systems. Emphasis upon computer assistance through use of existing design programs.

FPST 3143 Structural Designs for Fire and Life Safety. Prerequisite(s): Grade of "C" or better in 1213, 1373, 2243 and GENT 2323 or ENSC 2113. Building construction standards and codes to assure maximum life and property safety from fires, explosions and natural disasters. Egress design specifications, occupancy and construction classifications and fire protection requirements for building construction and materials.

FPST 3213 Human Factors in Accident Prevention. Prerequisite(s): 2344, 3013 and GENT 2323 or ENSC 2113. Human factors and workplace ergonomics as it relates to the prevention of accidents and workplace injuries. Fundamentals and techniques of task analysis.

FPST 3233 Radiological Safety. Lab 2. Ionizing radiation problems; detection and measurement, shielding and exposure limiting, radiation health aspects, storage, handling and disposal.

FPST 3373 Fire Dynamics. Lab 3. Prerequisite(s): Admission to Professional School and grade of "C" or better in CHEM 1314 or CHEM 1215 or CHEM 1225, ENGR 1412 or CS 1103 or EET 1003, GENT 2323 or ENSC 2113, MATH 2133 or MATH 2153, STAT 2013 or STAT 4013 or STAT 4033, and FPST 2483. Fundamental thermodynamics of combustion, fire chemistry and fire behavior. The physical evidence left by fire for investigation and the use of computer models to study fire behavior.

FPST 3383 Building Electrical Systems. Prerequisite(s): 1373. Detail current standards for design, selection and installation of electrical distribution ad utilization equipment. Emphasis on personnel safety and fire prevention using current codes and standards.

FPST 3713 Hydraulic Design of Automatics Sprinkler Systems. Prerequisite(s): 1373, 2483, MATH 1513. Hydraulic calculation technique for the design and analysis of automatic sprinkler fire extinguishing systems.

FPST 3723 Industrial Fire Pump Installations. Prerequisite(s): 2483, MATH 1513. Applications, design and analysis of industrial fire pump installations. Graphical analysis of fire pump contributions to existing fire protection water supply systems emphasized.

FPST 3733 Sprinkler System Design for High Piled and Rack Storage. Prerequisite(s): 2243, MATH 1513. Specific design techniques for sprinkler system protection of commodities stored in solid piles or racks over 12 feet in height.

FPST 4050 Special Problems in Loss Control. 1-4 credits, max 6. Prerequisite(s): Consent of department head. Special technical problems in fire protection and safety.

FPST 4143* Industrial Ventilation and Smoke Control. Prerequisite(s): Admission to Professional School; grade of "C" or better in 2344 and 2483 and 3373. Principles of dilution and comfort ventilation; heat-cold stress control,

system design, contaminant control; ventilation system testing and guidelines. Design and analysis of smoke management systems in buildings for survivability and safe egress. Assessment of human health hazards posed by smoke. Performance characteristics of smoke control systems.

FPST 4153 Issues in Local Government and Fire Services. Prerequisite(s): 2344, 3013, 3143, and STAT 2013 or 4013 or 4033 or consent of instructor. Fire and Safety techniques to anticipate, recognize and control hazards. Fault Tree, HazOp, FMEA and other process safety techniques.

FPST 4333 System and Process Safety Analysis. Lab 3. Prerequisite(s): 2344, 3013, 3143 and STAT 2013 or 4013 or 4033 or consent of instructor. Fire and safety techniques to anticipate, recognize and control hazards. Fault Tree, HazOp, FMEA and other process safety techniques.

FPST 4383* Fire and Safety Simulation Modeling. Prerequisite(s): Admission to Professional School; grade of "C" or better in 3373 and STAT 2013 or STAT 4013 or STAT 4033 or instructor consent. Zone and field simulation modeling techniques for building fire safety assessment. Monte Carlo models, probability distributions for risk modeling, input data for risk modeling, and risk modeling software. Analysis and interpretation of simulation modeling output. Simulation model is required for successful course completion.

FPST 4403 Hazardous Materials Incident Management. Lab 3. Prerequisite(s): 2023, 2344, CHEM 1225. An interdisciplinary approach to hazardous materials incident management. Legislative requirements. Emphasis on comprehensive safety and health program compliance relating to hazardous materials incidents or waste sites. Regulatory code activities, transport-related inspections, incident modeling, and use of environmental safety software for problem solving and documentation.

FPST 4684 Industrial Loss Prevention. Lab 3. Prerequisite(s): Prior or concurrent enrollment in all other required FPST courses and ENGL 3323 or consent of instructor. Specific industrial processes, equipment, facilities and work practices for detecting and controlling potential hazards.

FPST 4993 Advanced Fire and Safety Problems. Prerequisite(s): Prior or concurrent enrollment in all other required FPST courses. Selected problems in the fire, occupational safety, occupational health and industrial security areas. Research or state-of-the-art technologies to prevent or correct such problems. Selected topics covered.

Fire Safety and Explosion Protection (FSEP)

FSEP 5113* Fire and Explosion Hazard Recognition. Prerequisite (s): 30 credit hours of STEM coursework or instructor consent. Physical, chemical and electrical hazards and their relationship to loss of property and/or life. Safe storage, transportation and handling practices to eliminate or control the risk of fire or explosion.

FSEP 5123* Fire and Explosion Detection and Mitigation. Prerequisite (s): 30 credit hours of STEM coursework or instructor consent. Chemistry and physics of energetic materials and their relationship to their surroundings. The requirements for detection, suppression, and mitigation of energetic materials.

FSEP 5133* Principles of Industrial and Process Safety. Prerequisite (s): 30 credit hours of STEM coursework or instructor consent. Systemic assessment of industrial operations and processes to identify and mitigate related hazards. Improve skills in qualitative and quantitative analysis such as fault trees, HAZOP studies, and MORT charts.

FSEP 5143* Structural Design for Fire and Life Safety. Prerequisite (s): 30 credit hours of STEM coursework or instructor consent. Building construction standards and codes to assure maximum life and property safety from fires, explosions and natural disasters. Egress design specifications, human factors and fire and explosion protection requirements for building construction and materials.

FSEP 5153* Critical Infrastructure Vulnerability and Risk. Prerequisite (s): 30 credit hours of STEM coursework or instructor consent. Identification of critical infrastructure and the societal risk caused by its vulnerability. Methods of analyzing the hazards and threats facing critical infrastructure components and the methods of minimizing those risks.

FSEP 5163* Principles of Industrial, Physical and Building Security. Prerequisite (s): 30 credit hours of STEM coursework or instructor consent. Introduction to homeland security and the concept of integrated physical protection. Principles of industrial and building security, security management systems, security standards, and securing against asymmetrical threats.

Food Science (FDSC)

FDSC 1133 Fundamentals of Food Science. Food industry from producer to consumer and the current U.S. and world food situations.

FDSC 2103 (D) Regional Diversity in Food Production, Selection and Consumption. Examines the diversity of people associated with food production, selection, and consumption in the United States. Evaluate the cultural diversity in food production workplace and economic and social factors that influence this diversity. Examine various food selection and consumption criteria of varying contemporary cultures based on economic, social, and religious considerations.

FDSC 2253 Meat Animal and Carcass Evaluation. Lab 2. Prerequisite(s): ANSI 1124. Evaluation of carcasses and wholesale cuts of beef, pork, and lamb. Factors influencing grades, yields, and values in cattle, swine, and sheep. (Same course as ANSI 2253)

FDSC 3033 Meat Technology. Lab 3. The basic characteristics of meat and meat products as they relate to quality. Product identification, economy, nutritive value, preservation, and utilization. *No credit for students with credit in ANSI 2253 or 3333.*

FDSC 3113 Quality Control. Lab 2. Prerequisite(s): Introductory microbiology and organic chemistry. Application of the principles of quality control in food processing operations to maintain the desired level of quality.

FDSC 3154 Food Microbiology. Lab 4. Prerequisite(s): Introductory microbiology and organic chemistry. Relationship of microorganisms to food manufacture and preservation, to food spoilage and microbial food poisoning and to various aspects of primary food production. (Same course as MICR 3154)

FDSC 3232 Advanced Meat Evaluation. Lab 4. Prerequisite(s): 2253. Advanced evaluation of carcasses and wholesale cuts of beef, pork and lamb. (Same course as ANSI 3232)

FDSC 3310 Advanced Competitive Evaluation. Lab 6. Prerequisite(s): Consent of instructor. Advanced instruction in animal and/or product evaluation. For students competing on collegiate judging teams. (Same course as ANSI 3310)

FDSC 3333 Meat Science. Lab 3. Prerequisite(s): ANSI 2253, CHEM 1215 or equivalent. Anatomical and basic chemical and physical characteristics of meat animals studied. The application of scientific principles to the processing and economical utilization of meat animals, as well as in the manufacture of meat products emphasized in the laboratory. (Same course as ANSI 3333*)

FDSC 3373 Food Chemistry I. Lab 2. Prerequisite(s): ANSI 3543 or organic chemistry. Basic composition, structure, and properties of foods and the chemical changes or interactions that occur during processing and handling.

FDSC 3603 Processing Dairy Foods. Lab 2. Prerequisite(s): Organic chemistry. Theory and practice in formulation and processing: butter and margarine, cottage cheese, blue and processed cheeses, evaporated and sweetened condensed milk, ice cream, ice milk, and other frozen desserts.

FDSC 4123* Principles of Food Engineering. Prerequisite(s): 1513. For non-engineers. Application of the engineering approach to solving heat and mass transfer problems in food processing. An introduction to the basic concepts of the conservation laws, fluid flow, heat transfer, refrigeration, freezing, psychrometrics, and energy conservation. (Same course as MCAG 4123)

FDSC 4333* Processed Meat. Lab 3. Prerequisite(s): ANSI 3033 or 3333. Meat and meat product composition. Techniques in the molding and forming of meat; sausage formulation; curing; quality control; and cost analysis. (Same course as ANSI 4333*)

FDSC 4373 Food Chemistry II. Lab 2. Prerequisite(s): 3373. Chemical/biochemical mechanisms that affect the structure and properties of foods during processing and handling. *No credit for 5373.*

FDSC 4763* Analysis of Food Products. Lab 2. Prerequisite(s): Organic chemistry. Application of quantitative chemical and physical methods of analysis to the examination of foods.

FDSC 4900 Special Problems. 1-6 credits, max 6. Prerequisite(s): Consent of instructor. A detailed study of an assigned problem by a student wishing additional information on a special topic.

FDSC 4910 Food Industry Internship. 1-12 credits, max 12. Prerequisite(s): Consent of instructor. Full-time internship at an approved production, processing or agribusiness unit or other agency serving the food industry. Maximum credit requires a six month internship in addition to a report and final examination. *Graded on a pass-fail basis.*

FDSC 5000* Master's Research and Thesis. 1-6 credits, max 6. Prerequisite(s): Consent of major adviser. Research for Master of Science degree in Food Science planned, conducted and reported under guidance of major adviser.

FDSC 5120* Special Topics in Food Science. 1-4 credits, max 8. Prerequisite(s): Graduate standing and consent of instructor. Advanced topics and new developments in food science.

FDSC 5213* Advances in Meat Science. Prerequisite(s): BIOC 4113 and ZOOL 3204 or equivalent. Development of muscle and its transformation to meat. Properties of meat and their influence on water-binding, pigment formation, texture, and fiber characteristics. (Same course as ANSI 5213*)

FDSC 5300* Food Science Seminar. 1 credit, max 3. Prerequisite(s): Graduate standing. Maximum two credit hours for MS degree. Maximum three credit hours for PhD degree. Critical reviews or studies of the scientific research literature related to the field of food science. Oral reports or group discussions.

FDSC 5333* Carcass Value Estimation Systems. Prerequisite(s): Graduate classification. Analysis of scientific literature regarding carcass composition, quality and palatability. Overview of technology used to evaluate carcass quality factors. (Same course as ANSI 5333)

FDSC 5373* Advanced Food Chemistry. Lab 2. Prerequisite(s): FDSC 3373.

Chemical/biochemical mechanisms that affect the structure and properties of foods during processing and handling.

FDSC 5393* Issues in Food Science. Prerequisite(s): Graduate classification. Critical analysis of issues and challenges in the U.S. food industry. Advanced forms of communication to effectively convey information to stakeholders and advocate for a position.

FDSC 5553* Interpreting Animal and Food Science Research. Prerequisite(s): STAT 5013 or concurrent enrollment. Critical evaluation and knowledgeable communication on the design, analyses, and reporting of animal science and food science research. (Same course as ANSI 5553)

FDSC 6000* Doctoral Research and Dissertation. 1-10 credits, max 30. Prerequisite(s): MS degree or consent of major adviser. Independent research for PhD degree in Food Science planned, conducted and reported in consultation of a major professor.

Foreign Languages and Literature (FLL)

The Department of Foreign Languages and Literatures offers courses under the prefix FLL, and in the following languages each of which has its own prefix: French, German, Greek, Japanese, Latin, Russian and Spanish. These languages are listed in alphabetical order.

FLL 1000 Special Studies in Foreign Languages and Literatures. 1-10 credits, max 10. Special studies in areas not regularly offered; basic level. *Not for native speakers per University Academic Regulation 4.9*.

FLL 2000 Special Study in Foreign Languages and Literatures: Intermediate. 1-5 credits, max 10. Prerequisite(s): 10 hours or equivalent in target language (applies only to language course). Special study in areas other than those offered in regular program; intermediate level. *Not for native speakers per University Academic Regulation 4.9*.

FLL 2103 (H) Masterworks of Western Culture: Ancient and Medieval. Ideas and values of Western culture as revealed through literary, artistic, historical, and philosophical contexts from Greek, Roman, and Medieval periods.

FLL 2203 (H) Masterworks of Western Culture: Modern. Ideas and values of Western culture as revealed through literary, artistic, historical, and philosophical contexts from the Renaissance to the Modern period.

FLL 2443 (I) Languages of the World. A comprehensive survey of world languages. The essential structural and historical organization of languages. The process of languages as a basic human function. (Same course as ENGL 2443)

FLL 3103 (H) Hispanic Literature in Translation. Readings of significant works from Spanish and Spanish-American literatures in English translation. Does not apply to major or minor in Spanish.

FLL 3113 (H) French Literature in Translation. Readings of significant works from French literature in English translation. Does not apply to a major or minor in French.

FLL 3500 Specialized Study in a Modern Foreign Language. 1-20 credits, max 20, Lab 1-5. Prerequisite(s): Consent of instructor. Instruction and/or tutorial work in a modern foreign language other than those offered in a major program.

FLL 4000 Specialized Studies in Foreign Languages and Literatures. 1-9 credits, max 9, Lab 1-9. Prerequisite(s): Junior standing or consent of instructor. Individual guided study, tutorial or seminar on specially selected topics in a foreign language or literature.

FLL 4993 Senior Honors Thesis. Prerequisite(s): Departmental invitation, senior standing, Honors Program participation. A guided reading and research program ending with an honors thesis under the direction of a senior faculty member with second faculty reader, both of whom will be present at an oral defense of the thesis. Required for graduation with departmental honors in any foreign language major.

FLL 5210* Graduate Studies in Foreign Languages. 1-6 credits, max 20. Prerequisite(s): 15 upper-division hours in the language. Graduate studies in foreign languages.

Forensic Sciences (FRNS)

FRNS 5000* Research and Thesis. 1-6 credits, max 6, Lab 1-6. Prerequisite(s): Consent of major adviser. Research in forensic sciences for MS degree.

FRNS 5013* Survey of Forensic Sciences. Prerequisite(s): Consent of instructor. Predominantly online class providing overview of various forensic sciences and how they relate to presentation of evidence and to civil and criminal procedures involved in solving problems of law. Law and ethics, forensic pathology, forensic dentistry and anthropology, forensic toxicology and molecular biology (DNA), forensic nursing and death scene investigation, forensic psychology, criminalistics, questioned documents, forensic engineering and technology, forensic accounting, and management techniques in forensic sciences. A review of current guidelines for knowledge, procedures, quality assurance and control, and certification/accreditation from national standards boards and scientific and technical working groups.

FRNS 5023* Questioned Document Examination. Lab 2. Prerequisite(s): 5013 or concurrent enrollment. Functions of questioned document examiners, beyond document analysis to relating services and issues. History of questioned documents, handwriting and handprinting, process for obtaining exemplars, types of document examination (e.g., typewriting, mechanical processes, indented writing, obliterated writing, inks, currency, erasures, physical matches, and post marks.) Collection and preservation of evidence as well as courtroom procedures. (This course does not train the student as a document examiner and in no way certifies or qualifies the student to conduct questioned document analysis at the conclusion of this course.

FRNS 5033* Theory and Practice of Forensic Handwriting Examination. Prerequisite(s): 5023. Theoretical and practical aspects of handwriting as forensic evidence. Production of normal and false handwriting, variables in handwriting production, standards of comparison, identification theories, examination methodologies, expression of conclusions, characterization and validation of examiner skills, legal admissibility of handwriting expertise, and challenges to professional practice.

FRNS 5043* Technical Aspects of Forensic Document Examination. Prerequisite(s): 5023. Basic theory in visual examination of questioned documents. Visual and color theory, measuring tools, instruments, simple microscopy, and photographic techniques. Technical description, theory, operation and practical use of various instrumentation used in the field such as the Electrostatic Detection Apparatus (ESDA) and Video Spectral Comparator (VSC).

FRNS 5053* The Historical Aspects of Forensic Document Examination. Prerequisite(s): Graduate standing. This course presents historical aspects of forensic document examination. It covers development of handwriting, the acceptance of document examination expertise in Britain and North American, the early luminaries and famous cases.

FRNS 5063* Ethical Research and Scientific Writing. Prerequisite(s): Permission from research adviser. Develops knowledge and skills for ethical scientific research, writing and presentation. Covers responsible conduct, organization and design of research around a scientific question, and writing problems specific to science and the individual. Adviser guidance on some assignments required.

FRNS 5073* Quality Assurance in Forensic Science. Prerequisite(s): Admission to program. Preparation for the forensic scientist to develop and implement quality assurance and quality control procedures to ensure the excellence of a laboratory. Preparation of laboratory procedures ad policies, use of appropriate standards and controls, and validation methods for establishing an effective quality assurance program in the laboratory.

FRNS 5083* Ethics in Forensic Leadership. Focuses on leadership development for managers of forensic organizations, including examination of leadership and ethics theories, application to theories to problems in forensic settings, tasks and relational skills for developing effective teams and groups within an ethical framework.

FRNS 5090* Internship in Forensic Sciences. 1-3 credits, max 3. Prerequisite(s): 5073, initial course in chosen specialty, permission of adviser and program director, and letter of agreement or contract with designated facility or laboratory. Provides practical training and experience within a work or laboratory setting under the guidance of a designated supervisor. This experience should complement graduate studies in the forensic sciences and support related career goals. Note: requires four hours per week at internship site for each credit hour of enrollment; eight hours per credit for summer session.

FRNS 5213* Molecular Biology for the Forensic Scientist. Prerequisite(s): Admission to the program. Develops a solid foundation of knowledge in molecular biology for understanding the concepts of genetic marker analysis, especially DNA typing.

FRNS 5223* Forensic Biology. Prerequisite(s): 5013 and 5213 or Instructor permission. Covers derivation of forensic evidence from biological sources for criminal and civil investigations. Includes progression of laboratory testing to identify human body fluid and its source, detection and characterization of stains or fluids and genetic marker testing.

FRNS 5242* Population Genetics for the Forensic Scientist. Prerequisite(s): 5513. Population genetics relevant to DNA analysis technologies to identify perpetrators of crime. Includes foundation of statistical knowledge in forensic DNA analysis and family relatedness testing, history and application of statistical and population genetic theory to assigning weight to matches in DNA profiles for the court.

FRNS 5282* Methods in Forensic Sciences. Lab 4. Prerequisite(s): Permission of instructor. Advanced-level laboratory course in which students apply knowledge from earlier course work in a hands-on setting and employ fundamental techniques and methods related to forensic biology, forensic microbiology, forensic pathology, and forensic toxicology.

FRNS 5313* Forensic Engineering and Technology. Lab 2. Prerequisite(s): 5013; college-level chemistry and biology; knowledge of physics, calculus, and spreadsheet calculations. Review of disciplines of chemistry, biology, physics, math and computer science as regularly applied in support of forensic engineering and technology analysis. Case studies ranging from complex "multi-event" accidents to small but individually serious accidents.

FRNS 5323* Forensic Microbiology. Prerequisite(s): Permission of instructor

and basic microbiology recommended. Basic microbiologic techniques applied to actual forensic situations. Includes rules of evidence applied to investigations with suspected use of microorganisms as bioterrorism agents. Stresses recognition of biological agents, site sampling, and laboratory identification.

FRNS 5413* Forensic Pathology and Medicine. Prerequisite(s): Consent of instructor. Medico-legal investigation of death and injury due to natural causes, accidents and violence. Transportation injuries, homicides, suicides, blunt- or sharp-force injuries, gunshot wounds, asphyxia, drowning, and thermal and electrical injuries. Pediatric deaths; rape investigation; injury analysis; interpretive toxicology; identification by dental means; anthropologic studies for determining age, sex and race; and conducting of independent medical examinations. Demonstrations and data analysis from actual cases. Review of current guidelines for knowledge, procedures, quality control/assurance, and certification/accreditation from national standards boards and scientific/technical working groups.

FRNS 5513* Forensic Bioscience. Prerequisite(s): 5013; college-level chemistry and biology. Concepts of toxicology and identity testing, the two areas representing the most extensive application of the fields of chemistry, biology and genetics to forensic science. History, theory, application and quality assurance concepts to the material. Working knowledge of how toxic compounds affect human physiology and how they are identified in the laboratory. Basic concepts in genetics and their application to tracing origin of biological samples in civil or criminal investigations as well as resolving disputed family relationships.

FRNS 5523* Forensic Toxicology. Introduction of fundamental aspects of forensic toxicology and emphasis on major subfields of postmortem forensic toxicology, human performance toxicology and forensic drug testing. Examination of methodologies and analyses associated with these three major subfields.

FRNS 5533* Drug Toxicity. Introduces fundamental aspects of abused drugs from a toxicological perspective and examines major disciplines of toxicology. Also covers basic principles of toxicology applied to different classes of commonly abused drugs.

FRNS 5543* Advanced Forensic Toxicology. Prerequisite(s): 5523. Familiarizes the student with advanced aspects of forensic toxicology in view of current forensic toxicological trends. Covers risk assessment principles, factors in pharmacokinetics, weapons of mass destruction, and integrating concepts with current applications.

FRNS 5613* Criminalistics and Evidence Analysis. Lab 2. Prerequisite(s): Admission to program. Introduction to techniques and tools used for crime scene investigations and analysis of evidence. Introduction to the forensic laboratory, its operation and function, forensically applied scientific concepts, analytical instrumentation and microscopy, and documentation, collection and preservation of physical evidence. Review of FBI-sanctioned working group guidelines for evidence gathering, evidence handling, quality control and accreditation.

FRNS 5622* Advanced Criminalistics. Lab 4. Prerequisite(s): 5073, 5613, 5653 and basic course work in specialty. Application of strategies/techniques for effective crime scene investigation in laboratory or mock crime scene setting. Covers the duties of the first officer at the crime scene, the crime scene investigator/evidence collector, and analysis of evidence in the forensic laboratory. Builds on concepts from prerequisite courses for hands-on exercises.

FRNS 5653* The Law and Expert Evidence. Prerequisite(s): Admission to program. Review of ways that the law, particularly the law of evidence, affects the work of the forensic scientist. The beginning of the case, most often the crime scene, through the legal process, through trial and including appeals and motions for a new trial. Legal doctrines of interest to the forensic scientist, such as chain of custody, work product privileges, laying of the proper foundation, exhibits, and the standards necessary to obtain a new trial.

FRNS 5713* Forensic Psychology. Lab 2. Prerequisite(s): Consent of faculty. Introduction to the relationship between the disciplines of law and psychology via examination and contrast of the issues at the interface of both disciplines. Various legal terminology that calls for psychological input; legal and ethical responsibilities of forensic psychologists, criminal behavior, punishment and deterrence, violence and mental illness, competency to stand trial, the insanity defense, eyewitness testimony, the death penalty, and polygraph testing. Exploration of the role of legal and mental health systems in social control, impact of psychological knowledge on functioning of the legal system. Examination of psychological topics and paradigms relevant to study of particular legal subsystems or topics.

FRNS 5723* Advanced Forensic Psychology. Prerequisite(s): 5013 & 5713. Expands on topics covered in FRNS 5713. Covers function of the mental health professional in criminal cases, nature and impact of mental illness on individual life and freedom, reasons behind crimes, gender differences in the criminal justice system, and laws pertinent for mental health professionals.

FRNS 5733* Forensic Victimology. Prerequisite(s): 5013 or permission of instructor. Introduction to victimology, emphasizing victims' issues within the justice system and in medico-legal investigations. Explores impact of crime on victim; correlation between types of victims; crime and offender categories; risk factors; victim-offender and victim-society relationships; the role of victimologist as a researcher and consultant; influences of media, law enforcement, advocacy groups, businesses, and social movements.

FRNS 5743* Seminar in Forensic Psychology. Prerequisite(s): permission of instructor. Capstone seminar course for all subspecialty tracks in forensic psychology. Builds upon prior coursework to prepare student for comprehensive final examinations in area of specialization and provide a theoretical background suitable for research leading to publication, presentation, or a thesis or dissertation

FRNS 5913* Forensic Accounting and Fraud Investigation. Prerequisite(s): 5013. Introduction of concepts and tools used in the fields of forensic accounting and financial fraud investigations. Issues of alter ego, constructive trusts, fraudulent conveyances, accounting liability, business valuations, lost profits, damages, marital dissolution issues and bankruptcy. Aspects of fraud investigation, including overview of fraud in U.S., types and methods of fraud perpetration, red flags of fraud perpetrators, money laundering, and international fraud investigations. (Upon completion student will have an understanding of accounting methods used in a litigation services/fraud investigation environment and knowledge of basic requirements for drafting expert reports in accordance with Federal Rules of Civil Procedure.)

FRNS 5943* Forensic Management and Organizational Development. Prerequisite(s): 5013. Application of managerial and organizational leadership skills to the demands of forensic sciences, including attention to the human resource, relations and development issues. Inter-agency cooperation, quality control and assurance, certification and accreditation issues, and internal security.

FRNS 5960* Forensic Problem Solving through Applied Research. Prerequisite(s): Permission from instructor and faculty advisor. Examines mixed research methodologies and designs applicable to the forensic sciences. The course launches work toward a thesis or creative component, including development of a purpose statement, research question and/or hypothesis as well as construction of an introduction and literature review.

FRNS 5970* Directed Readings in Forensic Sciences. 1-3 credits, max 3. Prerequisite(s): Permission of instructor and faculty adviser. Provides guided reading under direction and supervision of the instructor; in-depth, independent study on an identified topic relative to forensic sciences.

FRNS 5980* Non-Thesis Creative Component in Forensic Sciences. 1-3 credits, max 3. Prerequisite(s): Permission of instructor and faculty adviser; 5063 (concurrent enrollment allowed). Provides final-semester capstone experience for the non-thesis graduate student through independent research or projection management. Culminates with presentation of results in writing and in a public forum, which may be via electronic delivery or in person.

FRNS 5990* Special Topics in Forensic Sciences. 1-3 credits, max 15. Prerequisite(s): Permission of instructor and faculty adviser. Provides for exploration on special topics in the forensic sciences. Students gain an understanding at an advanced level of the particular topic presented.

French (FREN)

FREN 1115 Elementary French I. Lab 1.5. Main elements of grammar and pronunciation, with work on the four basic skills of listening comprehension, speaking, reading and writing. *Not for native speakers per University Academic Regulation 4.9.*

FREN 1225 Elementary French II. Lab 1.5. Prerequisite(s): 1115 or equivalent. Continuation of 1115. *Not for native speakers per University Academic Regulation 4.9.*

FREN 2112 (I) Intermediate Reading and Conversation I. Lab 1. Prerequisite(s): 1225 or equivalent competence. (May have been gained in high school) Reading and discussion of simpler French texts, mostly cultural. May be taken concurrently with other 2000-level French courses. *Not for native speakers per University Academic Regulation 4.9.*

FREN 2113 Intermediate French I. Lab 1. Prerequisite(s): 1225 or equivalent competence. (May have been gained in high school.) Review and further presentation of grammar and pronunciation; consolidation of basic skills, with additional emphasis on writing. May be taken concurrently with other 2000-level French courses. *Not for native speakers per University Academic Regulation 4.9.*

FREN 2232 (I) Intermediate Reading and Conversation II. Lab 1. Prerequisite(s): 2112 or equivalent competence. (May have been gained in high school.) Reading and discussion of more advanced French texts, mostly literary. May be taken concurrently with other 2000-level French courses. *Not for native speakers per University Academic Regulation 4.9.*

FREN 2233 Intermediate French II. Lab 1. Prerequisite(s): 2113 or equivalent competence. (May have been gained in high school.) Continuation of 2113. May be taken concurrently with other 2000-level French courses. *Not for native speakers per University Academic Regulation 4.9.*

FREN 3073 French Conversation. Prerequisite(s): 2232 and 2233 or equivalent. Colloquial speech, with discussion of French newspapers and magazines. Practice in brief public address in French.

FREN 3203 Advanced Written Expression. Prerequisite(s): 20 hours of French or equivalent. Practice in composition and stylistics, designed to bring students up to a high level of proficiency in writing.

FREN 3213 Advanced Grammar. Prerequisite(s): 20 hours or equivalent proficiency. Conceptual framework and presentation of the finer points of French grammar.

FREN 3343 Business French. Prerequisite(s): 2232 and 2233 or equivalent. Applied French for students in commercial and technical fields. Overview and strategies of business and economic climate in France.

FREN 3463 Advanced Diction and Phonetics. Lab 1. Prerequisite(s): 2232 and 2233 or equivalent. Required course for teacher certification. French speech sounds and intonation patterns, with practice to improve the student's pronunciation.

FREN 3853 Introduction to Analysis of French Literature. Prerequisite(s): 2232 and 2233 or equivalent. Close reading of shorter texts in a variety of literary genres, with presentation of French versification and literary terminology.

FREN 4153 History of French Literature I. Prerequisite(s): 20 credit hours of French or equivalent. Historical survey of French literature before 1700, with reading of representative texts.

FREN 4163 History of French Literature II. Prerequisite(s): 20 credit hours of French or equivalent. Historical survey of French literature of the eighteenth century, with reading of representative texts.

FREN 4173 History of French Literature III. Prerequisite(s): 20 credit hours of French or equivalent. Historical survey of French literature of the nineteenth century, with reading of representative texts.

FREN 4183 History of French Literature IV. Prerequisite(s): 20 credit hours of French or equivalent. Historical survey of French literature of the twentieth century, with reading of representative texts.

FREN 4333 Background of Modern French Civilization. Prerequisite(s): 20 credit hours of French or equivalent. General overview of French history, geography, and culture, with emphasis on art, music, and intellectual movements. Capstone course.

FREN 4550 Directed Studies in French. 1-3 credits, max 9, Lab 1-2. Prerequisite(s): 20 credit hours of French or equivalent. Individual or group study of French language or literature.

FREN 4573 Modern French Theater. Prerequisite(s): 20 credit hours of French or equivalent. Analysis of French plays from the 19th and 20th centuries.

FREN 5110* Advanced Studies in French. 1-3 credits, max 9. Prerequisite(s): 15 credit hours of upper-division French. Discussion or research in specialized topics.

Gender and Women's Studies (GWST)

GWST 2113 (S) Transnational Women's Studies. Introduction to research on women and gender in transnational contexts. Interpersonal relationships, socioeconomic status, power and authority as women experience them, myths and realities among women of different races, classes, ethnicities, sexual orientation, nationalities, ages, and physical ability.

GWST 2123 (D,H) Introduction to Gender Studies. Introduction to critical thinking about the construction of gender and the intersections of gender with race, ethnicity, class, and sexuality. Basic methods of studying gender from an interdisciplinary humanities perspective.

GWST 3450 Topics in Gender Studies. 1-3 credits, max 12. Prerequisite(s): 2113 or 2123 or permission of instructor. Suggested topics include: women and health, women and science, women and religion.

GWST 3513 (D) Theorizing Sexualities. Prerequisite(s): 2113 or 2123. Examination of poststructuralist and/or feminist theories of sexualities in contexts of film, literature, history, or popular culture. Likely theorists include Foucault, Butler, D'Emilio, Lorde, Kristeva, Anzaldua, Chow, and/or Chauncey.

GWST 3613 (D) Race and Reproduction in the U.S. Prerequisite(s): 2113 or 2123 recommended. An interdisciplinary examination of the inextricable relationship between race relations and reproductive politics. Issues explored include malthusianism, sterilization abuse, criminalizing pregnancy, natalism and nationalism, eugenics, the role of women of color in campaigns for reproductive justice, and representations of motherhood.

GWST 3713 (D) Gender and Representation. Cultural analysis of gender representation and gender relations. Using cultural texts and practices in several areas such as children's culture, sport, music, film and TV.

GWST 4013* Approaches to Feminist Research. Prerequisite(s): 2113 or 2123 or consent of instructor. Examines the ethics and epistemologies of methodologies and theoretical frameworks most conducive to feminist analysis. This course prepares students to conceptualize their own research projects.

GWST 4113* Feminist Theories. Prerequisite(s): 2113 or 2123 or consent of instructor. Examines the different types of feminist theories and the role theory plays in the production of knowledge. A variety of feminist theories will be considered from an interdisciplinary perspective.

GWST 4503* Theorizing Men and Masculinities. Prerequisite(s): 4113 or permission of instructor. Examines the roles of men in various cultural contexts, the historical development of manhood as an ideal, and theories of masculinities.

GWST 4950* Special Topics in Global Feminism. 3 credits, max 6. Prerequisite(s): 2113 or 2123 or permission of instructor. Selected topics in the problems and issues of global women's and feminist activism. Highlights the continuing fight to secure gender equality, especially in developing nations. Exploration of the women's movement links with other human rights struggles across the globe.

GWST 4990* Directed Readings in Gender Studies. 1-3 credits, max 12. Prerequisite(s): Permission of instructor. Examines gender studies issues and topics.

GWST 5103* Gender and Sexuality. This course offers an interdisciplinary survey of major works and key concepts in the field of Gender and Women's Studies.

GWST 5300* Seminar in Gender and Women's Studies. This course will offer a topics-based graduate colloquium in the interdisciplinary and international field of Gender and Women's Studies. Potential topics include Gender and Modern War, Feminist Aesthetics, Sexuality and Space, Cold War Masculinities, and Gender and International Relations.

General Engineering (GENG)

GENG 4010 Senior Design Project. 2-4 credits, max 4. Prerequisite(s): Senior standing in general engineering. Capstone design project through independent application of engineering principles and concepts from the disciplines covered in earlier course work.

General Technology (GENT)

GENT 1153 Engineering Graphics. Lab 2. Sketching, manual drafting and CAD generation of engineering drawings to ANSI standards. Interpreting typical industrial drawings. Students with two years high school or one year practical ANSI drafting/CAD may substitute an advanced course in mechanical engineering technology with consent of their advisers.

GENT 1223 Manufacturing Processes. Lab 3. Basic methods and processes of fabrication with emphasis on manufacturing operations, metrology and conventional machining.

GENT 2323 Statics. Prerequisite(s): MATH 2123 or 2144 and PHYS 1114 or 2014. Forces acting on bodies at rest; forces, moments of force, distributed forces, reactions, free-body diagrams, friction, internal forces and moments of inertia. Applications.

GENT 2650 Technical Projects. 1-4 credits, max 4. Prerequisite(s): Completion of three semesters' work in a technical institute curriculum. Special projects assigned by advisers with the approval of the director. A comprehensive written report must be prepared and an oral examination may also be required.

GENT 3123 Applied Analysis for Technology. Prerequisite(s): MATH 2133 or equivalent. Applications of elements of matrix algebra, ordinary differential equations, and infinite series to problems in engineering technology.

GENT 3323 Strength of Materials. Prerequisite(s): GENT 2323 or ENSC 2113 and MATH 2123 or 2144. Stress and strain and their relation to loads. Axial, torsional and bending loads, beam deflection, columns and combined stresses. Applications emphasized.

GENT 3433 Basic Thermodynamics. Prerequisite(s): MATH 2123 or 2144 and PHYS 1114 or 2014. Basic scientific principles of energy and the behavior of substances as related to engines and systems. Gas laws, vapors and engine cycles.

GENT 4433 Heat Transfer. Prerequisite(s): MATH 2123 or 2144 and PHYS 1114 or 2014. Conduction, convection, radiation, condensation and boiling heat transfer. Heat exchangers. Prediction of heat transfer rates. Retardation and enhancement of heat transfer.

Genetics (GENE)

GENE 5102* Molecular Genetics. Prerequisite(s): BIOC 3653 or MICR 3033 and one course in genetics or consent of instructor. An introduction to molecular genetics on the graduate level.

Geography (GEOG)

GEOG 1113 (I,S) Introduction to Cultural Geography. Introduction to Cultural Geography. A thematic approach to the study of human groups and activities around the world, including agricultural practices, demographic trends, political behavior, religious beliefs, language patterns, folk and popular cultures, ethnicity and ethnic landscapes, urbanization and industrialization.

GEOG 1114 (L,N) Physical Geography. Lab 2. Distribution and analysis of natural features of the earth. Landforms, soils, minerals, water, climates, flora and fauna. Emphasis on human-environment relations where appropriate.

GEOG 2253 (I,S) World Regional Geography. The world's major culture regions, with emphasis on geographic aspects of contemporary economic, social and political relationships with the physical environment.

GEOG 2344 (L,N) Digital Tools for Environmental Exploration. Lab

2. This course provides an introduction to the fundamental concepts of environmental problem solving through the use of digital geographic technologies that have emerged in recent years. These technologies include the Global Positioning System (GPS), geographic information systems (GIS), and satellite remote sensing as well as mainstream computer mapping technologies like Google Earth. Additionally the course introduces students to the emerging use of social media, such as Twitter and Facebook, to collect environmental data and perform scientific research.

GEOG 3023 (N) Climatology. Characteristics and distribution of world's climate. Patterns and associations of temperature, precipitation, pressure and winds. Regional climates of Earth. Climate change.

GEOG 3033 (N) Meteorology. A non-quantitative introduction to weather. Physical elements that cause and influence weather. Interpretation of weather maps and satellite imagery.

GEOG 3053 (I,S) Introduction to Central Asian Studies. A comprehensive view of newly-emerged Central Asian states, examining the history, politics, economics, geography, and culture of Azerbaijan, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan as reflected in their thoughts, religion, literature, and architecture in the past, and the strategic importance of their natural wealth for the present and future. (Same course as HIST 3053, POLS 3053 & RUSS 3053)

GEOG 3063 Economic Meteorology. Economic impact of weather ranging from consumer spending to agriculture and energy commodity markets. Specific weather events, and their associated economic impact, weather and climate forecasting and methods for eliminating weather risk.

GEOG 3123 (D,S) Urban Geography. Locational aspects of urbanization; functions of and relations among cities and between cities and rural areas; internal structure of urban areas.

GEOG 3133 (I,S) Political Geography. Political structures, relationships and geopolitical implications of location, boundaries, culture and the natural environment of nations and states. Global patterns of political behavior, political history, international law and geostrategy.

GEOG 3153 (S) Conservation of Natural Resources. Problems and corrective methods of conservation of land, water, forests, wildlife, minerals and people.

GEOG 3163 (S) Economic Geography. Processes significant to the spatial structure of economic systems. Production, consumption and exchange activities examined in regard to location, distribution, aerial differentiation and spatial interaction patterns. Attention given to processes of change as well as to steady states.

GEOG 3173 (S) Cultural Geography. Geographic impact of human cultures. Emphasis on the concepts of social space, density, crowding, territoriality, diffusion, migration, environmental perception and cultural landscape.

GEOG 3183 Transportation Geography. Basic concepts and theories of transportation geography, selected transportation models and analysis methods related to spatial interactions, network analysis, allocation, and urban transportation planning.

GEOG 3243 (D,S) Geography of Indian Country. Systematic analysis of geographic patterns, processes, and issues peculiar to the lands of the indigenous peoples of the United States including American Indians, Alaska Natives, and Native Hawaiians. Spatial interaction of federal policy and indigenous sovereignties.

GEOG 3333 (A) Spatial Analysis. Prerequisite(s): STAT 2013, 2023, 2053, 4013, or 4053. The utility and application of modeling and statistics to spatial problem solving. The role of quantitative methods in geographic research.

GEOG 3703 (S) Geography of Oklahoma. Geographic interpretation of physical, economic, historical and scenic features.

GEOG 3713 (D,S) Geography of the United States and Canada. A regional analysis of the United States and Canada, including physical and cultural landscapes, population and migration trends, regional development, natural resources, U.S.-Canada relations and global relations.

GEOG 3723 (I,S) Geography of Europe. Analysis of the physical and human geography of Europe, including the distribution of physical features and natural resources, patterns of population change, and the geographic background to Europe's major contemporary social, political, economic, and environmental problems.

GEOG 3733 (I,S) Geography of Russia and Its Neighbors. A regional analysis encompassing cultural, economic and physical features.

GEOG 3743 (I,S) Geography of Latin America. A real distribution and analysis of physical, cultural and economic features of Latin America.

GEOG 3753 (I,S) Geography of Asia. Systematic interpretation of significant spatial patterns of man and natural environment. (Exclusive of the USSR.)

GEOG 3763 (I,S) Geography of Africa. General patterns and impact of population, cultural heritage, and natural resources in Africa. Historic and contemporary relationships between Africa and Western civilization. Divergent perspectives (debate) on development, government and conflict in Africa.

GEOG 3783 (I,S) Geography of the Middle East and Southwest Asia. A regional analysis of the Arab, Persian and Turkic lands, including the biophysical environment, agriculture, resource use, cultural patterns, urbanization, economic development, hydropolitics and conflict.

GEOG 3793 (I,S) Geography of Australia and the Pacific Realm. Systematic survey of Australia, New Zealand, and the island regions of Micronesia, Melanesia, and Polynesia including a study of human and environmental relations, factors affecting the spatial distribution of human groups and the activities, cultural diversity, and the way in which external involvement, both in the past and present, has shaped this region.

GEOG 3910 Applied Geographical Topics. 1-3 credits, max 6. Specialized physical, human, regional, or technical issues and trends in geography.

GEOG 4003 Natural Hazards and Society. Explores natural hazards and how humans respond and contribute to these hazards and how humans respond and contribute to these hazards and disasters such as earthquakes, extreme weather events and volcanic eruptions. The course will also examine how hazards impact society, how society deals with disasters, and how we can mitigate the effects of such events.

GEOG 4023 (N) Geography of Arid Lands. Analysis of the physical process shaping the landscapes of deserts and areas around them, emphasizing the causes and effects of climatic change and human activities.

GEOG 4053 (N) Biogeography. Distribution of plants and animals and processes causing distribution. Human impact on biotic resources considered along with policy and management practices.

GEOG 4063 Geoarchaeology and Environmental History. Theoretical and methodological aspects of geoarchaeology, a discipline that aims at recovering field data for reconstructing environment-society relationships of the past. Key themes include climate change and human-induced land transformation as demonstrated through interdisciplinary research in different geomorphic contexts and cultural groups (hunter gatherers, agriculturalists, and urbanites) from around the world. *Meets with 5063. No credit for students with credit in 5063.*

GEOG 4073 Climate Change: Past, Present, and Future. Aims at understanding and discussing the mechanisms of global climate change and how they have functioned in our past, in the recent decades and how scientists predict possible changes in the near and distant future. Meets with 5073. *No credit for students with credit in 5073.*

GEOG 4083 Geography of Grass-Dominated Ecosystems. This course is an analysis of the nature and distribution of grass-dominated ecosystems (grasslands, savannas, and grassy tundras) around the world with emphais on 1) co-evolutionary development with climate, herbivore, fire, and humans, 2) the grass-dominated ecosystems around the world, and 3) the challenges faced by these ecosystems in the context of modern global climate change and human development. *Meets with GEOG 5083. No credit for students with credit in GEOG 5083.*

GEOG 4103 (H) Historical Geography of the United States. Examination of the spatial dynamics of frontier encounter and settlement, regional development, and cultural landscape evolution in the United States from pre-European to modern times.

GEOG 4113* Cultural and Political Ecology. Focus on the relationship between culture and environment, people and place and how environments are politicized. Competing theories of human-environment interactions throughout history. The first half of the course focuses on theories of human agency, diffusion, migration, adaptation, decision-making and agricultural change. The second part of the course focuses on cultural landscapes, perception, and politicized environments to explain current environmental issues.

GEOG 4123* Geographical Aspects of Urban Planning. Prerequisite(s): 3123. Spatial aspects of urban planning: development of planning theory, various planning tools, and specific problem areas such as urban renewal and urban transportation.

GEOG 4143* Geography of Travel and Tourism. A systematic and comprehensive analysis of the geographical dimensions of tourism, illustrating the relevance of a spatial perspective to tourism planning, development, and management. Economic, social, and environmental impact of both domestic and international tourism considered.

GEOG 4153* Geography of Outdoor Recreation. Analysis of patterns of outdoor recreation with an emphasis on land-use planning in park and wildland areas. Demand forecasting methods, the analysis of the socioeconomic and spatial impacts of recreation facilities provision and visitor management practices.

GEOG 4163 Resource Management in the National Parks. Contemporary resource management issues in U.S. National Park units. The role of human and natural processes in the management of water, air, biotic and cultural resources. *No credit for students with credit in GEOG 5163.*

GEOG 4203* Fundamentals of Geographic Information Systems. Lab 2. Survey of fundamental principles of geographic information systems (GIS) technology and its use in resource management and socioeconomic applications.

GEOG 4213 (S) Sport, Place and Society. Spatial analysis of sport; its origin and diffusion, geographical organization and regional variation.

Geographical movements and interaction associated with sport. Application of geographical solutions for reorganization and reform. Focus on both U.S. and international scene.

GEOG 4223 (H) Geography of Music. Geographical and historical analysis of music as a cultural trait. The cultural significance of music and how it varies from place to place as well as how it helps shape the character of a place.

GEOG 4233 Human Dimensions of Global Environmental Change. Discusses the current global environmental science research agendas called for by the international community, explores the arguments set forth regarding global environmental change, and looks at the current explanations and theories explaining the human dimensions of land-use/cover-change (lucc). Special emphasis is on alternative, competing visions, and needs of developing countries within the context of economic development and global environmental change. *Meets with 5233. No credit for students with credit in 5233.*

GEOG 4253 (D,H) Geographic Perspectives on American Women's Travel Accounts Then and Now. Examination of American women's travel writing both past and contemporary to understand social practices involving both geography and gender associated with travel and tourism. Topics include: geographic imaginaries, identities, social norms and transgressions, constructing the "Other" and the tourist "gaze," ideas of "home" and "away", and mobilities of women, situating these ideas with place and "race."

GEOG 4273 Land Use Science. Basic understanding of human land use history and changes. Evaluation of land use impacts on environment, climate, and public health. Introduction to land use monitoring and modeling using geospatial technologies. *Meet with 5273. No credit for students with credit in 5273.*

GEOG 4303* Applications of the Global Positioning System in Field Research. Prerequisite(s): 2343. Theory and applications of the Global Positioning System (GPS), focusing on accuracy issues in field data collection and integration with geographic information systems (GIS). Use of both recreation and mapping grade receivers.

GEOG 4313* Field Techniques and Geodata Collection. Modern concepts and techniques for geographical analysis and research, including data acquisition and manipulation from field and secondary sources. *Field trips.*

GEOG 4323* Computer Cartography. Lab 2. Prerequisite(s): 2343 or consent of instructor. Fundamentals of map compilation and design using computers. Thematic mapping of both socioeconomic and natural resource information. Discussion and application of various map input techniques involving digitizers, scanners, and global positioning system receivers. 2-D and 3-D terrain representation.

GEOG 4333 Remote Sensing. Intermediate course in remote sensing focusing on principles of remote sensing, digital imagery from aerial photography, multispectral, thermal and microwave remote sensing, image processing techniques, and field data collection. Discussions will include applications to agriculture, climate, fisheries, forestry, geography, landscape architecture, planning, and wildlife management. Hands-on exposure to current image processing software. *Meets with 5333. No credit for students with credit in 5333.*

GEOG 4343 Geographic Information Systems: Resource Management Application. Lab 2. Prerequisite(s): 2343. Provides a theoretical and practical understanding of geographic information systems and its applications in natural resource management. Introduces industry popular GIS software for spatial and aspatial data analysis. Explores specific conditions, requirements, and processing considerations that allow geospatial data to be manipulated for problem solving. *Meets with 5323. No credit for students with credit in 5323.*

GEOG 4353* Geographic Information Systems: Socioeconomic Applications. Lab 2. Prerequisite(s): 2343. Theory and principles of geographic information systems (GIS) applied to socioeconomic problems, including location-allocation, market area determination, network analysis and analysis of demographic characteristics.

GEOG 4373* Spatial Analysis of Public Health. Prerequisite(s): 2343. Qualitative and quantitative analysis of public health issues from two geographic perspectives: human environment and spatial. Topics include medical geography, disease mapping, spatial data for public health, and basics and applications of spatial statistics, geographic information system and remote sensing. Lectures are combined with case studies and lab illustrations throughout the course.

GEOG 4383* Introduction to GIS Programming. Prerequisite(s): GEOG 4203. Designed to provide students with an introduction to basic programming concepts and how such concepts specifically apply to GIS and other geographically oriented applications. The course will cover some basic concepts, discuss Python and Model Builder for ArcGIS, KML/KMZ for Google Earth/Maps, and introduce some basic concepts of mobile mapping development in Android.

GEOG 4510 Senior Project. 1-3 credits, max 3, Lab 1-3. Prerequisite(s): Senior standing and consent of instructor. Individually designed projects involving laboratory work, field work, library research or a combination of these.

GEOG 4600 (I) Geography Study Abroad. Participation in an international experience sponsored by the Department of Geography. Study Abroad courses typically involve the study of a country or region to provide an integrated understanding, through research and personal experience, of relevant cultural, historical, political, economic and environmental issues.

GEOG 4910 Topics in Geography. 1-3 credits, max 6. Prerequisite(s): Consent of instructor. Specialized physical, social and methodological topics in geography.

GEOG 4930 Readings in Geography. 1-3 credits, max 6. Prerequisite(s): Consent of instructor. Directed readings on selected topics, regions or methods in geography.

GEOG 4940 Undergraduate Cooperative Education Internship. 1-3 credits, max 3. Prerequisite(s): Consent of departmental internship coordinator and undergraduate committee. Practical experience in applying geographical concepts and tools to business or governmental problems. Emphasis on educational aspects of applying discipline-related tools to real-world problems. *Credit not available for regular employment positions; must have fixed start/end dates.*

GEOG 4993 Senior Honors Thesis. Prerequisite(s): Departmental invitation, senior standing, Honors Program participation. A guided reading and research program ending with an honors thesis under the direction of a senior faculty member, with second faculty reader, both of whom will be present at an oral defense of the thesis. Required for graduation with honors in geography.

GEOG 5000* Thesis. 1-6 credits, max 6. Prerequisite(s): Consent of adviser or major professor. Open only to students working on the master's degree in geography.

GEOG 5001* Professional Development in Geography. Introduction and orientation to the graduate program in the Department of Geography.

GEOG 5023* Geography of Arid Lands. Analysis of the physical processes shaping the landscapes of deserts and areas around them, emphasizing the causes and effects of climatic change and human activities and including research and writing components.

GEOG 5063* Geoarchaeology and Environmental History. Theoretical and methodological aspects of geoarchaeology, a discipline that aims at recovering field data for reconstructing environment-society relationships of the past. Key themes include climate change and human-induced land transformation as demonstrated through interdisciplinary research in different geomorphic contexts and cultural groups (hunter gatherers, agriculturalists, and urbanites) from around the world. *Meets with 4063. No credit for students with credit in 4063.*

GEOG 5073* Climate Change: Past, Present and Future. Aims at understanding and discussing the mechanisms of global climate change and how they have functioned in our past, in the recent decades an how scientists predict possible changes in the near and distant future. *Meets with 4073. No credit for students with credit in 4073.*

GEOG 5083* Geography of Grass-Dominated Ecosystems. This course is an analysis of the nature and distribution of grass-dominated ecosystems (grasslands, savannas, and grassy tundras) around the world with emphais on 1) co-evolutionary development with climate, herbivore, fire, and humans, 2) the grass-dominated ecosystems around the world, and 3) the challenges faced by these ecosystems in the context of modern global climate change and human development. *Meets with GEOG 4083. No credit for students with credit in GEOG 4083.*

GEOG 5113* Landscape Ecology. Prerequisite(s): Graduate standing and BIOL 3034 or consent of instructor. Principles of landscape ecology, including structure and function of landscape elements such as patch, corridor, boundary, and matrix. Role of geographic processes, climate, biota, disturbance, and human influences in landscape structure and function. Interaction among landscape elements and role of landscape structure in ecosystem and landscape dynamics. Applications of landscape ecology to biodiversity conservation, wildlife management, and landscape planning. Survey of quantitative methods used in landscape ecology.

GEOG 5123* International Resource Management. Prerequisite(s): Graduate standing. Spatial perspectives on the assessment and management of natural resources. The role of resources in world trade, security and international environmental concerns.

GEOG 5140* Cultural and Historical Geography Seminar. 1-3 credits, max 9. Prerequisite(s): Consent of instructor. Development and critical analysis of research and theory in cultural and historical geography.

GEOG 5150* Geography of Sport, Recreation, and Leisure Seminar. 1-3 credits, max 3. This seminar is comprised of an advanced analysis of one or more topics in Sport Geography. The topics can include both cultural and economic issues in the spatial distribution of sport, or any other spatial aspect of the play, diffusion, or impact of sport. The seminar will also focus on student research activities on specific topics related to sport geography.

GEOG 5163* Resource Management in the National Parks. Contemporary resource management issues in U.S. National Park units. Focus on the role of human and natural processes in the management of water, air, biotic and cultural resources. *No credit for students with credit in 4163.*

GEOG 5183* Topics in Transportation Geography. Examination of a selected set of advanced topics in transportation geography, including network analysis, facility location problems, intelligent transportation systems and geographic information systems and logistics.

GEOG 5203* Writing Across the Discipline: Geographic Theses and Dissertations. Prerequisite(s): Permission of instructor. Addresses writing issues specific to the social sciences, including identifying an audience, finding a voice, engaging with a theoretical framework, organizing data, understanding differences in presenting quantitative and qualitative evidence and effectively communicating both, pacing in an argument, crafting creative introductions and persuasive conclusions, and compiling an effective bibliography.

GEOG 5233* Human Dimensions of Global Environmental Change. Discusses the current global environmental science research agendas called for by the international community, explores the arguments set forth regarding global environmental change, and looks at the current explanations and theories explaining the human dimensions of land-use/cover-change (lucc). Special emphasis is on alternative, competing visions, and needs of developing countries within the context of economic development and global environmental change. *Meets with 4233. No credit for students with credit in 4233.*

GEOG 5243* Geography of the World's Indigenous Peoples. Prerequisite(s): Graduate standing and consent of instructor. A regional survey of indigenous assertions of cultural, political and economic self-determination outside the United States. Native land claims, impact of regional development and environmental issues upon indigenous communities, and their efforts to establish geopolitical autonomy.

GEOG 5273 Land Use Science. Basic understanding of human land use history and changes. Evaluation of land use impacts on environment, climate, and public health. Introduction to land use monitoring and modeling using geospatial technologies. *Meet with 4273. No credit for students with credit in 4273.*

GEOG 5303* Geographical Analysis I. Prerequisite(s): One course in statistics. Application of models and statistics to geographic problem solving.

GEOG 5323* Geographic Information Systems: Resource Management Application. Lab 2. Prerequisite(s): 2343. Provides a theoretical and practical understanding of geographic information systems and its applications in natural resource management. Introduces industry popular GIS software for spatial and aspatial data analysis. Explores specific conditions, requirements, and processing considerations that allow geospatial data to be manipulated for problem solving. *Meets with 4343. No credit for students with credit in 4343.*

GEOG 5333* Remote Sensing. Intermediate course in remote sensing focusing on principles of remote sensing, digital imagery from aerial photography, multispectral, thermal and microwave remote sensing, image processing techniques, and field data collection. Discussions will include applications to agriculture, climate, fisheries, forestry, geography, landscape architecture, planning, and wildlife management. Hands-on exposure to current image processing software. *Meets with 4333. No credit for students with credit in 4333.*

GEOG 5343* Advanced Geographic Information Systems: Resource Management Applications. Lab 2. Prerequisite(s): 4343. Advanced theory and applications of geographic information systems (GIS) applied to resource management problems using both raster and vector data structures. Individual projects, presentations and group discussion sessions.

GEOG 5353* Advanced Geographic Information Systems: Socioeconomic Applications. Lab 2. Prerequisite(s): 4353. Advanced theory and applications of geographic information systems (GIS) applied to socioeconomic problems including location allocation, market area determination, network analysis, and analysis of demographic characteristics. Individual projects, presentations and group discussion sessions.

GEOG 5363* Enterprise Geographic Information Systems. Prerequisite(s): 4353 or equivalent. Basic setup and creation of online geodatabases and Internet mapping services as would be used in a large scale GIS operation or enterprise. Geodatabase design and Internet map service website development.

GEOG 5393* Remote Sensing of Water Resources. Prerequisite(s): 2323 or 4333. Advanced theories and techniques of remote sensing applied to various issues in water resources management. Sensor characteristics, theoretical algorithms, digital image processing, and field methods to extract information of multiple aspects valuable for both hydrological modeling and decision-making. Advantages and limitations of remote sensing compared to traditional methods will be explored.

GEOG 5403* Current Geographic Research. Prerequisite(s): Graduate standing in geography. Review of recent literature in light of current human and physical geography research themes.

GEOG 5413* History and Philosophy of Geography. Prerequisite(s): Graduate standing in geography. Identification and evaluation of major themes in geographical research and teaching.

GEOG 5423* Geographic Renderings in Qualitative Methods. Prerequisite(s): SCFD 5913 or SCFD 6123 or SOC 5273 or consent of instructor. Seminar engages with geographic facets in qualitative research and provides students with experience in collecting and working with qualitative data. Students explore avenues of qualitative inquiry in cross-cultural, community participation, and storytelling/testimonial/oral history/life history, and ethnographic research with special consideration to space, place, scale, context, body, and senses. Course addresses issues involved with analysis, interpretation, and "writing-up" research.

GEOG 5450* Seminar in Geography. 1-6 credits, max 6. Prerequisite(s): Graduate standing in geography or consent of instructor. Specialized topics in geography.

GEOG 5510* Research Problems in Geography. 1-3 credits, max 6. Prerequisite(s): Consent of instructor.

GEOG 5700* Geography Study Abroad. 1-3 credits. Participation in an international experience sponsored by the Department of Geography. Study Abroad courses typically involve the study of a country or region to provide an integrated understanding, through research and personal experience, of relevant cultural, historical, political, economic, and environmental issues.

GEOG 5930* Readings in Geography. 1-3 credits, max 6. Prerequisite(s): Consent of instructor. Directed readings on selected topics, regions or methods in geography.

GEOG 5940* Graduate Cooperative Education Internship. 1-3 credits, max 3. Prerequisite(s): Consent of departmental internship coordinator and graduate committee. Practical experience in applying geographical concepts and tools to business or governmental problems. Emphasis on educational aspects of applying discipline-related tools to real-world problems. Credit not available for regular employment positions; must have fixed start/end dates.

GEOG 6000* Doctoral Dissertation Research. 1-12 credits, max 30. Prerequisite(s): Admission to candidacy and consent of major professor.

GEOG 6013* Seminar in Quaternary Paleoecology. Prerequisite(s): Graduate standing in geography or consent of instructor. Analysis and discussion of various aspects of research on the Quaternary period, emphasizing the roles played by climate, geomorphic processes, vegetation, soil and fauna.

GEOG 6110* Seminar in Cultural and Political Ecology. 3 credits, max 6. Prerequisite(s): Graduate standing in geography or consent of instructor. Study of the relationship between culture and environment and competing theories of human-environment interactions. Traces the roots of cultural ecology starting with classic ecological systems and adaptation theory, to criticisms leading to the development of "political" and "hybrid" ecologies. Course focuses on Marxist influences, inequalities of third world development, gender and resource management, social and environmental movements, indigenous knowledge, natural disasters and environmental vulnerability.

GEOG 6120* Seminar in Urban Geography. 3 credits, max 6. Prerequisite(s): Graduate standing in geography or consent of instructor. Analysis of research on urban systems, internal morphology, urban problems and urban spatial behavior. Review and analysis of student research efforts.

GEOG 6130* Seminar in Political Geography. 3 credits, max 6. Prerequisite(s): Graduate standing in geography or consent of instructor. Theoretical foundations of political geography from MacKinder and Hartshorne to recent writings by Smith, Anderson and other modern theorists. Nationalism, national identity, state formation and cohesion considered in a spatial context.

GEOG 6180* Seminar in Transportation Geography. 3 credits, max 6. Prerequisite(s): Graduate standing. Examination of transportation systems, emphasizing their effects on trade, land use, location issues, and development. Review of trends, problems, and methods related to transport issues.

GEOG 6210* Seminar in Historical Geography. 3 credits, max 6. Prerequisite(s): Graduate standing. Current epistemological issues and archival methodologies in historical geography.

GEOG 6303* Geographic Analysis II. Prerequisite(s): 5303. Advanced methods of spatial analysis, including spatial autocorrelation, geographically weighted regression and related spatial analysis methods.

GEOG 6313* Mixed Methods in Field Research. Prerequisite(s): Graduate standing in geography or consent of instructor. This course will expose students to a variety of qualitative and quantitative techniques useful in successfully designing and completing field research. Special focus will include research and survey design, interviewing, ethnography, and visual techniques such as the use of imagery, photography, sketch mapping, and Global Positioning Systems (GPS) for the collection and analysis of geospatial data. *Required field trips.*

GEOG 6333* Advanced Techniques in Image Analysis/GIS. Prerequisite(s): 4333 or 5333. Advanced techniques and applications of image processing and geographic information systems (GIS). Special topics include image registration, georeferencing, advanced image enhancements, advanced classifications, and accuracy assessments. Specific issues and problems pertaining to data capture, preprocessing and analysis of semester-long projects will be discussed.

GEOG 6910* Topics in Geography. 1-3 credits, max 6. Prerequisite(s): Consent of instructor. Specialized physical, social and methodological topics in geography.

GEOG 6930* Readings in Geography. 1-3 credits, max 6. Prerequisite(s): Consent of instructor. Directed readings on selected topics, regions or methods in geography.

Geology (GEOL)

GEOL 1014 (L,N) Geology and Human Affairs. Lab 2. The influence of geology and related earth sciences on the human environment. Energy and

material resources, beneficial and hazardous natural processes, and the planetary and biological evolution of earth. Lab investigations environmentally oriented.

GEOL 1114 (L,N) Physical Geology. Lab 2. Composition and structure of the earth and the modification of its surface by internal and external processes. Mineral resources, sources of energy, and environmental aspects of geology. A background in pre-college science and math is recommended. *Field trip required.*

GEOL 1224 Evolution of the Earth. Lab 2. Prerequisite(s): 1014 or 1114 or BIOL 1114. A survey of the physical and biological history of the Earth from the coalescence of the solar system to the present. *Field trips required.*

GEOL 2254 Practical Mineralogy. Lab 2. Prerequisite(s): 1014 or 1114 and CHEM 1314 or 1414 completed with a grade of "C" or higher. Hand-specimen identification of minerals using physical and chemical properties. Introductory optical identification of common rock forming minerals. Society's utilization of mineral resources. *Field trips required.*

GEOL 2364 Igneous and Metamorphic Petrology. Lab 3. Prerequisite(s): 2254 completed with a grade of "C" or higher. Origin, occurrence and classification of igneous and metamorphic rocks; hand-specimen and thin section identification. *Optional field trip.*

GEOL 3004 Earth Science for Teachers. Lab 3. Prerequisite(s): 1114 or equivalent. Teaching natural earth systems and their environmental impact. Use of an adaptation approach in organizing, presenting, and evaluating earth science concepts in the curriculum. *Field trips required.*

GEOL 3014 Structural Geology. Lab 3. Prerequisite(s): GEOL 1224 and PHYS 2014 or 2314 with a grade of "C" or higher. Behavior of earth materials during various deformational processes and analysis of the resulting structural features such as folds, faults and fractures. *Field trips required.*

GEOL 3034 Principles of Stratigraphy and Sedimentology. Lab 3. Prerequisite(s): 1224 and 2254 each with a grade of "C" or higher. Principles of stratigraphy and their applications. Survey of sedimentary rock types, principles of description and classification, origin of sedimentary deposits, analysis of stratigraphic sequences. Topics include depositional systems; litho- and biostratigraphy; geochronology and chronostratigraphy; magnetic, seismic, and sequence stratigraphy; tectonic vs. climatic controls. Field work required.

GEOL 3043 (N) Geology of the National Parks. Prerequisite(s): 1014 or equivalent recommended. The geologic characteristics of national parks and scenic regions in North America and throughout the world. *Intended for non-majors.*

GEOL 3073* Geomorphology. Lab 2. Prerequisite(s): 1114 and MATH 2144 or concurrent enrollment. Study of land forms and the processes that form them, using topographic maps, air photos, remotely-sensed images, soils maps and field techniques. *Field trips required.*

GEOL 3103 Paleontology. Lab 3. Prerequisite(s): 1224 or consent of instructor. Basic principles of paleontology involving invertebrates, vertebrates and plants. Lab focused on the morphology, identification, paleoecology and biostratigraphy of marine invertebrates. *Field trips required.*

GEOL 3413 Petroleum Geology for Engineers. Lab 2. Prerequisite(s): MATH 2114 and CHEM 1414 or 1314 and PHYS 2114 or 2014. Examination of the fundamental concepts of petroleum geology with an emphasis on applications to drilling and reservoir engineering. Topics include reservoir architecture, traps and seals, the subsurface environment, wireline logs, geophysics and depositional systems. *Field trip required. No degree credit for geology majors.*

GEOL 3503 Environmental Geology. Prerequisite(s): 1114 or consent of instructor. Application of geologic principles to environmental issues, including human use of the surface and subsurface of the earth and human interaction with extreme natural events such as earthquakes, floods and landslides. *Field trip is required.*

GEOL 3546 Field Geology. Lab 12. Prerequisite(s): 2364 and 3014 and 3034 and 3073. Six weeks of field methods in geology. *Required of all geology majors. Transportation and room and board fees required.*

GEOL 4023* Petroleum Geology. Prerequisite(s): 3014 and 3034. Origin, migration and accumulation of petroleum, requirements for source rock, reservoir rock and traps. Structure and stratigraphy of selected oil fields. *Field trips required.*

GEOL 4030 Geologic Field Investigation. 1-3 credits, max 3. Prerequisite: 1014 or 1114. One to three weeks of required field study at sites of geological interest and significance. *Field trip charges apply. Does not substitute for GEOL 3546. No credit for students who have credit in 5030.*

GEOL 4103* Introduction to Geophysical Exploration. Lab 2. Prerequisite(s): PHYS 2114 and MATH 2153 each with a grade of "C" or higher. An overview of geophysical methods and their applications to exploration, environmental and engineering problems. Seismic reflection and refraction methods, gravity, magnetic, resistivity and electromagnetic methods. *A field trip required.*

GEOL 4113 Seismic Interpretation. Prerequisite(s): GEOL 4103, 3014, and 3034 each with grade of "C" or higher. Examination of the reflection seismic interpretation methods with emphasis on the oil and gas industry. Both structural and stratigraphic methods. Hands-on interpretation using a standard industry software package. Same course as GEOL 5213.

GEOL 4213* Plate Tectonics. Prerequisite(s): 3014 with a grade of "C" or higher. Earth's evolution within the framework of plate tectonics. Examination of structural associations in relation to tectonic plate boundaries. Mechanisms for place tectonics and implication for resources and the environment.

GEOL 4300 Geology Colloquium. 1 credit, max 2. Prerequisite(s): 15 credit hours in geology and junior status. Discussion of selected topics in the geological sciences with emphasis on professional presentation practices.

GEOL 4303* Geophysical Field Methods. Lab 2. Prerequisite(s): 4103. Hands-on field investigations using the different geophysical surveying methods including electrical resistivity/induced polarization, self potential, electromagnetic, ground penetrating radar, gravity, magnetic, and seismic reflection and refraction. Instrumentation, field data acquisition, and interpretation will be emphasized. *Several field trips and field projects required.*

GEOL 4313 Introduction to Well Log Analysis. Lab 2. Prerequisite(s): 3034 with a grade of C or better. Introduction for undergraduate Geology majors to basic properties of wireline well logs, including identification of lithology, influence of borehole fluids, porosity and permeability on well log properties. Some exercises involve concurrent interpretation of well logs and core samples. Course includes lectures, in-class exercises, homework and exams. *No credit for students who have completed GEOL 4323 or 5353.*

GEOL 4323 Advanced Well Log Analysis for Engineers. Lab 2. Prerequisite(s): 3413 with a grade of "C" or higher. This is a core course for the Minor in Petroleum Engineering. Course material builds on information to prerequisite course Geology 3413. This course covers geologic interpretation of reservoir characteristics based on a variety of well logs; quantitative determination of porosity and permeability, reservoir fluids and how they influence well log properties, calculation of water saturation, introduction to unconventional reservoirs, drilling and logging in lateral holes.

GEOL 4403 Geochemistry. Lab 2. Prerequisite(s): 1014 or 1114 or consent of instructor; CHEM 1314 and CHEM 1515 or concurrent enrollment; MATH 1513 or above. Application of chemical principles to geological processes. Processes affecting the composition of surface and ground waters.

GEOL 4453 Hydrogeology. Prerequisite(s): PHYS 2114. The water cycle and ground-water systems as well as general problems related to ground-water occurrence, quantity, quality and pollution. *Field trip required.*

GEOL 4463* Physical Hydrogeology. Lab 2. Prerequisite(s): 4453 or similar; PHYS 2114. Physical ground-water systems. Realistic problems to acquaint students with ground-water occurrence and movement. Geologic, geophysical, hydraulic testing and modeling techniques used to define an actual ground-water system. Ground-water regulations. *Field trips required.*

GEOL 4513 Marine Geology. Prerequisite(s): CHEM 1314 or equivalent; PHYS 1114 or 2014 or equivalent; GEOL 3034 or equivalent. All with a grade of "C" or higher. Comprehensive examination of the geology of the ocean basins. Topics include: techniques of data collection and interpretation; shoreline, shelf and deep ocean processes; physical oceanography; origin and distribution of marine sediments; paleoceanography; marine mineral resources; marine tectonics and ocean history. Same course as GEOL 5513.

GEOL 4543 Introduction to Exploration Seismology. Prerequisite(s): 4103 and 4303. Introduction to theory, techniques, and application of seismic to field of hydrocarbon, groundwater, and minerals exploration. Review of fundamentals of wave propagation, historical development of the science, and current literature on application and instrumentation. *No credit for students with credit in 5543.*

GEOL 4573 Marine Biogeochemical Cycles. Prerequisite(s): 1224 and 4403 and CHEM 1314. Analysis of the interactions between geological processes, biological activity, and chemical cycling for a range of elements. Limited discussion of atmospheric, terrestrial, and freshwater systems as they impact the oceans will also be discussed. Includes discussions of changes in elemental cycles through Earth's history and comparison to present-day patterns. *No credit for credit in 5573.*

GEOL 4753 Volcanology. Prerequisite(s): 2364 completed with a grade of "C" or higher. Examination of volcanic processes, products, and structures on Earth and other terrestrial bodies. *Optional field trip. No credit for students with credit in 5753.*

GEOL 4773 Planetary Geology. Prerequisite(s): GEOL 1114 (required) and GEOL 3073 (recommended). Geology of planets and planetary bodies, including geomorphology, tectonics, geochemistry, and geophysics; perspectives on exploration; and life in the universe.

GEOL 4981 Geoscience Internship. Prerequisite(s): Consent of instructor. Student participation in a research project during an internship in a Geoscience-related professional work setting. *Graded on a pass/fail basis.*

GEOL 4990 Special Problems in Earth Science. 1-8 credits, max 8. Prerequisite(s): 25 hours of geology and permission of instructor. Individually designed study projects involving assigned reading, library work, field work, laboratory work or a combination of these. *Field trips may be required.*

GEOL 4993 Senior Honors Thesis. Prerequisite(s): Departmental invitation, senior standing, Honors Program participation. A guided reading and research program ending with an honors thesis under the direction of a senior faculty

member, with second faculty reader and oral examination. *Required for graduation with departmental honors in geology.*

GEOL 5000* Master's Thesis. 1-6 credits, max 6. Prerequisite(s): Approval of graduate committee. Work toward master's thesis in geology.

GEOL 5030* Geologic Field Investigation. 1-3 credits, max 3. One to three weeks of required field study at sites of geological interest and significance. Emphasis will be placed on applicability to graduate research. Field trip charges apply. *No credit for students who have credit in 4030.*

GEOL 5093* Quaternary Geology and Geochronology. Prerequisite(s): GEOL 3034; MATH 1715 or equivalent; PHYS 2014 and 2114 or equivalent. All with a grade of "C" or higher. Examination of the causes and effects of climate change during the ice ages. Survey of dating methods applicable to the Quaternary, including radiocarbon and optical luminescence. Topics include the use of oxygen isotope proxy records, paleomagnetism, cosmogenic nuclides, isostasy and post-glacial rebound, causes of sea-level change, and ice age history.

GEOL 5100* Problems in Hydrogeology. 1-4 credits, max 8. Prerequisite(s): 4453. Advanced problems in hydrogeology with emphasis on quantitative methods. *Field trips may be required.*

GEOL 5133* Structural Styles in Oil and Gas Exploration. Prerequisite(s): GEOL 3014 with a grade of "C" or higher. The theoretical, experimental and descriptive approach to structural styles formed by different tectonic stresses (i.e. extensional, contractional, strike-slip and salt tectonics) and their importance in oil and gas exploration. Formerly GEOL 5203.

GEOL 5183* Paleontology of Depositional Sequences. Lab 2. Prerequisite(s): Graduate standing or permission of instructor. Paleoecology and biostratigraphy of depositional sequences. Evenly divided on lecture and laboratory components and field trips are mandatory.

GEOL 5213* Seismic Interpretation. Prerequisite(s): 4103, 3014 and 3034 with grades of "C" or higher. Examination of reflection seismic interpretation methods with emphasis on the oil and gas industry. Includes structural and stratigraphic methods. Hands-on interpretation using a standard industry software package. Same course as GEOL 4113.

GEOL 5223* Advanced Methods in Structural Geology. Lab 3. Prerequisite(s): 3014. Advanced geometric techniques and analysis of complex structural terrains. Elucidation of geometry and history of geological structures by interpreting seismic reflection profiles and constructing balanced cross-sections. *Field trips required.*

GEOL 5233* Trace Element Geochemistry. Lab 2. Prerequisite(s): One year of chemistry and 4403 or equivalent and 3034 or equivalent. Examination of the behavior of various trace elements in aqueous and sedimentary environments. Availability and mobility of trace elements, characterization of geochemical environments, and application to geologic problems.

GEOL 5243* Research Methods and Techniques in Geosciences. Application of the scientific method to geosciences research; introduction to library and internet searches; writing competitive research proposals; managing research activities; and disseminating research results.

GEOL 5253* Petrology and Diagenesis of Clastic Rocks. Lab 3. Prerequisite(s): 2364, 3034. Examination of petrology and depositional facies of sandstones and shales. Identification of detrital and diagenetic constituents and determination of paragenetic sequence of diagenetic events. The effect of burial and thermal history on reservoir quality. *Field trips required.*

GEOL 5273* Depositional Systems. Prerequisite(s): 3034, 3546. Examination of the processes within depositional environments and the facies they form. Focus on the environmental interpretation of rocks, cores and seismic profiles based on their composition, texture, character, stacking pattern and sedimentary structures. Emphasis on clastic systems. *Field trips required.*

GEOL 5283* Subsurface Geologic Methods. Lab 2. Prerequisite(s): 3014, 3034. Use of subsurface geologic information from cores and well logs to prepare maps and identify oil and gas prospects. *Field trips required.*

GEOL 5300* Geology Colloquium. 1 credit, max 2. Prerequisite(s): Graduate standing. Discussion of selected topics in the geological sciences with emphasis on professional presentation practices.

GEOL 5353* Advanced Well Log Analysis. Lab 3. Prerequisite(s): 3034 or 3413. The geologic interpretation of a variety of well logs, emphasized, as well as quantitative methods. Some exercises involve concurrent interpretation of well logs and core samples, or well logs and bit cuttings. Field trips required. *No credit for students with credit in 4313 or 4323.*

GEOL 5363* Carbonate Depositional Systems. Prerequisite(s): 3034 with a grade of "C" or higher. Survey course of the main types of carbonate sediments and depositional environments.

GEOL 5383* Sequence Stratigraphy. Lab 2. Prerequisite(s): 5253, 5353, 5363. Principles of sequence stratigraphy including carbonate and siliciclastic dominated intracratonic basins. Integration of surface and subsurface data in projects. *Field trips required.*

GEOL 5393* Stratigraphy of the Midcontinent. Lab 3. Prerequisite(s): GEOL 3034 with a grade of "C" or higher. This course will examine Paleozoic stratigraphy of the North American Midcontienct consisting of Texas, Oklahoma, Kansas, Nebraska, Missouri, and northwestern Arkansas. The course will consist of lectures, student presentations, and extensive field work that will serve to familiarize the students with the surface and subsurface relationships of geologic formation and their potential for commercial exploitation for oil and gas resources.

GEOL 5433* Isotope Geochemistry. Lab 2. Introduction to the basic principles of stable isotope geochemistry. Study of the production, distribution, and use of naturally occurring and anthropogenically introduced stable isotopes in the earth's near surface environment with applications to hydrology, biogeochemistry, global change and petroleum systems.

GEOL 5453* Groundwater Modeling. Prerequisite(s): 4453 or equivalent, MATH 2144, MATH 2153 each with a grade of "C" or higher. Modeling ground water systems. Realistic problems to acquaint students with the movement of geological fluids. Developing models of fluid movement through the subsurface using geological and geophysical data. *Field trips required.*

GEOL 5463* Physical Hydrogeology. Prerequisite(s): 4453 or similar with a grade of C or better; PHYS 2114 with a grade of C or better. Physical ground water systems. Realistic problems to acquaint students with ground-water occurrence and movement. Geologic, geophysical, hydraulic testing and modeling techniques used to define an actual ground-water system. Ground-water regulations. *Field trips required. May not be used for degree credit with GEOL 4463.*

GEOL 5483* Integrated Petroleum Water Resources Management. Prerequisite(s): GEOL 4453 or equivalent, MATH 2144 and 2153 each with grade of "C" or higher. Developing, maintaining, and disposing or recycling water for use in the petroleum industry. Problems associated with water production and disposal including water quality issues and sesmicity. *Field trips required.*

GEOL 5513* Marine Geology. Prerequisite(s): CHEM 1314 or equivalent; PHYS 1114 or 2014 or equivalent; GEOL 3034 or equivalent; all with a grade of "C" or higher. Comprehensive examination of the geology of the ocean basins. Topics include techniques of data collection and interpretation; shoreline, shelf and deep ocean processes; physical oceanography; origin and distribution of marine sediments; paleoceanography; marine mineral resources; marine tectonics and ocean history. *Same course as GEOL 4513.*

GEOL 5523* Environmental Organic Geochemistry. Prerequisite(s): CHEM 1314 and 1515 or equivalent; GEOL 3034 or equivalent; GEOL 4403 or equivalent or permission of instructor. Introduction to some environmental aspects of organic geochemistry. Soils and sediments as pollutant receptors, sources of pollutants and selected aspects of environmental health.

GEOL 5533* Organic Geochemistry. Prerequisite(s): CHEM 1314 and 1515 or equivalent; GEOL 3034 or equivalent. Chemistry of organic matter in sediments and rocks with an emphasis on marine and petroleum systems.

GEOL 5543* Introduction to Exploration Seismology. Prerequisite(s): 4103 and 4303. Introduction to theory, techniques, and application of seismic to field of hydrocarbon, groundwater, and minerals exploration. Review of fundamentals of wave propagation, historical development of the science, and current literature on application and instrumentation. *No credit for students with credit in 4543.*

GEOL 5573* Marine Biogeochemical Cycles. Prerequisite(s): 1224 and 4403 and CHEM 1314. Analysis of the interactions between geological processes, biological activity, and chemical cycling for a range of elements. Limited discussion of atmospheric, terrestrial, and freshwater systems as they impact the oceans will also be discussed. Includes discussions of changes in elemental cycles through Earth's history and comparison to present-day patterns. *No credit for credit in 4573.*

GEOL 5603* Basin Evolution. Prerequisite(s): 3014, 3034, 4403. Advanced topics in sedimentary basin studies, including tectonics, sequence stratigraphy, facies analysis, regional diagenesis, thermal evolution, regional hydrogeology, and distribution of natural resources.

GEOL 5633* Exploration Prospect Evaluation. Lab 6. Prerequisite(s): Graduate standing and permission of the instructor. Evaluation of exploration prospects in frontier and underdeveloped petroleum provinces using borehole-derived and geophysical data. Team taught course that uses industry provided datasets and current data management and interpretation software to reach drill or no-drill decisions based on science, risk analysis and economics.

GEOL 5753* Volcanology. Prerequisite(s): 2364 or equivalent with a grade of "C" or higher. Examination of volcanic processes, products, and structures on Earth and other terrestrial bodies. *Optional field trip. No credit for students with credit in 4753.*

GEOL 5773* Planetary Geology. Lab 2. Prerequisite(s): GEOL 1114, and GEOL 3073 recommended. Geology of planets and planetary bodies, including geomorphology, tectonics, geochemistry and geophysics; perspectives on exploration; and life in the universe.

GEOL 5981* Geoscience Internship. Prerequisite(s): Consent of instructor. Student participation in a research project during an internship in a Geoscience-related professional work setting for graduate credit. *Graded on a pass-fail basis.*

GEOL 5990* Advanced Studies in Geology. 1-4 credits, max 8. Prerequisite(s): Consent of instructor. Individual library, laboratory and/or field projects on facets of geology not covered by existing courses. *Field trips may be required.*

GEOL 6000* Doctoral Dissertation Research. 1-12 credits, max 60. Work toward doctoral dissertation in Geology.

GEOL 6103* Gravity and Magnetic Methods. Lab 2. Prerequisite(s): 4103. Principles of gravity and magnetic methods applied to petroleum, mineral, and groundwater exploration. Engineering applications will also be discussed. Data acquisition, processing and modeling using standard industry software will be emphasized.

GEOL 6133* Unconventional Petroleum Reservoirs. Prerequisite(s): 4023. Review of unconventional sources of oil and gas production including coalbed methane, tight gas-sandstones, gas and oil-bearing shales and transition zone, high-water saturation sandstones and carbonates.

GEOL 6283* Geology of Shales. Lab 2. Prerequisite(s): Graduate standing or permission of instructor. Team-taught course that combines different geological techniques towards gaining a better understanding of shales as source and reservoir rock. These include petrography, XRD, SEM, Organic and Inorganic chemistry, geophysical logs, paleoecology and biostratigraphy. This course will involve lecture as well as laboratory techniques.

GEOL 6303* Electrical and Electromagnetic Methods. Lab 2. Prerequisite(s): 4103. Principles of the different geoelectrical methods, including electrical resistivity, induced polarization, self potential, electromagnetic, and ground penetrating radar will be emphasized. Geophysical instrumentation, laboratory measurements of physical properties, field procedures, and basic interpretation and near surface geophysical applications will be discussed. Recent advances in geoelectrical methods and case studies will be examined by reviewing current literature. *Field trip required.*

GEOL 6363* Carbonate Reservoir Characterization. Prerequisite(s): 5363 with a grade of "B" or higher. Integrated study and application of modern and ancient depositional systems, diagenesis, petrophysics, sequence stratigraphy, and geostatistical modeling towards the understanding of the three dimensional distribution and reservoir characterization of carbonate and mixed carbonate/siliciclastic systems. This is a seminar and project-based course. *Field trip required.*

GEOL 6373* Advanced Carbonate Petrology and Geochemistry. Prerequisite(s): GEOL 4403 with a grade of "C" or higher and 5363 with a grade of "B" or higher or equivalents or consent of instructor. This course will cover advanced topics in carbonate petrology and geochemistry with emphasis on both early and late diagenetic processes, dolomitization, porosity and permeability, geochemical evolution of seawater and carbonate sediments, and regional diagenetic patterns in carbonate rocks and related strata.

GEOL 6386* Sequence Stratigraphy of Shales. Lab 12. Prerequisite(s): Graduate standing. Intensive field course focusing on hydrocarbon-bearing shales of the Midcontinent. Advanced field techniques including high resolution spectral gamma ray analysis and highly detailed measured sections will be taught. Fifty localities including Devonian-Early Mississippian (Woodford and Chattanooga shales), Upper Mississippian (Barnett, Caney, and Fayetteville shales) and Pennsylvanian-Lower Permian shales will be analyzed.

GEOL 6403* Biogeophysics. Lab 2. Prerequisite(s): 5443 or 4103 or 6303. Introduces students to the important role that microbes play in geologic processes and explores current cutting-edge research available to investigate these processes. Interactions of microorganisms with earth materials (soils, rocks, water, etc.) and geophysical methods used to investigate microbial processes will be emphasized.

GEOL 6503* Rock Fractures. Prerequisite(s): 3014. Mechanical analysis and tectonic implications of brittle structural features such as joints, veins, and faults. Examination of topics such as mechanical stratigraphy in layered rocks, factors controlling joint spacing, and the dependence of failure mode on lithology. Field trips may be required.

GEOL 6553* Contaminant Transport. Lab 4. Prerequisite(s): CHEM 1314 and CHEM 1515 or consent of instructor. Origin and evolution of natural water quality, with emphasis on anthropogenic and natural contaminants. Distribution and mobility of elements in the secondary environment. Computational methods for the interpretation of water analyses.

German (GRMN)

GRMN 1115 Elementary German I. Main elements of grammar and pronunciation, with work on the four basic skills of listening comprehension, speaking, reading and writing. *Not for native speakers per University Academic Regulation 4.9.*

GRMN 1225 Elementary German II. Prerequisite(s): 1115 or equivalent. Continuation of 1115. *Not for native speakers per University Academic Regulation 4.9.*

GRMN 2112 (I) Intermediate Conversation and Composition I. Prerequisite(s): 1225 or equivalent competence. (May have been gained in high school.) Colloquial speech patterns and grammar. *May be taken concurrently with other 2000-level German courses. Not for native speakers per University Academic Regulation 4.9.*

GRMN 2113 Intermediate German I. Prerequisite(s): 1225 or equivalent. Selections from German contemporary cultural reading material. *May be taken concurrently with other 2000-level German courses. Not for native speakers per University Academic Regulation 4.9.*

GRMN 2222 (I) Intermediate Conversation and Composition II. Prerequisite(s): 2112 or equivalent competence. (May have been gained in high school.) Continuation of 2112, with further work in composition, conversation and grammar. *May be taken concurrently with other 2000-level German courses. Not for native speakers per University Academic Regulation 4.9.*

GRMN 2223 Intermediate German II. Prerequisite(s): 1225 or equivalent competence. (May have been gained in high school.) Reading/viewing and analysis of prose, drama and poetry, and film for building literary and cultural appreciation. *May be taken concurrently with other 2000-level German courses. Not for native speakers per University Academic Regulation 4.9.*

GRMN 3013 German for Reading Requirements I. Reading in the humanities and the sciences. Translation from German to English.

GRMN 3023 German for Reading Requirements II. Prerequisite(s): 3013 or equivalent. Intermediate and advanced reading in the humanities and sciences. Translation from German to English.

GRMN 3333 Modern Germany. Prerequisite(s): 20 credit hours of German or equivalent. The major cultural, social and political forces that have shaped the Germany of today.

GRMN 3343 German for Professional Purposes. Prerequisite(s): 2222 and 2223 or equivalent. Introduction to business concepts, practices and the expectations of professional life in Germany. Focus on specialized vocabulary.

GRMN 3463 Advanced Diction and Phonetics. Prerequisite(s): 20 credit hours of German or equivalent. German speech sounds and intonation patterns. Practice to improve the student's pronunciation. *Required course for teacher certification.*

GRMN 3803 Advanced Conversation. Prerequisite(s): 2222 or 2223 or equivalent. Colloquial speech forms and sentence structure. Practice in brief public address in German.

GRMN 3813 Advanced Grammar and Composition. Prerequisite(s): 2222 and 2223 or equivalent. Practice in original composition in German. Problematic points of German grammar and stylistics.

GRMN 3902 Orientation to Internship Abroad. Lab 1. Prerequisite(s): 2222 and 2223 or equivalent. Preparation for residential internship in a German-speaking country. Culture, civilization, and contemporary conditions, and communication for students accepted for international cooperative education program.

GRMN 3903 Internship Abroad. Lab TBA. Prerequisite(s): 2222 and 2223 or equivalent. Practical studies in a German-speaking country. Supervised research papers and reports and oral testing during and following the practicum.

GRMN 4113 (I) German Literature in Translation. Influential German, Austrian, and Swiss novels, short stories, plays, and poetry in translation. Discussion to see how they reflect social, literary, and philosophical state of the society at the time. Will be exposed to different themes as well as genres. May focus on literary production either of a certain time frame or follow a theme through centuries.

GRMN 4153 Survey of German Literature I. Prerequisite(s): 20 credit hours of German or equivalent. German literature from the beginning to 1785.

GRMN 4163 Survey of German Literature II. Prerequisite(s): 20 credit hours of German or equivalent. German literature from 1785 to the present.

GRMN 4333 Backgrounds of Modern German Civilization. Prerequisite(s): 20 credit hours of German or equivalent. Historical, cultural, political and literary trends in the formation of German civilization. Capstone course.

GRMN 4513 The Age of Goethe. Prerequisite(s): 20 credit hours of German or equivalent. Principal figures of German Classicism and Romanticism.

GRMN 4523 19th Century German Literature. Prerequisite(s): 20 hours or equivalent proficiency. Prose, lyric and drama from Romanticism to Naturalism.

GRMN 4543 Contemporary German Literature. Prerequisite(s): 20 hours of equivalent proficiency. Main currents in German literature from Naturalism until present day.

GRMN 4550 Studies in German. 1-3 credits, max 9. Prerequisite(s): 20 credit hours of German or equivalent competence. Reading and discussion of vital subjects in German.

Graduate (GRAD)

GRAD 5082* ITA Training - Oral Proficiency. Communication strategies and oral skills necessary for international teaching assistants. *Courses may not be used on a student's plan of study to fulfill minimal degree requirements.*

GRAD 5092* ITA Training - Presentation Skills. Prerequisite(s): Graduate standing. Prepares students for the ITA test. Topics include communication strategies, organization of topic, presentation skills. Students will practice making presentations in class. *Course may not be used on a student's plan of study to fulfill minimal degree requirements.*

GRAD 5880* Graduate Traveling Scholar. 1-24 credits, max 24. Prerequisite(s): Graduate degree candidate. Credit will vary depending on the program of each traveling scholar. Enrollment of graduate traveling scholars in

academic or research courses.

GRAD 5890* Special Topics in Grantsmanship. Prerequisite(s): Graduate standing and consent of instructor. Special topics on grantsmanship from a multi/interdisciplinary perspective to develop grant writing skills, funding opportunity identification and selection; planning a grant proposal; organization and development of proposal components; proposal reviewing.

GRAD 5990* Special Problems in Graduate Education. 1-6 credits, max 6. Prerequisite(s): Graduate standing, permission of instructor. Special problems course with variable content. *Topics relevant to graduate education and interdisciplinary studies. Taken with instructor permission only.*

GRAD 5992* Succeeding in the Professoriate. Prerequisite(s): Graduate standing and permission of Director of College Teaching Certificate program. Preparation for doctoral students who wish to pursue careers in academia. Focuses on university-level teaching and scholarship. Serves as foundation course for doctoral students in the University Faculty Preparation Certificate program.

GRAD 6010* Research or Intern Practicum. 1-9 credits, max 12. Prerequisite(s): Graduate standing. Graduate-level internship program for public administration, service or research. Blends the theoretical and absolute phase of the academic with practical on-the-job experience.

GRAD 6913* College Teaching Apprenticeship. Lab 6. Prerequisite(s): 5992 and enrollment in College Teaching Certificate program; EPSY 5463 or 6613; EDLE 6713 or 6583. Other EPSY/EDLE courses may be approved by Coordinator of program. Faculty member mentors doctoral student in instructing a university-level course.

GRAD 6921* College Teaching Practicum. Lab 2. Prerequisite(s): 6913. Student acts as instructor of record for an undergraduate course under the mentorship of a faculty member appropriate to the course taught.

Greek (GREK)

GREK 1113 Elementary Classical Greek I. Grammar and vocabulary of ancient Greek.

GREK 1223 Elementary Classical Greek II. Prerequisite(s): 1113 or equivalent. A continuation of 1113. Grammar and readings of classical Greek authors.

GREK 2113 Elementary Classical Greek III. Prerequisite(s): 1223 or equivalent. A continuation of 1223. Grammar and readings of classical Greek authors.

GREK 2213 Intermediate Readings. Prerequisite(s): 2113 or equivalent. An introduction to a variety of classical authors to increase reading facility and grammatical comprehension.

GREK 3330 Advanced Readings. 1-6 credits, max 9. Prerequisite(s): 2213. Prose authors, epic poetry, drama, Koine Greek and religious texts.

GREK 4113 (H) Greek Literature in Translation. Readings of significant works from ancient Greek literature and philosophy in English translation, from Homer through Aristotle. Readings and classes conducted in English.

Health Care Administration (HCA)

HCA 5010* Research and Thesis. 1-3 credits, max 9. Serves as the independent research and preparation of the thesis for the MS degree in Health Care Administration. Course includes the study of existing research and methodologies directly related to the individual discipline via computer, literature review, classroom and applied training.

HCA 5013* Survey of Health Care Administration. Overview of current issues in health care administration that relate to planning, legal, ethical and other related topics.

HCA 5023* Human Resources in Health Care and Public Administration. Review, discuss and analyze current issues, rules, practices and governance of human resources in health care and public administration.

HCA 5033* Legal Issues in Health Care Administration. Explore, discuss and analyze current legal issues and topics that relate to all aspects of the health care profession.

HCA 5043* Organizational Leadership and Development in Health Care. Teaches leadership development theories, perspectives and skills found within health care organizations. Provides insight on leadership styles, team development, coaching and fostering growth. Prepares leaders for embracing change including globalization, knowledge management and sustainability.

HCA 5050* Directed Readings in Health Care Administration. 2 credits, max 2. Focuses on specific topics of interest and emphasis in healthcare administration. Topics will be chosen or assigned for focused literature review.

HCA 5063* Health Care Compliance. Introduces general concepts as they relate to health care compliance issues including legal issues, risk assessment, informed consent, credentialing, compliance and ethics.

HCA 5073* The Social Structure of Health Care Organizations. Sociology of health care with an understanding of the interconnectedness of financial incentives, social relationships, and health system performance. Examine the role physicians play in the social structure of health care institutions and the changing role of physicians in the health system.

HCA 5083* The Financial Structure of Health Care Organizations. Overview of the financial structure of the U.S. health care system in health organizations. Provide the non-financial health administrators tools to work effectively with financial professions to achieve organizational goals.

HCA 5093* Leadership Methods and Styles in Healthcare. Introduces leadership methods, styles and situations that are unique in the health care field. Interprets those styles through specific case studies. Discusses the importance of strategic leadership planning.

HCS 5103* Intro to Global Health. Highlights the chronic, emerging and re-emerging global health issues and examines possible measures to address them.

HCA 5113* Entrepreneurship and the Health Sciences. Introduces entrepreneurship as it relates to the health care industry. Includes concepts within the for- and non-profit sectors. Focuses on entrepreneurial competencies of creativity and innovation.

HCA 5123* Survey of Research and Evaluation in Health Care. Introduces a basic understanding of statistics used in healthcare and biomedical research and developing research from the biomedical bench to the final stages of clinical trials. Analyzes healthcare program outcomes.

HCA 5133* Health Care Informatics. Focuses on healthcare informatics for the entire spectrum within the medical community. Covers local and community applications to broad global initiatives.

HCA 5143* Relief and Development in Global Health. Explores the roles and interaction of intergovernmental and governmental agencies and NGOs involved in global health.

HCA 5153* International Health Systems. Provides an overview of the differences in global health care systems using a historical and sociopolitical context making extensive use of country case studies.

HCA 5163* Healthcare Accounting and Auditing. Introduces the unique aspects of healthcare accounting and auditing. Presents and discusses various accounting and auditing topics as they relate to healthcare administration.

HCA 5990* Special Topics in Health Care Administration. 3-9 credits, max 9. This course is designed to provide an overview of current issues in health care administration that relate to planning, human resources, legal, ethical and other related topics.

Health and Human Performance (HHP)

HHP 1713 Introduction to Athletic Training. Lab 1. Prerequisite(s): Admission to the athletic training program. An introduction to the profession of athletic training. The principles of injury prevention and care relative to athletic injuries and development of essential skills and competencies needed to perform selected athletic training procedures. Theory-based course with required laboratory experiences.

HHP 1753 Introduction to Physical Education. The nature, scope and significance of physical education. Historical and philosophical foundations, major sub-disciplines and their interrelationships, and career opportunities.

HHP 1812 Pedagogy of Non-Traditional Activities. Prerequisite(s): HHP and LEIS majors and minors only. Introduction of activities typically taught to supplement individual or team sports. Content includes teaching strategies, skill components, terms, safety issues, and selection of developmentally appropriate non-traditional activities, scope and sequencing of skill components by grade level, skill components, assessment, terms, safety issues, selection of developmentally appropriate team activities, lesson structure.

HHP 1822 Pedagogy of Rhythm and Movement. Prerequisite(s): HHP and LEIS majors and minors only. Introduction of basic fundamentals and methods of movement skills for rhythms including social, creative, developmental, and multicultural dance and activities. Analysis of skills, concepts, terms, safety issues, teaching strategies and developmental appropriateness.

HHP 1832 Pedagogy of Team Activities in PE. Prerequisite(s): HHP and LEIS majors and minors only. Introduction of activities typically taught as team or group activities. Instructional strategies (methodologies) of team sports, scope and sequencing of skill components, assessment, terms, safety issues, lesson structure, and writing performance objectives.

HHP 1842 Pedagogy of Individual Activities. Prerequisite(s): HHP and LEIS majors and minors only. Introduction of activities typically taught as individual sports and activities. Teaching strategies, skill components, terms, safety issues, and selection of developmentally appropriate individual activities, scope and sequencing of skill components, assessment, lesson structure, and writing performance objectives.

HHP 2213 Principles in Health Education and Health Promotion. Introduction to the field of health education and health promotion focusing on health principles, theories, career opportunities and a field experience.

HHP 2222 Introduction to Health Aspects of Gerontology. An introductory course of the physical and physiological aspects of aging combined with

common pathology and intervention.

HHP 2323 Drugs and Society. Impact of recreational use of drugs on society. Topics will include stimulant, depressant, and hallucinogenic recreational drugs, ergogenic substances and current research regarding addiction. Particular focus will be given to current trends of substance use and abuse. Cannot be substituted for HHP 3913.

HHP 2451 Athletic Training Practicum. Lab 1. Prerequisite(s): Full admission into athletic training program. Directed observation in supervised introductory laboratory and clinical experiences in athletic training.

HHP 2461 Athletic Training Practicum II. Lab 1. Prerequisite(s): Successful completion of 2451, 2844. Directed observation in supervised introductory laboratory and clinical experiences in athletic training.

HHP 2553 Basic Athletic Injury Management. Prerequisite(s): 2654. Identification of emergency medical situations and application of basic care for injury occurring in school and athletic setting.

HHP 2602 First Aid. Lab 2. A competency- and performance-based first aid course.

HHP 2603 (S) Total Wellness. Overview of individual, interpersonal, and sociocultural issues that have an impact on health. Behavioral decision-making, social relations, cultural diversity and environmental sensitivity.

HHP 2654 Applied Anatomy. Lab 2. Prerequisite(s): BIOL 1114. Action and location of individual muscles and muscle groups. Anatomy as applied to a living person. Common anatomical injuries and diseases will be presented with each joint structure. Lab sections will be structured around specific content area for students' discipline.

HHP 2664 Mechanism and Management of Musculoskeletal Pathology. Appropriate prevention of injury and administration of medical care. Didactic theory and practical experience regarding many aspects of health care. Preparation for future health-care professionals to identify and care for injury occurring during physical activity.

HHP 2712 Psychomotor Development. Prerequisite(s): HHP and LEIS majors and minors only. Fundamental aspects of motor development for infants, children, youth and adults.

HHP 2733 Procedures in Athletic Training. Lab 1. Prerequisite(s): 1713, 2654, 2664. Introduction to the psychomotor skills required in the profession of athletic training. Procedures relative to injuries and development of essential skills and competencies needed to perform selected athletic training procedures. Theory-based course with required lab experience.

HHP 2802 Medical Terminology for the Health Professions. Basic knowledge and understanding of medical language and terminology used in allied health and health professions.

HHP 2844 Clinical Examination and Diagnosis I. Lab 2. Prerequisite(s): 2654, 2733 and 2664. Advanced knowledge and skills related to the recognition, diagnosis and appropriate medical referral of injuries to the lumbar spine, pelvis and lower extremities.

HHP 2854 Clinical Examination and Diagnosis II. Lab 2. Prerequisite(s): 2654, 2664, 2733, and 2844. Advanced knowledge and skills related to the recognition, diagnosis and appropriate medical referral of injuries to the head, cervical and thoracic spine, upper extremities, abdominal and thoracic regions.

HHP 3010 Health and Human Performance Workshop. 1-3 credits, max 6. Concentrated study of selected areas of health and human performance, including problems in instruction and administration not usually addressed in the undergraduate curriculum.

HHP 3112 Radiography Evaluation and Assessment. Prerequisite(s): Full admission into ATEP clinical or pre-professional option. Introduction to the fundamental principles, equipment, and common methods and procedures of radiography.

HHP 3114 Physiology of Exercise. Lab 2. Prerequisite(s): MATH 1513. A study of the various bodily systems, including major organs and tissues, and how they respond to acute and chronic exercise of varying intensity, duration and frequency.

HHP 3223 Motor Learning. An in-depth study of motor learning and motor performance. Special emphasis on skilled performance, motor learning theory, motor abilities and individual differences in motor learning.

HHP 3233 General Medical Concepts. Prerequisite(s): 2654, 2664, and ZOOL 3204, CHEM 1314, HHP 3673. Specific pathologies, medical conditions, and possible avenues for treatment of non-orthopedic conditions. Based in current medical research, theory and practical outcomes.

HHP 3333 Ethics in Sports Administration and Coaching. Exploration of the ethical, legal, and professional dilemmas that occur in athletic administration and coaching.

HHP 3431 Early Laboratory and Clinical Experiences in Physical Education. Lab 1. Prerequisite(s): 1753 and declaration of intention to pursue a program in Professional Education. The initial pre-professional clinical experience for schools, kindergarten through grade twelve, with primary duties including assisting in physical education classes. *Required for full admission to Professional Education. Graded on a pass-fail basis.*

HHP 3443 Psychosocial Aspects of Sport and Coaching. Examination of the psychological aspects of sport that impact the performances of coaches and athletes.

HHP 3451 Athletic Training Practicum III. Lab 1. Prerequisite(s): Successful completion of 2461, 3802, and 3902. Directed observation in supervised intermediate laboratory and clinical experiences in athletic training.

HHP 3461 Athletic Training Practicum IV. Lab 1. Prerequisite(s): Successful completion of 3451, 3924. Directed observation in supervised intermediate laboratory and clinical experiences in athletic training.

HHP 3613 Community Health. Prerequisite(s): 2.75 major GPA, 2.50 overall GPA, 2213, 2603 or consent of instructor. A survey of issues impacting the health of populations from a community health perspective.

HHP 3623 School Health Programs. Prerequisite(s): 2603. The identity and relationships of school health instruction, services and environments.

HHP 3643 Health Behavior Theory. Prerequisite(s): Full admission to HEP and junior standing or consent of instructor. Survey of biopsychosocial behavioral models to determine basis for health risk behaviors, with emphasis on determinants of health/risk behavior and exploring health behavior theories across age, sex, ethnicity, culture and socio-economic status.

HHP 3663 Biomechanics. Prerequisite(s): 2654. The study of anatomical mechanical phenomena underlying human motion. Application of biomechanical concepts to a wide variety of exercise, fundamental movement, sport and physical activity.

HHP 3673 Pathology and Pharmacology in Sports Medicine. Prerequisite(s): 2664, CHEM 1314, and ZOOL 3204. Principles of cellular inflammation, immunopathology, tissue growth and circulation. Examination of physiological drug activity in the body, drug disposition and pharmacokinetics in sports medicine.

HHP 3723 Principles of Epidemiology. Prerequisite(s): Full admission to HEP and junior standing or consent of instructor. Survey of epidemiological principles as they relate to the planning of both community and consumer-focused health promotion and disease prevention programs.

HHP 3753 Methods in Teaching Elementary Physical Education. Prerequisite(s): 1753, 1812, 1822, 1832, 2712, and 3430. Theory and practical experience of physical education in the elementary school. Teaching styles and activities needed to meet the needs of children from kindergarten through grade five.

HHP 3763 Health and Physical Education for Elementary Age Children. Methods of teaching health and physical education to elementary age children. Theory and practical experience of health behaviors, movement skills and physical fitness.

HHP 3773 Methods in Teaching Secondary Physical Education. Prerequisite(s): 1753, 1812, 1822, 1832, 3430. Instructional styles, implementation of behavioral goals and objectives through unit and lesson preparation, teaching methods and classroom management.

HHP 3802 Therapeutic Modalities for Injury I. Lab 2. Prerequisite(s): 2654, 2664, CHEM 1314 and concurrent enrollment ZOOL 3204. Discussion and application of common thermal and mechanical interventions used in the treatment of acute and chronic injuries to the musculoskeletal systems.

HHP 3902 Therapeutic Modalities for Injury II. Lab 1. Prerequisite(s): 3802. Discussion and application of common electronic and physiologic devices used in the treatment of acute and chronic injuries to the musculoskeletal systems.

HHP 3913 Alcohol and Drug Education. Prerequisite(s): Full admission to HEP and junior standing or consent of instructor. Examines social, psychological, pharmacological, and cultural aspects of drug use, misuse, and abuse. In addition, the methods, materials, and theories of drug abuse prevention in the school and community will be explored.

HHP 3924 Therapeutic Exercise. Lab 2. Prerequisite(s): 3802. Scientific methods used in therapeutic exercise and rehabilitation of injuries. Investigation of mechanisms of injury, anatomical structures involved and methodological approach in designing rehabilitative programs.

HHP 4010 Directed Study. 1-3 credits, max 6. Prerequisite(s): Written approval by department head. Supervised readings, research or independent study of trends and issues related to the area of health, physical education or leisure services.

HHP 4233 Health and Human Sexuality. Prerequisite(s): Full admission to HEP and junior standing or consent of instructor. The study of human sexuality as it relates to the health and well-being of individuals in the community, college, school or worksite settings.

HHP 4243 Research Methods in Athletic Training. Prerequisite(s): STAT 2013. Interactive study of importance and process of conducting ethical research in athletic training and the healthcare professions. Emphasis placed on research design, ethics, collection of data, and the dissemination of results.

HHP 4451 Athletic Training Practicum V. Lab 1. Prerequisite(s): Successful completion of 3461. Directed observation in supervised advanced laboratory and clinical experiences in athletic training.

HHP 4461 Athletic Training Practicum VI. Lab 1. Prerequisite(s): Successful completion of 3233, 4451. Directed observation in supervised advanced laboratory and clinical experiences in athletic training.

HHP 4480 Internship in Health and Human Performance. 1-12 credits, max 12. Prerequisite(s): Last semester senior standing with cumulative GPA of 2.50. Supervised experience in school (physical education and health), community worksite or athletic training setting in order to qualify or prepare for appropriate teaching and professional certification.

HHP 4530 International Athletic Training. 1-3 credits, max 6. Explore and experience the techniques of prevention and care of athletic injuries in a culture outside of the United States. Course must be taken in two different countries to count as second time credit.

HHP 4533 Psychosocial Issues in Health Education/Promotion. Prerequisite(s): Full admission to HEP and senior standing or consent of instructor. Psychosocial issues as they relate to the practice of health education/promotion. Personal and professional applications of the course material will be emphasized.

HHP 4643 Methods in School and Community Health Education. Prerequisite(s): 3623; full admission to Professional Education. Conceptual approach to health education through a variety of teaching methodologies.

HHP 4723 Assessment in Physical Education. Prerequisite(s): Full admission to professional education. Evaluation techniques commonly used by physical educators and health professionals to measure knowledge, attitudes, sport skill proficiency and physical fitness.

HHP 4733 Organization, Administration and Curriculum in Physical Education and Athletics. Prerequisite(s): 3753, 3773 or concurrent enrollment; full admission to professional education. Curricular design and management of physical education (P-12) and athletic programs.

HHP 4773 Principles of Exercise Testing and Prescription. Prerequisite(s): 3114. Study of principles of exercise testing including submaximal and maximal tests, exercise and basic electrocardiography, and guidelines for recommending exercise as related to health promotion and exercise science.

HHP 4783* Health Issues in Gerontology. Prerequisite(s): 2603, or consent of instructor. An in-depth study of physiological aspects, special health concerns, chronic illnesses and services as applied to gerontology.

HHP 4793* Adapted Physical Education. Prerequisite(s): 3753, 3773, full admission to Professional Education. Cognitive and psychomotor characteristics of disabling conditions, needs and challenges of educating the exceptional learner in the regular physical education program.

HHP 4880* Internship in Health Education and Promotion - Community Health. Prerequisite(s): Last semester: Senior standing with cumulative GPA 2.75. Supervised field work experience in health promotion or health-related settings for students in the Community Health option.

HHP 4901 Rehabilitation Seminar. Prerequisite(s): 2844, 2854, 3673, 3904, 3924 and 4451. Capstone course using patient problems to develop clinical decision-making incorporating preceding course work in pathology assessment, therapeutic modalities, exercise and pharmacology.

HHP 4902 Pre-Internship Seminar. Prerequisite(s): Full admission to HEP, last semester prior to 4990 or consent of instructor. Capstone course for the health promotion program. Preparation for the health internship experience.

HHP 4933 Administration and Organization of Athletic Training Programs. Prerequisite(s): 4451. The administration and organization of athletic training programs including planning and implementation, certification procedures, code of professional practice, safety standards and resource management.

HHP 4973 Program Design in HEP. Prerequisite(s): Full admission to HEP and senior standing or consent of instructor. A survey of program design principles, including theoretical foundations, planning, marketing, delivering and evaluating.

HHP 4983* Current Issues in Athletic Training. Prerequisite(s): 3663, 4451 and admission to athletic training program. Development of competencies set by the National Athletic Trainers Association Board of Certification. Current issues facing athletic trainers and the role in today's health care systems.

HHP 4990* Internship in Health Education and Promotion - Exercise and Health. 1-12 credits, max 12. Prerequisite(s): Last semester; senior standing with cumulative GPA 2.75. Supervised field work experience in health promotion or health-related settings for students in the Exercise and Health option.

HHP 5000* Master's Thesis. 1-6 credits, max 6. Independent research required of candidates for master's degree. Credit awarded upon completion of thesis.

HHP 5010* Seminar. 1-2 credits, max 4. Selected topics from the profession not covered in other courses. Presentation and critique of research proposals and results.

HHP 5020* Health and Human Performance Workshop. 1-3 credits, max 6. Workshop in selected areas of health and human performance.

HHP 5030* Field Problems in Health and Human Performance. 1-3 credits, max 6. Individual investigations of issues in the areas of health and human performance.

HHP 5033* Advanced Techniques in Orthopedic Assessment. Knowledge in evaluating various upper and lower extremity orthopedic injuries.

HHP 5053* Research Design in Leisure, Health and Human Performance. Prerequisite(s): PSYC 5303 or STAT 5013. Research design with applicability toward leisure, health and human performance. Conceptual understanding of theory, tools and processes involved in designing research.

HHP 5073* Psychological Aspects of Sport. Psychological foundations of sport emphasizing performance enhancement by athletes through psychological training techniques.

HHP 5103* Emergency Management in Athletic Healthcare. Prerequisite(s): Admission into the Entry Level Masters degree Athletic Training Education Program. Development of essential skills and competencies necessary to manage emergency situations.

HHP 5113* Psychological Aspects of Health. Examination of the interactions of biological, psychological, social, and spiritual factors as they impact human health and disease.

HHP 5122* Therapeutic Modalities I. Prerequisite(s): Admission into the Entry Level Masters degree Athletic Training Education Program. Advanced knowledge in the application of common thermal and cryotherapeutic interventions for acute and chronic injuries as they related to evidence based practice.

HHP 5133* Environmental Health. Prerequisite(s): Successful admission to the Graduate College or special permission. Examination of health issues, etiology of disease, and control and prevention of major environmental health problems in industrialized and developing countries.

HHP 5173* Therapeutic Interventions in Athletic Training. Advanced understanding of various methods of how to treat orthopedic injuries commonly seen in health care.

HHP 5184* Injury Prevention. Prerequisite(s): Admission into the Entry Level Masters degree Athletic Training Education Program. Introduction to injury etiology, appropriate injury prevention and the administration of subsequent medical care. Based in didactic theory and practical experience regarding many aspects of Athletic Healthcare.

HHP 5201* Athletic Training Practicum I. Prerequisite(s): Admission into the Entry Level Masters degree Athletic Training Education Program. Supervised clinical experiences in athletic training emphasizing concepts in injury prevention, acute care injury management.

HHP 5222* Therapeutic Modalities for Injury II. Prerequisite(s): Admission into the Entry Level Masters degree Athletic Training Education Program and HHP 5122. Discussion and application of common electronic and physiologic devices used in the treatment of acute and chronic injuries to the musculoskeletal systems. This course is designed to introduce the student to various therapeutic agents used in the treatment of injury through problem based learning.

HHP 5233* Sexuality and Health. The study of human sexuality as it relates to the health and well-being of individuals in the community, college, school, and worksite settings. Particular emphasis will be on examining, developing, or modifying new programming related to sexuality and health.

HHP 5234* Clinical Evaluation and Diagnosis of the Lower Extremity. Prerequisite(s): Admission into the Entry Level Masters degree Athletic Training Education Program. Contemporary knowledge and skills related to evidence based practice in the recognition, diagnosis, and appropriate medical referral of injuries to the hip, pelvis, and lower extremity.

HHP 5244* Therapeutic Exercise of the Lower Extremity. Prerequisite(s): Admission into the Entry Level Masters degree Athletic Training Education Program. Scientific methods used in therapeutic exercise and rehabilitation of lower extremity injuries. Investigation of mechanisms of injury, anatomical structures involved and methodological approach in designing rehabilitative programs.

HHP 5301* Athletic Training Practicum II. Prerequisite(s): HHP 5201 Athletic Training Practicum I. Interactive and supervised clinical experiences in athletic training emphasizing diagnosis, treatment and rehabilitation of injuries to the lower extremity.

HHP 5314* Clinical Evaluation and Diagnosis of General Medical Conditions. Prerequisite(s): Admission into the Entry Level Masters degree Athletic Training Education Program. To present the student with specific pathologies, medical conditions and possible avenues for treatment of nonorthopedic conditions. Based in medical theory and practical outcomes, this course will prepare students to evaluate, treat and refer to proper medical professionals.

HHP 5323* Advanced Epidemiology. Prerequisite(s): Admission to the Graduate College or special permission from the instructor. Examination of epidemiological theory and its methodological application to public health.

HHP 5334* Clinical Evaluation and Diagnosis of the Upper Extremity. Prerequisite(s): HHP 5234. Advanced knowledge and skills related to evidence based practice in the recognition, diagnosis and appropriate medical referral of injuries to the upper extremities.

HHP 5344* Therapeutic Exercise of the Upper Extremity. Prerequisite(s): HHP 5244. Evidence based practices used in therapeutic exercise and rehabilitation of upper extremity injuries. Investigation of mechanisms of injury, anatomical structures involved and methodological approach in designing rehabilitative programs.

HHP 5401* Athletic Training Practicum III. Prerequisite(s): HHP 5301 Athletic Training Practicum II. Interactive and supervised clinical experiences in

athletic training emphasizing diagnosis, treatment and rehabilitation of injuries to the upper extremity.

HHP 5412* Radiography Evaluation and Assessment. Prerequisite(s): Admission into the Entry Level Masters degree Athletic Training Education Program. To introduce the student to the fundamental principles, equipment and common methods and procedures of radiography.

HHP 5444* Clinical Diagnosis, Evaluation, and Therapeutic Exercise of the Head and Spine. Prerequisite(s): HHP 5344. Advanced knowledge and skills related to the recognition, diagnosis and appropriate medical referral of injuries to the lumbar, thoracic and cervical spine and head. Scientific methods used in therapeutic exercise and rehabilitation of head and spine injuries.

HHP 5453* Cultural Issues in Health Education and Promotion. Examination of ways in which culture affects health and health care including perceptions of health, disease, treatments, and the values associated with these factors. The need for cultural sensitivity in health care is emphasized.

HHP 5483* Pathology and Pharmacology in Sports Medicine. Prerequisite(s): Admission into the Entry Level Masters degree Athletic Training Education Program. Discuss various pathophysiological conditions and common pharmaceutical interventions as they relate to pharmacodynamics and pharmacokinetics.

HHP 5501* Athletic Training Practicum IV. Prerequisite(s): HHP 5401 Athletic Training Practicum III. Interactive and supervised clinical experiences in athletic training emphasizing diagnosis, treatment and rehabilitation of injuries to the head and spine and general medical conditions.

HHP 5523* Current Readings in Health. Contemporary research, literature, projections and views as applied to total health and well-being.

HHP 5530* International Athletic Training. 1-3 credits, max 6. Explore and experience the techniques of prevention and care of athletic injuries in a culture outside of the United States. Course must be taken in two different countries to count as second time credit.

HHP 5533* Research Methods in Athletic Health Care. Prerequisite(s): Admission into the Entry Level Masters degree Athletic Training Education Program. Discuss the importance of conducting research in athletic training and the healthcare professions. Emphasis is placed on research design, ethics, collection of data, and the dissemination of results.

HHP 5573* Athletic Healthcare Administration. Prerequisite(s): Admission into the Entry Level Masters degree Athletic Training Education Program. The administration and organization of athletic healthcare programs including planning and implementation, certification procedures, code of professional practice, safety standards and resource management.

HHP 5583* Psychosocial Strategies in Athletic Healthcare. Prerequisite(s): Admission into the Entry Level Masters degree Athletic Training Education Program. Development of psychosocial strategies and referral competencies set by the National Athletic Trainers Association Board of Certification.

HHP 5593* Human Electrocardiographic Interpretation. Prerequisite(s): 3114 or consent of instructor. Knowledge concerning the collection and interpretation of the electrocardiogram (EKG) and its relationship to heart anatomy, physiology and electrophysiology.

HHP 5601* Athletic Training Practicum V. Prerequisite(s): HHP 5501 Athletic Training Practicum IV. Interactive and supervised clinical experiences in athletic training emphasizing evidence based practices and administrative responsibilities.

HHP 5603* Principles of Performance Enhancement. Prerequisite(s): 2654, 3114, ZOOL 3204. Theoretical foundation of specific tenets of exercise and performance enhancement. Upon successful course completion students will be eligible to sit for the National Academy of Sports Medicine (NASM) examination for NASM Performance Enhancement Specialist certification.

HHP 5613* Cardiac Rehabilitation. Prerequisite(s): 2653 and 3114 or equivalent. Factors involved in cardiovascular disease. History, implementation and administration of cardiac rehabilitation programs.

HHP 5653* Philosophical Foundations of Health Education and Promotion. Exploration of key concepts, philosophies, ethical principles, historical events, theories/models, and responsibilities and competencies of health education and promotion of professionals.

HHP 5683* Theoretical Applications in Health Education and Promotion. Prerequisite(s): 5663. Theories and concepts related to health science and exploration of the application of theories to health education practice and research.

HHP 5703* Principles of Corrective Exercise. A scientific approach to corrective exercise program design and implementation.

HHP 5733* Motor Learning. Research in psychology and physical education relevant to the understanding of the nature and basis of motor skill learning.

HHP 5823* Advanced Applied Anatomy. Prerequisite(s): 2653. Structure and movement of the human body with emphasis on the relationship of physical activity to musculoskeletal and neurological factors.

HHP 5843* Quantitative Biomechanics and Kinesiology. Prerequisite(s): 5823. Analytical approach to the study of the human nervous system and human motion as applied to kinematic and kinetic analysis.

HHP 5853* Stress Testing and Exercise Prescription I. Prerequisite(s): 3114, 5593. Theory and practice in resting and exercise EKG, stress test protocols and exercise prescription.

HHP 5873* Human Bioenergetics. Prerequisite(s): 3114. Human energy production, utilization and storage in response to exercise.

HHP 5894* Biochemistry of Exercise Lab Methods. Lab 2. Prerequisite(s): Consent of the instructor. Practice using basic laboratory skills which can be applied to sophisticated techniques in biochemical analysis. General biochemistry as it relates to exercise metabolism, laboratory procedures, calculations, common lab problems and solutions and laboratory safety procedures.

HHP 5973* Program Design in Health Education and Promotion. A survey of program design principles, including assessing, theoretical foundations, planning and marketing.

HHP 5983* Health Promotion Program Implementation and Evaluation. Prerequisite(s): 5973. An intensive overview of principles of health promotion program implementation and evaluation with special emphasis on application.

HHP 6000* Doctoral Dissertation. 1-25 credits, max 25. Required of all candidates for the Doctor of Philosophy degree. Credit is given upon completion of the dissertation.

HHP 6010* Independent Study in Health and Human Performance. 1-3 credits, max 6. Prerequisite(s): Consent of instructor. Supervised readings, research or independent study of trends and issues related to the areas of health and human performance.

HHP 6020* Research Colloquium. 1-3 credits, max 3. Exploration and presentation of selected topics and research in health and human performance.

HHP 6023* Special Topics in Health and Human Performance. Prerequisite(s): Admission to the Graduate College. Special topics related to health and human performance. Investigation, discussion and analysis of contemporary topics.

HHP 6053* Advanced Research in Health and Human Performance. Prerequisite(s): Graduate elementary statistical methods course. In-depth study of selected surveys and experimental research in HHP, including questionnaire development, survey methodology and analysis of data.

HHP 6063* Statistical Computing and Proposal Writing. Prerequisite(s): Consent of instructor. Instruction in the use of SPSS using a personal computer. Preparation of research proposals.

HHP 6723* Curriculum Development in Health, Leisure and Human Performance. Prerequisite(s): Admission to the Graduate College. Identification and analysis of curriculum theories with emphasis on traditional and innovative approaches to curriculum design for programs in health, leisure and human performance.

History (HIST)

HIST 1010 Studies in American History. 1-2 credits, max 2. Special study in American history to allow transfer students to fulfill general education requirements as established by Regents' policy.

HIST 1020 Freshman Historical Research Methods. 1-3 credits, max 3. Prerequisite(s): Requires consent of instructor. For lower-division students interested in learning research methods in history while working on a research project with an individual faculty member. Preference given to students in A&S Freshman Research Seminar.

HIST 1103 Survey of American History. Meaning, vitality, and uniqueness of United States history since 1492 through a thematic examination of the nation's past. Satisfies, with POLS 1113, the State Regents requirement of six credit hours of American history and American government before graduation. *No degree credit for students with credit in 1483 or 1493.*

HIST 1483 American History to 1865. From European background through the Civil War. Intended for Education majors seeking certification as Social Studies teachers. *No degree credit for students with credit in HIST 1103.*

HIST 1493 American History Since 1865. May be taken independently of HIST 1483. Development of the United States including the growth of industry and its impact on society and foreign affairs. Intended for Education majors seeking certification as Social Science teachers. *No degree credit for students with credit in HIST 1103.*

HIST 1613 (H) Western Civilization to 1500. History of western civilization from ancient world to Reformation.

HIST 1623 (H) Western Civilization after 1500. History of western civilization from Reformation to present.

HIST 1713 (H) Survey of Eastern Civilization. History of three eastern civilizations (East Asia, South Asia and West Asia) from pre-history to the 18th century. Special attention to their origins, development, and contributions to the evolution of world civilization.

HIST 2323 Oklahoma History. Early exploration and establishment of Indian Territory; the rise and demise of the Five Indian Nations; and the organization and development of the 41st state to the present. Required of all candidates for teacher's licensure/certification in social studies.

HIST 2333 (H) American Thought and Culture: Survey. Survey of American religious, philosophical, artistic, and scientific ideas and their impact on culture and values.

HIST 2343 (H) Religion in America. Survey of the history of religion in America and its impact on social reform, politics, and intellectual life.

HIST 3003 (I,S) Soviet Union: History, Society and Culture. A comprehensive view of the Soviet Union, stressing those issues in the political, economics, technological, geographical, and cultural spheres which are most relevant to the current situation. Accessible to beginning undergraduates. (Same course as POLS 3003 and RUSS 3003)

HIST 3013 (H) Ancient Egypt and Israel. The Ancient Near East with a focus on Egyptian and Israelite history, from the earliest times to the 5th century B.C.

HIST 3023 (H) Ancient Greece. The Greek world from the Bronze Age through Alexander the Great with special emphasis on politics, culture and institutions of Classical Greece.

HIST 3033 (H) Ancient Rome. Political, social, economic and cultural history of the Roman Republic and Empire.

HIST 3043 (H) Ancient Mesopotamia: Iraq, Iran & Syria from 4000-333 B.C. From the birth of civilization to the end of the Persian Empire, this course examines the history, archaeology and cultures of the fertile crescent.

HIST 3053 (I,S) Introduction to Central Asian Studies. A comprehensive view of newly-emerged Central Asian states examining the history, politics, economics, geography, and culture of Azerbaijan, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan as reflected in their thoughts, religion, literature, and architecture, in the past, and the strategic importance of their natural wealth for the present and future. (Same course as GEOG 3053, POLS 3053 & RUSS 3053)

HIST 3113 (H,I) Germany Since 1815. Creation of a centralized state in Germany; impact of World War I and the subsequent failure of the Weimar Republic; rise of national socialism, totalitarianism, and the Third Reich; German experience in WWII, repression of minorities, and the Holocaust; post-war Germany and modern reunification.

HIST 3133 (H) African Diaspora History. Introduction to the origin, development, and maturation of the African Diaspora in the Americas and the Caribbean, from the transatlantic slave trade to the mid-20th century. Emphasis is placed on a critical reading and discussion of a selection of essays, historiographies and primary materials on diasporic and transnational experiences and identities of Africans, African descendents, and Caribbean transmigrants.

HIST 3153 (H) Russia to 1861. Political, institutional, societal and economic development of Russia from the Kievan period to the Great Reforms.

HIST 3163 (H,I) Russia Since 1861. Modernizations of Russia in the 19th and 20th centuries. Great reforms and their effects and the 1917 revolutions and their consequences.

HIST 3203 (H) Early Medieval Europe, 325-1000. Early Middle Ages in Europe with emphasis on political, economical, religious, and social developments. Considerations of Europe's interactions with Byzantium and Islam.

HIST 3233 (H) Later Medieval Europe, 1000-1450. High and Late Middle Ages in the Europe with emphasis on political, economic, religious, and social developments. Considerations of Europe's interactions with Byzantium and Islam.

HIST 3243 (H) Renaissance, 1350-1517. The development of the Renaissance from the Italian city-states to the New World. Political development, cultural innovation, and the role of disease in history.

HIST 3253 Absolutism and Enlightenment, 1648-1789. Political, economic, social, intellectual and religious transformation of Europe between the Peace of Westphalia and the French Revolution.

HIST 3263 (H) Modern Europe, 1815-1914. Impact of modernization on the character of European society. Factors that transformed the Continent into a battle ground in the 20th century.

HIST 3273 (H,I) Modern Europe Since 1914. Origins, character and impact of the first World War; emergence and consequences of the totalitarian state; nature of political and intellectual terrorism. Effects of worldwide economic depression; dilemmas of modern democracies; political collapse of Europe as a consequence of World War II.

HIST 3323 (H) Modern France, 1789-Present. French politics, economy, society, and culture from the defeat of Napoleon to France's post-World War II "rebirth.''

HIST 3333 (H,I) History of the Second World War. Problems leading to World War II with their international implications and consideration of the war years.

HIST 3343 (H,I) World War I in Modern European Culture. Analysis of the war as the principal event determining the course of twentieth century European history: battles, home fronts, personal, literary and artistic expression.

HIST 3353 (H) Mediterranean World. Examination of the cultural and social encounters between East and West, Christian and Muslim. The meeting point for three world cultures and three continents explored in the following themes: pilgrimage, commerce, slavery, intellectual exchange, warfare, and minority communities.

HIST 3363 (H) Popular Religion in the West, 1300-1700. The study of the religious experience of both lay people and clergy between 1300 and 1700, when their religious worldview underwent fundamental challenges and changes. The effort to understand the relationship between the secular world and the supernatural will be explored through devotional ideas, practices and religious rituals.

HIST 3373 (H) Medieval England: 55 B.C.-1485 A.D. English History from Roman Britain to the beginning of the Tudor period. Development of the English constitution from the early Germanic state through feudalism to the New Monarchy.

HIST 3383 (H) Tudor-Stuart England. History of England from the War of the Roses through the coming of the House of Hanover in 1714. Development of the centralized state, parliamentary reaction, reorientation of the English society and economy and the English Reformation.

HIST 3393 (H) Modern England: 1714-Present. English history from the arrival of the house of Hanover through the decline of British influence following the Second World War. Political, social, and economic problems encountered as a result of the creation of the first modern industrialized state.

HIST 3403 (H) East Asia to 1800. Traditional Chinese civilization and its impact on Japan, Korea and Southeast Asia.

HIST 3413 (H,I) East Asia Since 1800. Impact of the Occident on China, Japan and Southeast Asia. Problems of trade and diplomacy; political and industrial transformation of Japan; revolutionary process in China; the rise of nationalism in Southeast Asia.

HIST 3423 (H,I) Modern Japan. Modernization process in Japan since 1868.

HIST 3433 (H,I) Modern China. Response of China to the West since 1840, with stress on economic, social and intellectual currents.

HIST 3443 (H) Gender Relations in Chinese History. Men's and women's social, cultural, religious, political, economic, family, and sexual experiences in Chinese history; particularly women's own voices and efforts in pursuing their own goals and aspirations.

HIST 3453 (H) Colonial Latin America. Impact on the Indian cultures of Spanish and Portuguese conquerors, priests, administrators and entrepreneurs in the creation of a new society. Class structure, 18th century reforms, and independence movements.

HIST 3463 (H,I) Modern Latin America. Latin America republics emphasizing the dictators and the liberal reform movements of the 19th century. U.S. involvement and the recent social revolutions of the 20th century.

HIST 3483 (H) Reformation Europe, 1517-1648. Development and impact of religious reform movements, overseas expansion, statebuilding, the Scientific Revolution, and the Thirty Years' War on European civilization.

HIST 3493 (H,I) Scandinavia Since 1500. Exploration of Scandinavia from 1500 to the present. Focus on key historical and contemporary questions such as the spread of Lutheran reform, Sweden and Denmark as major European powers, the growth of nationalism and Scandinavian identity, industrialization, the welfare state, and multiculturalism.

HIST 3503 (H) Islamic Civilization 600-1800. Rise of Islam in Arabia and subsequent spread to Africa, Asia and Europe. Nature of Islamic civilization through discussion of political, social, cultural and economic institutions established in the Middle Ages as well as diversity of Islamic traditions.

HIST 3513 (H,I) Modern Middle East Since 1800. Main political events, social institutions, cultural and economic developments, as well as various aspects of everyday life in the Middle East since 1800. Transformation of traditional society, imperialism and independence, Arab nationalism, Arab-Israeli conflict, the impact of oil, westernization, the rise of militant Islam, and the prospects of democratization.

HIST 3543 (H,I) Israel & Palestine in Modern Times. History of 19th and 20th century Palestine, Zionism and the founding of modern Israel. The Palestine-Israeli conflict in local and regional perspectives.

HIST 3553 (H,I) Media and Popular Culture in the Arab Middle East. Popular culture throughout the Arab-speaking world in light of the most important political and economic events of the 19th and 20th centuries.

HIST 3613 (H) American Colonial Period to 1750. Colonization of British and French North America; colonial political, social, cultural, intellectual and economic development; international rivalries; the imperial structure.

HIST 3623 (H) Era of the American Revolution. British imperial problems; the American Revolution; political, cultural, economic, social and religious change; the War for Independence; the Articles of Confederation; the critical years.

HIST 3633 (H) Early National Period, 1787-1828. Drafting and adopting the Constitution, organizing the government, Jeffersonian Republicanism, the War of 1812, territorial expansion, the new West, nationalism and sectionalism.

HIST 3643 (H) The Jacksonian Era, 1828-1850. Development of a modern political system and an entrepreneurial economy; social reform; territorial expansion; and sectionalism.

HIST 3653 Civil War and Reconstruction, 1850-1877. Causes, decisive events, personalities and consequences of the disruption and reunion of the United States.

HIST 3663 (H) Robber Barons and Reformers: U.S. History, 1877-1919. The impact of industrialization upon American society and politics. America's rise to world power, the Progressive movement and World War I.

HIST 3673 (D,H) United States History, 1919-45. The political, economic, social and cultural changes in the United States from 1919 to 1945, the 1920s, the Depression, the New Deal, WWII, and domestic impact of the war.

HIST 3683 (D,H) United States History Since 1945. The political, social, and cultural history of the United States since World War II. The Cold War, McCarthyism, 1950s ideals of the nuclear family, the civil rights and other social movements, the Vietnam War, Watergate, the Reagan years and globalization.

HIST 3693 (H) The Modern West. Social, political, economic changes that define the twentieth-century American West.

HIST 3753 (H) Trans-Mississippi West. Emergence of the modern West from Spanish and French settlement and exploration, the Rocky Mountain fur trade, the settlement of Texas, Oregon, California, and Utah, the mining, ranching and farming frontiers, the Indian Wars and transportation.

HIST 3763 (D,H) American Southwest. Southwestern states of Texas, Arizona, New Mexico and California from the Spanish colonial period to the present. Mining, ranching, farming frontiers, Indian wars of the Apache, Comanche and other southwestern tribes, and the emergence of the modern Southwest.

HIST 3773 (S) Old South. Social, political and industrial conditions in the South before the Civil War.

HIST 3793 (D,H) Indians in America. American Indian from Columbus to the present, emphasizing tribal reaction to European and United States cultural contract and government policy.

HIST 3913 (H) History of Medicine. Historical growth of medicine and its relationship to the society in which it develops. Scientific problems, cultural, religious and medicine.

HIST 3953 Religion in Modern Europe. Religions thought and experience as influences on the politics, economy, and general culture of European nations from the 17th century to the present.

HIST 3963 (H) Ideas and Ideologies in Modern Europe. Prerequisite(s): 1623. Intellectual and ideological developments in modern Europe, including political, social, and cultural foundations and impact on modern Europe.

HIST 3980 Studies in History. 1-3 credits, max 9. Presented for general audiences. *Not intended for history majors.*

HIST 4063 Historic Preservation. Focuses on the United States and examines the history and theory of the preservation movement, the legal basis for preservation of the built environment and the methodology of preservation. *No credit for students with credit in 5063.*

HIST 4153 (D,H) African American History, 1619-1865. Overview of the history of African Americans from the onset of slavery and the slave trade to the Civil War. Topics include: African background; interaction between Africans, Indians and Europeans; development of slavery; forms of resistance; rise of the abolitionist movement; and conditions of free blacks.

HIST 4163 (D,H) African American History, 1865-1954. Major issues and actions from the beginning of the Civil War to the 1954 Supreme Court decision. Focus on political and social history: transition from slavery to emancipation and Reconstruction; the Age of Booker T. Washington; urban migrations, rise of the ghettoes; the ideologies and movements from integration to black nationalism.

HIST 4173 (D,H) Black Intellectual History. Examines the nature of black social and political thought from the early 18th to the mid-20th century and the contributions made by black intellectuals to discussions of race, citizenship and nationality. Emphasis is placed on topics of abolitionism, labor movements, populism, socialism, pan-Africanism, feminism, and the civil rights movement.

HIST 4253 (H) U.S. Foreign Relations to 1945. Overview of the history of U.S. foreign relations from the colonial era through World War II.

HIST 4273 (H) U.S. Foreign Relations Since 1945. Overview of the history of U.S. foreign relations from World War II to the present.

HIST 4353 (H) American Military History. Civil-military relations, the military implications of American foreign policy, and the impact of technological advances on warfare since colonial times.

HIST 4453 (H) History and Film. Examines the ways in which historical events are made available to viewers through the medium of the cinema. The primary focus involves examining the relationship between historical events and the ways in which those events are depicted, commemorated, memorialized, remembered and misremembered in film.

HIST 4463 (H) American Cultural History to 1865. American society in nonpolitical aspects: sections, classes, national culture and social structure, immigration, education, religion, reform, world influences; ends with Civil War.

HIST 4483 (H) American Cultural History Since 1865. Continuation of 4463; may be taken independently. Emphasis on nonpolitical aspects of American society and thought and on world influences.

HIST 4493 (D,H) Frontier in American Memory. Examination of the ways in which several American frontiers have been remembered, especially in popular culture. These frontiers include those informed by imagery related to Euro-American pioneers, women, people of color, and the tribal peoples of the American West.

HIST 4503 (H) American Urban History. Impact of urbanization upon American communities from 1865 to the present. Evolving political and social institutions, social change, technological innovations and planning theories.

HIST 4513 (S) American Economic History. Economic development and economic forces in American history; emphasis upon industrialization and its impact upon our economic society since the Civil War. (Same course as ECON 3823)

HIST 4523 (H) American Environmental History. Examination of the changing ways society (from Native American to post-industrial) has defined, interpreted, valued, and used nature.

HIST 4543 (H,I) Vietnam War. Origins of the Vietnamese struggle against colonialism, international policy, making of military strategy and diplomacy, anti-war movement, impact on the war on soldiers and civilians, reflections of the war in popular memory and culture.

HIST 4553 (D) Gender in America. Cultural, societal and political reflections of American men and women from the colonial era to the present. Examination of the women's movements and their opponents. Exploration of changing notions of masculinity and femininity. (Same course as AMST 4553)

HIST 4563 (H,I) Cold War. International perspectives on the origins, conflicts and ideologies of the Cold War, the nuclear arms race, impact on daily life, cultural reflections, the collapse of communism, victors and losers in the post Cold War world.

HIST 4573 (H) Women in Western Civilization. Women in the development of Western Civilization from the earliest times to the present.

HIST 4583 History of Technology. The development of technology in western civilization. The relationship between science and technology and the effect of technology on society.

HIST 4593 (H) America in International Perspective. Prerequisite(s): 1103 or lower-division survey course in U.S. History, any period. A transnational interpretation of American history from the colonial era to the present day. Uses a variety of interdisciplinary sources to place the history of the United States within a comparative, global framework. (Same course as AMST 4593)

HIST 4903 Senior Seminar. Prerequisite(s): History major or consent of instructor. An introduction to historical research for senior history majors. Students will be required to select, research, and write a seminar paper based on primary documents and use standard footnoting and bibliographical methods.

HIST 4980* Topics in History. 1-3 credits, max 9. For students interested in pursuing either a research or a reading project. Open to honors students in history and to others by permission of the department head.

HIST 4990 Undergraduate Internship. 1-6 credits, max 6. Prerequisite(s): Consent of instructor. History related internship experience designed to introduce majors to career possibilities.

HIST 4993 Senior Honors Thesis. Prerequisite(s): Departmental invitation, senior standing, Honors Program participation. A guided reading and research program ending with an honors thesis under the direction of a faculty member, with second faculty reader and oral examination. Required for graduation with departmental honors in history.

HIST 5000* Thesis. 1-6 credits, max 6.

HIST 5021* Teaching History at the College Level. Survey of objectives and methods in the teaching of history at the college level.

HIST 5023* Historical Methods. Methods of historical research and the writing of history.

HIST 5030* Public History Internship. 3-6 credits, max 6. Prerequisite(s): Consent of graduate committee. Supervised practical experience in applied history.

HIST 5033* Introduction to Public History. Prerequisite(s): Graduate student standing. Introduction to theory and practice of public history. Includes public history careers, public history as a field in the discipline, and the public perception and use of the past.

HIST 5053* Museum Studies. Prerequisite(s): Graduate student standing. Introduction to museum theory and practice, especially as it pertains to history museums and sites.

HIST 5063* Historic Preservation. Prerequisite(s): Graduate student standing. Focuses on the United States and examines the history and theory of the preservation movement, the legal basis for preservation of the built environment, and the methodology of preservation. *No credit for students with credit in 4063.*

HIST 5120* Reading Seminar in American History. 3 credits, max 15. Historiographical and bibliographical study of special areas of American history.

HIST 5140* Reading Seminar in European and World History. 3 credits, max 15. Historiographical and bibliographical study of special areas of European and World history.

HIST 5220* Research Seminar in American History. 3 credits, max 15. Research in selected problems in American history.

HIST 5240* Research Seminar in European and World History. 3 credits, max 15. Research in selected problems in European and World history.

HIST 6000* Doctoral Dissertation. 1-19 credits, max 30. Prerequisite(s): Admission to candidacy. Advanced research in history.

HIST 6023* Historiography. Major writers of history, historical schools and patterns of developments in historical interpretation from the earliest times to present.

HIST 6100* Directed Readings in History. 1-3 credits, max 36. Prerequisite(s): Graduate student standing. Readings in selected topics in history to develop factual knowledge, analytical skills, and interpretive understanding.

HIST 6120* Creative Component. 1-3 credits, max 36. Research in designated topic in History resulting in the preparation of a major paper demonstrating historiographical and bibliographical command of subject. Required for students in Plan III of MA program.

HIST 6130* Graduate Studies in History. 3 credits, max 39. Prerequisite(s): Graduate student standing. Graduate-level work under taken in association with upper-division lecture courses. Added component ordinarily entails a graduate-level research paper or historiographical essay of substantial length.

Honors College (HONR)

HONR 1000 Introductory Honors Topics. 1-3 credits, max 6. Prerequisite(s): Honors Program participation. Introduction to topics in various disciplines by faculty from the undergraduate colleges for freshman and sophomore students in the University Honors Program.

HONR 1013 (H) The Ancient World. Prerequisite(s): Honors Program participation. Interdisciplinary study of art, history, philosophy and literature from ancient Greece and Rome as well as the religious ideas central to Judaism and Christianity. Team-taught by faculty from appropriate disciplines in a lecture and discussion format. For the Honors student. *No degree credit for students with prior credit in HONR 2113.*

HONR 1023 (H) The Middle Ages and Renaissance. Prerequisite(s): Honors Program participation. Interdisciplinary study of art, history, philosophy and literature from the Middle Ages to the early Renaissance. Team-taught by faculty from appropriate disciplines in a lecture and discussion format. For the Honors student. *No degree credit for students with prior credit in HONR 2113.*

HONR 1033 (H) The Early Modern World. Prerequisite(s): Honors Program participation. Interdisciplinary study of art, history, philosophy and literature from the late Renaissance to the mid-19th century. Team-taught by faculty from appropriate disciplines in a lecture and discussion format. For the Honors student. *No degree credit for students with prior credit in HONR 2223.*

HONR 1043 (H) Romanticism to Postmodernism: 19th and 20th Centuries. Prerequisite(s): Honors Program participation. Interdisciplinary study of art, history, philosophy and literature from the 19th century to the present. Team-taught by faculty from appropriate disciplines in a lecture and discussion format. For the Honors student. *No degree credit for students with prior credit in HONR 2223.*

HONR 1093 (A) Patterns and Symmetry in Mathematics. Prerequisite(s): Honors Program participation. Tesselations, or repetitive patterns in the plane and in space, and the symmetries, or rigid motions, that preserve them. Illustrations from art, architecture, science, and nature. For the Honors student.

HONR 2013 (S) Honors Law and Legal Institutions. Prerequisite(s): Honors Program participation. An introduction to law in American society with reference to its European origins; its political, economic, psychological, and sociological dimensions; and the substantive law in selected areas. Introduction to legal reasoning and legal research techniques. For the Honors student.

HONR 2023 (D,S) Constitutional Dimensions of Diversity. Prerequisite(s): Honors College participation. An introduction to American constitutional law as it relates to diversity issues through the study of landmark Supreme Court decisions affecting the rights of various minorities. Introduction to legal research techniques.

HONR 2063 (H) Ethical Issues Across Cultural Perspectives. Prerequisite(s): Honors Program participation. An introduction to reasoned methods of evaluating ideas and arguments as they pertain to ethical issues from a global perspective. Concepts including obligation, justice, and ethnicity from Lao Tzu, Maimonides, Kant, and Indian wisdom stories. Environmentalism, technology, and cultural knowledge. Team-taught by faculty from appropriate disciplines in a lecture and discussion format. For the Honors student.

HONR 2514 Honors Scientific Inquiry. Lab 2. Prerequisite(s): Honors Program participation. A team-taught interdisciplinary course dealing with philosophy of science and the application of the scientific method in the natural and social sciences. Selected topics that involve interdisciplinary scientific inquiry. For the Honors student.

HONR 3000 Advanced Honors Topics. 1-3 credits, max 6. Prerequisite(s): Honors Program participation, junior standing. Topical study in various disciplines taught by faculty from the undergraduate colleges for junior and senior students in the University Honors Program.

HONR 3013 (H,I) Holocaust Studies Seminar. Prerequisite(s): Junior standing, Honors Program participation. An interdisciplinary study of one of the problematic events of human history—the Holocaust. Addresses questions of good and evil, divinity and humanity, and truth and responsibility that arise from this event. For the Honors student.

HONR 3023 (H,I) Contemporary Cultures of the Western World. Prerequisite(s): Honors College participation. Interdisciplinary examination of selected cultures of Europe and the western hemisphere. Emphasis will be on identification of main characteristics of "Western" culture and their manifestations in a variety of modern societies on both sides of the Atlantic Ocean. Key values, institutions, and practices will be examined to illustrate the twin themes of commonalities and cultural diversity. The course is team taught by faculty from appropriate disciplines in a lecture and discussion format.

HONR 3033 (I,S) Contemporary Cultures of the Non-Western World. Prerequisite(s): Honors College participation. Interdisciplinary study of contemporary cultures of non-western world including lifestyle, housing and food. Team-taught by faculty from appropriate disciplines in a lecture and discussion format.

HONR 3043 (D,S) Contemporary Cultures of the United States. Prerequisite(s): Honors Program participation. Interdisciplinary study of racial and ethnic diversity in the United States in context of social, political, and economic systems to promote knowledge of racial and ethnic minority groups in the United States and appreciation of their contributions to the mosaic of contemporary American life. Team-taught by faculty from appropriate disciplines in a lecture and discussion format.

HONR 3053 (D,H) Biology, Race, and Gender. Prerequisite(s): Honors College participation. Critical interdisciplinary investigation of relationships between biological theory (especially Darwinism) and social and ethical issues. Attention to views of alleged biological aspects of perceived racial and gender differences and attempts to implement these views socially, legally, and medically in the United States and elsewhere.

HONR 4993* Honors Creative Component. Prerequisite(s): Honors Program participation, senior standing. A guided creative component for students completing the requirements for college or departmental honors awards leading to an honors thesis, project or report under the direction of a faculty member from one of the undergraduate colleges, with a second faculty reader and oral examination.

Horticulture (HORT)

HORT 1003 Home Horticulture. Offered by correspondence only. An introduction to horticultural practices for the home gardener. Planning and care of home grounds, home orchards and vegetable gardens; selection, use and care of indoor plants. *Non-majors only. Credit will not substitute for required courses.*

HORT 1013 (L,N) Principles of Horticultural Science. Lab 2. Basic physical and physiological processes responsible for plant dormancy, growth, flowering, fruiting, and senescence with respect to the science and art of production, cultivation, utilization, and/or storage of horticultural plants. Current research associated with various horticultural commodity groups.

HORT 2010 Internship in Horticulture or Landscape Management. 1-6 credits, max 6. Prerequisite(s): 24 credit hours and consent of adviser. Supervised work experience with approved public and private employers in horticulture, landscape management, or related fields. Credit will not substitute for required courses. *Graded on a pass-fail basis.*

HORT 2123 (N) Environmental Issues in Horticultural Science. Impact of urban and suburban development on the environment and a study of horticultural solutions to limit or reverse environmental damage. Emphasis on horticultural design, construction, and maintenance techniques as they relate to the conservation of water, soil, native species, and ecosystems.

HORT 2513 Herbaceous Plant Materials. Lab 2. Identification, cultural requirements, and use of ornamental garden and indoor herbaceous plants.

HORT 2613 Woody Plant Materials. Lab 2. Identification, cultural requirements, and use of ornamental woody plants including deciduous and evergreen trees, shrubs and vines.

HORT 2652 Basic Floral Design. Lab 2. Fundamentals of floral arrangement and design for the home and the retail shop; basic skills useful to flower shop employment and operation.

HORT 3013 Arboriculture. Lab 2. Prerequisite(s): 2613 or NREM 2134 and SOIL 2124. Theory and practice of selecting, planting and maintaining trees, shrubs and vines in the landscape.

HORT 3084 Plant Propagation. Lab 2. Prerequisite(s): 1013 or PLNT 1213, BIOL 1404 and SOIL 2124. Principles and practices involved in propagation of plants. Anatomical, morphological and physiological aspects of sexual and asexual methods of regeneration and their importance.

HORT 3113 Greenhouse Management. Lab 3. Prerequisite(s): 1013, BIOL 1404, MATH 1483 or 1513 or above. Commercial greenhouse operation with emphasis on floricultural plant production aspects; environment, growing media,

fertilizers and application methods, watering, pest and disease control, chemical growth regulators, production costs.

HORT 3153 Turf Management. Prerequisite(s): 1013, SOIL 2124 and 2 hours plant science. Selection, establishment and maintenance of grass species and other plant materials for special use areas.

HORT 3213 Fruit and Nut Production. Prerequisite(s): BIOL 1403. Commercial production of fruits and nuts, with emphasis on pecan, apple, peach, strawberry, blackberry and blueberry. A two-day field trip is required.

HORT 3253 Personnel and Financial Management for Horticulture. Prerequisite(s): 1013 or LA 1013 and one upper division HORT or LA course. Preparing and executing an operational budget in a horticultural service industry and methods for maintaining an effective work force.

HORT 3433* Commercial Vegetable Production. Prerequisite(s): 1013, SOIL 2124 and BIOL 1404. Commercial production and marketing of vegetable crops.

HORT 3513 Landscape Irrigation. Lab 2. Prerequisite(s): 1013 or LA 1013. Basics of landscape irrigation with an emphasis on residential irrigation design, maintenance and installation.

HORT 3612 Bidding and Estimating. Prerequisite(s): 1013 or LA 1013 or NREM 1114 or PLNT 1213. Bid preparation and job cost estimation for landscape related projects including quantity take-offs, plant material and hardscape estimates, budgeting and pricing.

HORT 3713 Urban Horticulture Production. Prerequisite(s): 1013. Principles and production of crops for public or community practices with emphasis on production associated with hydroponics, raised beds, containers, controlled environments, roof tops, high tunnels, and farmers markets.

HORT 4053 (I) International Experience in Horticulture. Participation in international travel to develop an understanding of different horticultural systems and technologies used outside the U.S.

HORT 4313* Commercial Flower Production and Marketing. Lab 3. Prerequisite(s): 3113. Commercial production of cut flower, pot plant and bedding plant crops. Application of plant physiological principles to crop culture, crop production costs and marketing.

HORT 4453* Turfgrass Physiology and Ecology. Prerequisite(s): 3153, BOT 1404. A study of the relationship between turf physiology and modern turf management practices. Concepts of stand ecology with emphasis on species dominance in stressful environments.

HORT 4543* Sustainable Nursery Production. Lab 2. Prerequisite(s): 2613 and SOIL 2124. Sustainable commercial production of field- and container-grown woody ornamental crops.

HORT 4713* Public Garden Management. Lab 4. Prerequisite(s): 1013. Issues and methods in public garden management, including database management of collections, conservation of native species, grant writing, volunteer coordination, computerized mapping systems, master planning, and other topics pertaining to a career in public horticulture. *Field trips required.*

HORT 4773 Applied Landscape Planning. Lab 3. Prerequisite(s): 2313 or 2413. Concepts of landscape contracting, design and planning. Preparation of plans, and cost estimates with an emphasis on residential landscapes and use of plant materials. *No credit for students in the landscape architecture or landscape contracting programs.*

HORT 4901* Horticulture in Controlled Environments Laboratory. Lab 2. Prerequisite(s): 4903 or concurrent enrollment. Hands-on experiences and virtual field trips designed to reinforce principles discussed in HORT 4903, and to develop skill sets important to successful implementation of horticultural practices in controlled environments. *Offered through web-based instruction.*

HORT 4903* Horticulture in Controlled Environments. Prerequisite(s): CHEM 1215 and HORT 3113. Designing, constructing, monitoring, and manipulating controlled environments for efficient horticultural production. *Offered through web-based instruction.*

HORT 4933 Principles of Sustainable and Organic Horticulture. Prerequisite(s): 1013. Principles and practices of sustainable, organic, and alternative horticultural management systems. *Offered through web-based instruction.*

HORT 4943* International Horticulture. Prerequisite(s): 1013. Overview of the horticulture industry worldwide. Export, marketing, and international trade issues in a global horticulture context. Individual country analyses of specific fruit, vegetable and ornamental crops. *Offered through web-based instruction.*

HORT 4953* Plant Growth and Development. Prerequisite(s): 1013 and BOT 1404. Plant embryogenesis and organogenesis; growth and development of shoots and reproductive structures; plant developmental processes including shoot expansion and dormancy as influenced by temperature, light, and other environmental factors. *Offered through web-based instruction.*

HORT 4963* Horticulture Physiology. Prerequisite(s): CHEM 1215 and BIOL 1114. Physiology of horticultural plants, including water relations, respiration, photosynthesis, and growth and development. *Offered through web-based instruction.*

HORT 4973* Sustainable Landscape Management. Prerequisite(s): 1013 or LA 1013. The ecological principles and landscape resources supporting decision-making for sustainable landscape management. Retrofits of existing development for enhanced sustainability, including equipment selection, stormwater management, use of successional landscapes, permaculture, and organic methods. *Offered through web-based instruction.*

HORT 4990* Horticultural Problems. 1-6 credits, max 6. Prerequisite(s): Consent of instructor. Problems related to pomology, olericulture, nursery production, landscape design, or the culture, sales and arrangement of flowers.

HORT 5000* Master's Research and Thesis. 1-6 credits, max 6. Research on thesis problems required of master's degree candidates.

HORT 5020* Graduate Seminar. 1-2 credits. Prerequisite(s): Graduate standing. Proposal and results seminars for graduate programs.

HORT 5110* Advanced Horticultural Problems. 1-12 credits, max 20. Selected research problems in horticulture, floriculture, landscape design; nursery production, olericulture and pomology.

HORT 5133* Temperature Stress Physiology. Prerequisite(s): BIOC 3653, BOT 3463 or consent of instructor. Effects of heat, chilling and freezing stress on plants. Responses to temperature extremes at the molecular to whole plant levels with emphasis on mechanisms of injury and resistance.

HORT 5233* Experimental Horticulture. Methods of conducting research with horticultural crops, including organization and plans, field plot techniques and analysis of data.

HORT 5422* Flowering and Fruiting in Horticultural Crops. Prerequisite(s): BOT 3463. Environmental, chemical and cultural factors affecting the flowering and fruiting of horticultural crops.

HORT 5433* Postharvest Physiology. Prerequisite(s): BOT 3463 and 3460. Physiological causes for post-harvest changes in horticultural crops (ripening and senescence) and the basis for certain postharvest treatments (precooling at harvest, controlled atmosphere storage, refrigeration, and packaging techniques). Commodity-specific postharvest phenomena.

HORT 5443* Basic Laboratory Experimentation. Lab 3. Principles and theory of safe laboratory practice and experimentation. Techniques for developing and optimizing plant sample acquisition, extraction and analysis protocols. Theory of operation and maintenance of common laboratory instrumentation (pH measurement, solid and liquid analytical measurement, temperature measurement, spectrophotometry, HPLC, GC). Laboratory provides hands-on experience for integrated protocol development and instrument use.

HORT 6000* Doctoral Research and Dissertation. 1-12 credits, max 20 for crop science; max 24 for environmental science; max 30 for plant science. Research on dissertation problems required of PhD candidates in multidisciplinary programs.

Hotel and Restaurant Administration (HRAD)

HRAD 1102 Introduction to Hotels, Restaurants, and Tourism in a Global Environment. Study of hotels, restaurants, tourism and the hospitality industry from a global perspective. Emphasizes development and history, ethical issues, and professional opportunities.

HRAD 1114 Introduction to Professional Food Preparation. Lab 3. Prerequisite(s): Restricted to HRAD, NSCI and HDFS (Family and Consumer Sciences Education option) majors. Theory and technique of food preparation using a science-based approach. Includes mis en place, recipe analysis, use and selection of equipment, quality controls, and plate presentation.

HRAD 2021 Food Safety and Sanitation. Prerequisite(s): Restricted to HRAD, NSCI, and HDFS (Family and Consumer Sciences Education option) majors. Principles and theory of food safety and sanitation focused on prevention of food borne illnesses, and ensuring public health and consumer safety.

HRAD 2152 Introduction to Hospitality Accounting. Accounting principles, procedures and transactions used for the compilation of financial reports in hospitality businesses. Theory related to assets, liabilities, owners' equity, revenues and expenses and current hospitality accounting practices.

HRAD 2243 The Business of Tourism. All aspects of the tourism business including segments of global tourism, business practices, economic impact, management as well as marketing strategies and processes.

HRAD 2283 Hospitality Industry Financial Analysis. Prerequisite(s): 2152. Study of managerial accounting concepts and applications specific to the hospitality industry with an emphasis in analysis of financial reports, ratio analysis, CVP analysis, and operations budgeting.

HRAD 2533 Hospitality Information Technology. Lab 2. Prerequisite(s): Restricted to HRAD majors. Overview and practical experience in computer systems utilized in the hospitality industry including POS and PMS, databases, file structure, and productivity software. An analysis of the interaction between technology and hospitality organizational operations.

HRAD 2643 Lodging Operations. Lab 2. Prerequisite(s): 2533, restricted to HRAD majors. The organization and administration of lodging operations including front desk operations, housekeeping, laundry, sales/marketing, management and other positions common to lodging operations. Includes a laboratory experience in The Atherton Hotel at OSU.

HRAD 2665 Food Production Management. Lab 5. Prerequisite(s): 1114 and 2021 and 2533 and ServSafe Food Production Managers Certification. Planning

and preparation of various foods in food service settings with an emphasis on production systems, food safety and sanitation, quality management, and customer satisfaction.

HRAD 2771 Hospitality and Tourism Industry Speakers Series. Seminars presented by distinguished hospitality or tourism industry professionals. Current issues and implications for the future of the hospitality and tourism industries.

HRAD 2900 Hospitality and Tourism Undergraduate Research. An introduction to research in hospitality and tourism including a guided research project under the direction of a faculty member.

HRAD 3120 Special Events Management. 1-3 credits, max 12. Prerequisite(s): Restricted to HRAD majors, consent of instructor. Study of special event planning, implementation and evaluation. The interaction between the staff, customer, guests, contractors, and others necessary to implement a successful special event. Additional focus on catering through hotels, restaurants or private companies.

HRAD 3193 Hospitality Training Program Development. Prerequisite(s): 30 credit hours completed. Study of the design, delivery and evaluation of training programs for hospitality and tourism organizations. Needs assessment, performance objectives, instructional design, and a variety of presentation methods. Organizational and individual development.

HRAD 3213 Hospitality and Tourism Management and Organizations. Prerequisite(s): 30 credit hours completed. Function and methods of management as related to the hospitality and tourism industries. Management principles, decision-making, organizations, interpersonal relationships, and production systems.

HRAD 3223 (I) International Travel and Tourism. The study of international travel and tourism for business and pleasure. The management of travel and tourism concepts in the hospitality industry and related businesses around the world. International travel industry financial management, technology, economic planning and policy formulation.

HRAD 3330 Pre-Professional Experience. 1-3 credits, max 6. Prerequisite(s): Consent of instructor. Supervised experience in an organization related to a future career in the hospitality industry. Human resource, customer service, management, or supervisory experience in multiple aspects of the unit.

HRAD 3344 Fine Dining and Theme Restaurant Management. Lab 4.5. Prerequisite(s): 3213 and 3575. Management applications to theme and fine dining restaurants; lab practice in Ranchers Club teaching restaurant.

HRAD 3403 Lodging Services Management. The organization and management of guest services in lodging properties. Examination of the principles of concierge, bell staff, retail outlets and business services.

HRAD 3411 Hospitality and Tourism Pre-Internship Seminar. Prerequisite(s): HS 1112 or 3112 (or concurrent). Preparation in written communication, resumes, interviews, securing an internship, professional behavior and ethics in the hospitality and tourism industries.

HRAD 3443 Hospitality and Tourism Industry Internship. Prerequisite(s): 2643, 2665, 3411 and 480 hours of documented hospitality or tourism work experience. Supervised experience in an approved work situation related to a future career in the hospitality or tourism industry. Management and supervisory experience in multiple aspects of a hospitality or tourism organization.

HRAD 3473 Mechanical Equipment and Facility Management. Prerequisite(s): 30 credit hours completed. Fundamentals of building mechanical systems, maintenance and facilities management. The theory and interaction of illumination electric wiring, plumbing, heating, ventilation, air conditioning systems. Principles of facility management in the hospitality industry related to coordination of the physical space with guest services.

HRAD 3543 Lodging Property Management. Prerequisite(s): 2643. The organization, duties, and administration of hotel support departments. The various jobs in lodging housekeeping, engineering, security, and convention and meeting services. Facilities management, purchasing, and furnishing, fixtures and equipment concepts.

HRAD 3573 Franchising and Quick Service Restaurant Management. Study of the history and transformation of hospitality industry chains. The organization of chains, fundamentals of franchising, sales and growth, evaluation of franchise financial performance, and unit ownership characteristics. Quick service restaurant organization, guest services, cost controls, sanitation, personnel management, purchasing, marketing, and time management.

HRAD 3575 Service Management in Hospitality Operations. Lab 4. Prerequisite(s): 2665. Development of service management skills for the hospitality industry, including leadership behavior, motivation; communication training, staffing and professionalism with an emphasis on food service.

HRAD 3623 Purchasing and Cost Control for Hospitality and Foodservice. Lab 2. Prerequisite(s): 2283. Theory, processes and complexities of procurement and cost controls for products and services utilized in hospitality industries. Emphasis on management of the purchasing process, cost control systems, and technology applications.

HRAD 3643 (S,D) Geotourism. A unique tourism destination will be examined and evaluated in depth related to the authenticity of its environment, culture, aesthetics, and heritage emphasized through specific geotourism practices.

HRAD 3663 Hotel Food and Beverage Operations. Prerequisite(s): 30 credit hours completed. Examination of the products, production techniques, presentation, and service styles of hotel food and beverage operations. Planning, producing and marketing hotel food and beverage services.

HRAD 3721 Overview of Beverages in the Hospitality Industry. Prerequisite(s): Proof of minimum age 21. Overview of the international dimensions, history, classifications, production techniques, distribution, and quality factors of beverages such as wines, distilled spirits, beers, and non-alcoholic beverages used in the hospitality industry. Responsible alcohol beverage service and management techniques.

HRAD 3783 Hospitality Industry Human Resources Management. Prerequisite(s): 30 credit hours completed. Theories and practices used for personnel management in the hospitality and services industries. The organization of a human resources department, hiring, discipline, compensation, job analysis and performance evaluation.

HRAD 4090* International Hospitality Studies. 1-18 credits, max 18. Prerequisite(s): 45 credit hours completed. Participation in a hospitality educational experience outside of the U.S. The international aspects of the hospitality industry especially in the country or countries included in the experience. Development of an understanding of local, regional and national customs and cultures through experiential learning.

HRAD 4103* Hospitality Law and Ethics. Prerequisite(s): 30 credit hours completed. Examination of the laws regulating the hospitality industry. The interrelationships between law, the hospitality industry, and the public. Exploration of ethics, how legal principles apply in a global environment, and fundamental principles of tort and contract law.

HRAD 4120* Advanced Special Events Management. 1-3 credits, max 6. Prerequisite(s): Consent of instructor and restricted to HRAD majors. Hands on study of special events, forums and conferences. Planning activities include conception, planning, implementation, and evaluation of an event, forum or conference including marketing, public relations and volunteer coordination.

HRAD 4163* Hospitality and Tourism Marketing. Prerequisite(s): 30 credit hours completed. Strategies for marketing and decision-making in the hospitality and tourism industries. Customer identification, consumer behavior, competition, and product, promotion, placement and pricing strategy.

HRAD 4213* Hospitality Sales and Catering. Fundamentals of sales and catering including the sales department, publicity and advertisement, policies, and techniques used to sell the organization in all aspects of the hospitality industry. Includes planning for versatility, customer responsiveness, cost, timing, and follow up for events.

HRAD 4263 Beverage Management and Controls. Prerequisite(s): 3575 and 3623. Foundation in beverage service, operations and management. Strategies to manage beverage and bar operations, control systems and profitability, product selection and marketing, facility requirements and responsible alcohol service.

HRAD 4293* Hospitality Small Business Development. Prerequisite(s): 3543, 3575, 3623 and 4163. The theories and procedures necessary to develop a small business in the hospitality industry. Financial analysis, feasibility study, pro-forma creation, building and site construction and brand selection.

HRAD 4333* Hospitality and Tourism Financing. Prerequisite(s): 2283. The theory and practice of operational and strategic financial policy and problems in the hospitality industry. Financial information systems, fund allocation, asset management, financial structure and analysis of the financial environment.

HRAD 4343 Fine Dining and Theme Restaurant Professional Practicum. Prerequisite(s): 3344 and application process successfully completed. Restaurant production or service professional applying management theory to in-depth practice.

HRAD 4413* Hospitality Information Systems. Prerequisite(s): 2533, 2643 and 2665. Conceptional analysis of hospitality technology systems such as food and beverage service, housekeeping, sales, property management, personnel, accounting, front office, and inter- and intra-departmental functions. The ethical implications of technology.

HRAD 4443* Advanced Hospitality and Tourism Industry Internship. Prerequisite(s): 3443, 75 credit hours completed, consent of instructor. Management experience in multiple aspects of a hospitality or tourism organization. Exploration of human resources, development of an understanding of organizational behavior, conflict resolution, negotiating and communication techniques. Application of critical thinking skills to solve problems. The interaction between the customer and the products and services provided by the organization.

HRAD 4453* Revenue Management in Hospitality Operations. Prerequisite(s): 3623 or concurrent enrollment and 3543. Focus on revenue management in hospitality organizations with specific emphasis on pricing and strategies, forecasting sales and trend analysis.

HRAD 4523* Integrated Capstone Seminar. Prerequisite(s): 3543 and 3575 and 3623 and 4163 or concurrent enroll and 90 credit hours completed. Integration of previous classroom, laboratory, and practical experiences through development of a comprehensive project. Additional focus on application of critical thinking, demonstration of leadership principles, interaction with industry professionals and development of an awareness of societal and ethical issues

and their application to the hospitality and tourism industries.

HRAD 4561* Hospitality Management Seminar. The issues having an impact on the hospitality industry. Exploration of the issues utilizing various strategies and a multi-disciplinary approach. Discussion and interpretation of multiple perspectives with an emphasis on critical thinking, strategic decision making, and the formulation of innovative solutions and processes to enhance the workplace.

HRAD 4563 Gastronomy. Prerequisite(s): 2665 or consent of instructor. An introduction and evolution of the ideas, philosophies and attitudes toward food production and the role of the chef, restaurateur and hospitality professional.

HRAD 4573* Non-Commercial, Institutional and Contract Services in the Hospitality Industry. The organization and administration of non-commercial food and hospitality services. Business and industry, athletic venues, colleges and universities, prisons, schools, government services, hospitals, healthcare, assisted living, and other similar facilities. Additional emphasis on self operation and services provided by contract management companies. The principles associated with development of a request for proposals, analysis of proposals, services evaluation, contract liaison activities and communication.

HRAD 4610 Hospitality Leadership Symposium. 1-3 credits, max 9. Case study based course focusing on leadership and innovation in the hospitality industry. Course taught in an interactive seminar format.

HRAD 4643* Applied Human Resources in Hospitality. Prerequisite(s): 3783 and concurrent enrollment in 3443 or permission of instructor. Directed learning for effective and legal employee management within hospitality industry operations utilizing strategies for recruiting, minimizing turnover and maximizing productivity and diversity. Also incorporates a Certificate in Human Resource Management and Supervision.

HRAD 4723 Beverage Education. Prerequisite(s): Proof of minimum age 21. Emphasis on the international dimensions of the history, classifications, production techniques, distribution, and quality factors of beverages such as wines, distilled spirits, beers, and non-alcoholic beverages. Emphasis on responsible alcohol beverage service and management techniques.

HRAD 4783* Critical Issues in the Hospitality and Tourism Industry. Breadth of vision and broad perspective of contemporary issues in the management of hospitality and tourism industry organizations. Awareness of societal, economic, cultural, and international issues and their impact on hospitality and tourism organizations.

HRAD 4833* Casino and Gaming Management. Prerequisite(s): 2152 and 2283. Focus on the management of casino and gaming operations including the history and trends of gaming, current issues, cultural influences and social consequences of casino, lottery and pari-mutual segments. Also theory and practice in the analysis of gaming operations in the areas of casino management, marketing, accounting/controls, security, human resources and law.

HRAD 4850* Special Unit Course in Hotel and Restaurant Administration. 1-15 credits, max 15. Prerequisite(s): Consent of instructor. Special unit of study related to specific problems in the hospitality industry.

HRAD 4900 Honors Creative Component. 1-3 credits, max 3. Prerequisite(s): College of Human Sciences Honors Program participation, senior standing. Guided creative component for students completing requirements for College Honors in the College of Human Sciences. Thesis, creative project or report under the direction of a faculty member in the major area, with second faculty reader and oral exam.

HRAD 4983* Conference and Meeting Planning. Prerequisite(s): 2643, 2665, and 2283 or consent of instructor. Planning and implementing conferences, teleconferences, conventions, special events, seminars and symposia. Designing, promoting, managing and evaluating educational events, and contract management.

HRAD 5000* Master's Thesis. 1-6 credits, max 6. Prerequisite(s): Graduate standing and consent of adviser. Individual research interests in hospitality administration fulfilling the requirements for the MS degree.

HRAD 5030* Master's Creative Component and Independent Study. 1-3 credits, max 3. Prerequisite(s): Graduate standing and consent of instructor. Individual research and study having relevance to the hospitality field and a positive impact on the hospitality industry.

HRAD 5111* Hospitality and Tourism Graduate Studies and Research. Prerequisite(s): Master's degree students only or consent of instructor. Systematic introduction to the competencies of graduate education and research in hospitality and tourism education and administration.

HRAD 5213* Hospitality and Tourism Management. In-depth study of hospitality and tourism management including theory, research, operations and practical experience. Emphasis on lodging operations systems, commercial food service systems, and tourism. Analysis and synthesis of a comprehensive management philosophy consistent with theory.

HRAD 5233* Convention and Special Event Management. Meeting and event design, working with industry suppliers, on-site management, post-event analysis, computers and technology, and meetings documentation.

HRAD 5243* Retailing and Franchising in the Hospitality Industry. Entrepreneurial perspective of growth and performance of commercial and noncommercial food service and health care organizations. Challenges relative to operations management, convenience stores, quick service operations, procurement, price analysis, communication, efficient customer response, capital and human resources, competition, governmental influence, and decision-making process.

HRAD 5253* Critical Issues in Gaming. Focuses on current issues, advanced research and the theoretical constructs of the gaming industry and includes exploration of current issues, cultural influences and social consequences of casino, lottery, racing and pari-mutual segments. Students will also gain theoretical knowledge and learn to apply research skills in the analysis of gaming operations in the areas of casino management, marketing, accounting/controls, security, human resources and law.

HRAD 5262* Seminar in Contemporary Hospitality Administration. Principles, theories, and methods of hospitality management applied to various types of hospitality organizations. Hospitality Administration topics of finance, human resources, marketing, technology, education and management. Supervised readings of current literature not included in regularly scheduled courses. Course taught in an interactive seminar format.

HRAD 5313* Hospitality and Tourism Information Technology. Conceptual analysis of the technology used in the hospitality industry. Investigation of technology applications, ethical implications of technology and system development practice.

HRAD 5323* Hospitality Accounting and Finance. Understanding the role of the accounting and financial function in hospitality firms. Learn how to read hospitality financial statements, to use analytic concepts as managerial tools to examine the profitability of hospitality firms and to make superior capital investment decisions, and to become familiar with major financial instruments and concepts.

HRAD 5333* Hospitality Business Analysis. Fundamental understanding of the logic and structure of business plan, and knowledge of concepts for analyzing hospitality businesses. Examination of the application of hospitality management concepts and principles within hospitality organizations, assessment of factors contributing to a company's business orientation.

HRAD 5413* Employee Development Issues in the Hospitality and Tourism Industries. Recent theories and research in human resource management, employee development, and labor issues affecting the hospitality and tourism industry in maintaining a productive workforce.

HRAD 5423* Hospitality Customer Development Strategies. Prerequisite(s): Undergraduate marketing course. The concepts and strategies of hospitality and tourism marketing and customer development.

HRAD 5513* Hospitality Corporate Strategy. Focus on strategic decisions in hospitality businesses, and with both the content of those decisions and the processes by which managers position the businesses and strategically allocate resources to maximize its economic value under conditions of uncertain, dynamic, and competitive environments.

HRAD 5613* Service Quality in Hospitality and Tourism Management. Study of contemporary management principles in the hospitality industry. Service improvement and customer satisfaction in the hospitality industry through the use of total quality management. How service industries such as hospitality can use business techniques such as continuous improvement, employee involvement, measurement and organizational change to improve unit operations.

HRAD 5813* Research Methods in Hospitality and Tourism Administration. Prerequisite(s): REMS 5953 or STAT 5013. Scientific methods and current research methodologies as applied to problems in hospitality and tourism administration. Proposal planning, research design, statistical use and interpretation, and research reporting.

HRAD 5850* Special Topics in the Hospitality Industry. 1-3 credits, max 9. Special topics related to the hospitality industry. A problem-solving technique to design the research model and investigative procedures. Presentations to faculty, students and industry professionals at specialized workshops with research, instructional and industry project components.

HRAD 5870* Problems in the Hospitality Industry. 1-3 credits, max 9. Special recurring problems in the hospitality industry. Broad perspective of these issues and their application to the industry. Critical thinking skills to solve operational dilemmas.

HRAD 5992* Hospitality and Tourism Research Seminar I. Prerequisite(s): 5813 and Master's degree students only or consent of instructor. Review and critique hospitality and tourism research articles. Address the problems encountered in communicating and presenting hospitality and tourism research papers.

HRAD 6000* Doctoral Dissertation. 1-12 credits, max 30. Prerequisite(s): Consent of major professor. Research in hospitality administration for the PhD degree.

HRAD 6111* Hospitality and Tourism Doctoral Studies and Research. Prerequisite(s): Doctoral degree students only or consent of instructor. Systematic introduction to the competencies of graduate education and research in hospitality and tourism education and administration for doctoral students.

HRAD 6113* Hospitality and Tourism Education. Prerequisite(s): Doctoral degree students only or consent of instructor. Theoretical and practical

components of hospitality and tourism education with emphasis on universities, community colleges and vocational schools.

HRAD 6213* Advanced Hospitality Purchasing. Development of supply chain management systems for hospitality businesses. Management of hospitality procurement operations.

HRAD 6313* Tourism Policy and Planning. Examination of current international and national tourism policies, planning and development perspectives and the economic impact.

HRAD 6413* Leadership in a Diverse Society. Comparing and critiquing leadership and diversity research, theories and practices society. Development of models for future professional practice that integrate leadership an diversity principles.

HRAD 6513* Hotel and Restaurant Planning and Development. Theories and practices related to the acquisition, development and investment in hospitality-oriented real estate. The undertaking of site analysis, feasibility studies and building construction. Acquisitions, financing alternatives and management contract options. Current trends in hotel investing.

HRAD 6613* Advanced Research Methodology in Hospitality and Tourism. Advanced research methodologies in hospitality and tourism. Essential concepts in contemporary research, examination of multivariate data analysis techniques in hospitality and tourism research. Development of individual research projects.

HRAD 6680* Seminar in Food Service Management. 1-3 credits, max 9. Examination of research, practice, and future trends in food service management issues from a strategic perspective.

HRAD 6713* Contemporary Hospitality and Tourism Theory. Prerequisite(s): Doctoral degree students only or consent of instructor. Advanced survey of both the classic and current body of knowledge in the area of hospitality and tourism management. Introduction to important works in the research area of hospitality and tourism management that will prepare students to assess fundamental research questions, opportunities, and limitations of the research.

HRAD 6780* Seminar in Lodging Management. 1-3 credits, max 9. Examination of lodging management issues from a strategic perspective. Latest developments in research, practice, and future trends in the lodging industry.

HRAD 6880* Seminar in Travel and Tourism Management. 1-3 credits, max 9. Study of the latest developments in travel and tourism research and management.

HRAD 6993* Advanced Hospitality and Tourism Research. Prerequisite(s): Graduate level basic and/or intermediate research methods and intermediate statistics and doctoral degree student or consent of instructor. The latest advances in hospitality and tourism research theory development, modeling and research design. Focus is on improving ability to effectively develop/build a conceptual framework/model with an appropriate research design and hypotheses.

Human Development and Family Science (HDFS)

HDFS 1101 Relationships 101. An applied course designed to actively involved students in the exploration of topics which influence the development of positive relationships. Topics include gender differences, relationship principles, family of origin and personal needs. Application to personal and professional settings.

HDFS 1112 Introduction to Human Development and Family Science. Exploration of the philosophy of human development and family science including topics related to academic achievement, risk and resilience, careers in HDFS, and specific fields of study within HDFS.

HDFS 2113 (S) Lifespan Human Development. Study of human development within diverse family systems. Taught from a life span perspective.

HDFS 2114 (S) Lifespan Human Development: Honors. Prerequisite(s): Honors students only. Honors course critically examining the study of human development within diverse family systems. Taught from a lifespan perspective.

HDFS 2123 (D) Developmental Disabilities: Issues Across the Lifespan. Prerequisite(s): 2113. The intersection of biological and environmental influences on patterns of atypical development across the lifespan. Assumes a basic knowledge of cultural diversity and research methods employed in human development. Directed observation of persons with developmental disabilities.

HDFS 2211 Early Childhood Field Experience I. Prerequisite(s): concurrent enrollment in 2233 and 2243; Full admission to Professional Education. Clinical experience working with children ages birth through 5, including observation of children in classroom contexts and design and teaching of creative activities with groups of students.

HDFS 2213 Human Sexuality and the Family. Sexual development emphasizing personal adjustment and interaction with family and culture.

HDFS 2223 Foundations in Early Childhood. Lab 3. Prerequisite(s): 1112 and 2113. Introduction to early childhood. Historical background of the profession and its future. Opportunities in early childhood as a professional. Developing an awareness of appropriate contexts for learning through realistic experiences in the early childhood classroom. Professional Education requirements introduced.

HDFS 2233 Development of Creative Expression, Play and Motor Skills in Early Childhood. Prerequisite(s): 2113 and Full admission to Professional Education or consent of instructor. Consideration of appropriate experiences in the areas of play, art, music and motor skills for young children from birth through eight years of age with an emphasis upon such experiences as a curricular base in early educational group settings. Observation and participation experiences with young children.

HDFS 2243 Infant-Toddler Programming. Prerequisite(s): 2113, and Full admission to Professional Education or consent of instructor. Program planning, implementation and evaluation of developmentally appropriate programs for infants and toddlers. Directed observation and participation in infant and toddler programs.

HDFS 2433 (S) Relationship Development and Marriage. Theory and research on the formation and development of interpersonal relationships from dating through courtship and marriage.

HDFS 2453 Management of Human Service Programs. Prerequisite(s): 1112 and 2113 and 2433 and 3443. Designing and managing human service programs: planning, needs assessment, program hypothesis, grant writing; developing human resources, budget management, monitoring and evaluation. Emphasis on accountability.

HDFS 2523 Professional Skills in Human Services. Prerequisite(s): 1112 and 2113. Development of professional skills for the human services. Intakes, interviewing, assessment, reporting, program marketing, case management, advocacy, facilitating change, community collaboration and using databases.

HDFS 2850 Special Unit Courses in HDFS. 1-6 credits, max 6. Various units taught by specialists in Human Development and Family Science.

HDFS 3021 Topics in Early Childhood Education. Current selected problems or topics in early childhood education which influence individual and family risk and resiliency, including NCLB, current legislative issues, policy issues and other topics that are of interest and importance to students enrolled during the semester.

HDFS 3023 Child Development - Birth to 3. Prerequisite(s): Admission to Great Plains IDEA Early Childhood Non-certification program and HDFS 2113. Major theories and research on development from birth to age 3 including growth patterns, influences of disabilities and risk factors, environmental factors and their effects on attachment styles, language acquisition, brain development, cognitive development, social-emotional development, and perceptual and sensory motor skills. Web-based instruction.

HDFS 3024 Literacy Assessment and Instruction in Early Childhood Education. Prerequisite(s): Concurrent enrollment in 2123, 4363, 4323, 4313 and full admission to Professional Education. Developmentally appropriate assessment and instructional practices to meet language and literacy needs of children, age birth to 8 years. Based on a constructivist framework, formal and informal assessments will be used to inform classroom practices. Assessments consistent with SBRR, NAEYC and IRA guidelines, with a focus on performance, observation, and interviews will address literacy needs of diverse learners in the context of an EC classroom practicum.

HDFS 3033 Child Development - 4 to 8. Prerequisite(s): Admission to Great Plains IDEA Early Childhood Non-certification program and HDFS 2113. Physical, cognitive, social/emotional and personality growth and development during early childhood. Major theories of development and current research and ideas in conjunction with historical approaches to examining growth and development in ages 4-8. Web-based instruction.

HDFS 3043 Professional Development for Early Childhood Educators. Prerequisite(s): Admission to Great Plains IDEA Early Childhood Non-certification program and HDFS 2113. The role of a professional as a teacher, administrator or advocate in early childhood programming. Professionalism and ethics, identifying child abuse, and applying universal precautions. Discussion of qualities of the early childhood educator role, program models, and working with children and professional colleagues. Web-based instruction.

HDFS 3053 Child Guidance and Classroom Environments. Prerequisite(s): Admission to Great Plains IDEA Early Childhood Non-certification program and HDFS 2113. Developmentally appropriate practice in child guidance through review of current guidance methods and programs to familiarize students with successful guidance techniques. Students will develop their own approach to guidance based upon practices best suited to their own unique skills and strengths. Web-based instruction.

HDFS 3063 Health, Safety and Nutrition. Prerequisite(s): Admission to Great Plains IDEA Early Childhood Non-certification program and HDFS 2113. Planning, promoting and maintaining healthy and safe learning/care environments, understanding childhood illnesses and establishing healthy lifestyles, first aid, and maintaining care provider's own health. Maintaining safe relationships with others, including identifying and reporting abuse, neglect, and exploitation of children. Exploration of nutrients for life and feeding, food preparation and safety policies and guidelines, food allergies and intolerances, appropriate feeding practices. Web-based instruction.

HDFS 3103 Social Development and Social Studies in Early Childhood. Prerequisite(s): Concurrent enrollment in 3213, 3223, 3233 and 3202; full admission to Professional Education. Developmentally appropriate social studies curriculum and instruction for young children; content selection, lesson planning, teaching methods, materials and evaluation strategies.

HDFS 3123 (S) Parenting. Prerequisite(s): 2113 or other life-span development course. Examination of the fundamental issues and special topics in parent child relationships across the life span. Current theory and empirical research in multiple contexts of family, school and community.

HDFS 3202 Early Childhood Field Experience II. Prerequisite(s): Concurrent enrollment in 3103, 3213, 3223; 3233; full admission to Professional Education. Field experiences in classroom setting working with children in PreK through 3rd grade. Reflective decision making that incorporates the major content area concepts and skills involved in organizing, planning, and developing instruction in early childhood classrooms.

HDFS 3203 (I) Children's Play: A World Perspective. An examination of children's play in contemporary international cultures. Play in children from birth through late childhood will be reviewed; social and cognitive outcomes will be analyzed as related to complex, modern world systems.

HDFS 3213 Literacy Development in Early Childhood Education. Prerequisite(s): Concurrent enrollment in 3103, 3202, 3223 and 3233 and full admission to Professional Education. Theoretical and research based rationale for an integrated language arts and an interdisciplinary approach to literacy development as it addresses writing, reading and oral language for infants through age eight. Use of children's literature.

HDFS 3223 Mathematics and Science in Early Childhood. Prerequisite(s): Concurrent enrollment in 3103, 3213, 3233, and 3202; full admission to Professional Education. Mathematics and science teaching and curriculum in preK through 3rd grade. Content and materials appropriate for preK through 3rd grade, mathematics and science curricula, instructional practices, and assessment techniques for young children. Content selection and organization, lesson planning, teaching and assessment materials.

HDFS 3233 Guidance and Classroom Management in Programs for Young Children. Prerequisite(s): Concurrent enrollment in 3103, 3213, 3223, and 3202; and full admission to Professional Education. Effective guidance practices in group settings (PreK-3) based upon the application of theoretical models. Various guidance models will be examined. Relevant theories, influential research and developmentally appropriate guidance techniques that facilitate the development of pro-social behaviors.

HDFS 3263 Curriculum Development for Children Ages Birth to 3. Prerequisite(s): Admission to Great Plains IDEA Early Childhood Non-certification program and HDFS 3023, 3033, 3043, 3053, 3063. Learn and utilize assessment and documentation to inform curriculum, plan and evaluate developmentally appropriate activities, and learn effective ways to share curriculum information with families for children ages 0-3. Developmental domains and content areas; issues related to diversity in family composition, culture, and individual abilities will also be addressed. Web-based instruction.

HDFS 3273 Curriculum Development for Children Ages 4-8. Prerequisite(s): Admission to Great Plains IDEA Early Childhood Non-certification program and HDFS 3023, 3033, 3043. Learn and utilize assessment and documentation to inform curriculum, plan and evaluate developmentally appropriate activities, and learn about effective ways to share curriculum information with families for children ages 4-8. Developmental domains and content areas; issues related to diversity in family composition, culture, and individual abilities will also be addressed. Web-based instruction.

HDFS 3283 Assessing Young Children and their Environments to Enhance Development. Prerequisite(s): Admission to Great Plains IDEA Early Childhood Non-certification program and HDFS 3023, 3033, 3043, 3053, 3063. Select, evaluate, and use appropriate assessment tools for children birth to age 8 using assessment data to inform decisions about teaching (environments and practice) and intervention. Emphasis on the ethical use of assessments, validity of assessments, multicultural sensitivity, and assessments for children with special needs. Web-based instruction.

HDFS 3293 Understanding and Adapting for Developmental Differences. Prerequisite(s): Admission to Great Plains IDEA Early Childhood Non-certification program and HDFS 3023, 3033, 3043, 3053, 3063. Knowledge of disability conditions, assessment and identification, interventions in inclusive environments, and collaborations among family members and service providers. Web-based instruction.

HDFS 3303 Administration and Supervision in Early Childhood Settings. Prerequisite(s): Admission to Great Plains IDEA Early Childhood Non-certification program and HDFS 2113. Exploration of issues surrounding the administration of early childhood programs including identification of community needs, analysis of business opportunities, evaluation and appropriate use of space and quality programming, consideration of policy and legal responsibilities, and professionalism in the field. Best practices in staff selection, training, coaching and supervision. Web based instruction.

HDFS 3313 Technology and Young Children. Prerequisite(s): Admission to Great Plains IDEA Early Childhood Non-certification program and HDFS 2113. Electronic technology's impact on the development of young children in educational, home, and community environments and how it can be used in early childhood classrooms to enhance teaching and learning. Students will be critical thinkers and informed consumers of technology related to young children. Web-based instruction.

HDFS 3323 Diversity in the Lives of Young Children and Families. Prerequisite(s): Admission to Great Plains IDEA Early Childhood Non-certification program; SOC 1113; PSYC 1113; and HDFS 2113 or equivalents. Exploration of cultural diversity in daily life and beliefs in families with young children. The focus is on U.S. families, with attention to the multiple cultures from which they come. Web-based instruction.

HDFS 3333 Working with Families. Prerequisite(s): Admission to Great Plains IDEA Early Childhood Non-certification program and HDFS 2113. Application of an ecological model to the understanding of variation in parental roles, perspectives, relationships, approaches, and challenges. Web-based instruction.

HDFS 3413 (S) Infant and Child Development. Prerequisite(s): 2113. Examination of continuity and change in physical, cognitive/language, and socioemotional development from the prenatal period through early middle childhood (age nine). Diverse contexts, directed observation of infants and children.

HDFS 3423 (S) Adolescent Development in Family Contexts. Prerequisite(s): 2113. Development of the adolescent physically, socially, intellectually and emotionally with emphasis on the search for identity, sexuality, vocational choice and interpersonal relations. Observation of adolescents.

HDFS 3443 (S) Family Dynamics. Prerequisite(s): 2113. Applying family theories and current research to the examination of dynamics of diverse families across the life course and within the social context.

HDFS 3511 Research Methods Lab. Lab 2. Prerequisite(s): STAT 2053 and ENGL 3323, co-requisite for HDFS 3513. Development of research skills for human development and family science. Introduction to and practice using SPSS data analysis software; exercises in and critique of scientific writing using American Psychological Association (APA) style.

HDFS 3513 Research Methods in Human Development and Family Science. Prerequisite(s): STAT 2053, ENGL 3323, co-requisite: HDFS 3511. Examination of fundamentals of scientific method as applied to research in human development and family science. Research design, sampling, and measurement. Analytical, evaluative, and interpretive skills needed to understand the professional research literature. Application of statistical analysis to research in human development and family science.

HDFS 4000 Senior Thesis. 1-6 credits, max 6. Prerequisite(s): 4743, STAT 2013, senior standing, consent of instructor. Supervised research for the bachelor's degree.

HDFS 4013 Practicum I in Early Childhood. Prerequisite(s): Admission to Great Plains IDEA Early Childhood Non-certification program and HDFS 3023, 3033, 3043, 3053, 3063. Guided learning experience in a professional agency that provides services to children and families. Learning experiences and projects will provide teacher candidates the opportunity to utilize and implement theories and practices learned in other ECE classes. Web-based instruction.

HDFS 4023 Practicum II in Early Childhood. Prerequisite(s): Admission to Great Plains IDEA Early Childhood Non-certification program and HDFS 3023, 3033, 3043, 3053, 3063, 4013. Guided learning experience in a professional agency that provides services to children and families. Learning experiences and projects will provide teacher candidates the opportunity to utilize and implement theories and practices learned in other ECE classes. Web-based instruction.

HDFS 4033 Practicum III in Early Childhood. Prerequisite(s): Admission to Great Plains IDEA Early Childhood Non-certification program and HDFS 3273, 3283, 3293, 3303, 3313, 3323, 3333, and 4013. 15 week experience of practical application of developmentally appropriate early childhood teaching techniques and skills, actual teaching experience and developmental feedback. Observation and evaluation of classroom experiences, environmental design, classroom management, and parent communication. Web-based instruction.

HDFS 4223 Preparation for Field Experience at Primary Level. Prerequisite(s): Concurrent enrollment in 4226 and 4333, and full admission to Professional Education. Decision-making, priority-setting, self-assessment, classroom organization and management, selection of appropriate content, and teaching strategies in public schools and state accredited programs.

HDFS 4313 Early Childhood Field Experience III. Prerequisite(s): Concurrent enrollment in 2123, 3024, 4363, 4323; full admission to Professional Education. Field experience in pre-kindergarten settings through third grade. Develop philosophical perspectives of teaching, consider effective parent-teacher relations, and connect with the wider community as a resource context for teaching and learning. Plan and teach an integrated, thematic curriculum unit for prekindergarten through grade three as part of the field component. *Graded on a pass-fail basis.*

HDFS 4323 Family, School and Community. Concurrent enrollment in 2123, 3024, 4363, and 4313; Full admission to Professional Education. Examination of theories of families and their relationships with schools and communities and the implications for early childhood practices.

HDFS 4333 Early Childhood Capstone. Prerequisite(s): Concurrent enrollment in 4339; and Full admission to Professional Education. Examination of the role of the early childhood professional in broader society contexts such as policy, advocacy, research and funding.

HDFS 4339 Student Teaching in Early Childhood Education. Prerequisite(s): Concurrent enrollment in 4333, and full admission to Professional Education. A prekindergarten through grade three classroom

teaching experience under the direction of a certified early childhood teacher and an early childhood education faculty member.

HDFS 4363 Integrated Curriculum in Early Childhood Education. Prerequisite(s): Concurrent enrollment in 2123, 3024, 4313, and 4323; full admission to Professional Education. Develop philosophical perspectives of teaching, consider effective parent-teacher relations, and connect with the wider community as a resource context for teaching and learning. Plan and teach an integrated, thematic curriculum unit for prekindergarten through grade three. Selection of appropriate content, and teaching strategies in public schools and state accredited programs.

HDFS 4373* Early Childhood Health & Well-being. Prerequisite(s): 2113. Examination of issues in early childhood health and well-being, including physical health; infant and early childhood mental health; nutrition, exercise, and childhood obesity; safety; resilience; and exposure to biological and psychosocial risks that impact health. Exploration of policies and programs related to children's health and well-being, as well as identification of practical implications for promoting children's health and well-being.

HDFS 4413 (S) Adulthood and Aging. Prerequisite(s): 2113. Study of the unique characteristics of development during the middle and later years of development. Emphasis on the aging process and the effects on the individual and family.

HDFS 4423 Family Risk and Resilience. Prerequisite(s): 3443. Examination of selected theoretical approaches; areas of family risk; protective factors; individual and family qualities relating to resilience; and prevention and intervention strategies.

HDFS 4433* Family Life Education. Prerequisite(s): 2113 and 3123 and senior standing. Philosophy and principles of family life education. Planning, implementing, and evaluating family life programs in community and education settings. Field experience.

HDFS 4443 (S) Fatherhood: Developmental, Social and Historical Perspectives. Developmental, social and historical perspectives of fatherhood. Context and contemporary issues relating to fatherhood in the U.S., the contribution of involved fathering to men's adult development, the roles and responsibilities of fathers, skills for effective fathering, and father and child interaction in relation to both father and child adjustment and well being.

HDFS 4473 Policy, Law and Advocacy. Prerequisite(s): 3513. The study of local, state, and federal legislations, regulations, social policies, and advocacy that affect children and families. Domestic relations, child welfare, health, education, social services, employment and housing.

HDFS 4520 Student Teaching in Family and Consumer Sciences Education. 1-9 credits, max 9. Prerequisite(s): Full admission to Professional Education. Directed experience in an approved Family and Consumer Sciences classroom. Applications of methods and skills in Family and Consumer Sciences education as related to selecting, adapting, using, and evaluating curriculum materials, including experiences to meet educational goals and to facilitate learning for individual students. Experiences will also involve responsibilities with other school personnel and parents.

HDFS 4521 HDFS Child and Family Services: Pre-Internship. Prerequisite(s): 1112 and 2523 and HS 1112 or 3112 (or concurrent) and senior standing and consent of adviser and instructor. Preparatory workshop for HDFS Child and Family Services internship.

HDFS 4533 Critical Issues in Human Development and Family Science. Prerequisite(s): Senior standing. An examination of the place of Human Development and Family Science in the context of broader themes. An exploration of the students' specialization and its implications for an educated life.

HDFS 4543 (S) Family and Interpersonal Relationships in Adulthood. Prerequisite(s): 2113. Analysis of the aging process as it relates to relationships across the lifespan. Special emphasis on multigenerational family issues, peer relationships, and transitions associated with normative and non-normative life experiences.

HDFS 4563 Internship in Child and Family Services I. Prerequisite(s): 1112 and 2523 and 4521 and senior standing and consent of adviser and instructor. Supervised field experience applying HDFS knowledge and skill base. Must complete application for internship. This component of the internship includes class assignments that demonstrate application of HDFS knowledge and skill base.

HDFS 4572 Internship in Child and Family Services II. Prerequisite(s): 1112, 2523, 4521, senior standing, and consent of adviser and instructor. Supervised field experience applying HDFS knowledge and skill base. Must complete application for internship.

HDFS 4573* Introduction to Marriage and Family Therapy. Introduction to the field of Marriage and Family Therapy (MFT). Includes theoretical foundations of the disciplines as well as assignments that demonstrate the application of the theories in a family therapy session.

HDFS 4713 Family Resource Management. Examination of individual and family management of interpersonal, financial, workplace, social, and community resources over the lifespan. Includes an emphasis on decision making within the family system, particularly for families with issues that affect timing and balancing of resource management.

HDFS 4750 Topics in HDFS. 1-6 credits, max 6. Prerequisite(s): Consent of instructor. Various units of work related to specific issues in Human Development and Family Science.

HDFS 4793 (S) The Family: A World Perspective. Family structure and interaction that transcend specific cultures or nationalities; examination of specific cultural and international family forms, their social issues and relevant services to meet their needs.

HDFS 4813 Dying, Death and Bereavement. Physical, psychological, emotional and social aspects to dying and death across the life course. Examination of human experiences with and responses to dying and death within various contexts such as family, medical and cultural.

HDFS 4823 Aging Concepts and Controversies. Interdisciplinary review of contemporary ethical issues and opposing arguments of risk and resilience in human aging. Critical analysis and assessment of developmental, psychological, social, economic, and legal strategies for prevention, intervention, and policy programming for older adults.

HDFS 4850 Special Courses in Human Development and Family Science. 1-6 credits, max 6. Prerequisite(s): Consent of instructor. Various courses related to specific issues in Human Development and Family Science.

HDFS 4900 Honors Creative Component. 1-3 credits, max 3. Prerequisite(s): College of Human Sciences Honors Program participation, senior standing. Guided creative component for students completing requirements for College Honors in College of Human Sciences. Thesis, creative project or report under the direction of a faculty member in the major area, with second faculty reader and oral exam.

HDFS 4950 Research Practicum in HDFS. 1-6 credits, max 6. Prerequisite(s): Consent of instructor. Hands-on research experience under the direction of faculty members in various human development and family science topics. *Graded pass/fail.*

HDFS 5000* Master's Thesis. 1-6 credits, max 6. Research in HDFS for MS degree.

HDFS 5110* Directed Study in HDFS. 1-9 credits, max 9. Prerequisite(s): 5253, 5293, 5513 or 5523 and consent of instructor. Directed individual study in human development and family science.

HDFS 5112* Computer Applications in HDFS Research. Creating variable codebooks, data coding, data entry, variable specifications and data manipulation, merging files, and basic analysis using SPSS software. No computer experience necessary.

HDFS 5133* Research Methods and Design in Human Development and Family Science. Prerequisite(s): Admission to the HDFS graduate program. Research processes, design, and methods in human development and family science. Application of research tools and methods to investigate theoretical, empirically-based, or field-based research issues with a focus on individual and family risk and resilience. Development of a research proposal.

HDFS 5153* Policy in Human Development and Family Science. Critical analysis of approaches to and models of policy in Human Development and Family Science. Examination of policy analysis and evaluation, development, advocacy, and implementation of state and federal policy and legislation.

HDFS 5160* Master's Creative Component. 1-6 credits, max 6. Prerequisite(s): 5253, 5293, 5513 or 5523 or equivalent and consent of instructor. Creative application of student's knowledge to solve a problem of interest in HDFS.

HDFS 5163* Creative Component in HDFS: Development and Application. Prerequisite(s): 5133 and 5290. Development and implementation of a creative component project related to an area of human development and family science. Interfaces with practicum experience and involves the integration of theory, research, and application.

HDFS 5173* Program Design, Implementation, and Evaluation in Human Development and Family Science. Prerequisite(s): Admission to the HDFS GPIDEA Graduate Program. An exploration of the principles and methods of program design, implementation, and outcome evaluation of family and community programs. *Web-based instruction.*

HDFS 5183* Practicum in Developmental and Family Sciences Research. Prerequisite(s): Admission to graduate study in HDFS, nine hours of graduate credit in HDFS, and consent of instructor. Supervised research experiences in human development and family sciences.

HDFS 5190* Teaching Practicum. 1-3 credits, max 3. Prerequisite(s): Six hours of graduate course work and consent of instructor. Teaching human development and family sciences; content and techniques.

HDFS 5203* Family Systems. Research and theory related to family functioning throughout the life cycle, especially financial decision making during crisis and conflict. Factors that shape family values, attitudes and behaviors from a multicultural perspective. New and emerging issues critical to family functioning.

HDFS 5213* Human Development in the Context of Family and Community. Prerequisite(s): Admission to the HDFS GPIDEA Graduate Program. An examination of human development including the cognitive, social-emotional, motor, language, and moral domains from both a lifespan and a bio-ecological perspective. *Web-based instruction.*

HDFS 5223* Resilience in Individuals and Families. Prerequisite(s): Admission to the HDFS GPIDEA Graduate Program. Exploration of resilience approaches to the study of families and human development across the life cycle. *Web-based instruction.*

HDFS 5243* Infant Behavior and Development. Survey of research and theory pertaining to infant development, including behavioral genetics, perception, cognition and learning, social and emotional development, and assessment.

HDFS 5253* Theory and Research: Social and Emotional Development. Research and theory pertaining to social and emotional development, including attachment and family context, social interaction, friendships and temperament. Incorporates applications to policy and practice.

HDFS 5263* Theory and Research: Cognitive and Language Development. Research and theory pertaining to cognitive and language development including environmental influences and family influences, attention and memory, problem solving, and social cognition. Incorporates applications to policy and practice.

HDFS 5273* Parent Education. Prerequisite(s): Consent of instructor. Parent-child relations, parenting strategies, and other major components of empirically validated parent education programs that lead to certification. Supervised practice.

HDFS 5283* Developmental Disabilities. Recent theories and research related to developmental disabilities, including both physical and mental handicapping conditions and their impact on human development.

HDFS 5290* Practicum. 1-6 credits, max 6. Prerequisite(s): Consent of instructor. Supervised experience in various settings relevant to human development and family sciences.

HDFS 5293* Developmental Contexts of Normative Behavior Problems. Examines the theory and research regarding biological, developmental and contextual factors associated with normative behavior problems. Contexts include families, neighborhoods, peers and schools. A lifespan perspective examining the origins and course of individual patterns of maladaption, such as aggression, delinquency, social withdrawal, anxiety and depression. Addresses prevention of and intervention with normative adjustment difficulties.

HDFS 5323* Issues in Early Childhood. Systematic examination and in-depth reflection on selected issues and trends in early childhood education.

HDFS 5333* Early Childhood Education History and Theory. The history of early childhood education and theoretical approaches for planning educational programs and learning experiences for young children.

HDFS 5343* Developmental and Family Assessment. Applications of qualitative and quantitative approaches to observation and developmental assessment strategies for students preparing to become specialists or practitioners working with children and families, including early childhood educators, child and parenting practitioners, and human service practitioners.

HDFS 5353* Diversity in Early Childhood. Exploration and critical review of the state of early childhood programming with emphasis on research, theory, and policy making that bear on current diversity and multicultural issues in practice.

HDFS 5363* Early Childhood Development and Education. The interaction of biology, family, culture, and extended environment on children's emotional, social, and cognitive development during the early childhood years. The implications of regularities and diversity in development for teaching and learning and on principles of educational practice to enhance development.

HDFS 5373* Early Childhood Administration. Examination of the administration, management, and supervision of programs for young children. Legal, social, and economic conditions affecting programs.

HDFS 5400* Professional Seminar in Gerontology. 3 credits, max 3. An integrative experience for gerontology students designed to be taken near the end of the degree program. By applying knowledge gained in earlier course work, students strengthen skills in ethical decision-making and behavior, applying these skills in gerontology-related areas such as advocacy, professionalism, family and workplace issues. Students from a variety of professions bring their unique perspectives to bear on topics of common interest. *Web-based instruction.*

HDFS 5403* Perspectives in Gerontology. An overview of current aging issues including current focus of gerontology theory and research; critical social and political issues in aging, the interdisciplinary focus of gerontology, current career opportunities, and aging in the future. *Web-based instruction.*

HDFS 5411* Ethics and Aging. Analysis of ethical issues for the aging population. Critical examination of various ethical issues from legal, psychological, social, and financial perspectives. Enrollment requires attendance of the one-day, Oklahoma Ethics and Aging Conference.

HDFS 5413* Adult Development and Aging. The biological, psychological and social factors associated with aging. Special emphasis on developmental adaptation in late and very late life.

HDFS 5423* Research Perspectives in Gerontology. Critical review of gerontological literature. Special emphasis on current knowledge related to research methodologies, measurement applications, and clinical interventions used to study age-related processes and outcomes.

HDFS 5433* Theories of Aging. Addresses the historical, contemporary and interdisciplinary basis of aging theory. Biological, psychological, sociological and human developmental conceptualizations of aging are critically assessed. Emphasis is placed on conceptual models, as well as theoretical development and application within gerontological research and the field of aging.

HDFS 5443* Interpersonal Relationships. Prerequisite(s): Admission to the HDFS GPIDEA Graduate Program. An examination of interpersonal relationships in context, including theoretical perspectives, research methods, relationship forms, and relationship processes. *Web-based instruction.*

HDFS 5453* Aging in the Medical Context. Orients students to the unique issues related to health and the health system for individuals in later life. A particular focus is placed on health programs, the role of medical personnel and tasks of family members as older persons face health issues and decisions.

HDFS 5470* Developments and Innovations in Human Development, Family Science, and Early Childhood Education. 1-3 credits, max 3. Analysis of current developments and innovative practices in one or more of the specified areas. Emphasis upon evolving concepts with implications for programs serving societal needs in these areas.

HDFS 5483* Aging Network Seminar. Personal, academic, and professional development in preparation for a career in the aging service network. Primary focus on networking with applied aging researchers and aging service providers.

HDFS 5493* Aging and Families. Theories and research related to individual and family adjustments in later life affecting older persons and their intergenerational relationships. Critical issues include marriage, divorce and remarriage, adult children and their parents, grandparenting, and alternative family forms.

HDFS 5513* Issues in Family Science. Current and classic literature in family studies. Consideration of philosophical bases and current research issues relevant to the family as a field of study.

HDFS 5523* Family Theory. Theoretical frameworks and processes in family science. Overview of the interface between theory, research, and application in family science.

HDFS 5543* Coping with Family Crises. Strategies for helping families deal with various family crises including illness, death and divorce. Focus on dealing with these from a family systems approach.

HDFS 5553* Perspectives on Parenting and Parent Education. Prerequisite(s): Admission to the HDFS GPIDEA Graduate Program. An examination of theories, models, methods, research, and skills related to parenting and parent education. *Web-based instruction.*

HDFS 5563* Community and Family. Prerequisite(s): Admission to the HDFS Graduate Program. Examination of current research and theory in the interactions of families and communities. Emphasis on empirical strategies for intervention to address community and family-based problems.

HDFS 5573* Adolescent in Family Context. Physical, social, emotional and intellectual development of adolescents within the context of family relationships. Exploration of research and theory as it relates to adolescent development and parent-adolescent relationships.

HDFS 5583* Human Sexuality. Multiple aspects of human sexuality including physiological and psychosexual development and response, sexual relationships, and sexual dysfunction.

HDFS 5603* Pre-Practicum in Marriage and Family Therapy: Counseling Skills. Prerequisite(s): Admission to the marriage and family therapy specialization and consent of instructor. Pre-clinical experience for students in the marriage and family therapy (MFT) specialization, emphasizing counseling skills and structured observations.

HDFS 5612* Pre-Practicum in Marriage and Family Therapy: Group Processes. Prerequisite(s): Admission to marriage and family therapy specialization and consent of instructor. Pre-clinical experience for students in the marriage and family therapy specialization emphasizing group processes, designing and running therapy groups.

HDFS 5613* Theoretical Models of Marriage and Family Therapy. An introduction to the historical context of marriage and family therapy. An overview of the major schools of marriage and family therapy and emerging models.

HDFS 5623* Systems Theory and Applications to the Family. Examination of the cybernetic roots and terminology used with general systems theory providing an understanding, appreciation and integration of the role of "systems'' approaches to family theory and clinical practice.

HDFS 5633* Couples Treatment in Marriage and Family Therapy. Prerequisite(s): Graduate standing or consent of instructor. Focus on assessment of couples and the systemic interventions available to address common couple issues. Pre-marriage, divorce and remarriage, sexuality, domestic violence, infidelity, and gender.

HDFS 5643* Child and Adolescent Treatment in Marriage and Family Therapy. Prerequisite(s): Graduate standing or consent of instructor. An overview of the issues surrounding children and adolescents in marriage and family therapy including child abuse and neglect, drug abuse, oppositional behaviors, ADHD, and family structures and hierarchies. Assessment and treatment methods. Strategies for engaging families.

HDFS 5653* Systemic Approaches to Psychopathology and Psychopharmacology. Prerequisite(s): Graduate standing or consent of

instructor. Overview of major mental disorders and other conditions that maybe the focus of clinical mental health treatment. Treatment issues and an introduction to psychopharmacology.

HDFS 5663* Professionalism and Ethics in Marriage and Family Therapy. Prerequisite(s): Graduate standing and consent of instructor. The development of the professional attitude and identity of a marriage and family therapist. The AAMFT Code of Ethics, family law, ethnicity, and gender issues, as related to the practice and profession of marriage and family therapy.

HDFS 5673* Family Dynamics of Addiction. Prerequisite(s): Graduate standing and consent of instructor. An examination of the theory and research related to addictive behaviors and couple and family relationships, and an exploration of the techniques and strategies of relational intervention for addiction.

HDFS 5690* Marriage and Family Therapy Practicum. 1-3 credits, max 18. Prerequisite(s): Admission to the marriage and family therapy program and consent of instructor. Supervised clinical experience for students in the marriage and family therapy specialization.

HDFS 5693* Child Treatment Practicum in Marriage and Family Therapy. Prerequisite(s): Admission to the marriage and family therapy program and consent of instructor. Supervised clinical experience focusing on the treatment of children within a family context.

HDFS 5713* Individual and Family Resource Management. Survey course of personal finance and family resource management literature to provide an overview of how individuals and family members develop and exercise their capacity to obtain and manage resources to meet life needs. Resources include the self, other people, time, money, energy, material assets, space, and environment. Web-based instruction.

HDFS 5750* Seminar in Human Development and Family Science. 1-9 credits, max 9. Current research in human development and family science. Critical study of classic and current research.

HDFS 5753* Leadership and Management of Community Service Programs. Prerequisite(s): Admission to the HDFS GPIDEA Graduate Program. An examination of leadership and management concepts related to the effective administration of community-based agencies. *Web-based instruction.*

HDFS 5813* Practicum in Human Development and Family Science. Prerequisite(s): Admission to graduate study in HDFS, 9 hours of graduate credit in HDFS, and consent of instructor. Supervised experiences in child development, family services or health-related settings.

HDFS 5913* Foundations and Principles of Family and Community Services. Prerequisite(s): Admission to the HDFS Great Plains IDEA Graduate Program. An introduction to the field of family science and related professions that involve working with individuals and families in communities. *Web-based instruction.*

HDFS 5923* Dynamics of Family Interaction. Prerequisite(s): Admission to the Great Plains IDEA Graduate Program. An examination of theories of family function and dysfunction, techniques of assessment, and models of family intervention. *Web-based instruction.*

HDFS 6000* Doctoral Dissertation. 1-12 credits, max 30. Prerequisite(s): Consent of instructor. Research in human environmental sciences for the PhD degree under supervision of a graduate faculty member.

HDFS 6101* Doctoral Seminar in Human Development and Family Science. Prerequisite(s): 5253, 5293, 5513, 5523 or equivalent and consent of instructor. Selected topics in human development and family science focusing on current research, theory or application.

HDFS 6110* Doctoral Directed Study in HDFS. 1-9 credits, max 9. Prerequisite(s): 5253, 5293, 5513, 5523 or equivalent and consent of instructor. Doctoral level directed individual study in human development and family science.

HDFS 6123* Advanced Research in Risk and Resilience. Prerequisite(s): 5133 and 5253 or 5293, 5513 or 5523. Integration of current research and theory in human development and family science to address current issues in individual and family risk and resilience.

HDFS 6133* Advanced Research Methods in Human Development and Family Science. Prerequisite(s): One course in research methods and one in statistics. Research design and analysis of data appropriate to the areas of human development and family science.

HDFS 6143* Structural Equation Modeling for HDFS Applications. Prerequisite(s): 6133, REMS 6013 or equivalents. Introduction to structural equation modeling (SEM) with applications to longitudinal and grouped data typical of research in Human Development and Family Science. Includes elementary matrix algebra, measurement models (factor analysis), and latent path models, such as growth curve models. Applications using appropriate statistical software.

HDFS 6153* Multilevel Modeling for HDFS Applications. Prerequisite(s): 6133 and REMS 6013 or equivalents. Introduction to advanced statistical methods for analyzing longitudinal and grouped data. Multilevel modeling is emphasized, with brief introductions to other advanced statistical procedures, such as survival analysis and developmental trajectory analysis. Models include occasions nested within persons and persons nested within groups. Applications using appropriate statistical software.

HDFS 6190* Research Internship. 1-15 credits, max 15. Prerequisite(s): Consent of instructor. Special research studies under the supervision of a graduate faculty member.

HDFS 6223* Risk and Resilience in Human Development. Prerequisite(s): 5253 or 5293 or equivalent course. Critical analysis of research and theory on risk and resilience processes in human development across the life course. Emphasis on roles of families in enhancing resilience. Demonstration of application to selected aspects of individual development.

HDFS 6273* Parent-Child Relations. Examination of theory and research related to parenting and the impact of parenting on the well-being of children, parents and the broader family system.

HDFS 6283* Seminar in Human Development. Prerequisite(s): 5253. Selected topics in human development with special attention given to recent research literature and current theory.

HDFS 6523* Advanced Family Theory. Prerequisite(s): 5523. Family theory process, including logic, theory construction, and relating conceptual orientations to current research areas.

HDFS 6553* Marital and Couple Relationships. In-depth analysis of historical and contemporary research on developmental and relational processes in marital and couple relationships. Emphasis on research and theory addressing the nature, dynamics and developmental course of committed couple relationships.

HDFS 6583* Seminar in Family Science. Prerequisite(s): 5513 or 5523 or consent of instructor. Current research and theory in selected topics in family science.

HDFS 6613* Contemporary Issues in Marriage and Family Therapy. Prerequisite(s): Admission to marriage and family therapy specialization. Critical issues facing students in the marriage and family therapy (MFT) specialization, while taking advantage of the unique expertise of clinical faculty. Professional seminar on dialogue with participants taking an active role in the learning process.

Human Resources and Adult Education (HRAE)

HRAE 4010* Occupational and Adult Education Workshop. 1-3 credits, max 6. Professional workshops of various topics and lengths. Each workshop focused on a particular topic from such areas as the development, use and evaluation of instructional methods and materials.

HRAE 4023* Training and Development in the Workplace. Introduction to the field of training and development. Definitions, history, roles and models. Connection between learning and performance in the workplace.

HRAE 5000* Thesis or Report. 2-10 credits, max 10. Students studying for a master's degree may enroll in this course for a total of two credit hours if they write a report or six hours if they write a thesis. *Students working on a specialist's degree may earn a maximum of 10 hours credit.*

HRAE 5010* Seminar. 1-3 credits, max 6. Graduate student seminars focusing on current and critical issues and common problems relevant to occupational and adult education.

HRAE 5223* Organization and Administration of Adult Education. Organizational procedures and administrative practices for effective planning, implementation and management of adult and continuing education programs. Analyses of legislation, finances and community groups that influence and impact upon adult and continuing education programs.

HRAE 5233* Needs Analysis. Techniques of conducting organizational analyses of human performance problems, including surveys, interviews, records analysis, group interaction, and task analysis.

HRAE 5340* Special Problems. 1-6 credits, max 6. Directed independent study of special topics involving assigned readings, library research, field work or a combination of these.

HRAE 5433* Instructional Design for Training. Design and development of training to address performance problems in organizations, business and industry. In-depth study of a systematic approach to training for performance.

HRAE 5533* Human Resource Development. Introduction to training and development, including history and nature of the field, trainer roles, needs analysis, program development, evaluation, and techniques of conducting training.

HRAE 5633* Technology Application in Human Resource Development. The practice, theory, and research related to human resource development applications for technology and background information on specific technology-related topics. Development of technology applications.

HRAE 5703* Adult Learning in Diverse Settings. The study of adult learning in diverse geographic and cultural settings. Interaction with experts in the field and reflection upon their experiences after returning from travel.

HRAE 5730* Special Topics in Human Resource Development. 1-3 credits, max 6. The practice, theory and research related to a current topic in human

resource development.

HRAE 5833* Global Consulting. The consulting process, including contract, entry, diagnosis, response, disengagement, closure and ethical considerations. The competencies of successful consultants and trainers in the international environment, including cultural adaptations of self and of training materials.

HRAE 5880* Internship. 3-6 credits, max 6. Supervised experience working in business, industry, human service or education settings.

HRAE 6000* Doctoral Dissertation. 2-10 credits, max 15. Required of all candidates for the Doctor of Education degree in adult education and human resource development.

HRAE 6103* Foundations of Lifelong Learning. The definitions, historical and philosophical development, and the scope and function of lifelong learning.

HRAE 6110* Graduate Readings in Adult Education and Human Resource Development. 1-6 credits, max 6. Prerequisite(s): Consent of supervising professor. Supervised readings of significant literature not included in regularly scheduled courses.

HRAE 6203* Managing Adult Education Research. Analysis and application of techniques necessary for managing research projects in diverse agencies with adult learners. Practice with computer-based programs. Data sets from adult education research projects.

HRAE 6213* Lifelong Learning and Performance. Lifelong learning theory within the context of applications in formal and informal settings in the community as well as in the workplace. Synthesis of research findings on changes of cognitive performance due to aging and analysis of recent literature on participation in adult education and training.

HRAE 6223* Current Research in Adult Education. Analysis of the major research trends in the field of adult education. Recent research studies in the field.

HRAE 6233* Critical Issues in Adult Education. Exploration of current issues of concern to adult educators from diverse settings.

HRAE 6330* Special Topics in Adult Education. 1-3 credits, max 9. Prerequisite(s): 5203, 5213. Analysis and critique of the application of adult learning principles and methods in one of the numerous diverse settings in which adult education is practiced.

HRAE 6340* Independent Study in Human Resources and Adult Education. 1-3 credits, max 9. Directed independent study for doctoral students involved in a research-based project.

HRAE 6533* Organization and Development. Seminar examining the field of organization development. Emergence of the field, diagnosis, performance, change management, the client and the consultation.

HRAE 6633* Advanced Human Resource Development. Prerequisite(s): 5533. Scholarly critique of organizations as adaptive systems and the role human resource development plays in organization, process and individual performance.

HRAE 6880* Internship in Human Resources and Adult Education. 1-8 credits, max 8. Directed Field experiences related to the participant's area of concentration. Provides opportunities for an individual to put into practice and test ideas, theories and concepts learned in graduate study.

HRAE 6881* Doctoral Seminar: Level 2. Preparation of the required tentative proposal for dissertation and the comprehensive doctoral examination. Required for HRAE doctoral candidates.

Human Sciences (HS)

HS 1112 Human Sciences Freshman Experience. Experiences that effectively facilitate transition from high school to the College of Human Sciences at OSU. Introduction to the developmental advising process to ensure a successful adviser/advisee partnership. Career development through connections among the student's major curriculum, general education courses, career goals, and eventual careers. Analysis of case scenarios. *Required of all first semester freshmen in COHS*.

HS 2080 Introduction to International Experiences. Prerequisite(s): consent of Associate Dean. Introduction to international cultures through an educational experience outside the USA.

HS 2111 Career Exploration in Human Sciences. Acquisition of career information critical to introduce students to the world of work. Career searches, processes for interviewing and acquiring careers.

HS 2210 Professional Field Experience in Human Sciences. 1-3 credits, max 3. Prerequisite(s): Consent of instructor and DHM or HDFS or HRAD or NSCI major and freshman or sophomore standing. Supervised field experience in professional setting related to Human Sciences field of study.

HS 2510 Human Sciences Freshman Research Seminar. 1-3 credits, max 6. Prerequisite(s): College of Human Sciences major; Admission to the Freshman Research Scholars program. Seminar for College of Human Sciences' freshmen participating in the Freshman Research Scholars Program. Includes exploration of what "research" means in a variety of settings and introduces basic research skills and processes.

HS 2511 Dynamics of Leadership in Human Sciences. Prerequisite(s): consent of Associate Dean. Major topics related to personal and professional development, including developing and utilizing leadership skills, teamwork and team building, total quality management, ethics, public speaking, and business and social etiquette. Open to sophomores in the College of Human Sciences who have been accepted in the Ambassadors student organization.

HS 3002 Leadership and Collaboration in the Workplace. Prerequisite(s): Junior standing in a major in the College of Human Sciences. Exploration of personal and workplace leadership, conflict resolution, workplace diversity and ethics. Development of transferable skills and emotional intelligence. Generation of personal mission statements. Current leadership and collaboration strategies, issues and terminology.

HS 3080 International Experience. 1-18 credits, max 36. Prerequisite(s): Consent of associate dean. Participation in a formal or informal educational experience outside of the USA.

HS 3090 (I) Study Abroad. 1-18 credits, max 36. Prerequisite(s): Consent of the Office of Study Abroad and associate dean of the College of Human Sciences. Participation in an OSU reciprocal exchange program.

HS 3112 Human Sciences First-Year Transfer Experience. Experiences that effectively facilitate transition for the first year transfer student to the College of Human Sciences at OSU. Introduction to the developmental advising process to ensure a successful adviser/advisee partnership. Career development through connections among the student's major curriculum, general education courses, career goals, and eventual careers. Analysis of case scenarios. *Required of all first semester transfer students in COHS*.

HS 3210 Internship in Human Sciences. 1-3 credits, max 3. Prerequisite(s): Consent of instructor and DHM or HDFS or HRAD or NSCI major and sophomore standing and HS 1112 or 3112. Supervised internship related to a Human Sciences field of study.

HS 3511 Public Policy and Human Sciences. Prerequisite(s): consent of Associate Dean. The impact of human, economic and material resources. Analysis of developmental, ethical, cultural and public policy factors that influence need satisfaction. Open to juniors and seniors in the College of Human Sciences who have been accepted in the Ambassadors student organization.

HS 4000 Honors Seminar in Human Sciences. 1-6 credits, max 6. Prerequisite(s): Junior standing and admission to the Honors Program. In-depth interdisciplinary seminar focused on a current national or international issue having an impact on quality of life. Exploration of the issue utilizing various strategies and national resources. Dialogue and debate from multiple perspectives with emphasis on verbal and written expression.

HS 5110* Directed Studies in Human Sciences. 1-6 credits, max 6. Prerequisite(s): Consent of instructor. Directed individual study in Human Sciences.

HS 5240* Master's Creative Component. 1-6 credits, max 6. Prerequisite(s): Consent of associate dean. An in-depth application of theoretical models and philosophies related to area of specialization.

HS 5253* Family Economics. Issues related to the economics of families, household production, and human capital development; economics of crises public policy and family life cycle spending, saving and borrowing; special attention to the role of ethics in family economic issues. A theoretical and a research perspective used to illuminate the concepts in the course. *Web-based instruction.*

HS 5303* Fundamentals of Family Financial Planning. The nature and functioning of financial systems, including currencies, markets, monetary and fiscal policy, and supply and demand for land, labor and capital. Focus on the impact of global financial interdependence on individuals and families in the U.S. Current and emerging issues, as well as current research and theory relative to financial systems. *Web-based instruction.*

HS 5333* Theories and Research in Family Financial Planning. Prerequisite(s): Admission to the Great Plains IDEA FFP program. Introduction of the social science of family finances. Focus on theories of family functioning, microeconomic theory related to family resource allocation decisions, the family as an economic unit, and the interaction of economy and families. Web-based instruction.

HS 5353* Financial Counseling for Family Financial Planning. Theory and research regarding the interactive process between client and practitioner, including communication techniques, motivation and esteem building, counseling environment, ethics, and data intake, verification, and analysis. Legal issues, compensation, technology to identify resources, information management, and current or emerging issues. *Web-based instruction.*

HS 5403* Estate Planning for Families. Fundamentals of estate planning process, estate settlement, estate and gift taxes, property ownership and transfer, and powers of appointment. Tools and techniques in implementing effective estate plan, ethical considerations in providing estate planning services, new and emerging issues in the field. Experience with case studies in developing estate plans for varied family forms. *Web-based instruction.*

HS 5453* Retirement Planning, Employee Benefits and the Family. Study of micro and macro considerations for retirement planning. Survey of

various types of retirement plans, ethical considerations in providing retirement planning services, assessing and forecasting financial needs in retirement, and integration of retirement plans with government benefits. *Web-based instruction.*

HS 5483* Military Family Financial Issues. An overview of topics relevant to the financial planning process, adapting topics to address the unique needs of and resources available to military service members and their families. Topics include status of service member; financial readiness; financial, risk, investment, tax, retirement and estate management; record keeping; cash flow management; credit and debt management; savings; education planning; and special topics. *Web based instruction.*

HS 5533* Economics of Aging and Public Policy. Policy development in the contest of the economic status of the elderly populations. Retirement planning and the retirement decision; Social Security and public transfer programs for the elderly; intrafamily transfers to or from the elderly; private pensions; financing medical care for the elderly; prospects and issues for the future. *Web-based instruction.*

HS 5543* Environments and Aging. Special needs of older people and attributes of physical environments that support these needs including attention to the "meaning of and attachment to home." Application of knowledge to design and management of housing, institutional settings, neighborhoods and communities. Environment-person fit; aging-in-place, assisted living and long-term care; and therapeutic environments. *Web-based instruction.*

HS 5553* Insurance Planning for Families. Study of risk management concepts, tools, and strategies for individuals and families, including life insurance; property and casualty insurance; liability insurance; accident, disability, health, and long-term care insurance; and government-subsidized programs. Current and emerging issues and ethical considerations. Relationships between investment options and employee/employer benefit plan choices. *Web-based instruction.*

HS 5603* Investing for the Family's Future. Evaluation of investment markets for the household. Analysis of how families choose where to put their savings. Using the family's overall financial and economic goals to help make informed decisions about which investments to choose. *Web-based instruction.*

HS 5633* Program Evaluation and Research Methods in Gerontology. Overview of program evaluation, research methods and grant writing in gerontology. Application of quantitative and qualitative methods in professional settings. *Web-based instruction.*

HS 5653* Personal Income Tax for Family Financial Planning. Information on income tax practices and procedures including tax regulations, tax return preparation, tax audit processes, appeals process, preparation for an administrative or judicial forum, and ethical considerations of taxation. New, emerging issues related to taxation. Family and individual case studies practice in applying and analyzing tax information and recommending appropriate tax strategies. *Web-based instruction.*

HS 5703* Professional Practices in Family Financial Planning. Challenges of managing financial planning practices, including business valuation, personnel, marketing, client services, ethics and technological applications. Relying on theoretical as well as applied approach, analysis of case studies that provide relevant, practical exposure to practice management issues, with strong emphasis on current research findings. *Web-based instruction.*

HS 5803* Case Studies in Family Financial Planning. Prerequisite(s): 5303, 5403, 5453, 5553, 5603, 5653 or consent of adviser. Professional issues in financial planning, including ethical considerations, regulation and certification requirements, communication skills, and professional responsibility. Utilization of skills obtained in other courses and work experiences in the completion of personal finance case studies, the development of a targeted investment policy, and other related financial planning assignments. *Web-based instruction.*

HS 6993* Graduate Seminar in Human Sciences. Prerequisite(s): Consent of instructor. Analysis of philosophy, critical issues, current developments and interrelationships among elements in human sciences.

Industrial Engineering and Management (IEM)

IEM 2903 Manufacturing and Service Systems and Tools I. Prerequisite(s): ENGR 1111; MATH 2144. Introduction to definition, design, operation, and improvement of systems that produce goods and services. Case studies featuring classical and contemporary issues in industrial engineering and management. Issues include system effectiveness and efficiency in meeting customer needs, demands and expectations. Introduction to computer-aided tools useful in documentation, analysis, and modeling within contemporary organizations.

IEM 3103 Introduction to Probabilistic Modeling. Prerequisite(s): MATH 2153. Introduction to concepts and models of randomness, which support industrial engineering and engineering management analyses and decision-making. Includes probability models, statistical models and distributions, Markov processes and Little's Law.

IEM 3303 Manufacturing Processes. Lab 3. Prerequisite(s): ENGR 1322 and ENSC 3313. Manufacturing processes used to transform new materials including metals and non-metals into finished goods. Traditional and nontraditional manufacturing processes. Introduction to CAD/CAM. Basic process selection. Metrology and measurement fundamentals.

IEM 3403 Collaborative Engineering Project Management. Prerequisite(s): 2903, 3703. Engineering management and group issues involved in project planning, implementation and topics addressed include project management methodologies and software; teamwork structures, processes, and collaborative technologies; process management, leadership and other team roles.

IEM 3503 Engineering Economic Analysis. Prerequisite(s): MATH 2153. Development and use of time value of money models. Bases for comparison of alternatives, including present worth, annual worth, rate of return and payout period methods. Decision-making among independent, dependent, capital-constrained and unequal-life projects. Replacement, breakeven and minimum cost analyses. Depreciation and depletion methods and their effect on corporate income taxes, leading to after-tax cash flow analysis. Introduction to financial reports.

IEM 3513 Economic Decision Analysis. Prerequisite(s): MATH 2123. Quantitative evaluation of investment alternatives for non-engineering majors. The role of interest in economic equivalence and in formulating economic comparisons based on present worth, annual equivalent, rate of return and payout criteria. Accounting, depreciation and income tax considerations. Benefit-cost and cost-effectiveness analysis. Cost estimation and allowance for variance in estimates. *Not available for credit in industrial engineering curriculum.*

IEM 3523 Engineering Cost Information and Control Systems. Prerequisite(s): MATH 2144. Introduction to basic accounting concepts and operating characteristics of accounting systems relevant to engineering analysis and decision making. Principles of financial and managerial accounting, activity based costing, taxes and depreciation. Emphasis on interpretation and use of accounting information for decision-making.

IEM 3703 Manufacturing and Service Systems and Tools II. Prerequisite(s): ENGR 1111, MATH 2144. Introduction to definition, design, operation, and improvement of systems that produce goods and services. Case studies featuring classical and contemporary issues in industrial engineering and management. Issues include system effectiveness and efficiency in meeting customer needs, demands and expectations. Introduction to computer-aided tools useful in documentation, analysis, and modeling within contemporary organizations.

IEM 3813 Work Design, Ergonomics, and Human Performance. Lab 3. Prerequisite(s): 3103. Evaluation and design of work systems and processes employing humans. Emphasis on simultaneously achieving high productivity and employee health, safety and satisfaction.

IEM 4010 Industrial Engineering Projects. 1-3 credits, max 6. Prerequisite(s): Consent of school head. Special undergraduate projects and independent study in industrial engineering.

IEM 4013* Introduction to Operations Research. Prerequisite(s): 3103, MATH 3263. Introduction to operations research, analytics, and mathematical optimization with an emphasis on topics in linear, integer, and network optimization. Effective model formulation and software solution of strategic, tactical and operational problems encountered in manufacturing, and service industries. Covers the simplex method, duality theory, sensitivity analysis, branch-and bound, network simplex, and Dijkstra's algorithm.

IEM 4020 Undergraduate Engineering Practicum. 1-3 credits, max 4. Prerequisite(s): Consent of IEM adviser, admission to the Professional School of Industrial Engineering and Management and satisfactory completion of at least 12 hours of IEM 3000 or 4000 level courses. Professionally supervised experience in real life problem solving involving industrial projects for which the student assumes a degree of professional responsibility. Activities approved in advance by the instructor. May consist of full or part-time engineering experience, on-campus or in industry, or both, either individually or as a responsible group member. Periodic reports both oral and written required as specified by the adviser.

IEM 4103* Introduction to Quality Control. Prerequisite(s): 3103. Performance excellence in a enterprise, including relationships between industrial engineering and quality control. Statistical quality control concepts to measure, monitor, diagnose, and improve performance at the enterprise level, the operational level, and the project level. Quantitative and qualitative quality tools to solve problems and capture opportunities for improvement.

IEM 4113* Industrial Experimentation. Prerequisite(s): 3103. Analytical methods for the purpose of process improvement. Experimental designs including single, blocked and multiple factors. Introduction to fractional factorial designs, central composite designs, and Taguchi robust designs. Data collection , analysis, and interpretation, including graphical methods, confidence intervals, and hypothesis tests. Multiple linear regression analysis methods. Industrial applications.

IEM 4163 Service Systems and Processes. Prerequisite(s): 3103, 3503, 4613. Design and analysis of service systems and processes from the perspective of industrial engineering and engineering management. Application of basic industrial engineering principles and tools applied to service systems. Basics of service quality and productivity, including metrics, measurement and improvement.

IEM 4203* Facilities and Material Handling System Design. Prerequisite(s): 3303, 3813, 4013, 4713. Design principles and analytical procedures for

determining facility location and location of physical assets within a facility. Introduction to material-handling concepts, technologies and methods. Considerations include production processes, product volume, material flow and information flows.

IEM 4343 Introduction to Micro Devices Assembly. Micro devices assembly. Use of virtual reality in design of micro assembly cells, micro gripping techniques, interactive forces in micro assembly, design of factories to support rapid assembly of micro devices, review of state of the art. Information modeling and virtual reality technology in the context of micro assembly cell design. *No credit for students with credit in 5343.*

IEM 4413* Industrial Organization Management. Prerequisite(s): 2903, 3703. Issues, concepts, theories and insights of engineering management and applications emphasizing effective performance.

IEM 4613* Production Planning and Control Systems. Prerequisite(s): 4013. Concepts of planning and control for production and control systems. Design of operation planning and control systems. Techniques used in demand forecasting, operations planning, inventory control, scheduling, and progress control.

IEM 4623* Introduction to Supply Chain Management. Prerequisite(s): IEM 3103, IEM 4013 and consent of instructor. Introducing basic concepts and methods in supply chain management. Developing managerial insights into supply chain strategies in the global economy. Measuring supply chain performance under dynamic market conditions. *May not be used for graduate credit with IEM 5763.*

IEM 4713* Introduction to Systems Simulation Modeling. Lab 3. Prerequisite(s): 4013. Simulation of discrete-event systems, including problem formulation, translation to a computer model, and use of a model for problem solution as well as concepts of random variable selection and generation, model validation and statistical analysis of results.

IEM 4723* Information Systems Design and Development. Prerequisite(s): 2903, 3703. Information systems development methodologies, modeling methods and software tools for the design and development of information systems. Different phases of system design and implementation. Data modeling using entity-relationship diagrams and process modeling using data flow diagrams, IDEF0 and IDEF3. Introduction to enterprise resource planning systems and their use within different enterprise functional units.

IEM 4893* Fundamentals of Medical Smart Garment Engineering. Prerequisite(s): 90+ hours or Graduate standing. Students will gain elementary knowledge in focus areas of health science, biomedical sensing and analysis, and apparel design necessary to undertake the development of wearable electronic sensing systems. Lecture and laboratory based instruction. *May not be used for degree credit with BIOM 6933, DHM 4043 or IEM 5893.*

IEM 4913 Senior Design Projects. Lab 6. Prerequisite(s): 3403, 3503, consent of instructor; IEM majors only. Student teams work on professional-level engineering projects selected from a wide range of participating organizations. Projects are equivalent to those normally experienced by beginning professionals and require both oral and written reports. Normally taken during student's last semester of undergraduate work.

IEM 4931 Industrial Engineering and Management Seminar. Prerequisite(s): Senior standing. Designed to orient seniors to their professional work environment. Topics include placement procedures, resume construction, interviewing skills, professional dress, graduate school, professional societies and registration, personal management of time and money, and job-related expectations. Taught by senior faculty; utilizes outside speakers.

IEM 4953 Industrial Assessment and Improvement. Prerequisite(s): Senior standing and consent of instructor. Plant assessment and improvement-based concepts, strategies, and tools for manufacturing operations. Emphasis is on small to medium-sized manufacturing operations. Issues include energy, water, waste, quality, and productivity analysis across the organization from a systems perspective. Justification of improvement projects and measurement of results.

IEM 4990 Selected Topics in Industrial Engineering and Management. 1-6 credits, max 6. Prerequisite(s): Consent of instructor. Study of selected contemporary topics in industrial engineering and management, including operations research; quality; manufacturing systems; engineering management; enterprise systems and supply chains; facilities, energy, and environmental management.

IEM 5000* Master's Research and Thesis. 1-6 credits, max 6. Prerequisite(s): Approval of major adviser. Research and thesis for master's students.

IEM 5003* Statistics and Research Methods. Prerequisite(s): STAT 4033 or IEM 3103. Statistical and research methods used in various areas of industrial engineering including problem definition, managing the research process statistical methods and analysis tools, survey vs. experimental research techniques.

IEM 5010* Industrial Engineering Projects. 1-6 credits, max 6. Prerequisite(s): Consent of school head and approval of major adviser. Special graduate projects and independent study in industrial engineering.

IEM 5013* Introduction to Mathematical Programming. Prerequisite(s): 4013 or equivalent. Introduction to mathematical programming with an emphasis on linear programming, integer programming, minimum cost network flows and convex programming. Effective formulation techniques, basic mathematical and algorithmic concepts, and software solution of large-scale industrial engineering problems arising in manufacturing and service applications.

IEM 5020* Graduate Engineering Practicum. 1-3 credits, max 3. Prerequisite(s): Consent of IEM adviser and satisfactory completion of 12 hours of IEM 5000- or 6000-level courses. Professionally supervised experience in real-life problem solving involving projects for which the student assumes a degree of professional responsibility. Activities approved in advance by the instructor and must reflect graduate level analysis. May consist of full or part-time engineering experience, on-campus or in industry, or both, either individually or as a responsible group member. Periodic reports, both oral and written, required as specified by the adviser.

IEM 5023* Optimization Applications. Prerequisite(s): Graduate standing. A survey of various methods of unconstrained and constrained linear and non-linear optimization. Applications of these methodologies using hand-worked examples and available software packages. Intended for engineering and science students. (Same course as CHE 5703, ECEN 5703 & MAE 5703)

IEM 5030* Engineering Practice. 1-9 credits, max 12. Prerequisite(s): Approval of adviser. Professionally supervised experience in a real-life problem involving authentic projects for which the student assumes a degree of professional responsibility. Activities must be approved in advance by the student's adviser. May consist of full or part-time engineering experience, on-campus or in industry, or both, either individually or as a responsible group member. Periodic reports, both oral and written, required as specified by the adviser.

IEM 5033* Linear Optimization. Prerequisite(s): 5013 or equivalent. Mathematical theory of linear programming and the implications for algorithm development. Fundamentals of convex analysis, polyhedral sets, development of the simplex method, Farkas' lemma, development of duality theory, sensitivity analysis, Dantzig-Wolfe decomposition, Benders decomposition, interior point algorithms.

IEM 5043* Nonlinear Optimization. Prerequisite(s): 5033 or equivalent. Mathematical theory and algorithms of nonlinear programming. Convexity, local/global optima, optimality conditions and duality in nonlinear programming and their effect on model and algorithm development. Convex analysis, optimality conditions and algorithms for unconstrained/constrained optimization, Lagrangian duality, relaxation-linearization techniques and interior point algorithms for convex optimization.

IEM 5063* Network Flows & Combinatorial Optimization. Prerequisite(s): IEM 5013 or equivalent. Network flows and combinatorial optimization models, and algorithms with an emphasis on applications in transportation and logistics planning. Covers basics of graph theory and complexity theory; algorithms for shortest paths, max flows and min cut, min cost flows, assignments and matchings, min spanning trees, traveling salesman problem, local search and metaheuristics including simulating annealing, genetic algorithm and tabu search.

IEM 5103* Breakthrough Quality. Prerequisite(s): 4103 and 4113 or equivalents. Structured, systematic approach and advanced statistical and modeling tools to achieve breakthrough improvement across all areas of an enterprise. Rigorous application, integration, and betterment of strategies and tools for improving or redesigning products and processes such that performance gains are noticeably higher or quicker than those achieved under traditional incremental improvement approaches.

IEM 5113* Strategic Quality Leadership. Prerequisite(s): STAT 4013 or equivalent and graduate standing. Quality-related strategies. Critical elements that differentiate high performing organizations from their competitors. Delivering value to customers. Quality leadership, strategic planning, customer value, learning organizations, knowledge management, quality systems and business results.

IEM 5123* Service Quality. Prerequisite(s): STAT 4013 or equivalent. Theory and application of service quality, including characteristics of services (intangibility, heterogeneity, perishability and inseparability of production and consumption), dimensions of service quality, measurement methodologies for service quality and improvement methodologies for service quality. Certification and accreditation processes for service industries.

IEM 5133* Stochastic Processes. Prerequisite(s): MATH 2233, MATH 3013, STAT 5123. Definition of stochastic processes, probability structure, mean and covariance function, the set of sample functions. Renewal processes, counting processes, Markov chains, birth and death processes, stationary processes and their spectral analyses. (Same course as STAT 5133 & MATH 5133)

IEM 5143* Reliability and Maintainability. Prerequisite(s): STAT 4033 or equivalent. Probabilistic failure models of components and systems. Detailed study of reliability measures, and static and dynamic reliability models. Classical and Bayesian reliability testing for point and interval estimation of exponential and Weibull failures. Reliability optimization through allocation and redundancy. Fundamentals of maintainability.

IEM 5153* Process Design and Integration. Prerequisite(s): STAT 4033 or equivalent. Process design, integration, control, and improvement within and between enterprises. Analytical and systems approaches to address physical and statistical characterization of inputs, transformations, and outputs. Modeling

issues, including process mapping, cause and effect analysis, and impact projection. Purpose, linkages, value, leverage, measurement, creativity and leadership.

IEM 5163* Service Systems and Processes. Prerequisite(s): 3103, 3503, 4613. Design and analysis of service systems and processes from the perspective of industrial engineering and engineering management. Application of basic industrial engineering principles and tools applied to service systems. Basics of service quality and productivity, including metrics, measurement, and improvement.

IEM 5203* Facility Location, Warehousing and Freight Transportation. Prerequisite(s): 3503, 4013, and 4203. Analytical models for single and multi facility location problems. Algorithms for network location problems including the median, center and covering problems. A discussion of storage location policies such as dedicated, randomized and class-based and their relationship to the warehouse layout problem. Analysis and design of warehouse material handling systems. Introduction to warehouse management systems, freight movement modeling and transportation infrastructure planning.

IEM 5303* Computer Integrated Manufacturing Systems Design for Higher Volume Products. Prerequisite(s): 4613, 3303 or equivalents. Principles and procedures related to the design, implementation, documentation, and control of manufacturing systems focusing on higher volume, lower product variety production systems. Introduction to product life cycle concepts and the application of computer-aided design and computer-aided manufacturing tools to systems characterized by dedicated production equipment and the need for absolute minimization of unit costs. Product and production system design, analysis, and operation for fixed automation. Operational philosophies and applicable systems concepts, especially those relating to line design, analysis, efficiency, and unit production cost reduction.

IEM 5343* Introduction to Micro Devices Assembly. Prerequisite(s): Graduate standing or consent of instructor. Micro devices assembly. Use of virtual reality in design of micro assembly cells, micro gripping techniques, interactive forces in micro assembly, design of factories to support rapid assembly of micro devices, review of state of the art. Information modeling and virtual reality technology in the context of micro assembly cell design. No credit for students with credit in 4343.

IEM 5350* Industrial Engineering Problems. 1-6 credits, max 6. Prerequisite(s): Approval of major adviser. A detailed investigation into one area of industrial engineering with a required written report.

IEM 5413* Managing the Engineering and Technical Function. Prerequisite(s): 4413 or equivalent industrial experience. Advanced study of the engineering and technical organization. Engineering and technical functions, management process, roles, and activities. Individual study of current technical management issues of student interest.

IEM 5503* Financial and Advanced Capital Investment Analysis. Prerequisite(s): 3503, 4013, STAT 4033 or IEM 3103 or equivalent. An understanding of financial concepts and markets, and an advanced treatment of proper methods of capital project selection under risk and uncertainty. Decision making under capital rationing. Financial environment and valuing securities, representing cash flows, selecting investments, avoiding common pitfalls, evaluating timing consideration, depreciation and corporate taxation, replacement analysis, and incorporating risk and uncertainty.

IEM 5603* Project Management. Prerequisite(s): 4413 or equivalent. A systems approach to planning, organizing, scheduling and controlling projects. The behavioral and quantitative aspects of project management. Importance of working with personnel as well as technology. Project management software utilized.

IEM 5613* Integrated Manufacturing Control Systems. Prerequisite(s): 4613. Advanced treatment of planning and control philosophies and techniques for manufacturing and production systems. Approaches focusing on demand-driven control and achieving competitive advantage through manufacturing. Material requirements planning, capacity planning, shop floor control, master scheduling, production planning and demand management. Just-in-time and the theory of constraints.

IEM 5633* Advanced Production Control. Prerequisite(s): 4013, 4613. Advanced concepts and quantitative techniques used in production planning and control, including demand forecasting using regression, time series analysis, and Box-Jenkins models, mathematical programming approaches, to aggregate planning and disaggregation, static and dynamic scheduling of machines and cells, and independent demand inventory management. Deterministic and stochastic models and their relationship to Just-In-Time and Zero Inventory practices.

IEM 5703* Discrete System Simulation. Discrete-event systems via computer simulation models. Model building and the design and analysis of simulation experiments for complex systems. Application to a variety of problem areas. Use of simulation languages and related software tools.

IEM 5723* Data, Process and Object Modeling. Prerequisite(s): Graduate standing or consent of instructor. Logical and physical models in the analysis, design and improvement of enterprise systems. Structured and object-oriented analysis and design techniques. Data modeling using entity-relationship diagrams and IDEF1x. Data normalization techniques. Process modeling using data flow diagrams, IDEF0, IDEF3, and Petri nets. Object modeling using the unified modeling language (UML).

IEM 5743* Information Systems and Technology. Prerequisite(s): Graduate standing or consent of instructor. For current and potential engineering and technology managers. Knowledge of information systems and technology to lead the specification, selection, implementation, and integration of information technology in manufacturing and service organizations. Management issues involved in the use of information technology in organizations.

IEM 5763* Supply Chain Strategy. Prerequisite(s): 4613 and 5503 or equivalents. Supply chain strategy including the philosophical base of business practice and the analytical base of modeling. Supply chain strategy, including key objectives and financial considerations, supply chain dynamics, supply chain performance measurement, supply chain integration, characteristics of different supply chains and supply chain performance modeling.

IEM 5773* Supply Chain Modeling. Prerequisite(s): 5763 and 5013 or 5033 and 4713 or 5703 or equivalents. Supply chain analysis using different approaches to the supply chain modeling, including the Supply Chain Council's SCOR (Supply Chain Operations Reference) model, optimization and simulation. Specialized software is used to develop each modeling approach.

IEM 5803* Human Factors. Lab 3. Prerequisite(s): Graduate standing and consent of instructor. Human factors theories and concepts and their impact on job and organization design. Evaluation and analysis of human performance in the workplace. System redesign for improved human-machine interaction.

IEM 5813* Performance Measurement Systems. Prerequisite(s): 3813, 4413 or equivalents. Strategies and methods to define, measure, and apply individual, group- and organizational-level performance metrics in a variety of service and production contexts. Implementation and effective use of metrics. Measurement's role in a management system, managerial decision styles and preferences, operational definitions of performance, processes for identifying and applying metrics, performance measurement tools and techniques, data collection, portrayal of quantitative and qualitative information, and the role of computer technology in measurement system application.

IEM 5893* Fundamentals of Medical Smart Garment Engineering. Prerequisite(s): 90+ hours or Graduate standing. Students will gain elementary knowledge in focus areas of health science, biomedical sensing and analysis, and apparel design necessary to undertake the development of wearable electronic sensing systems. Lecture and laboratory based instruction. *May not be used for degree credit with BIOM 6933, DHM 4043 or IEM 4893.*

IEM 5953* Industrial Assessment and Improvement. Prerequisite(s): Senior standing and consent of instructor. Plant assessment and improvement-based concepts, strategies, and tools for manufacturing operations. Small to medium-sized manufacturing operations. Energy, water, waste, quality, and productivity analysis across the organization from a systems perspective. Justification of improvement projects and measurement of results.

IEM 5990* Special Topics in Industrial Engineering and Management. 1-6 credits, max 6. Prerequisite(s): Consent of instructor. Study of selected contemporary topics in industrial engineering and management including operations research; quality and reliability; manufacturing systems; engineering management; enterprise systems and supply chains; facilities, energy, and environmental management.

IEM 6000* Doctoral Research and Dissertation. 1-15 credits, max 30. Prerequisite(s): Approval of major adviser and advisory committee. Independent research for PhD dissertation requirement under direction of a member of the Graduate Faculty.

IEM 6023* Integer Programming. Prerequisite(s): 5033 or equivalent. Theory, algorithms and applications of integer programming. Formulation of binary, pure, and mixed integer linear programs, relaxations, duality, preprocessing, implicit enumeration, branch and bound, cutting plane methods, column generation, Lagrangian relaxation, Benders decomposition; theory of polyhedra, convex hulls and facets, theory of valid inequalities, superaddivity and master polytope, lifting and projection.

IEM 6110* Special Problems in Industrial Engineering. 1-6 credits, max 12. Prerequisite(s): Consent of school head and approval of major adviser. Special problems in industrial engineering and management under supervision of a member of the Graduate Faculty.

IEM 6123* Queuing Systems: Theory and Manufacturing Applications. Prerequisite(s): 5003, STAT 4033, 5133 or consent of instructor. Review of probability, stochastic processes, and Markov chains. Single-server and multi-server exponential queuing models. Queuing models with Poisson arrivals and general service times. Product form queuing network models: open and closed network models, mean value analysis algorithms for closed models, and single class and multiclass models. Approximations for general single server queues and non-product form networks. Applications of queuing models in the performance analysis of transfer lines, automatic assembly systems, and flexible manufacturing systems.

IEM 6133* Dynamic Programming and Stochastic Control. Prerequisite(s): 5013, 5133. Models and solution techniques for problems of sequential decision making under uncertainty. Deterministic discrete-time optimal control, deterministic continuous-time optimal control, stochastic optimal control with perfect state information, stochastic optimal control with imperfect state information, suboptimal control, and infinite horizon problems.

IEM 6990* Advanced Topics in Industrial Engineering and Management. 1-

6 credits, max 6. Prerequisite(s): Consent of instructor. Study of advanced topics in industrial engineering and management including operations research, quality and reliability, manufacturing systems, engineering management, enterprise systems and supply chains, facilities, energy, and environmental management.

Interdisciplinary Toxicology (ITOX)

ITOX 5103* Biochemical Toxicology. Prerequisite(s): Graduate standing; consent of instructor. In-depth overview of biochemical and molecular mechanisms of interactions between exogenous chemicals and living systems. Transport, distribution, elimination and alteration of exogenous chemicals within the body and mechanisms whereby exogenous chemicals disrupt biochemical processes critical for cell/organ/organismal integrity and function. (Same course as VBSC 5103*)

ITOX 5282* Methods of Forensic Science. Advanced-level laboratory course in which students apply knowledge from earlier course work in a hands-on setting and employ fundamental techniques and methods related to forensic biology, forensic microbiology, forensic pathology, and forensic toxicology. (Same course as FRNS 5282*)

ITOX 5303* Organismal Ecotoxicology. Prerequisite(s): Consent of instructor. Comparative study of the major groups of environmental contaminants (e.g. heavy metals, PCB's, insecticides) and an introduction to the basic theories, principles and techniques associated with the study of contaminant fate and effects on organisms. (Same course as ZOOL 4303 and 5303*)

ITOX 5343* Population & Community Toxicology. Prerequisite(s): course in ecology strongly recommended. Examines the exposure of animals to environmental contaminants and resulting effects at the individual through community level. The dynamic nature of exposure to contaminants will be of particular interest in this course. For example, how do the natural history traits of a species either protect it from exposure, or enhance its potential for exposure to contaminants? Topics will range from the historical perspectives to ecotoxicology to study design and risk assessment. (Same course as ZOOL 5343*)

ITOX 5423* Techniques in Environmental Toxicology. Prerequisite(s): organic chemistry or consent of instructor. Practical understanding of modern techniques used to quantify exposure and effects of environmental toxicants. Laboratory topics include gas chromatography, HPLC, atomic absorption spectroscopy, immunoassay, and toxicity testing. (Same course as ZOOL 5423*)

ITOX 5523* Forensic Toxicology. Introduction of fundamental aspects of forensic toxicology and emphasis on major subfields of postmortem forensic toxicology, human performance toxicology and forensic drug testing. Examination of methodologies and analyses associated with these three major subfields. (Same course as FRNS 5523*)

ITOX 5543* Advanced Forensic Toxicology. Prerequisite(s): FRNS 5523*. Familiarizes the student with advanced aspects of forensic toxicology in view of current forensic toxicological trends. Covers risk assessment principles, factors in pharmacokinetics, weapons of mass destruction, and integrating concepts with current applications. (Same course as FRNS 5543*)

ITOX 6213* Toxicology: From Molecules to Ecosystems. Prerequisite(s): Graduate standing; consent of instructor. An integrated systems-based approach to toxicology form molecular, cellular, organ, organismal, and ecological perspective. (Same course as VBSC 6213*)

ITOX 6223* Xenobiotic Disposition. Prerequisite(s): Graduate standing; consent of instructor. Discussion of xenobiotic absorption, distribution, metabolism, and excretion. Analysis of xenobiotic concentration-time data using pharmacokinetic software. (Same course as VBSC 6223*)

ITOX 6543* Neurochemical Toxicology. Prerequisite(s): BIOM 5215*, 5616*. The fundamental aspects of neurochemistry and neurotoxicology using both cellular and molecular approaches in neurotoxicology will be emphasized using the effects of exogenous toxins such as heavy metals, pesticides, solvents, and drugs of abuse and their role in the pathogenesis of neurological toxicity.

ITOX 6820* Selected Topics in Biochemistry. Prerequisite(s): BIOC 5853*. Recent developments in biochemistry. Subject matter varies from semester to semester; students should inquire at the department office before enrolling. (Same course as BIOC 6820*)

International Agriculture (AGIN)

AGIN 5000* Master's Thesis/Report in International Agriculture. 1-6 credits, max 6. For students working on a masters degree in International Agriculture. Independent research and thesis under the direction and supervision of a major professor.

AGIN 5312* Applied Issues in International Agriculture and Natural Resources. Prerequisite(s): Graduate standing or consent of instructor. Applied global issues in international agriculture and natural resource development, including sustainability, food security, trade, project evaluation, and international agricultural institutions. Written and oral reports and discussion of selected topics.

AGIN 5333* Guided Readings in International Agriculture and Natural Resources. Prerequisite(s): Graduate standing or consent of instructor. Understanding of international agricultural development objectives, challenges, and solutions to the most critical problems facing the developing world's food and agricultural systems, through readings of a set of classic and contemporary books and constructing book reports.

AGIN 5353* Advanced Case Studies in Agricultural Marketing and International Development. Prerequisite(s): Consent of instructor. Advanced real world issues in marketing and international development of agricultural and food products. Development of an understanding of issues facing policy makers, producers, consumers, and other groups in examining the costs and benefits of various international marketing, trade and development programs.

AGIN 5800* International Agriculture Internship Experience. 1-6 credits, max 12. Prerequisite(s): Graduate standing or consent of instructor. Students conducting an international internship experience, under the direction and supervision of a faculty member.

AGIN 5990* Advanced Studies in International Agriculture and Natural Resources. 1-12 credits, max 15. Prerequisite(s): Consent of instructor. Individual or small group study and/or research in international agriculture and natural resources.

International Studies (INTL)

INTL 4020 Independent Study. 1-3 credits, max 6. Prerequisite(s): Instructor permission. Directed study in student's area of interest.

INTL 4110 Internship in International Studies. 1-3 credits, max 6. Prerequisite(s): Instructor permission. Internship in International Studies.

INTL 4200 Study Abroad. 1-6 credits, max 6. Prerequisite(s): Consent of instructor and consent of SIS Director of Academic Programs. Academic work abroad on either a group or individual basis.

INTL 5000* Master's Thesis. 1-6 credits, max 6. Prerequisite(s): Graduate standing and consent of adviser. For students studying for a master's degree in international studies under the thesis option.

INTL 5013* Contemporary Issues in International Studies. Prerequisite(s): Enrollment in MS program in International Studies or enrollment in an OSU graduate program and consent of instructor. Examination of major transnational issues and associated problems of international cooperation, including ethnic conflicts, environmental degradation, global standards for human rights, and economic globalization.

INTL 5020* Independent Study. 1-3 credits, max 6.Prerequisite(s): Consent of supervising faculty member. Readings and directed study in student's focus area.

INTL 5043* Politics of the Global Economy. Prerequisite(s): Graduate standing. Theory and practice of international political economics. The patterns and associations between political and market-based processes among nation states. Emphasis on interactions among advanced industrial states, transnational phenomena, and opportunities and pitfalls in north-south relations. (Same as POLS 4043)

INTL 5100* Research in International Studies. 3-6 credits, max 6. Prerequisite(s): Graduate standing. Individually supervised research on topic within the student's focus area for the International Studies Program.

INTL 5110* International Studies in Internship. 1-6 credits. Prerequisite(s): Graduate standing and consent of Director. Individually supervised internships in international career areas.

INTL 5200* Study Abroad. 1-6 credits. Prerequisite(s): Graduate standing, consent of instructor, and consent of SIS Director of Academic Programs. Academic work abroad on either a group or individual basis.

INTL 5223* Culture, History and World Systems. Prerequisite(s): Graduate standing. Study of the impact and influence of culture and history on the development of contemporary world systems with future projections. (Same course as SOC 5223*)

INTL 5233* Global Competitive Environment. Development of a global business strategy for the organization. Issues of highly diversified markets and business environments, global competition, financial markets, and complex organizational relationships. (Same course as MKTG 5233)

Japanese (JAPN)

JAPN 1115 Elementary Japanese I. Pronunciation, conversation, grammar and reading. *Not for native speakers per University Academic Regulation 4.9.*

JAPN 1225 Elementary Japanese II. Prerequisite(s): 1115 or equivalent. Reading, the writing system, culture, grammar, conversation. *Not for native speakers per University Academic Regulation 4.9.*

JAPN 2015 Intermediate Japanese I. Prerequisite(s): 1225 or equivalent proficiency. Oral and written practice of modern Japanese. A continuation of 1225. *Not for native speakers per University Academic Regulation 4.9.*

JAPN 2225 Intermediate Japanese II. Prerequisite(s): 2115 or equivalent proficiency. Oral and written practice of modern Japanese. A continuation of 2115. *Not for native speakers per University Academic Regulation 4.9.*

JAPN 3013 Advanced Japanese Conversation. Prerequisite(s): 2225 or equivalent proficiency. Designed to increase facility and naturalness of delivery in dialogue. Development of general oral and aural proficiency.

JAPN 3133 Readings in Japanese. Prerequisite(s): 2223 or equivalent proficiency. Development of the student's competence in reading a wide variety of materials by contemporary Japanese writers.

Landscape Architecture (LA)

LA 1013 Introduction to Landscape Architecture and Landscape Management. An overview of the fields of landscape architecture and landscape management with an emphasis on the application of artistic and scientific principles of design, planning, and management of natural and built environments.

LA 2213 Visual Communication I for Landscape Architecture. Lab 3. The practice and application of drafting, freehand sketching, design vocabulary, and design concepts to explore, communicate, and represent built and imagined landscapes.

LA 2223 Visual Communication II for Landscape Architecture. Lab 3. Prerequisite(s): 2213. Visual journaling and communication. The practice and application of delineation techniques and computer based multimedia for conveying information and conceptual ideas about landscape through the development of understandable graphic presentations.

LA 2323 Computer-Aided Design. Lab 2. Prerequisite(s): 1013, 2213. Introduction to computer operating systems. Principles of electronic drafting and visual communication techniques related to the landscape for two-dimensional and three-dimensional systems.

LA 2513 (D) Native American Symbolism in Landscape Design. Lab 3. Study of cultural diversity through Native American symbolism and application of these symbols as design elements relating to functional and aesthetic qualities in landscape design.

LA 2523 Garden Design in Harmony with Local Ecology. Lab 3. History, theory, and practice of creating gardens in harmony with local ecology to express aesthetic and cultural values of individuals and societies. Environmental aspects of place related to design form and expression.

LA 3010 Internship in Landscape Architecture. 1-7 credits, max 10. Prerequisite(s): 45 credit hours and consent of internship chairperson. Supervised work experience with approved public or private employers in landscape architecture or related fields. *May not be substituted for other required courses. Graded on a pass-fail basis.*

LA 3112 Landscape Architecture Regional Built Works. Prerequisite(s): 1013. Analysis of various aspects of the landscape architecture profession and designed works with guest speakers. One-day field trips to cities in the region to view landscape architecture built works and visit professional offices. *Required of third year students.*

LA 3315 Studio I: Principles and Theory of Design. Lab 9. Prerequisite(s): 1013, 2223 and 2323. Introduction to basic elements, principles, and theory of design. Exploration of design process, both 2D and 3D form, spatial organization, and temporal nature of landscape. Applied projects in small scale landscape design.

LA 3325 Studio 2: Site Design. Lab 9. Prerequisite(s): 3315. Design process, site inventory and analysis as it relates to physical and social site design. Place making, experiential, behavioral, and environmental considerations among several issues to be examined. Applied projects will focus on residential design, site design and design development.

LA 3673 (H) History and Theory of Landscape Architecture. History and historic styles and approaches to landscape architectural design. Past and present landscape design theory.

LA 3682 Professional Practice and Office Procedure. Ethics, office practice and procedure. Contract documents and specifications relating to landscape architecture.

LA 3884 Landscape Architectural Construction I. Lab 4. Prerequisite(s): 2323, MCAG 2313. Review mechanical drafting and lettering techniques, understanding contours, principles of stormwater runoff, site grading and earthwork calculations, methods of managing stormwater runoff, erosion control, introduction to paving and drainage construction materials, specifications, cost estimating. Semester project covering grading, drainage, cut and fill, stormwater runoff, specifications, and cost estimating. Utilizing Auto CAD and other computer applications.

LA 3894 Landscape Architectural Construction II. Lab 4. Prerequisite(s): 2323, 3884. Advanced grading and drainage, horizontal and vertical roadway alignment, site layout and dimensioning, construction documents, site utilities, engineering properties of soils, introduction to paving and drainage construction materials, introduction to retaining wall design and site lighting. Semester project covering construction documents, site layout and dimensioning, grading and drainage, cut and fill, site utilities, retaining walls, site lighting and cost estimating utilizing Auto CAD and other computer applications.

LA 4034* Landscape Planting Design. Lab 4. Prerequisite(s): 3324, HORT 2313 and 2413. Plants in the landscape as aesthetic and functional elements. Environmental enhancement by and for plants. Preparation of planting sketches, plans and specifications.

LA 4053 (I) International Experience in Landscape Architecture - Japan. Prerequisite(s): Consent of appropriate faculty member. Participation in a formal or informal educational experience related with landscape architecture in Japan.

LA 4063 (I) International Experience in Landscape Architecture - Peru. Prerequisite(s): Consent of appropriate faculty member. Participation in a formal or informal educational experience related with landscape architecture in Peru.

LA 4112 Landscape Architecture National Built Works. Prerequisite(s): 4514 or consent of instructor. Examine issues of the design/build environment, sustainable strategies for land use and rehabilitation, and professional practice while exploring career opportunities for students. Expose students to built works, including sustainably-developed sites, and landscape architectural professional offices with targeted practices and market niches. *Includes 4-6 day out-of-state field trip component.*

LA 4415* Studio 3: Recreation and Open Space Design Lab 9. Prerequisite(s): 3325, 3884. Recreation and play, the interface of nature, human-kind and land ethic. Applied projects will address structured and nature play, active and passive parks, open space planning, and natural landscapes.

LA 4423* Planning and Design for Sustainable Landscapes. Lab 2. Prerequisite(s): 3324. Explore the origins of sustainability as a basis for understanding how to improve the planning and design of natural and cultural environments in the practice of landscape architecture.

LA 4425* Studio 4: Ecological Planning and Community Design Lab 9. Prerequisite(s): 4415, 4894. Environmental assessment/analysis as related to ecological planning and community design. Applied project will focus on new urbanism and community design solutions while addressing environmental and sustainability issues.

LA 4433* Land Use and Community Planning. Prerequisite(s): 3325. The inventory and analysis of natural and man-made landscape resources and their application to land use and community planning within the framework of a municipality's comprehensive plan and regulations.

LA 4453* Principles of Landscape Analysis for Site Design. Prerequisite(s): 2323 and 3325. Analysis of landscapes for design and management decision-making using real-world projects integrating computer-aided design (CAD) and geographic information systems (GIS), aerial photography, and global positioning system (GPS) technologies. Applications will be related to landscape architecture and site design.

LA 4515* Studio 5: Urban Design Lab 9. Prerequisite(s): 4425, 4894. Contemporary urban issues affecting the design process, site master planning, and multi-disciplinary problem solving. Applied project will address influences on urban design, from regional influences to user behavior.

LA 4525* Studio 6: Collaborative Design Lab 9. Prerequisite(s): 4515. Exploration of the dynamics of design teams, professional office environments, and community involvement. This capstone course will apply collaborative comprehensive solutions to community based projects while addressing environmental, social, and economic dynamics.

LA 4573* Recreation Planning. Lab 2. Prerequisite(s): 3324. Theory and methods for small and large scale area planning with emphasis on natural and cultural resources.

LA 4583* Landscape Environmental Planning. Prerequisite(s): 3325. Development of landscape architectural projects in the context of the National Environmental Policy Act (NEPA) and state and local government environmental regulations affecting planned projects encountered by the landscape architect.

LA 4894* Landscape Architectural Construction III. Lab 4. Prerequisite(s): 2323, 3324, 3884. A capstone course utilizing design techniques, computer skills, construction materials, methods and applications for the landscape industry. Detailed computerized construction drawings of pavement, fences, walls, wood structures, irrigation, and water features will be prepared. Comprehensive construction documents are required as a semester project utilizing computer drafting, design and calculation applications.

LA 4990* Landscape Architecture Special Problems. 1-6 credits, max 12. Prerequisite(s): Consent of appropriate faculty member. Landscape architectural related problems.

LA 5110* Advanced Special Problems. 1-12 credits, max 20. Prerequisite(s): Consent of appropriate faculty member. Specific landscape architectural problems.

Latin (LATN)

LATN 1113 Elementary Latin I. The rudiments of beginning Latin: grammar, vocabulary and elementary readings.

LATN 1223 Elementary Latin II. Prerequisite(s): 1113 or equivalent proficiency. Continuation of 1113. Grammar, vocabulary and readings.

LATN 2113 Elementary Latin III. Prerequisite(s): 1223 or equivalent. A continuation of 1223. Grammar and readings of Latin authors.

LATN 2213 Intermediate Readings. Prerequisite(s): 2113 or equivalent proficiency. Readings from Virgil's Aeneid.

LATN 3330 Advanced Readings in Latin. 1-6 credits, max 9. Prerequisite(s): 2213. Prose authors, poetry, and medieval Latin.

LATN 4113 (H) Latin Literature in Translation. Readings of significant works from Latin literature in English translation, from the late Republic through the early Christian era. Readings and classes conducted in English.

Legal Studies in Business (LSB)

LSB 1113 Law in Society. Forms and types of law and their evolution, including antitrust, ecology, consumerism and civil rights. Political, social and economic forces affecting legal developments. Legal needs of society and the probable future direction of the law.

LSB 3010 Special Topics in Legal Studies in Business. 1-3 credits, max 6. Prerequisite(s): 3213, prior consent of instructor. Analysis of a contemporary topic in business law. Changing social issues and trends in legal studies in business.

LSB 3213 Legal and Regulatory Environment of Business. Prerequisite(s): Junior standing. General concepts regarding the nature of the legal system, ethical issues in business decision making, dispute resolution processes, basic constitutional limitations on the power of government to regulate business activity, the nature of government regulation, fundamental principles of tort and contract law.

LSB 4323 Law of Commercial Transactions and Debtor-Creditor Relationships. Prerequisite(s): 3213. Concentrated study of law relating to certain commercial transactions and debtor/creditor relationships. Includes law of sales, negotiable instruments, secured transactions, suretyship and bankruptcy.

LSB 4403 Law and Entrepreneurship. Prerequisite(s): 3213 or permission of instructor. Explores how to recognize and ethically manage legal risks within an emerging enterprise in order to optimize opportunities. Topics include: evaluating appropriate business organizations; understanding alternatives for obtaining capital; using employees to help achieve organizational goals; protecting intellectual property; and complying with the regulatory environment when advertising and marketing a product or service.

LSB 4413* Law of Business Organizations. Prerequisite(s): 3213. General principles of law relating to the formation, operation and termination of various forms of business organizations. Includes a study of the law of agency, partnerships and corporations.

LSB 4423* Employment Law. Prerequisite(s): 3213 or equivalent. Legal foundations of employment in the United States. Contemporary topics relating to the employment environment such as state legislative and judicial limitations on employment at will doctrine, federal legislation relating to equal employment opportunity and affirmative action, fair labor standards, safety in the work place and state workers compensation laws.

LSB 4523* Law of Real Property. Prerequisite(s): 3213 or equivalent. Nature of real property and of the legal transactions relating thereto. Topics may include deeds and conveyancing, landlord-tenant relationships, mortgages, easements, oil and gas interests, types of estates, joint ownership, and legal descriptions.

LSB 4633 (I) Legal Aspects of International Business Transactions. Prerequisite(s): 3213 or equivalent. Legal aspects of operating a business entity engaged in international commerce. Topics may include: foreign business organizations, U.S. taxation of foreign investors, common clauses in transnational contracts, problems of technology transfer on the international market, anti-trust aspects of international business, and jurisdictional problems in resolving disputes.

LSB 5010* Research and Independent Studies. 1-3 credits, max 10. A workshop arrangement or supervised independent study.

LSB 5163* Legal Environment of Business. Prerequisite(s): Admission to a SSB graduate program or consent of MBA director. Legal environment within which business must operate. Nature and source of law, the operation of the judicial system, the operation of administrative agencies, selected Constitutional provisions frequently involved in litigation of business problems, and selected substantive legal areas having a direct relationship with business operation and decision-making.

LSB 5203* Foundations of Issue and Conflict Management. Provides professionals from all fields with the skills necessary to handle conflicts, solve disputes, influence decisions and develop positive interpersonal relationships. It provides an overview of the alternative dispute resolution processes by utilizing readings, research, discussion and role-playing exercises.

LSB 5213* Mediation and Facilitation: Theories and Practice. Prerequisite(s): 5203. This course examines the theories, skills, and boundaries of the mediation and facilitation processes, and analyzes the role of the third party neutral in the intervention and resolution conflicts. Ethical, practical and legal constraints are also addressed.

LSB 5233* Introduction to Arbitration and Litigation. Prerequisite(s): 5203. This course examines the elements and process of arbitration, situations, in which arbitration skills are required, including construction, securities, civil conflicts, labor disputes and commercial contracts. Topics include comparisons to litigation, the role of judicial review and the enforcement of arbitration awards.

LSB 5290* Seminar in Negotiation and Alternative Dispute Resolution. 1-3 credits. Prerequisite(s): Consent of instructor. Individual investigations in the areas of issue and conflict management under the direct supervision of a faculty member.

Leisure (LEIS)

LEIS 1232 Beginning Golf. Lab 2. Theory and practice of basic skills, rules, terminology and etiquette.

LEIS 1242 Beginning Tennis and Racquetball. Lab 2. Theory and practice of tennis and racquetball; basic skills, rules, terminology, and game strategy for singles and doubles play. *No credit for students with credit in 1252.*

LEIS 1252 Beginning Tennis. Lab 2. Theory and practice of basic skills, rules, terminology and game strategy for singles and doubles play. *No credit for students with credit in 1242.*

LEIS 1322 Bowling. Lab 2. Theory and practice of approaches, deliveries, releases and mechanical principles involved in aiming and follow through.

LEIS 1342 Physical Fitness. Lab 2. Theory and practice of aerobic and weight training activities with learning experiences designed to promote physical fitness.

LEIS 1352 Weight Training. Lab 2. Improvement of muscular strength and endurance in the major muscle groups of the body through progressive resistive exercise. Fundamental anatomy, physiology, mechanical principles, methods and techniques as applied to weight training programs.

LEIS 1362 Self Defense. Lab 2. Theory and practice of self defense; scientific principles of gravity and body control over opposing forces, and principles of contest judo.

LEIS 2112 Rock Climbing. Lab 2. Theory and practice in the basics of technical rock climbing, bouldering and spelunking.

LEIS 2122 Backpacking and Hiking. Lab 2. Theory and practice of outdoor skills and leadership techniques for executing and evaluating a wilderness activity.

LEIS 2322 Recreational Dance. Lab 2. Theory and practice of traditional social dances and a variety of "free style" dance forms.

LEIS 5000* Master's Thesis. 1-6 credits, max 6. Prerequisite(s): Consent of major professor. Research in leisure studies for master's degree.

LEIS 5010* Directed Study in Leisure Services. 1-3 credits, max 6. Directed study in leisure and from the profession on topics not included in other courses.

LEIS 5020* Workshop in Leisure Studies. 1-6 credits, max 6. Prerequisite(s): Consent of instructor. Advanced instruction on specialized topic area in leisure studies.

LEIS 5023* Legal Aspects of Health, Physical Education and Leisure Services. The application and interpretation of the law as it applies to teachers, coaches and administrators of health, physical education and leisure services programs.

LEIS 5030* Field Problems in Leisure Studies. 1-6 credits, max 6. Prerequisite(s): Consent of instructor. Applied research within the practice of leisure studies.

LEIS 5073* Therapeutic Recreation and Geriatrics. Prerequisite(s): 2433 or consent of instructor. Role of Therapeutic Recreation (TR) specialists working with the geriatric population. Topics include terminology, etiology, prognosis, assessment, and program development in TR.

LEIS 5403* Interpretation in Leisure Services. Organization and administration of visitor centers and interpretive naturalist programs, philosophic approaches, and methods for interpreting the natural and cultural history of public parks and recreation areas.

LEIS 5413* Organization and Administration of Leisure Services. Systematic approach to problem solving and decision-making for structure, personnel management, finance and program development for leisure service delivery systems.

LEIS 5423* Supervision and Leadership in Leisure Services. Prerequisite(s): Graduate standing. Administrative supervision and leadership in leisure services delivery systems. An examination of theories and practice as it relates to human, programmatic, and facility resources.

LEIS 5433* Current Issues in Leisure Services. Prerequisite(s): Admission to the leisure studies program. Current issues related to the leisure services profession. Investigation, discussion and analysis of contemporary issues.

LEIS 5443* Social Foundations of Leisure Services. Prerequisite(s): Graduate standing. Social, psychological, philosophical and historical foundations of leisure. The impact of social forces on leisure throughout history.

LEIS 5453* Social Psychology of Leisure. Inquiry into the understanding of human behaviors, thoughts and attitudes related to leisure, and the understanding of complex issues related to the social psychology of leisure.

LEIS 5463* Issues in Therapeutic Recreation. Prerequisite(s): LEIS 2433 or professional experience in therapeutic recreation. Current issues in therapeutic recreation with emphasis on accreditation, certification, licensure, quality assurance and ethics.

LEIS 5473* Leisure and Aging. Prerequisite(s): 2433 or consent of instructor.

Overview of the leisure needs and services for older adults, with emphasis upon the delivery system and leisure interventions.

LEIS 5483* Therapeutic Recreation for Persons with Physical Disabilities. Prerequisite(s): 3483 or consent of instructor. Role of therapeutic recreation in the treatment and rehabilitation of individuals with physical disabilities, with emphasis on terminology, prognosis, etiology of specific disabilities, program development and assessment.

LEIS 5493* Therapeutic Recreation in Mental Health and Mental Retardation. Prerequisite(s): 3483 or consent of instructor. Role of therapeutic recreation in mental health with emphasis upon client prognosis and methodologies of treatment programs.

LEIS 6000* Doctoral Dissertation. 1-25 credits, max 25. Required of all candidates for the Doctor of Philosophy degree. Credit is given upon completion of the dissertation.

LEIS 6010* Independent Study in Leisure Studies. 1-6 credits, max 6. Prerequisite(s): Consent of instructor. Supervised readings, research or study of trends and issues related to leisure studies.

LEIS 6013* Professional Issues in Leisure Studies. Prerequisite(s): Admission to the Graduate College. Introduction to higher education issues relevant to professional preparation in leisure studies curricula, including roles of the educator, curriculum development, implementation and management, instructional strategies and accreditation.

LEIS 6020* Leisure Research Colloquium. 1-3 credits, max 6. Prerequisite(s): Doctoral standing. Exploration and presentation of selected topics and research in leisure studies.

LEIS 6023* Special Topics in Leisure Studies. Prerequisite(s): Admission to the Graduate College. Special topics related to recreation, parks and leisure studies. Investigation, discussion and analysis of contemporary topics.

LEIS 6043* Ethical Issues in Health, Leisure, and Human Performance. Prerequisite(s): Admission to the Graduate College. A survey of ethical issues with specific emphasis on health, leisure, and human performance in higher education.

LEIS 6453* Leisure Behavior. The advanced study of leisure and human behavior. Research related to the understanding of how and why humans engage in leisure.

LEIS 6763* Management in Health, Leisure, and Human Performance Settings. Prerequisite(s): Admission to the Graduate College. Essential elements of organizational structures, management issues, functions and styles in public, non-profit and private settings in health, leisure and human performance.

Library Science (LBSC)

LBSC 1011 Library and Internet Information Competencies. Introduction to the organization, retrieval and evaluation of information found in research libraries and on the Internet. Development of information-seeking competencies using both print resources and electronic databases.

LBSC 5013* Library Media Center in the Schools. Effective utilization of the centralized school media center for the teaching-learning process.

LBSC 5113* Selection of Print and Non-Print Materials. Selection, evaluation and use of print and non-print materials including reference materials.

LBSC 5413* Organization of Information. Basic principles of the organization of information in schools. Information and knowledge organization techniques that exist or are emerging and focuses on standards and tools that are used in educational environments.

LBSC 5613* Library Networks and Databases. Introduction to the organization, retrieval and evaluation of information found in research libraries and on the Internet. Development of information-seeking competencies using both print resources and electronic databases.

LBSC 5823* Administration of School Library Media and Technology Programs. Vision of, planning, organizing, policy making, staffing, budgeting, decision-making and evaluating a standards-based school library media or school technology program.

Management (MGMT)

MGMT 3011 Business, Government and Society. Students will be exposed to topics in business sustainability including ethics and corporate responsibility; social environment and stakeholders; natural environment and externalities; and the regulatory environment.

MGMT 3013 Fundamentals of Management. Survey of management principles and techniques. Examines a variety of issues at individual, team and organizational levels and challenges faced by today's managers.

MGMT 3023 Management of Sustainable Enterprises. Students will be introduced to the social and natural environments and threats to sustainability. The course will cover the external drivers of sustainability as well as internal responses to these pressures. *Students may not take both MGMT 3023 and MGMT 5023* for credit.*

MGMT 3123 Managing Behavior and Organizations. Prerequisite(s): 3013. Focuses on the complexities of human behavior in organizational settings. Performance expectations and determinants at the individual, team and organizational levels are examined. *Priority enrollment is given to management majors.*

MGMT 3133 Developing Leadership Skills. Prerequisite(s): 3013. The study of personal, interpersonal and group factors relating to leadership performance. An integration of the theory and practice of leadership.

MGMT 3313 Human Resource Management. Prerequisite(s): 3013. Policies and practices used in personnel management. Focuses upon the functions of a human resource management department.

MGMT 3943 Sports Management. Prerequisite(s): 3013. Basic management skills necessary in the operation of sport organizations. The social, behavioral and managerial foundations of sport management, public relations, finance, economics, budgeting in the sport industry and managing a sports facility.

MGMT 4011 Crucial Interactions. Examines methods for increasing positive communication between you and organizational members. Crucial conversations are those conversations that we must have. Ways to increase the free-flow of dialogue to maximize benefit from a crucial conversation are discussed. *No credit for students with credit in 5011.*

MGMT 4013 Current Topics in Management and Leadership. Prerequisite(s): 3013. Examination of selected topics representing the most current management and leadership theories and practices.

MGMT 4021 Managing Professional Relationships. The study of political behaviors and ways to use them effectively in order to be successful in your career. Ways to be prepared for political dynamics at work and what you can do to emerge a winner will be discussed. *No credit for students with credit in 5021.*

MGMT 4031 Leading Organizational Change. An introduction to ways of leading change in an organization to keep pace with the economy and the competition. Building an eight step process for developing, selling and implementing change initiatives. *No credit for students with credit in 5031.*

MGMT 4041 Performance Management. A study of the role of a performance management (PM) system in an organization, the basic components of a PM system (standards, measurement, judgment and action), PM methods and performance management interviews and the Balanced Scorecard. *No credit for students with credit in 5041.*

MGMT 4051 Creating Ethical Work Places. An examination of the meaning of ethics in business and human resource management, how ethical, work-related behavior can be maximized, and how ethical organizational cultures facilitate organizational effectiveness. Establishing and critiquing an ethics program and examining your own code of ethics. *No credit for students with credit in 5051.*

MGMT 4061 Managing Confrontations. Crucial confrontations directly address gaps between expectations and performance with a model that ensures individual and team effectiveness. Learn to hold people accountable, master face-to-face performance discussions, motivate without using power, enable without taking over, and move to action. It will improve the quality of your life and of your organization. *No credit for students with credit in 5061.*

MGMT 4063 Management of Corporate Philanthropy. The course is designed as an opportunity for students to learn about the relationship between nonprofit and for-profit organizations, about individual and corporate philanthropy, and possibly to take part in a philanthropic experience.

MGMT 4073 Management and Ethical Leadership. This course focuses on the application and evaluation of real-life ethical dilemmas using ethical decision-making models. Students will evaluate personal value systems, individual, leadership driven, organizational, and community ethical issues. *Students may not take both MGMT 4073 and MGMT 5073* for credit.*

MGMT 4083* Corporate and Social Responsibility. Prerequisite(s): 3013. Management of situations to minimize adverse consequences and serve an organization's best interests.

MGMT 4093 Management of Non-Profit Organizations. Students will be introduced to the role of non-profits in the economy including management systems, strategy, and the interface between non-profits, other businesses and various stakeholders. *Students may not take both MGMT 4093 and MGMT 5093* for credit.*

MGMT 4123* Labor Management Relations. Prerequisite(s): 3013. Labor relations and collective bargaining. Negotiation and administration of labor agreements and employee relations in non-union organizations. Modes of impasse resolution.

MGMT 4133* Compensation Administration. Prerequisite(s): 3313, STAT 2023. Introductory course. Fundamentals of compensation such as the legislative environment, compensation theories, job analysis, job evaluation, wage structures and indirect compensation programs.

MGMT 4143 Preventive Stress Management. Prerequisite(s): 3013. Management to promote eustress (positive stress) and prevent or resolve distress (negative stress) in organizations. Psychophysiology of the stress response and the individual and organizational costs of distress. The principles and methods of preventive stress management.

MGMT 4153 Managing Training and Development. Prerequisite(s): 3313. The role of training and development in organizational sustainability and

competitiveness is examined. Topics include assessing training needs, developing and delivering training, evaluating training effectiveness, and career development. Students develop a training program and trainer skills.

MGMT 4213 (D) Managing Diversity in the Workplace. The American workforce is becoming increasingly more diverse. Successful leaders need to be able to interact with a wide-range of individuals. In this class, students will examine how managers build a successful organization by embracing diversity.

MGMT 4313 Organization for Action. Prerequisite(s): 3013. A behavioral approach to the study of inter-organizational processes and the implementation strategies of firms. Building on Strategic Management and Human Resource Management, from the behavioral science, the study of the cognitive, social, cultural, and political aspects of strategy implementation in simple and complex organizations.

MGMT 4413 Change Management. Prerequisite(s): 3013. Managing organizational change and redesign. The study of organizational change processes and the enhancement of performance through change management. Study of the body of knowledge and applications in this branch of organizational science.

MGMT 4513 Strategic Management. Prerequisite(s): Senior standing or business core classes. Builds on concepts from business core courses to explain the upper management tasks of formulating and implementing strategies that increase organizational performance. Teaching methods may include case analysis and business simulation.

MGMT 4533 Leadership Dynamics. Prerequisite(s): MGMT 3013. Contemporary business challenges require managerial leadership of the highest order. Students will learn about the latest developments in leadership theory and research. Students will also gain experience in putting into action the concepts learned in this class.

MGMT 4573 Managerial Decision Making. Prerequisite(s): 3013. The goal of this course is to help students become more effective decision-makers. It attempts to provide an understanding of decision-making at two levels - the individual and the group. It examines the mechanisms that underlie decision choices, preferences, and judgments, and through this examination, attempt to discover how to improve decision-making processes.

MGMT 4613 (I) International Management. Prerequisite(s): 3013 or 3123. Survey of the organization, planning and management of international operations of business firms. Exploration of major cultural, economic and political systems and their effects on the management function.

MGMT 4623* Small Business Management. Prerequisite(s): 3013 or 3123. Starting and managing a small business.

MGMT 4650 Leadership Issues. 1-6 credits, max 9. Prerequisite(s): 3013. Examination of leadership issues. Specific topics vary from semester to semester.

MGMT 4693* International Human Resource Management. Prerequisite(s): 3013 required, 3133 preferred and LSB 4423 recommended. A comparison of human resource management policies and practices in the United States with those of major U.S. trading partners. Major human resource functions such as planning, staffing, training, compensation, performance appraisal and labor relations. Human resource policies and practices of China, Japan, Mexico, Canada and other countries.

MGMT 4713* Negotiation Essentials. Prerequisite(s): 3013. Fundamentals of effective negotiation and dispute resolution practices. Current theory, strategies and tactics. More effective negotiations and how to secure “win-win” solutions.

MGMT 4743 Advanced Sports Management. Prerequisite(s): 3943. This course builds on the material covered in MGMT 3943. More in-depth coverage is given to selected topics related to managing a sports entity.

MGMT 4750 International Leadership Experience. 3 credits, max 6. This course focuses on developing leadership skills through international travel. Students will learn the skills and values used by leaders in other countries. The cultural and business environment faced by leaders in other countries will also be explored.

MGMT 4813* Staffing Organizations. Prerequisite(s): 3313. Theories and methods of recruiting and selecting employees. Job analysis, human resource planning, recruiting, employment laws, and staffing. Staffing methods such as interviews, references, application blanks, cognitive ability and personality tests and others. Development and critique of a selection plan and conduct of a behavioral interview.

MGMT 4843 Strategic Sport Management. Prerequisite(s): 3943. An in-depth analysis and review of revenue generation in the sport industry. Topics will include past and present examples from many different types of sports, both in the United States and internationally. Revenue generation strategies will be discussed in terms of management planning and decision making.

MGMT 4850 Applied Leadership Studies. 1-6 credits, max 6. Prerequisite(s): 3013. Structured internship of field project with supporting academic study.

MGMT 4883 (I) Multiple Perspectives in Global Management. Prerequisite(s): 3013 or 3123. View of how multinational corporations and cross-border business transactions have an impact on countries, cultures, employees, and ecological systems.

MGMT 4943 (I) International Sports Management. A broad overview of the industry of sports around the globe. The historical, political, cultural, and business influences of sport development and management across the world will be discussed. The similarities and differences in organizational and management strategy from various countries, regions, and continents will also be examined.

MGMT 5011* Crucial Interactions. Examines methods for increasing positive communication between you and organizational members. Crucial conversations are those conversations that we must have. Ways to increase the free-flow of dialogue to maximize benefit from a crucial conversation are discussed. *No credit for students with credit in 4011.*

MGMT 5021* Managing Professional Relationships. The study of political behaviors and ways to use them effectively in order to be successful in your career. Ways to be prepared for political dynamics at work and what you can do to emerge a winner will be discussed. *No credit for students with credit in 4021.*

MGMT 5023* Management of Sustainable Enterprises. Students will be introduced to the social and natural environments and threats to sustainability. The course will cover the external drivers of sustainability as well as internal responses to these pressures. *Students may not take both MGMT 3023 and MGMT 5023* for credit.*

MGMT 5031* Leading Organizational Change. An introduction to ways of leading change in an organization to keep pace with the economy and the competition. Building an eight step process for developing, selling and implementing change initiatives. *No credit for students with credit in 4031.*

MGMT 5041* Performance Management. A study of the role of a performance management (PM) system in an organization, the basic components of a PM system (standards, measurement, judgment and action), PM methods and performance management interviews and the Balanced Scorecard. *No credit for students with credit in 4041.*

MGMT 5051* Creating Ethical Work Places. An examination of the meaning of ethics in business and human resource management, how ethical, work-related behavior can be maximized, and how ethical organizational cultures facilitate organizational effectiveness. Establishing and critiquing an ethics program and examining your own code of ethics. *No credit for students with credit in 4051.*

MGMT 5061 Managing Confrontations. Crucial confrontations directly address gaps between expectations and performance with a model that ensures individual and team effectiveness. Learn to hold people accountable, master face-to-face performance discussions, motivate without using power, enable without taking over, and move to action. It will improve the quality of your life and of your organization. *No credit for students with credit in 4061.*

MGMT 5073* Management and Ethical Leadership. This course focuses on the application and evaluation of real-life ethical dilemmas using ethical decision-making models. Students will evaluate personal value systems, individual, leadership driven, organizational, and community ethical issues. *Students may not take both MGMT 4073 and MGMT 5073* for credit.*

MGMT 5083* Corporate and Social Responsibility. Ethics and decision-making in corporations. Students will be exposed to managerial responsibility as well as social responsibility at the corporate level. *Students may not take both MGMT 4083 and MGMT 5083* for credit.*

MGMT 5093* Management of Non-Profit Organizations. Students will be introduced to the role of non-profits in the economy including management systems, strategy, and the interface between non-profits, other businesses and various stakeholders. *Students may not take both MGMT 4093 and MGMT 5093* for credit.*

MGMT 5113* Management and Organization Theory. Prerequisite(s): Admission to a SSB graduate program or consent of MBA director. Contemporary theories of organization. Structure and dynamics of organizational goals and environments.

MGMT 5123* Contemporary Management Topics. Prerequisite(s): Admission to a SSB graduate program or consent of MBA director. Examination of selected topics representing the most current management theories and practices.

MGMT 5153* Managing Training and Development. Prerequisite(s): 5113. A study of training development (T&D) concepts and methods. A study of the theories, principles, methods, and related terminology of T&D and their application to T&D problems.

MGMT 5163* Fundraising for Non-Profits. Students will be introduced to the theory and practice of raising external funding for social causes. Course may include exposure external speakers and non-profit executives.

MGMT 5213* Seminar in Organizational Behavior. Prerequisite(s): Admission to MBA program or consent of MBA director. Current research on group behavior in organizations. Group processes and structural factors affecting the interaction process and intra- and intergroup performance characteristics. Laboratory simulation and team research projects used to pursue advanced topics.

MGMT 5223* Seminar in Human Resource Management. Prerequisite(s): Admission to a SSB graduate program or consent of MBA director. Principles, theories and methods of human resource management applied to various types of organizations. Human resource functions of planning, staffing, training and development, performance management, compensation and benefits, safety and health, and labor relations.

MGMT 5303* Corporate and Business Strategy. Prerequisite(s): FIN 5053

or concurrent enrollment. Key issues in formulating and implementing business and corporate strategies. The orientation of top management and diagnosis of what is critical in complex business situations and realistic solutions to strategic and organizational problems.

MGMT 5313* Project Management. Prerequisite(s): Admission to a SSB graduate program or consent of MBA director. The processes and techniques of managing projects in today's business world. The processes of idea generation, needs analysis, implementation, evaluation, and learning. The techniques of team building and conflict resolution in project management.

MGMT 5323* Teams in Organizations. Prerequisite(s): 5113, admission to MBA program or consent of MBA director. The different ways in which organizations use teams. Many aspects of team development and the skills needed to effectively work in a team environment.

MGMT 5443* Building the Effective Organization. Prerequisite(s): 5113, 5513 (concurrent enrollment). The steps involved in building a small to mid-sized business into a well-run organization.

MGMT 5453* Technology Commercialization. Prerequisite(s): Admission to MBA program or consent of MBA director. The steps involved in evaluating and commercializing new technologies. The necessary steps in moving from prototype to product.

MGMT 5500* Special Projects in Management. 1-6 credits, max 9. Structured internship, academic project, or field project on a management topic under the direction of a faculty member.

MGMT 5533* Leadership Challenges. Prerequisite(s): 5113, admission to MBA program or consent of MBA director. Contemporary leadership practices. Leadership as a behavior, not as a position. The challenges of leadership, regardless of position.

MGMT 5553* Management of Technology and Innovation. Prerequisite(s): Admission to a SSB graduate program or consent of MBA director. Business applications of research, practice, and theory in the management of technology and innovation. To improve the effectiveness by which technologies are developed, implemented, and institutionalized. Emphasizes both management with advanced technologies and strategic management of technology.

MGMT 5563* Crisis in Organizations. Prerequisite(s): 5113, admission to MBA program or consent of the MBA director. Management and leadership in the face of crisis, from the smallest mom and pop store to the largest multinational corporation.

MGMT 5613* Business Opportunity Identification and Analysis. Prerequisite(s): Admission to MBA program or consent of MBA director. The techniques required for locating business opportunities, assessing their feasibility, and evaluating their potential returns.

MGMT 5643* Sport Management. Designed to give the student an understanding of the basic management skills necessary in the operation of sport organizations. Topics include the social, behavioral, and managerial foundations of sport management, public relations, finance, economics, and budgeting in the sport industry, and managing a sports facility.

MGMT 5673* Advanced Sport Management. Builds on the material covered in 5643. More in-depth coverage is given to selected topics related to managing a sports entity.

MGMT 5713* Negotiation and Third-Party Dispute Resolution. Prerequisite(s): Admission to a SSB graduate program or consent of MBA director. This course is designed to improve students' personal effectiveness and increase their productivity by drawing on the latest research in the psychology of judgment combined with the art of negotiation and decision-making. Students learn to develop effective strategies and systematic approaches to negotiations and influence opportunities.

MGMT 5743* International Negotiations. Prerequisite(s): Admission to MBA program or consent of MBA director. Improvement of negotiation skills and learn how cultural and national issues affect negotiations.

MGMT 5750* International Leadership Experience. Prerequisite(s): 3 credits, max 6. This course focuses on developing leadership skills through international travel. Students will learn the skills and values used by leaders in other countries. The cultural and business environment faced by leaders in other countries will also be explored.

MGMT 5800* Special Topics in Management. 1-6 credits, max 9. Exploration of emerging management topics. Specific topics will vary from semester to semester.

MGMT 5843* Advanced Strategic Sports Management. Brand management in collegiate sports, the role of collegiate athletics in higher education in the United States, brand management in sports merchandising and entertainment, stadium financing and politics, franchise movement, legal cases, biographical stories, and the role of sports and tourism.

MGMT 5943* Advanced International Sports Management. Historical, political, cultural, and business influences of sport development and management across the world. Emphasis on similarities and differences in organizational and management strategy form various countries, regions and continents.

MGMT 6313* Advanced Organizational Behavior. Prerequisite(s): Doctoral student standing and consent of instructor. Theory and research focusing on individual and group behavior in organizations. Both classic and contemporary topics in organizational behavior, including work attitudes, motivation, job design, leadership, group processes, power and politics, and individual differences.

MGMT 6323* Advanced Strategic Management. Prerequisite(s): Doctoral student standing and consent of instructor. Research concerning the content of organizational strategy and the process through which it is formulated and implemented.

MGMT 6333* MESO Organization Studies. Prerequisite(s): Doctoral student standing and consent of instructor. Integration of macro- and micro-level concepts and topics across individual, group and organizational levels of analysis. Work and organization design, teams and groups, decision-making, and conflict management.

MGMT 6343* Contemporary Research in Management I. Prerequisite(s): Doctoral student standing and consent of instructor. Introduction to the research process in management and building a career as a management scholar.

MGMT 6353* Advanced Methods in Management Research. Prerequisite(s): Doctoral student standing and consent of instructor. Course examines issues in theory building and development, strategies for collecting behavioral research. At conclusion of course, student should be able to: develop research questions, develop appropriate measures for constructs to be tested, and design research study using various methodologies. (Same course as BADM 6353)

MGMT 6363* Advanced Organizational Theory. Advanced organization theory in the field of management research. Analysis of key theoretical contributions within the field of management and related disciplines.

MGMT 6443* Contemporary Research in Management II. Prerequisite(s): Doctoral student standing and consent of instructor. Specialized contemporary topics in management for doctoral students.

MGMT 6453* Advanced Measurement in Management Research. Scale transformations, test construction, scale development, item analysis, reliability testing, validity, EFA/CFA, and regression and endogeneity.

MGMT 6553* Structural Equation Modeling Applications in Business. Prerequisite(s): Doctoral student standing and consent of instructor. Conceptual and statistical underpinnings of structural equation modeling and application to organizational and business research including measurement development and model testing. Recent advances in this technique. Hands-on experience with structural equation modeling software.

Management Science and Information Systems (MSIS)

MSIS 2103 Business Computer Concepts and Applications. Lab 2. Concepts for the design, operation, and use of computer information systems in organizations, including fundamentals of key information technologies, information assurance, and the use of personal computing applications to support problem-solving. Lab-based computer training in fundamental productivity software and Internet tools.

MSIS 2203 Computer Programming for Business. Prerequisite(s): 2103 or equivalent. Computer programming for organizations from the perspective of integrating the Internet into business information systems. Fundamental principles and constructs of programming and applied programming in the business environment.

MSIS 3023 (D) Technology, Diversity and Entrepreneurship. Prerequisite(s): 2103 or consent of instructor. A study of technology, diversity and entrepreneurship. The use of technology as a research tool to study diversity and the opportunities available to diverse groups through entrepreneurship.

MSIS 3103 End User Database Systems Design and Management. Prerequisite(s): 2103 and Non-MIS (or CS) majors only. Use of computer technology and software to represent, manipulate and manage data. Principles and techniques of logical database design and related database concepts. Analysis, design and implementation of a database system using a relational DBMS. *No credit for students in the MIS major.*

MSIS 3123 Information Assurance Management. A broad investigation of the elements of information assurance and security with an emphasis on the management impact to corporations and businesses engaged in the information services and e-commerce. Students should come away from the course with the ability to advise management on the risks and mitigation for all types of threats to information and privacy.

MSIS 3203 Advanced Computer Programming for Business. Prerequisite(s): 2203. Advanced programming features are examined with an emphasis on the development of computer programs for business applications.

MSIS 3223 Operations Management. Prerequisite(s): MSIS 2103, STAT 2023 and MATH 2103 or equivalent. Introductory examination of the management of processes or systems that create goods and provide services. Management decision-making techniques and their application to problems in production and operations management. Decision analysis, forecasting, facility layout, location planning, quality management, inventory planning, and project management.

MSIS 3233 Management Science Methods. Prerequisite(s): 3223 and calculus. Deterministic operations research techniques applied to the resource allocation and operational problems encountered in accounting, economics,

finance, management and marketing. Linear programming, goal programming, integer programming and network models.

MSIS 3243 Managerial Decision Theory. Prerequisite(s): 3223 and calculus. Decision processes under risk and uncertainty. The use of models in business decision-making with outcomes governed by probability distributions. Bayesian decision analysis, utility measurements, game theory, Markov chains, queuing theory, simulation, and inventory models.

MSIS 3333 Database Systems Design, Management and Administration. Prerequisite(s): 2203 and MIS or CS or ACCT majors only. Extensive data modeling implemented and queried using SQL, DDL, and DML. Data integrity and accessibility in a shared network environment. Related database concepts including data warehousing, database security, data and database administration. *Required for MIS majors*.

MSIS 3363 Advanced Management Information Systems Programming. Prerequisite(s): 2203 or equivalent. Programming tools with applications in industry. Advanced programming procedures, processes and algorithms.

MSIS 3393 Advanced Spreadsheet Modeling and Programming. Prerequisite(s): 2103 and permission of instructor. This class provides students with advanced spreadsheet skills, including the ability to formulate math programming models, simulations, risk analysis, and other business decision-making tools. The class will also provide students with an introduction to spreadsheet programming (VB, macros, etc.), building decision support systems in spreadsheets, etc.

MSIS 4003 Systems Analysis and Design. Prerequisite(s): 3333 and 3363. Systems thinking. Systems analysis and design as a profession. Role of the analyst. Systems development methodologies. Requirements analysis. Use of computer-aided software engineering tools (CASE). Modeling of data, processes, and objects. Logical design, interface design and security issues.

MSIS 4010 Applied Management Science and Information System Studies. 1-6 credits, max 6. Prerequisite(s): Consent of department head and MSIS majors only. Structured internship, field study or independent project with supporting academic study.

MSIS 4020 Applications Software Tools and Techniques. 1-3 credits, max 3. Prerequisite(s): 3303, 2203, permission of instructor. Hands-on experience with selected software-based tool or programming languages such as SAP, SQL, PERT/CPM, etc.

MSIS 4033 Information Systems Project Management and Communication. Prerequisite(s): 2103. This class discusses the multi-faceted dimensions critical to successfully leading information systems projects. Topics will include behavioral, strategic, technical, quantitative and communications issues faced by those directing projects.

MSIS 4113 Enterprise Systems and Collaborative Commerce. Prerequisite(s): 2013. Current and emerging management and technical concepts, practices, and tools for information integration and re-engineering of organizational processes. The use of enterprise resource planning tools (ERP II), collaborative commerce, supply chain, business intelligence, and e-business.

MSIS 4133 Information Technologies for Electronic Commerce. Prerequisite(s): 4003. The Internet and web-based technologies, systems and applications that allow organizations to overcome the barriers of time and distance for conducting commerce. Scripting and markup languages, web programming tools, and the connectivity technologies for designing and developing electronic commerce and systems.

MSIS 4233 Applied Information Systems Security. Prerequisite(s): 3123, 4523. An investigation into the various technical aspects of attacking and guarding against attacks and failures in various types of information systems. Course content may vary but will generally include computer, network, and data protection technologies (e.g. firewalls, packet filters, proxy servers, user authentication and validation techniques, encryption, backup methodologies, system and component redundancies, etc.). Various threats and attack methods will be examined.

MSIS 4243 Digital Forensic Analysis. Prerequisite(s): 3123, 4523. Procedures for identification, preservation and extraction of electronic evidence. Auditing and investigation of network and host systems intrusions, analysis and documentation of information gathered, and preparation of expert testimonial evidence. Forensic tools and resources for system administrators and information system security offices. Ethics, law, policy and standards concerning digital evidence.

MSIS 4253 System Certification and Accreditation. Prerequisite(s): 3123. Introduction to the certification and accreditation process. Risk analysis, system security analysis, and other topics.

MSIS 4263 Decision Support and Business Intelligence Applications. Prerequisite(s): 2103. Applied knowledge management tools and techniques for organizational decision support. Knowledge-based systems, decision support systems, and data mining techniques such as inductive learning and neural networks.

MSIS 4273 Legal and Ethical Issues in Information Systems. Prerequisite(s): 3123. Reviews the current status of information systems law in regard to rights of privacy, freedom of information, confidentiality, work product and protection, copyright, security, legal liability, ethical issues, and a range of additional legal and information policy topics. Investigates the legal difficulties that technological innovations are causing in all of these areas. Legal options for dealing with the conflicts caused by technological change and likely adaptations of the law over time in response to societal changes will be explored.

MSIS 4283 Operating Systems for Information Assurance. Operating Systems (OS) concepts for security. Vulnerabilities and threats. Security models. User authentication. Smart cards: architectures, technologies, application environments, and case studies. System availability. Software and data integrity. Auditing. Sensitive data confidentiality. Access control. Secure OS development: design principles, design methodologies, security certification. Case studies: Unix/Linus, MS/Windows XP/2000.

MSIS 4363* Web Application Development. Prerequisite(s): 4003. Develop next-generation, data driven web applications involving database development, server-side business logic, and advanced user interface design.

MSIS 4373* Advanced Topics in Management Information Systems. Prerequisite(s): Senior standing and consent of instructor. Current and emerging advanced topics in the field of management information systems. Advanced network management, advanced electronic commerce issues, international management information systems and legal and regulatory issues in telecommunications.

MSIS 4443* Introduction to Business Dynamics. Prerequisite(s): 2103 and 3223 and STAT 2023. Simulation modeling of business systems, such as inventory, financial management, data communications, information system problems, or other queuing situations. Collection and numerical analysis of associated data model verification and validation, model sustainability, and understanding of simulation as a useful tool in management science and information systems.

MSIS 4523* Data Communication Systems. Prerequisite(s): 2103. Broad coverage of network types and protocols used to drive the diverse voice, video and data needs of today's business. Network vocabulary and the understanding of how telecommunications components function are stressed.

MSIS 4943 Decision-Making Tools for Sports Management. Prerequisite(s): 3223. This course is designed as an elective for MGMT students enrolled in the Sports Management option. Useful decision tools such as statistical inference, decision analysis, mathematical programming, forecasting and simulation are used to address decisions faced by sports administrators and decisions made during sporting contests. Current 'hot' issues in sports decision-making will also be examined.

MSIS 5020* Advanced Applications Software Tools. 1-3 credits, max 3. Advanced hands-on experience with selected software-based tool or programming languages such SAP, SQL, PERT/CPM, etc. *For graduate credit only.*

MSIS 5033* Information Systems Project Management. Prerequisite(s): Consent of MS in MIS director, MSTM director or MBA director. This class covers the important multi-faceted dimensions of directing and leading information systems projects. Topics will include behavioral, strategic, technical and quantitative issues faced by information system project teams.

MSIS 5123* Enterprise Resource Planning. Prerequisite(s): Admission to a graduate program. Challenges of data integration and redesign of processes in organizations. Introduction to enterprise resource planning (ERP) concepts, software, and practices. ERP issues architecture, planning, design, implementation, and project management. Extensions of ERP Technologies for managing supply chains and customer relationships. Emerging trends.

MSIS 5133* Advanced Web Based Application Development. Prerequisite(s): Admission to MBA, MSTM, or MS in MIS program, a programming object-oriented language and 5643 or instructor consent. Development of n-tier web-based applications, including concepts and technologies relating to the presentation, business, and data tiers. Technologies include (but are not limited to) browser and other client programming, server-side programming, data tier programming and XML technologies.

MSIS 5223* Object-Oriented Programming Applications for Business. Prerequisite(s): 5643, graduate standing and computer programming proficiency; or consent of MS in MIS director. Object-oriented programming concepts and applications for business in a global environment. Implementation through an appropriate object-oriented programming language.

MSIS 5303* Quantitative Methods in Business. Prerequisite(s): Admission to a SSB graduate program or consent of MBA director; algebra and spreadsheet proficiency required. Application of quantitative techniques to business problems. Linear programming, transportation and assignment models, goal programming, integer programming, and networks.

MSIS 5313* Production Operations Management. Prerequisite(s): Admission to MBA program or consent of MBA director and 5303. The management of operations in manufacturing and service organizations. Production planning, facility location and layouts. Inventory control, waiting line problems and simulation. Project management and quality control. Emphasis is on a management science approach.

MSIS 5393* Advanced Spreadsheet Modeling. Advanced spreadsheet modeling skills critical to business problem solving. Presentation, analysis, solution and communication facets are emphasized.

MSIS 5413* Advanced Management Science. Prerequisite(s): Admission to MBA program or consent of MBA director. Advanced management science methods, with computer applications. Mathematical programming, simulation, forecasting, queuing, Markov processes.

MSIS 5600* Special Projects in Business Information Systems. 1-6 credits, max 6. Prerequisite(s): Consent of MS in MIS director. Study of advanced topics not covered directly in other classes or directed study under the supervision of a faculty member.

MSIS 5613* Advanced Production and Operations Management. Prerequisite(s): 5313 or equivalent; admission to MBA program or consent of MBA director. Production system, including a synthesis of production and management techniques used by operations managers. A computerized management simulation game provides decision-making experience.

MSIS 5623* Information and Network Technology Management. Prerequisite(s): Admission to a SSB graduate program or consent of MBA director. Major principles and impact of information technology from a manager's perspective in relation to the operation and success of businesses in today's global digital economy. Topics include the internet, networks and wireless systems, database management systems, decision support systems, social media and e-business applications.

MSIS 5633* Business Intelligence Tools and Techniques. Prerequisite(s): Admission to MBA, MSTM, or MS in MIS program or consent of instructor. A comprehensive analysis of contemporary business intelligence tools and techniques used in managerial decision-making, including decision support systems, data and text mining, knowledge management, expert systems, neural networks, and other tools and techniques.

MSIS 5643* Advanced Database Management. Prerequisite(s): Admission to the MBA, MSTM or MS in MIS program or consent of instructor. Advanced theoretical and practical foundations of database systems. Brief review of classical issues surrounding design, analysis, and implementation of databases. Overview and use of modern database systems. Current and emerging issues in the database field.

MSIS 5653* Advanced Systems Analysis and Design. Prerequisite(s): Consent of MS in MIS director, MSTM director or MBA director. Systems thinking. Systems life cycle, modeling approaches, methods, tools, and techniques of systems analysis and design for the development of modern organizational information systems.

MSIS 5900* Practicum in Management Information Systems. 1-6 credits, max 6. Prerequisites: Consent of director of and admission to the MS in MIS program. Application of MIS-related methods and skills in a business environment. Integration of knowledge through real-world problem solving situations in organizational contexts.

MSIS 6200* Advanced Topics in Management Information Systems. 3-6 credits, max 12. Prerequisite(s): Doctoral student status and consent of instructor. Special advanced topics in management information systems for doctoral students.

MSIS 6300* Contemporary Topics in MSIS Research. 1-6 credits, max 6. Prerequisite(s): Doctoral standing. In-depth study in one or more topics in the MSIS field. An ongoing conversation about major issues in the field. Topics related to any one of the areas within the broad, interdisciplinary field of management science and information systems, such as management information systems, management science, telecommunications, and operations management.

MSIS 6333* Overview of MSIS Research. Prerequisite(s): Doctoral standing. Recent research studies that fall within the broad, interdisciplinary field of management science and information systems. An introduction to the academic "way of life", focusing on research productivity.

MSIS 6343* Advanced Methods in MSIS Research. Prerequisite(s): Doctoral standing. Development of advanced methodological skills necessary to carry out research in the chosen area of study within the field of MSIS. Skills related to any one of the areas within the broad, interdisciplinary field of management science and information systems, such as management information systems, management science, telecommunications, and operations management. (Same course as BADM 6343)

Marketing (MKTG)

MKTG 3213 Marketing. Prerequisite(s): Minimum of 45 credit hours. Marketing strategy and decision-making. Consumer behavior, marketing institutions, competition and the law.

MKTG 3263 Entrepreneurial Marketing. Prerequisite(s): EEE 3023, MKTG 3213 and completion of business core classes or instructor permission. Examination of the roles of marketing in entrepreneurial ventures and entrepreneurship in the marketing efforts of any organization. Emphasis on marketing as it relates to risk management, resource leveraging and guerrilla approaches. *No credit for students with credit in EEE 5223 or MKTG 5223.* (Same course as EEE 3263)

MKTG 3313 Personal Marketing and Professional Development. The purposes of this course are (1) to provide an understanding of the role of marketing as applied to the individual student and (2) to provide students basic skills necessary for a successful business career. The course will make extensive use of outside speakers (e.g., professional trainers, alumni, recruiters, professors) covering a broad range of topics. In addition, the course will have a strong experiential dimension (both within and outside the classroom).

MKTG 3323 Consumer and Market Behavior. Prerequisite(s): 3213. Qualitative and quantitative analyses of the behavior of consumers; a marketing consideration of the contributions of economics and the behavioral disciplines to consumer behavior.

MKTG 3333 Nonprofit Marketing. Prerequisite(s): 3213. Applied marketing knowledge with attention given to those concepts and methods used in nonprofit marketing.

MKTG 3433 Promotional Strategy. Prerequisite(s): 3213. Promotional policies and techniques and their application to selling problems of the firm.

MKTG 3473 Professional Selling. Prerequisite(s): 3213. Skills to understanding the professional personal selling process. Strong emphasis on the communications function of personal selling. Lecture sessions combined with experiential exercises and role playing.

MKTG 3511 Sales Practicum. Prerequisite(s): 3213, 3513 or concurrent enrollment in MKTG 3513. Students use their work experience, and other resources, to gain a practical understanding of sales marketing. Students must have a sales position (paid or volunteer) where they work at least 100 hours over the course of the semester.

MKTG 3513 Sales Management. Prerequisite(s): 3213. Sales planning and control, organization of the sales department, developing territories, motivating salespersons and control over sales operations.

MKTG 3611 Retailing Practicum. Prerequisite(s): 3213, 3613 or concurrent enrollment in MKTG 3613. Students use their work experience, and other resources, to gain a practical understanding of Retail Marketing. Students must have a retail position (paid or volunteer) where they work at least 100 hours over the course of the semester.

MKTG 3613 Retailing Management. Prerequisite(s): 3213. Applied marketing knowledge, with attention given to those concepts and methods which provide the necessary foundation for a retailing manager.

MKTG 3713 Sports Marketing. Prerequisite(s): 3213, 3323 and 3433. Applied marketing knowledge with attention given to those concepts and methods used in sports marketing.

MKTG 3813 Business to Business Marketing Management. Prerequisite(s): 3213. A strategic overview of the marketing of products and services to business, government and not-for-profit organizations.

MKTG 3993 (I) International Business. Development of international business strategy based on the integration of economic, accounting, financial, management and marketing concepts.

MKTG 4223 Supply Chain Management. Prerequisite(s): 3213. An economic and operational analysis of the physical flow of goods and materials. A system interpretation of marketing channels.

MKTG 4333* Marketing Research. Prerequisite(s): 3213; 3323; STAT 2023. Basic research concepts and methods. Qualitative and quantitative tools of the market researcher.

MKTG 4343 Brand Marketing. Prerequisite(s): 3213 and 3323. Examines the broad topic of brand marketing. Consumers, competitors, the media, and the government all focus on the brand as the basic unit of marketing. Thus some of the most important and exciting elements of modern business involve conceiving, building, and marketing the brand. Important issues such as building and measuring brand equity, brand positioning, brand names and logos, and global branding will be discussed.

MKTG 4443* Social Issues in the Marketing Environment. Prerequisite(s): 3213. Social and legislative considerations as they relate to the marketplace.

MKTG 4550 Problems in Marketing. 1-9 credits, max 9. Prerequisite(s): 3213. Problems in marketing. Specific topics vary from semester to semester.

MKTG 4553 International Marketing. Prerequisite(s): 3213. The conceptual framework for marketing into and from foreign countries. The development of action-oriented strategies with emphasis on the uncontrollable factors that affect marketing decisions in an international setting.

MKTG 4683 Managerial Strategies in Marketing. Prerequisite(s): 3213, 3323 and a minimum of nine credit hours in marketing, ACCT 2103 and 2203, ECON 2103 and 2203, FIN 3113, LSB 3213, MGMT 3013, MSIS 2103. Analysis of the marketing management decision process; marketing opportunity analysis, strategy development, planning and integration with corporate strategy. (Students may not take both MKTG 4683 and MKTG 4693 for degree credit.)

MKTG 4693 Marketing Strategy and Customer-Employee Interactions. Prerequisite(s): 3213, 3323 and a minimum of nine credit hours in Marketing, ACCT 2103 and 2203, ECON 2103 and 2203, FIN 3113, LSB 3213; Requires consent of department to enroll. Analysis of the marketing management decision process with respect to the customer-employee interface; management of frontline employees; marketing opportunity analysis, strategy development, planning and integration with corporate strategy. (Students may not take both MKTG 4683 and MKTG 4693 for degree credit.)

MKTG 4773 Services Marketing. Prerequisite(s): 3213. Conceptual and managerial tools for students who intend to be involved with the marketing of

services. Characteristics of services, listening to customers, managing customer expectations, conceiving and creating service breakthroughs, service quality, positioning of services, managing demand and supply, creating a strategic service vision and designing a customer focused organization to create and retain customers.

MKTG 4850 Applied Marketing Studies. 1-6 credits, max 6. Prerequisite(s): 12 credit hours of marketing and consent of instructor. Structured internship or field project with supporting academic study.

MKTG 4973 New Product Development. Prerequisite(s): 3213, 4333. The elements involved in creating and marketing a successful new product. Qualitative and quantitative methods will analyze data collected from focus groups, including surveys to test a new product concept.

MKTG 4983 Database Marketing. Prerequisite(s): 3213, 3323, MSIS 2103 or consent of instructor. An information-driven process to develop, test, implement, measure, and adopt customized marketing programs and strategies.

MKTG 4993 Electronic Commerce Marketing. Prerequisite(s): 3213, 3433, MSIS 2103 or consent of instructor. Digital interactive tools changing the management of markets. The development and impact of electronic commerce on business and use of interactive (electronic) marketing for building one-to-one relationship with customers.

MKTG 5133* Marketing Management. Prerequisite(s): Admission to a SSB graduate program or consent of MBA director. Consideration at an advanced level of the major elements of marketing from the point of view of the marketing executive. Emphasis on problem solving and decision making; using an interdisciplinary approach. Development of an integrated, comprehensive marketing strategy.

MKTG 5213* Services Marketing. Prerequisite(s): 5133. Services and services marketing with emphasis on services research and services management.

MKTG 5220* Seminar in Marketing. 3 credits, max 9. Prerequisite(s): 5133. Selected topics in marketing. Industrial marketing, product management, strategic marketing planning, international marketing, and services marketing.

MKTG 5223* Entrepreneurial Marketing. Prerequisite(s): Admission to MBA program or instructor permission. Interplay of entrepreneurship concepts and marketing concepts, including the role of marketing in entrepreneurial ventures, and the role of entrepreneurship in a firm's marketing efforts. Emphasis is placed on how to address the significant changes taking place in markets and the modern marketing function. (Same course as EEE 5223)

MKTG 5233* Global Competitive Environment. Prerequisite(s): Admission to a SSB graduate program or consent of MBA director. Development of a global business strategy for the organization. Issues of highly diversified markets and business environments, global competition, financial markets, and complex organizational relationships. (Same course as INTL 5233*)

MKTG 5243* Base SAS Programming for Database Marketing. Prerequisite(s): Admission in any graduate program. Learn basics of SAS programming, data manipulation in SAS environment and applications of SAS tools in the context of database marketing and business management. Class will help students prepare for Base SAS Programming and Advanced SAS Programming Certification Exam.

MKTG 5253* Advanced SAS Programming for Marketing Analytics. Prerequisite(s): MKTG 5243 or consent of instructor. Advanced SAS techniques to create more efficient and powerful SAS programs for analyzing marketing and business data. Extensive use of SQL, Macro along with Arrays, Hash objects and memory control within SAS environment, Helps students prepare for Advanced SAS Programming Certification Exam.

MKTG 5313* Marketing Research Methodology. Prerequisite(s): 5133. Research methodology applied to marketing problems. Measurement, survey research, experimentation, and statistical analysis of data.

MKTG 5500* Current Topics in Marketing Analytics. Prerequisite(s): Admission in any graduate program in business school or consent of instructor. Current topics in marketing analytics such as web analytics, marketing optimization analytics, high-performance analytics, visual analytics, marketing campaign analytics.

MKTG 5553* International Marketing Strategy. Prerequisite(s): 5133. An analysis of marketing in the global environment. Environmental effects on international marketing management and corporate strategy decisions.

MKTG 5613* Seminar in Consumer Behavior. Prerequisite(s): 5133 or consent of instructor. Psychological, sociological, and anthropological theories related to consumer decision processes. Special emphasis on current empirical research in consumer behavior.

MKTG 5733* Introduction to Marketing Analytics. Prerequisite(s): Admission in MBA program or consent of instructor. Analytic tools including exploratory and graphical techniques, variable associations and correlations, regression, ANOVA and other related modeling techniques to improve managerial decision making.

MKTG 5743* Advanced Marketing Analytics. Prerequisite(s): MKTG 5733 or consent of instructor. Advanced analytic tools such as neural networks, decision trees, classification and prediction models to generate deeper customer insights and to improve managerial decision making.

MKTG 5883* Advanced Data Mining Applications. Prerequisite(s): 5963 or permission from instructor. Use advanced data mining tools such as clustering, Self Organizing maps (SOM) and Kohonen Networks, two-stage models, customer attrition and churn models via survival analysis, credit scoring models, etc. In the context of common applications in business management.

MKTG 5963* Data Mining and Customer Relationship Management Applications. Lab 2. Prerequisite(s): 5983 or consent of MBA, MIS/MSIS, MSTM director or assistant director or instructor. Data mining and turning business data into actionable information. Use of various data mining tools such as neural networks, decision trees, classification and prediction algorithms, in the context of most common applications in business-sales, marketing, and customer relationship management (CRM). Use of state-of-the-art industrial strength data mining software to analyze real-world data and make strategic recommendations for managerial actions.

MKTG 5973* New Product Development. Prerequisite(s): Acceptance into the MBA program or consent of the MBA director. Elements involved in creating and selling a successful new product in a complex environment, including internal organizational and external environmental influences.

MKTG 5983* Database Marketing. Prerequisite(s): Consent of MBA, MIS/MSIS, MSTM director or assistant director or instructor. Learn how to manage data, and analyze data using statistical tools such as multiple regression, ANOVA, Logistic regression, etc., and frameworks/models commonly used in database marketing such as RFM, LTV, etc. An overview of basic probability concepts and statistical sampling techniques including hypothesis testing (t-tests), contingency tables and Chi-square analysis will be provided.

MKTG 5993* Digital Business Strategy. Prerequisite(s): Consent of MBA, or MIS/AIS or MSTM director or instructor. Businesses employment of digital technologies to craft a superior and unique value proposition for its customers and strategic partners.

MKTG 6100* Advanced Seminar in Marketing. 1-3 credits, max 6. Prerequisite(s): Consent of instructor and doctoral student standing. Specialized topics in marketing for doctoral students.

MKTG 6323* Seminar in Advanced Consumer Behavior. Prerequisite(s): MKTG 5133 or consent of the instructor. An interdisciplinary course examining empirical and theoretical studies of the factors that influence the acquisition, consumption, and disposition of goods, services, and ideas. Analysis of the psychological, sociological, anthropological, demographic, and regulatory forces that impact consumers. Examination of research methodologies employed to conduct empirical studies of consumer behavior.

MKTG 6413* Advanced Marketing Research. Prerequisite(s): 5983 or 5963 or consent of MBA director or MIS director or instructor. Introduction to the latest empirical marketing research and advanced analytics techniques such as MANOVA, Confirmatory Factor Analysis, Cluster Analysis, Scaling Techniques, Conjoint Analysis and Structural Equation Models.

MKTG 6513* Seminar in Marketing Theory. Prerequisite(s): 5133 or consent of instructor. Development of an evaluation of marketing theory.

MKTG 6683* Seminar in Marketing Strategy. Prerequisite(s): 5133 or consent of instructor. Examination of a broad range of marketing management topics from a strategic perspective. Understanding of content, theory and research methods involved in the development of strategic marketing knowledge.

MKTG 6913* Measurement and Experimental Design. An analysis of measurement issues from both psychometric and marketing perspectives. Scale construction and validation. The design, analysis, and evaluation of marketing experiments.

Mass Communications (MC)

MC 1143 (D,S) Media in a Diverse Society. A study of the media and their effect on our culture, with an emphasis on the media's role in racial, gender and sexual orientation issues in the United States. By analyzing the mass media, we learn to interpret the consequences of the stories they tell. An introductory survey course for majors and non-majors.

MC 2003 Mass Media Style and Structure. Lab 2. Prerequisite(s): ENGL 1213 or 1223 or 1413 with grade of "C" or higher, and departmental majors only. Teaches basic writing skills vital to any career in mass communication. Emphasizes language skills with a focus on the rules of grammar and the meaning of words. Also teaches the basic strategies of information gathering, including how to glean accurate and useful background information from traditional and online sources. Introduces students to the fundamental writing styles and objectives required to convey information in different media. No credit for students with credit in SC 3003.

MC 2023 Electronic Communication. Prerequisite(s): ENGL 1213 or 1223 or 1413 with a grade of "C" or better, and departmental majors only. Introduces students to electronic communication with a series of hands-on projects to develop their skills with basic photography, videography, podcasting and Web page development. Compares the various media platforms and teaches students visual grammar. Students create slide-shows and podcasts, learn to edit video, and develop Web pages using content created in class. No credit for those with prior credit in SC 3023.

MC 3173 (H) History of Mass Communication. Growth and development of mass communication systems in America, with emphasis upon the economic,

social and political interaction of the media.

MC 4143 Ethics and Issues in Mass Communications. Prerequisite(s): 2003 and 2023 with a grade of "C" or better in both; and a minimum grade of 70 on the Language Exam. Students examine classical theories of ethical behavior and their relevancy to professional communicators. Students learn to analyze various moral viewpoints, so they can discern a justifiable system of ethical decision-making. Students apply ethical reasoning and professional codes of conduct to scenarios to determine the most ethical action to take.

MC 4153 (I) International Mass Communication. Examination of the nature and flow of news and information within and among nations, states and societies from a theoretical vantage point grounded in region-specific realities. The political, economic, social, cultural and historical forces determining media practice in a global environment. *No credit for students with credit in 5253.*

MC 4163 Mass Communication Law. Prerequisite(s): 2003 and 2023 with a grade of "C" or better in both; and a minimum grade of 70 on the Language Exam. Major principles of media law by examining the important court decisions, statutory and regulatory enactments in each area of communication law. Relevant constitutional freedoms and legal issues affecting professional communicators and all participants in a self-governing society. Practice applying the law and precedents to specific situations to determine if potential legal problems exist. *No credit for students with credit in 5163.*

MC 4360 Special Problems in Mass Communication. 1-3 credits, max 6. Prerequisite(s): Junior standing, a minimum of 3.0 GPA, or consent of instructor. Independent study and project development to fit the student's field of study.

MC 4733 Responsibility in Mass Communication. Prerequisite(s): 2003 with a grade of "C" or better; and a minimum grade of 70 on the Language Exam. Interaction between mass media and society with emphasis upon the communicator's ethics and responsibilities. *Meets with 5733. No credit for students with credit in 5733.*

MC 4993 Senior Honors Thesis. Prerequisite(s): Departmental invitation, senior standing, Honors Program participation. A guided reading and research program ending with an honors thesis under the direction of a senior faculty member, with second faculty reader and oral examination. *Required for graduation with departmental honors in the School of Media and Strategic Communications.*

MC 5000* Thesis. 1-6 credits, max 6. For mass communication graduate students who are candidates for the master's degree.

MC 5010* Capstone Project or Creative Component. 1-3 credits, max 4. Prerequisite(s): "B " or better in 5113, 5333, and 5651. Capstone research project or creative activity for a mass communication graduate student electing to not write a thesis to complete a master's degree.

MC 5020* Advanced Practicum or Internship in Mass Communication. 1-3 credits, max 3. Prerequisite(s): One semester of graduate course work and consent of instructor. Applied training allowing students to relate theoretical principles to situations in professional settings. Required for students without mass media backgrounds.

MC 5030* Independent Study in Mass Communication. 1-3 credits, max 3. Prerequisite(s): Consent of instructor. Independent study, directed readings or project development in mass communications to fit the student's academic and professional interests.

MC 5113* Methods of Research in Mass Communication. Principles and techniques of research; research planning, design and measurement in mass communication.

MC 5163* Mass Communication Law. Prerequisite(s): 2003 and graduate standing. Major principles of media law by examining the important court decisions, statutory and regulatory enactments in each area of communication law. Relevant constitutional freedoms and legal issues affecting professional communicators and all participants in a self-governing society. Practice applying the law and precedents to specific situations to determine if potential legal problems exist. *Meets with 4163. No credit for students with credit in 4163.*

MC 5223* Mass Communication Research Analysis and Interpretation. Prerequisite(s): 5113. Single- and multi-variate analysis, interpretation and reporting of mass communication research data. Use of computers in research analysis.

MC 5253* International Mass Communication. Examination of the nature and flow of news and information within and among nations, states, and societies from a theoretical vantage point grounded in region-specific realities. The political, economic, social, cultural and historical forces determining media practice in a global environment. *No credit for students with credit in 4153.*

MC 5333* Process and Effects of Mass Communication. Mediating factors that affect interaction of ingredients in the communications process, and how these factors can affect the fidelity of information conveyed.

MC 5383* Media Relations. Prerequisite(s): Graduate standing. Strategies for dealing with the news media. Students will gain hands-on experience in conducting media news conferences, pitching story ideas and preparing themselves and others for dealing with news media interviews. *Meets with SC 4383. No credit for students with credit in SC 4383.*

MC 5520* Specialized Strategic Communication Applications. 3 credits, max 6. Prerequisite(s): 3353 and graduate standing. Professional strategic communications at an advanced level. Strategic communications study of non-profit, corporate, agency, international and other specialized applications. Course content varies by semester. *No credit for students with credit in SC 4520 during the same semester or with the same subtitle.*

MC 5540* Specialized Multimedia Journalism Applications. 3 credits, max 6. Prerequisite(s): Graduate standing. Professional journalism at an advanced level. Special topics in areas such as announcing, performance; political, business, and investigative reporting; advanced layout and design or audio production; feature, column and editorial writing. Course content varies by semester. *Meets with MMJ 4540. No credit for students in MMJ 4540 during the same semester or with the same subtitle.*

MC 5560* Specialized Sports Media Applications. 3 credits, max 6. Prerequisite(s): Graduate standing. Professional sports media at an advanced level. Special topics in areas such as sports media production, announcing, performance; sports feature, column and editorial writing. Course content varies by semester. *Meets with SPM 4560. No credit for students in SPM 4560 during same semester or with same subtitle.*

MC 5603* Integrated Marketing Communication. Prerequisite(s): 2003 and SC 2013 or SC 2183 or MKTG 3213; and graduate standing. Planning and the value of coordinating the various promotional mix elements within a communication campaign to create maximum clarity and impact. Communication elements including advertising, public relations, direct marketing and sales promotion and examine strategies for combining and integrating them into an effective campaign. Theories, models and tools to make better promotional communication decisions. *No credit for students with credit in SC 4603.*

MC 5651* Introduction to Graduate Study in Mass Communications. Prerequisite(s): Graduate standing. Orientation to skills necessary for successful completion of graduate work. Training in library and archival research, academic writing and preparation of research reports, familiarization with theoretical concepts and issues associated with mass communication. Required of all mass communication MS candidates, and prerequisite to MS candidates enrolling in mass communication seminars.

MC 5733* Responsibility in Mass Communication. Prerequisite(s): Graduate standing. Interaction between mass media and society with emphasis upon the communicator's ethics and responsibilities. *Meets with 4733. No credit for students with credit in 4733.*

MC 5753* Media and Elections. Prerequisite(s): Graduate standing. Examination of media's role in the political process with primary emphasis on print and broadcast journalism practices. *Meets with MMJ 4753. No credit for students with credit in MMJ 4753.*

MC 5770* Seminar in Communication Media. 1-3 credits, max 9. Prerequisite(s): Graduate standing. International communication, media history, legal research, new technology, women and the media, television and children, industrial television, and communication research.

MC 5773* Censorship. Prerequisite(s): Graduate standing. A critical examination of historical and contemporary occurrences of censorship from legal, philosophical, political, religious and sociological perspectives. The course will explore the definition of censorship, the common elements found in all forms of censorship, the rationalizations and justifications for censorship, and the consequences and unintended results of censorship. *No credit for students with credit in MMJ 4773.*

MC 5853* Strategic Communication Management. The focus of this course is on an integrated approach to the management of communication in an organization, using theoretical components from both public relations and advertising, but particularly grounded in organizational theory. It highlights 13 themes/issues relevant to strategic communication managers and reviews communication, management, organizational, cultural, philosophical, and paradigm theories.

MC 5863* Managing Multimedia News Outlets. Prerequisite(s): 2003 and graduate standing. Basic issues, concepts, operational procedures and strategies associated with effectively managing media corporations. Examines management operations related to media convergence. Emphasis is placed on making ethical decisions and administrative choices in staffing and content that reflect a community's diversity. *Meets with MMJ 4863. No credit for students with credit in MMJ 4863.*

MC 5883* Advanced Media Management. Prerequisite(s): Graduate standing. Management concerns in four areas of mass communication practice: public relations, advertising, broadcasting and print journalism. Different emphases offered according to student demand or need.

MC 5923* Law and Ethics for Public Relations and Advertising. Prerequisite(s): 5163 and graduate standing. A critical examination of the legal and ethical issues confronting public relations and advertising practitioners. Focus on First Amendment rights of public relations and advertising professionals; the interpretation and application of statutes, regulations and judicial opinions to specific situations; and the application of ethical reasoning and professional codes of conduct to determine the most ethical action. *Meets with JB 4923. No credit for students with credit in JB 4923.*

MC 5953* Strategic Health Communications Campaigns. Prerequisite(s): Graduate standing. The course will focus on theoretical approaches to health message design and the most effective and strategic use of traditional and new media outlets. Students also will review and discuss examples of past

and current health communication campaigns in the United States and around the world. Integrating theory and practice, students will apply these concepts to design strategic communication campaigns for area health agencies and organizations.

Master of Business Administration (MBA)

MBA 5010* Independent Study. 3-6 credits, max 6. Prerequisite(s): Admission to MBA program or consent of MBA director. Investigation of advanced research topics or directed study under the supervision of a faculty member. Consent of MBA Graduate Studies Committee required.

MBA 5100* Professional Development. 1 credit, max 6. Prerequisite(s): Admission to MBA program or consent of MBA director. Career and professional development of MBA students. A blend of guest speakers, projects, and exercises used to better prepare students for advanced business careers.

MBA 5192* Managing Operations and Decision Processes. Prerequisite(s): 5172. Study of concepts of management of production and service operations. Contemporary manufacturing technologies and application of quantitative techniques. Development of analytical skills required to conduct detailed investigations of real-world systems.

MBA 5261* Legal Issues in Business. Prerequisite(s): Admission to MBA program or consent of MBA director. Analysis of the basic concepts of public and private law related to business decisions. Overview of the laws affecting private business relationships including employment law, agency laws, and various forms of business organizations.

MBA 5300* Current Business Topics. 1-6 credits, max 9. Prerequisite(s): Admission to the MBA program or consent of the director. Examination of selected topics representing the most current academic and business concepts.

MBA 5310* Integrative Decision-Making II: Crossing Organizational Boundaries. 2-6 credits, max 6. Prerequisite(s): Consent of MBA director and completion of minimum of 24 MBA credit hours. Identification and analysis of environmental forces affecting an organization's ability to compete and survive. Interaction among all corporate functional units. Development of a comprehensive, integrated plan of action for the firm.

MBA 5400* Business Practicum. 1-3 credits, max 3. Prerequisite(s): Consent of MBA director and completion of 18 MBA credit hours. Application of knowledge and skills developed in MBA functional courses in an organizational environment. Integration of functional concepts, allowing students to experience the adaptation of concepts to fit organizational reality, and assisting students in understanding ways in which their academic training can help organizations.

MBA 5500* Interdisciplinary Inquiry in Business Administration. 1-3 credits, max 9. Prerequisite(s): Admission to a SSB graduate program or consent of MBA director. Investigation of various business problems using an interdisciplinary approach. Courses team taught to ensure problems viewed from varying functional perspectives.

MBA 5990* MBA Applied Business Report. 3-6 credits, max 6. Prerequisite(s): Admission to MBA program or consent of MBA director. Independent investigation of a business problem under the direction of a supervising professor.

Materials Science and Engineering (MSE)

MSE 5000* MS Thesis. Lab 1-6. Prerequisite(s): Graduate standing and permission of instructor. Students will be performing thesis research under the guidance of a thesis advisor. This will involve performing literature search, writing proposal for the research and conducting research in the laboratories. At the end of the course students will present the findings of research to the committee and prepare a thesis for approval by the thesis committee.

MSE 5013* Advanced Thermodynamics of Materials. Prerequisite(s): Graduate standing and permission of instructor. Thermodynamics of materials is important for materials synthesis, stability and performance. The course will cover basic laws of thermodynamics, solution theory, phase equilibrium diagrams and thermodynamics of electrochemical systems.

MSE 5023* Diffusion and Kinetics. Prerequisite(s): Graduate standing and permission of instructor. Diffusion and kinetics are important for materials processing, stability, microstructure evolution and performance. The course will cover basic concepts underlying diffusion and kinetics as they relate to materials behavior. Topics on diffusion, nucleation and growth, spinodal decomposition, reactions involving solid with solids, gases and liquids, and phase transformation will be covered.

MSE 5033* Composite Materials. Prerequisite(s): Graduate standing and permission of instructor. Composites are important for advancing performance and reliability of existing and new products for aerospace, electronics, and medical systems. This course is to introduce fundamental concepts for the design, fabrication and mechanical property evaluation of composites. This includes methods of fabricating fibers, matrices and composites, toughening mechanisms in composites, mechanical properties, and role of interfaces. The focus will be for composites useful at high temperatures.

MSE 5043* Advanced Materials Characterization. Lab 1. Prerequisite(s): Graduate standing and permission of instructor. Advances in materials require availability, training, and proficiency in advanced instrumentation to characterize materials at length scales from macro- to nanometer-scale. This course is to introduce fundamental concepts forming the basis of different equipments, their operation and capability for developing advanced materials. This includes instruments such as SES, TEM, x-ray diffraction, FTIR, AFM, and Nanoindentation. The lectures will be complemented with hands-on experience to students in labs housing these equipments.

MSE 5053* Smart Materials. Prerequisite(s): Graduate standing and permission of instructor. Advances in new technologies rely on the availability of "smart" materials that adapt to environment. Examples include sun-sensor glasses that become dark in sunlight and clear-out when indoors, and shape-memory materials used as stents in human body. In this course, the definition of a smart material and to understand principles of using electrical and other functional properties of materials to create smart systems is covered. Students are also taught to search literature on a suitable topic and work as a group to write a term paper and make a presentation to the class.

MSE 5063* Biomedical Materials. Prerequisite(s): Graduate standing and permission of instructor. The course will discuss about structure, composition, properties, and performance of materials with applications in medical and health science.

MSE 5103* Electrical and Optical Properties of Ceramics. Prerequisite(s): Graduate standing and permission of instructor. Inorganic ceramic materials are useful in many applications because of their electrical, optical, dielectric, and magnetic properties. These are important for advancing performance and reliability of existing and new products for aerospace, electronics and medical systems. This course is to introduce fundamental concepts for the understanding of principles of electrical and optical behaviors of ceramic materials including atomic structure, conduction mechanisms, processing and electrical-optical properties.

MSE 5123* Advanced Composites Manufacturing: Materials, Methods and Applications. Prerequisite(s): Graduate standing and permission of instructor. Covers important topics such as basic concepts and definitions of composite materials, fabrication, structure, properties, and applications of fibrous materials, structure and properties of polymer matrix, metal matrix and ceramic matrix materials, constituent materials, fabrication and repair methods, properties and applications of polymer matrix composites, metal matrix composites, ceramic matrix composites and carbon/carbon composites and markets.

MSE 5133* Solid Oxide Fuel Cells. Prerequisite(s): Graduate standing and permission of instructor. The objective of this course is to introduce fundamental concepts for energy production using solid oxide fuel cells. The course will include fundamentals of solid oxide fuel cells. Efficiency based on thermodynamics will be described. In addition, roles of important materials as electrolyte for oxygen transport, anode and cathodes as electronic conductors, and high temperature seals required for solid oxide fuel cells will be covered. The role of fuel cells in the current and future energy systems will also be described.

MSE 5143* Batteries and Supercapacitors for Energy Storage. Prerequisite(s): Graduate standing and permission of instructor. The objective of this course is to introduce fundamental concepts for energy storage using batteries and supercapacitors. The course will include fundamentals of electrochemical systems/batteries and supercapacitors. Efficiency of storage based on thermodynamics will be described. In addition, role of important materials required in selected battery systems and capacitors will be included. The role of batteries and supercapacitors in the current and future energy storage devices will be described.

MSE 6000 PhD Thesis. Lab 1-30. Prerequisite(s): Graduate standing and permission of instructor. Students will be performing thesis research under the guidance of a thesis advisor. This will involve performing literature search, writing proposal for the research and conducting research in the laboratories. At the end of the course, students will present the findings of the research to the committee and prepare a thesis for approval by the thesis committee.

Mathematics (MATH)

MATH 1483† (A) Mathematical Functions and Their Uses. Prerequisite(s): An acceptable placement score (see http://placement.okstate.edu). Analysis of functions and their graphs from the viewpoint of rates of change. Linear, exponential, logarithmic and other functions. Applications to the natural sciences, agriculture, business and the social sciences.

MATH 1493† (A) Applications of Modern Mathematics. Prerequisite(s): An acceptable placement score (see http://placement.okstate.edu). Introduction to contemporary applications of discrete mathematics. Topics from management science, statistics, coding and information theory, social choice and decision making, geometry and growth.

MATH 1513 (A) College Algebra. Prerequisite(s): An acceptable placement score (see http://placement.okstate.edu). Two years of high school algebra recommended. Quadratic equations, functions and graphs, inequalities, systems of equations, exponential and logarithmic functions, theory of equations, sequences, permutations and combinations. *Combined credit toward a degree for 1513, 1613 and 1715 limited to six hours.*

MATH 1583 (A) Applied Geometry and Trigonometry. Prerequisite(s): A grade of "C" or better in one of 1483 or 1513, or an acceptable placement score

†Updated 1/12/2015 to correct errors in the original printed catalog

(see placement.okstate.edu). Geometry, trigonometry, and their applications to technology and design. Not intended for calculus-bound students.

MATH 1613 (A) Trigonometry. Prerequisite(s): 1513 with grade of "C" or better or an acceptable placement score (see http://placement.okstate.edu). Trigonometric functions, solution of triangles and applications to physical sciences. *Combined credit toward a degree for 1513, 1613 and 1715 limited to six hours.*

MATH 1715 (A) Precalculus. Prerequisite(s): An acceptable placement score (see http://placement.okstate.edu). One year of high school geometry and two years of high school algebra recommended. Includes an integrated treatment of topics from College Algebra and Trigonometry. *Combined credit toward a degree for 1513, 1613 and 1715 limited to six hours. Satisfies the six hour general education Analytical and Quantitative Thought requirement.*

MATH 2103 (A) Business Calculus. Prerequisite(s): A grade of "C" or better in one of 1483 or 1513 or 1715, or an acceptable placement score (see http://placement.okstate.edu). An introduction to calculus in the context of applications to business.

MATH 2123 (A) Calculus for Technology Programs I. Prerequisite(s): 1613 with grade of "C" or better, or 1715 with a grade of "C" or better, or an acceptable placement score (see http://placement.okstate.edu). First semester of a terminal sequence in calculus for students in the School of Technology. Functions and graphs, differentiation and integration with applications.

MATH 2133 (A) Calculus for Technology Programs II. Prerequisite(s): 2123 with a grade of "C" or better. Second semester of a terminal sequence in calculus for students in the School of Technology. Calculus of trigonometric, exponential and logarithmic functions and applications to physical problems.

MATH 2144 (A) Calculus I. Prerequisite(s): 1613 with grade of "C" or better, or 1715 with a grade of "C" or better, or an acceptable placement score (see http://placement.okstate.edu). An introduction to derivatives, integrals and their applications.

MATH 2153 (A) Calculus II. Prerequisite(s): 2144 with grade of "C" or better. A continuation of 2144, including techniques of integration, series and their applications, parametric equations, and polar coordinates.

MATH 2163 Calculus III. Prerequisite(s): 2153 with grade of "C" or better. A continuation of 2153, including differential and integral calculus of functions of several variables and an introduction to vector analysis.

MATH 2233 Differential Equations. Prerequisite(s): 2153 with grade of "C" or better. Methods of solution of ordinary differential equations with applications. First order equations, linear equations of higher order, series solutions and Laplace transforms.

MATH 2910 Special Studies. 1-3 credits, max 6. Prerequisite(s): Consent of instructor. Special subjects in mathematics.

MATH 3013* Linear Algebra. Prerequisite(s): 2153. Algebra and geometry of finite-dimensional linear spaces, linear transformations, algebra of matrices, eigenvalues and eigenvectors.

MATH 3263* Linear Algebra and Differential Equations. An integrated treatment of linear algebra and differential equations. *No degree credit for those with credit in 2233 or 3013.*

MATH 3303 Functions and Modeling. Prerequisite(s): 2153. Models of real-world phenomena using functions, rates of change, basic differential equations, and other concepts from algebra and calculus. Connections between college mathematics, secondary school mathematics, and applications. Includes laboratory assignments.

MATH 3403 Geometric Structures for Early Childhood and Elementary Teachers. Prerequisite(s): 1483, 1493 or 1513. Foundations of geometry for prospective early childhood and elementary educators. Linear and angular measure, polygons and polyhedra, similarity and congruence, geometric constructions, motion and transformations. Class format may emphasize student investigation and discovery, discussion and presentation, and working with mathematical tools. *This course, together with MATH 3603, prepares students for CIED 3153 and 4153 and/or HDFS 3223.*

MATH 3603 Mathematical Structures for Early Childhood and Elementary Teachers. Prerequisite(s): 1483, 1493 or 1513. Foundations of mathematics and number concepts for prospective early childhood and elementary educators. Problem solving, logic, set theory, functions and relations, number systems, number theory, rational numbers, decimals and fractions, exponentiation, probability, and applications. Class format may emphasize student investigation and discovery, discussion and presentation, and working with mathematical tools. *Together with MATH 3403, it prepares students for CIED 3153 and 4153 and/or HDFS 3223.*

MATH 3613* Introduction to Modern Algebra. Prerequisite(s): 3013. An introduction to mathematical reasoning including logical structure of statements, quantifiers, basic set theory and techniques of proof. Modular arithmetic, the Euclidean algorithm, rings and integral domains, polynomial rings.

MATH 3933 Research Methods. Prerequisite(s): 2144; PHYS 1114 or 2014 or 2314, STAT 2013 or 4013. Students perform independent inquiries and learn to combine skills from mathematics and science to solve research problems. Students will design experiments, collect and analyze data, formulate hypotheses, justify conclusions, create mathematical models, read and evaluate the research literature, and write and present research papers. No credit for students with degree credit in BIOL 3933.

MATH 4003* Mathematical Logic and Computability. Prerequisite(s): 3613 or PHIL 3000 or 3003 or consent of instructor. The basic metatheorems of first order logic: soundness, completeness, compactness, Lowenheim-Skolem theorem, undecidability of first order logic, Godel's incompleteness theorem. Enumerability, diagonalization, formal systems, standard and nonstandard models, Godel numberings, Turing machines, recursive functions, and evidence for Church's thesis. (Same course as PHIL 4003*)

MATH 4013* Calculus of Several Variables. Prerequisite(s): 2163 and 3013. Differential and integral calculus of functions of several variables, vector analysis, Stokes' Theorem, Green's Theorem and applications.

MATH 4023* Introduction to Modern Analysis. Prerequisite(s): 2163 and 3613 or consent of instructor. An introduction to the theorems and proofs of one-variable calculus. Properties of the real numbers, sequences and series of constants and functions, limits, continuity, differentiation and integration.

MATH 4033* History of Mathematics. Prerequisite(s): 2153. Early development of mathematics as a science, contributions of Greek mathematics, mathematical advancements of the 17th and 18th centuries, and the mathematics of the 19th and 20th centuries. The emphasis in the course will be on replicating the setting and techniques of the times to understand the nature of a discovery and its relationship to contemporary thought.

MATH 4063 Advanced Linear Algebra. Prerequisite(s): 3013. A rigorous treatment of vector spaces, linear transformations, determinants, orthogonal and unitary transformations, canonical forms, bilinear and hermitian forms, and dual spaces. Meets with 5023. No degree credit for students with credit in 5023.

MATH 4143 Advanced Calculus I. Prerequisite(s): 3013 and 4023. A rigorous treatment of calculus of one and several variables. Elementary topology of Euclidean spaces, continuity and uniform continuity, differentiation and integration. Meets with 5043. *No credit for students with credit in 5043.*

MATH 4153* Advanced Calculus II. Prerequisite(s): 4143. Continuation of 4143. A rigorous treatment of sequences and series of functions, uniform convergence, differentiation and integration of vector-valued functions, and differential forms. Meets with 5053. *No credit for students with credit in 5053.*

MATH 4233* Intermediate Differential Equations. Prerequisite(s): 2233, 3013. Systems of differential equations, series, solutions, special functions, elementary partial differential equations, Sturm-Liouville problems, stability and applications.

MATH 4263* Introduction to Partial Differential Equations. Prerequisite(s): 2163, 2233, 3013. Solution of the standard partial differential equations (Laplace's equation, transport equation, heat equation, wave equation) by separation of variables and transform methods, including eigenfunction expansions, Fourier and Laplace transform. Boundary value problems, Sturm-Liouville theory, orthogenality, Fourier, Bessel, and Legendre series, spherical harmonics.

MATH 4283* Complex Variables. Prerequisite(s): 2163. Properties of complex numbers, analytic functions of a complex variable, contour integrals, Cauchy's Integral Theorem, power series and Laurent series, residues and poles, conformal mapping, and applications.

MATH 4343* Introduction to Topology. Prerequisite(s): 3613. Topological spaces, basic point-set topology, introduction to surfaces and three-manifolds, introduction to knot theory, applications.

MATH 4403* Geometry. Prerequisite(s): 3013, recommended 3613. An axiomatic development of Euclidean and non-Euclidean geometries.

MATH 4453* Mathematical Interest Theory. Prerequisite(s): 2153. Fundamental concepts of financial mathematics including simple and compound interest, inflation, yield rates, and equations of value for annuities, stocks, bonds, and other financial instruments. Determining equivalent measures of interest, determining yield rates, estimating rates of return, amortization.

MATH 4513* Numerical Mathematics: Analysis. Prerequisite(s): 2233, 3013, knowledge of programming or consent of instructor. Machine computing, algorithms, and analysis of errors applied to interpolation and approximation of functions solving equations and systems of equations, discrete variable methods for integrals and differential equations. (Same course as CS 4513)

MATH 4553* Linear and Nonlinear Programming. Prerequisite(s): 2163, 3013. Linear programming, simplex methods, duality, sensitivity analysis, integer programming and nonlinear programming.

MATH 4583* Introduction to Mathematical Modeling. Prerequisite(s): 3013. Techniques of problem solving and mathematical models presented by examples and case studies of applications of mathematics in industrial settings. Oral and written presentation of solutions.

MATH 4590 Professional Practice in Mathematics. Prerequisite(s): 2163, 2233, 3013 and consent of instructor. Experience in applying mathematical principles to solve problems encountered during employment or an internship in business, industry or government. Documentation of solutions through written and oral reports.

MATH 4613 Modern Algebra I. Prerequisite(s): 3613. An introduction to the theory of groups and vector spaces. *Meets with 5003*. No credit for students with credit in 5003.*

MATH 4623 Modern Algebra II. Prerequisite(s): 4613. Continuation of 4613. An introduction to the theory of rings, linear transformation and fields. *Meets with*

5013. No credit for students with credit in 5013.*

MATH 4663* Combinatorial Mathematics. Prerequisite(s): 3013. Counting techniques, generating functions, difference equations and recurrence relations, introduction to graph and network theory.

MATH 4713* Number Theory. Prerequisite(s): 3613. Divisibility of integers, congruencies, quadratic residues, distribution of primes, continued fractions and the theory of ideals.

MATH 4813* Groups and Representations. Prerequisite(s): 3013 and either 3613 or consent of instructor. An introduction to groups, group actions, symmetry groups, representations and characters. Further topics may include infinite symmetry groups, applications to chemistry and physics, and finite isometry groups and geometry.

MATH 4900 Undergraduate Research. 1-4 credits, max 4. Prerequisite(s): Consent of instructor. Directed readings and research in mathematics.

MATH 4910* Special Studies. 1-3 credits, max 9. Prerequisite(s): Consent of instructor. Special subjects in mathematics.

MATH 4950 Problem Solving Seminar. 1-3 credits, max 3. Prerequisite(s): 2233, 3013. The general process of problem solving. Selected problem-solving techniques. Applications to challenging problems from all areas of mathematics.

MATH 4993 Senior Honors Thesis. Prerequisite(s): Consent of instructor, senior standing, Honors Program participation, and one credit hour of HONR 3000 or MATH 4900. A guided reading and research program ending with an honors thesis under the direction of a faculty member, including a public presentation. Required for graduation with departmental honors in mathematics.

MATH 5000* Master's Research and Thesis. 1-6 credits, max 6. Prerequisite(s): Consent of advisory committee. Directed reading and research culminating in the master's report or master's thesis.

MATH 5003* Modern Algebra I. Prerequisite(s): 3613. An introduction to the theory of groups and vector spaces. Meets with 4613. *No credit for students with credit in 4613.*

MATH 5010* Seminar in Mathematics. 1-3 credits, max 12. Prerequisite(s): Consent of instructor. Topics in mathematics.

MATH 5013* Modern Algebra II. Prerequisite(s): 4613 or 5003. Continuation of 5003. An introduction to the theory of rings, linear transformations and fields. *Meets with 4623. No credit for students with credit in 4623.*

MATH 5023* Advanced Linear Algebra. Prerequisite(s): 3013. A rigorous treatment of vector spaces, linear transformations, determinants, orthogonal and unitary transformations, canonical forms, bilinear and hermitian forms, and dual spaces. Meets with 4063. No credit for students with credit in 4063.

MATH 5043* Advanced Calculus I. Prerequisite(s): 3013 and 4023. A rigorous treatment of calculus of one and several variables. Elementary topology of Euclidean spaces, continuity and uniform continuity, differentiation and integration. *Meets with 4143. No credit for students with credit in 4143.*

MATH 5053* Advanced Calculus II. Prerequisite(s): 4143 or 5043. Continuation of 5043. A rigorous treatment of sequences and series of functions, uniform convergence, differentiation and integration of vector-valued functions and differential forms. *Meets with 4153*. No credit for students with credit in 4153.*

MATH 5133* Stochastic Processes. Prerequisite(s): 2233, 3013 and STAT 5123. Definition of stochastic processes, probability structure, mean and covariance function, the set of sample functions, stationary processes and their spectral analysis, renewal processes, counting analysis, discrete and continuous Markov chains, birth and death processes, exponential model, queuing theory. (Same course as IEM 5133* & STAT 5133*)

MATH 5143* Real Analysis I. Prerequisite(s): 4153 or 5053. Measure theory, measurable functions, integration and differentiation with respect to measures.

MATH 5153* Real Analysis II. Prerequisite(s): 5143. Aspects of point set topology: nets, locally compact spaces, product spaces, Stone-Weierstrass theorem. Elementary functional analysis: Hahn-Banach, uniform boundedness, and open mapping theorems, Hilbert spaces. Riesz representation theorems: duals of Lebesgue spaces and spaces of continuous functions.

MATH 5213* Fourier Analysis and Wavelets. Prerequisite(s): 4013 or 4023. Orthogonal series expansions, Fourier series and integrals and boundary value problems. Haar wavelets and multiresolution analysis. Applications.

MATH 5233* Partial Differential Equations. Prerequisite(s): 4013, 4143 and 4233 or consent of instructor. Representation formulas for solutions of transport equation, Laplace's equation, heat equation and wave equation, mean value theorems, maximum principle, Green's functions, characteristics, eigenvalue problems, separation of variables, transform methods, variational methods, general theory of first order equations.

MATH 5243* Ordinary Differential Equations. Prerequisite(s): 4143 or 5043; 4233; 5023. Banach space, contraction mapping principle, existence and uniqueness theorems, linear systems, higher-order linear equations, boundary value and eigenvalue problems, stability and asymptotic behavior, attractors, Gronwall's inequality, Liapunov method.

MATH 5253* Advanced Ordinary Differential Equations. Prerequisite(s): 5243. Selected topics in ordinary differential equations.

MATH 5283* Complex Analysis I. Prerequisite(s): 4143 or 5043. Basic topology of the plane, functions of a complex variable, analytic functions, transformations, infinite series, integration and conformal mapping.

MATH 5293* Complex Analysis II. Prerequisite(s): 5283. Riemann Mapping Theorem, meromorphic functions, analytic continuation, Dirichlet problem, and entire functions.

MATH 5303* General Topology. Prerequisite(s): 4143 or 5043 or consent of instructor. Basic properties of topological spaces and continuous functions, including connectedness, compactness, and separation and countability axioms. Metric, product, and quotient spaces, Urysohn lemma, and Tietze extension theorem.

MATH 5313* Geometric Topology. Prerequisite(s): 4613 or 5003, 5303. Manifolds, complexes, the fundamental group, covering spaces, combinatorial group theory, the Seifert-Van Kampen theorem, and related topics.

MATH 5413* Differential Geometry. Prerequisite(s): 4013 or 4143 or 5043. Differential manifolds, vector fields, differential forms, connections, Riemannian metrics, geodesics, completeness, curvature, and related topics.

MATH 5473* Financial Calculus. Prerequisite(s): 4143 or 5043, STAT 4203 or consent of instructor. Introduction to derivative pricing and market derivatives. Introduction to the Ito-Doeblin calculus and martingales; the martingale properties of Brownian motion, the Black-Scholes-Merton theory as a simple, special case of martingale pricing, market models of modern fixed income pricing. Insurance, hedging, and options.

MATH 5543* Numerical Analysis for Differential Equations. Prerequisite(s): 4233, 4513 or CS 4513. Advanced machine computing, algorithms, analysis of truncation and rounding errors, convergence and stability applied to discrete variables, finite elements, and spectral methods in ordinary and partial differential equations.

MATH 5553* Numerical Analysis for Linear Algebra. Prerequisite(s): 3013, and 4513 or CS 4513. Advanced machine computing, algorithms, analysis of rounding errors, condition, convergence, and stability applied to direct and iterative solution of linear systems of equations, linear least squares problems, and algebraic eigenvalue problems, including LU and QR factorization, conjugate gradients, QR algorithm, and Lanczos method.

MATH 5563* Finite Element Methods for Partial Differential Equations. Prerequisite(s): 4023; 4263; and 4513 or CS 4513 or equivalent. 4143 or 5043 preferred. Theory and practice of finite element methods, including elliptic boundary value problems, weak formulations, the Ritz-Galerkin method, conforming and non-conforming finite elements, error estimates, and numerical experiments.

MATH 5580* Case Studies in Applied Mathematics. 1-3 credits, max 6. Prerequisite(s): 2233, 4013, and knowledge of computer programming. Selected mathematical problems from industry. Independent problem-solving, oral presentation of solutions, and technical report writing. Seminar-style format.

MATH 5593* Methods of Applied Mathematics. Prerequisite(s): 2233, 4013, and knowledge of computer programming. Continuous and discrete techniques in modern applied mathematics. Positive definite matrices, eigenvalues and dynamical systems, discrete and continuous equilibrium equations, least squares estimation and the Kalman filter, potential flow, calculus of variations, network flows, and combinatorics.

MATH 5613* Algebra I. Prerequisite(s): 4613 or 5003. A rigorous treatment of classical results in group theory and ring theory.

MATH 5623* Algebra II. Prerequisite(s): 5613. A rigorous treatment of classical results in module theory and field theory.

MATH 5902* Seminar and Practicum in the Teaching of College Mathematics. Prerequisite(s): Graduate standing in mathematics or consent of instructor. Foundations of college mathematics teaching, including lecturing, grading and exam preparation. Adapting classroom activities to better serve different types of learners. Current trends in mathematics education such as calculus reform, cooperative learning, and technology in the classroom.

MATH 5913* Introduction to Research in Mathematics Education. Prerequisite(s): 3613 or 4023 or equivalent. Examination and critique of research in mathematics education. A comparative study of research design, analysis, and reporting of both qualitative and quantitative research.

MATH 6000* Doctoral Research and Dissertation. 1-9 credits, max 24. Prerequisite(s): Consent of advisory committee. Directed reading and research culminating in the PhD or EdD thesis.

MATH 6010* Advanced Seminar in Mathematics. 1-3 credits, max 12. Prerequisite(s): Consent of instructor and student's advisory committee. Directed reading on advanced topics in mathematics.

MATH 6143* Functional Analysis I. Prerequisite(s): 4613 or 5003 or 5023, 5153, 5303. Theory of topological vector spaces including metrizability, consequences of completeness, Banach spaces, weak topologies, and convexity.

MATH 6213* Harmonic Analysis. Prerequisite(s): 5153, 5283. Classical results giving connections among the size of a harmonic or analytic function on a complex domain, the existence and smoothness of its boundary values, and behavior of the Fourier series; selected extensions, related topics and applications.

MATH 6233* Advanced Partial Differential Equations. Prerequisite(s): 5233 or consent of instructor. Schwarz class, tempered distributions, basic linear functional analysis, Holder spaces, Sobolev spaces, spaces involving time, Sobolev inequalities, existence and regularity theory of second-order elliptic, parabolic, and hyperbolic equations, semigroup theory.

MATH 6283* Several Complex Variables. Prerequisite(s): 5293. Elements of function theory of several complex variables, including extension phenomena, domains of holomorphy, notions of convexity, holomorphic maps, and complex analytic varieties.

MATH 6290* Topics in Analysis. 1-3 credits, max 9. Prerequisite(s): Consent of instructor. Advanced topics in analysis.

MATH 6323* Algebraic Topology I. Prerequisite(s): 5313. Chain complexes, homology and cohomology groups, the Eilenberg-Steenrod axioms, Mayer-Vietoris sequences, universal coefficient theorems, the Eilenberg-Zilber theorem and Kunneth formulas, cup and cap products, and duality in manifolds.

MATH 6390* Topics in Topology. 1-3 credits, max 9. Prerequisite(s): Consent of instructor. Advanced topics in topology.

MATH 6433* Algebraic Geometry. Prerequisite(s): 5623. Affine and projective varieties, dimension, algebraic curves, divisors and Riemann-Roch theorem for curves.

MATH 6453* Complex Geometry. Prerequisite(s): 5283. Complex manifolds, analytic sheaves, differential forms, Dolbeault cohomology, Hodge theory, line bundles, divisors, Kodaira embedding, and vanishing.

MATH 6490* Topics in Geometry. 1-3 credits, max 9. Prerequisite(s): Consent of instructor. Advanced topics in geometry.

MATH 6513* Theoretical Numerical Analysis. Prerequisite(s): 5153, 5543 or CS 5543, and 5553 or CS 5553. An advanced theoretical treatment based on function spaces and operator theory of algorithms for machine computing and analysis of errors.

MATH 6590* Topics in Applied Mathematics. 1-3 credits, max 9. Prerequisite(s): Consent of instructor. Advanced topics in applied mathematics.

MATH 6613* Commutative Algebra. Prerequisite(s): 5623. Commutative rings, exactness properties of modules, tensor products, integral dependence, chain conditions, completions, filtrations, local rings, dimension theory, and flatness.

MATH 6623* Homological Algebra. Prerequisite(s): 5623. Closed and projective classes, resolution and derived functors, adjoint theorem, construction of projective classes in the categories of groups, rings and modules; categories, Abelian categories.

MATH 6690* Topics in Algebra. 1-3 credits, max 9. Prerequisite: consent of instructor. Advanced topics in algebra.

MATH 6713* Analytic Number Theory. Prerequisite(s): 4283 or 5283. Arithmetic functions, Zeta and L functions, distribution of primes and introduction to modular forms.

MATH 6723* Algebraic Number Theory. Prerequisite(s): 5013 or 5623. Number fields, ideal theory, units, decomposition of primes, quadratic and cyclotomic fields, introduction to local fields.

MATH 6790* Topics in Number Theory. 1-3 credits, max 9. Prerequisite(s): Consent of instructor. Advanced topics in number theory.

MATH 6813* Lie Groups and Representations. Prerequisite(s): 4153 or 5053, 4613 or 5003, 5303. Differentiable manifolds, vector fields, Lie groups, exponential map, homogeneous spaces, representations of compact Lie groups, and maximal tori.

MATH 6823* Lie Algebras. Prerequisite(s): 5013 and 5023. Matrix groups, Lie algebras, root systems, structure of semisimple Lie algebras, universal enveloping algebra, and representations of lie algebras.

MATH 6890* Topics in Representation Theory. 1-3 credits, max 9. Prerequisite(s): Consent of instructor. Advanced topics in representation theory.

MATH 6923* Research in Undergraduate Mathematics Education. Prerequisite(s): 5913. Continuation of 5913 with an emphasis on design of research in undergraduate mathematics education. Development of research questions, review of the literature, data collection and analysis, development and evaluation of research proposals, reporting research results.

MATH 6990* Topics in Collegiate Mathematics Education. 1-3 credits, max 9. Prerequisite(s): Consent of instructor. Advanced topics in collegiate mathematics education.

Mechanical and Aerospace Engineering (MAE)

MAE 3013 Mechanical and Aerospace Engineering Analysis. Prerequisite(s): MATH 2233 and ENSC 2123 and ENSC 2613. Setup and solution of equations which govern mechanical engineering systems. Application and solution of the governing equations to describe the steady state or transient behavior of dynamics, mechanics and circuit problems. Linear sets of equations, ODEs and PDEs will be used to describe systems. Solutions may be simplified using complex numbers of Fourier/Laplace transforms. Numerical methods for solutions will be covered. Data analysis, quality control and statistical hypothesis testing will be covered.

MAE 3033 Design of Machines and Mechanisms. Lab 2. Prerequisite(s): ENGR 1332 and MAE 3013 and 3323. Lecture: Study of the position, velocity, acceleration, and static and dynamic force behavior of machines and mechanisms. Analysis and synthesis of linkages and gear trains. Characteristics and selection of power sources, including electric motors, hydraulics, pneumatics and internal combustion engines. Lab: Machine tool safety. Use of common machine tools to build machine components. Use of lecture concepts in designing, building, and testing machines and mechanisms.

MAE 3113 Measurements and Instrumentation. Lab 2. Prerequisite(s): ENSC 2123 and 2613. Application of basic electronic laboratory measurement equipment. Selection and testing of transducers for measurement of displacement, time frequency, velocity, pressure, force, temperature, flow-rate, and vibration, for machine design applications. Considerations of accuracy, uncertainty and repeatability. Design projects involving the use of analog and digital integrated circuits and construction of prototype sensors. Practice in the use of signal processing, including digital filtering and applications of Fast Fourier Transform theory. Practice in the use of computer-based data acquisition systems. Preparation of formal reports, including the presentation of plots, figures and tables.

MAE 3123 Manufacturing Processes. Prerequisite(s): ENSC 2143 and 3313 or equivalent. An introduction to manufacturing processes including the fundamental processes of casting, forging, rolling, extrusion, drawing and metal cutting. Quantitative relationships to identify important parameters which influence a given process.

MAE 3223 Thermodynamics II. Prerequisite(s): ENSC 2213. A continuation of ENSC 2213. Irreversibility and availability, power cycles, refrigeration cycles, mixtures and solutions, chemical reactions, phase and chemical equilibrium, and introduction to compressible flow.

MAE 3233 Heat Transfer. Prerequisite(s): ENSC 3233. Mechanisms of heat transfer. Steady and transient conduction, free and forced convection, heat exchanger design and analysis, radiation and multiphase behavior. Numerical methods, dimensional analysis and boundary layer theory.

MAE 3253 Applied Aerodynamics and Performance. Prerequisite(s): ENSC 3233, MATH 2233. Relevant fluid properties; standard atmospheres; mathematical models of flows about bodies. Characteristic parameters of airfoils and wings. Thin airfoil theory and flows about finite wings. Boundary layers. Propeller theory. Supersonic and hypersonic flows about wings and lifting bodies. Drag polars. Power required for level flight. Rate of climb and descent. Steady turns. Maximum range and endurance. Design applications.

MAE 3293 Compressible Fluid Flow. Prerequisite(s): ENSC 2213, 3233, MATH 2233. Gas flows in one and two dimensions. Basic thermodynamic and dynamic equations. Nozzle and duct flows, choking, plane and oblique shock waves, Prandtl-Meyer expansions, rocket propulsion, frictional high-velocity flows and heat addition effects. Two-dimensional ideal fluid flow, stream function, velocity potential, linearized flows and method of characteristics.

MAE 3323 Mechanical Design I. Prerequisite(s): ENSC 2113, 2143. Introduction to the design process. Consideration of reliability, factors of safety, product liability, and economics. Use of codes, standards, and other design resources. Design stress analysis of mechanical components such as beams, rings, cylinders, and shafts. Analysis of stiffness and deflection of straight and curved beams, columns, and links. Consideration of failure theories for various types of engineering materials. Application of fatigue analyses in the design process.

MAE 3403 Computer Methods in Analysis and Design. Prerequisite(s): ENGR 1412. Application of linear algebra, numerical methods, statistics, and computer methods in the design, analysis, and simulation of mechanical, thermal, and fluid systems.

MAE 3723 Systems I. Prerequisite(s): ENSC 2123, 2613, and MATH 2233. Physical and mathematical modeling of electrical and mechanical dynamic systems. Transient response of first and second-order systems. Laplace transform technique for solving differential equations; transfer functions, frequency response and resonance.

MAE 4010* Mechanical and Aerospace Engineering Projects. 1-6 credits, max 6. Prerequisite(s): Senior standing in MAE and consent of adviser/instructor. Special projects and independent study in mechanical or aerospace engineering.

MAE 4053* Automatic Control Systems. Prerequisite(s): Admission to MAE professional school; 3723 or ECEN 3723. Properties of feedback control systems, mathematical models of basic components, state-variable models of feedback systems, design specifications of control systems, time-domain analysis, stability, stability robustness, transform analysis, frequency domain techniques, root-locus, design of single-input-single-output systems and compensation techniques for engineering systems. (Same course as ECEN 4413*)

MAE 4063* Mechanical Vibrations. Prerequisite(s): Admission to MAE professional school; 3723. Lumped parameter analysis of multi-mode vibrating systems. Analysis techniques including classical analytical methods, matrix methods and numerical methods. Selection and design of vibration isolation systems. Selection of vibration instrumentation. Machine dynamics, including balancing, whirl, nonlinear effects, and self-excited vibrations.

MAE 4213* Spacecraft Design. Prerequisite(s): 3253 and 3113; Admission to MAE professional school. Basic aerospace engineering concepts and spacecraft design. Orbital dynamics, rocket theory and launch vehicle performance, principles of spacecraft stability and control, propulsion systems, aerospace structures, space environments and its effect on spacecraft design (thermal, radiation, magnetosphere and solar wind), atmospheric reentry, thermal management, power systems, telecommunications, cost analysis, spacecraft design.

MAE 4223* Aerospace Engineering Laboratory. Lab 2. Prerequisite(s): Admission to professional school; 3113 and 3253 and 4283. Experimental study of aerospace principles including topics in aeronautics and astronautics. State-of-the-art instrumentation, diagnostic, and computerized data acquisition equipment and techniques applied to experiments including application of low speed wind tunnel testing techniques, rocket propulsion and control-jet experiments, fundamentals of supersonic nozzles, and flight test evaluation of performance, stability, control, and handling qualities of a propeller-driven airplane.

MAE 4243* Propulsion and Power Systems. Prerequisite(s): Admission to MAE professional school, ENSC 3233 and MAE 3293. The study of aerospace power and propulsion engines utilizing a gas as the working fluid. Design and analysis of complete aircraft engine systems and individual components of the aircraft engine. Engine component matching for design using analysis routines, including centrifugal and axial flow turbines and compressors, inlets, diffusers, nozzles, fans, and propellers. Additional propulsion and power systems including chemical and non-chemical rocket motors and other internal combustion and electric motors.

MAE 4263* Energy Conversion Systems. Prerequisite(s): 3233 and 3223; admission to MAE professional school. This course covers the use of renewable and non-renewable energy sources in power production. Energy conversion processes are analyzed, and performance characteristics of components and systems are modeled using modern computational methods. Applications include overall design of conventional Rankine power systems and may also include design of nuclear, solar, wind, wave, thermoelectric, and geothermal energy systems.

MAE 4273* Experimental Fluid Dynamics. Prerequisite(s): Admission to MAE professional school; 3113 and ENSC 3233. Experimental study of basic and applied fluid dynamics systems with comparisons to analytical predictions. Fluid dynamics instrumentation, digital data acquisition and processing, design of facilities and experiments, technical report writing and design project with experimental verification.

MAE 4283* Aerospace Vehicle Stability and Control. Prerequisite(s): Admission to MAE professional school; 3253 and 3723 and ENSC 2123. Motion and control of aerospace vehicles. Derivation of equations of motion for aircraft and spacecraft. Aerodynamic stability derivatives. Static and dynamic aircraft stability and control. Handling qualities. Satellite orbital and attitude dynamics. Satellite attitude control. Design experience for stability and control in aeronautical and astronautical vehicles.

MAE 4313* Advanced Processing of Engineered Materials. Prerequisite(s): Admission to MAE professional school; ENSC 3313. Introduction of novel processing methods for a range of engineered materials, such as electro-slag remelting, vacuum melting, melting to remove tramp elements, precision casting, sintering, hot-pressing, directional solidification, mechanical alloying, liquid infiltration, net-shaped finishing, superplastic forming, sol-gel processing, float glass process, tape laying, microwave processing, laser processing, CVD and PVD, sputtering, ion plating, ultraprecision machining and grinding, polishing and lapping, multilayer coatings, Czhochralski single crystal growth, processing of nanocrystalline materials, engineered surfaces and surface modification, and layer processing for electronic materials.

MAE 4333* Mechanical Metallurgy. Lab 2. Prerequisite(s): Admission to MAE professional school; ENSC 3313. Mechanical deformation processes and strengthening mechanisms in engineering materials. Material failure modes including creep, fatigue, stress corrosion, ductile and brittle fractures.

MAE 4342 Design Projects I. Prerequisite(s): Admission to MAE professional school and 3033, 3113 and 3323. Two-semester design project with team format. Projects are sponsored by a company, agency, or individual. Team members work with sponsors and faculty who serve as mentors in fields related to their topics. Students complete oral presentations, progress reports, and create a professional log book to document their activities and contributions. Topics include safety, patent law, product liability, report writing, and scheduling.

MAE 4344* Design Projects. Prerequisite(s): Admission to MAE professional school; 3233 and 3113 and 3323. Students work in small teams on a semester-long design project sponsored by a company, agency, or individual. Team members work with mentors from sponsors and with faculty members in fields related to their topics. Presentations on safety, patent law, product liability, report writing, oral presentations, scheduling and ideation. Oral presentations, progress reports, and a professional log book documenting personal activity and contributions.

MAE 4352 Design Projects II. Prerequisite(s): Admission to MAE professional school and 4342. Second of two-semester sequence of senior design courses.

MAE 4353* Mechanical Design II. Prerequisite(s): Admission to MAE professional school; 3033 and 3323. Design of power transmission systems, including belts, chains and gears. Selection and application of hydraulic and pneumatic components in machine design applications. Selection of electric motors, actuators, encoders, and related electromechanical components. Design practice in the form of short projects integrating segments of the course.

MAE 4354* Aerospace Systems Design for Mechanical Engineers. Lab 4. Prerequisite(s): Admission to MAE professional school; 3233 and 3113 and 3323. Multidisciplinary design of aerospace vehicles. Multidisciplinary teams that work on a semester-long project that includes the design, construction, and a flight test of an aerospace vehicle optimized for a given set of requirements. Teamwork, leadership and presentation skills emphasized. Students from all appropriate disciplines who wish to participate in this course are encouraged to do so by enrolling in MAE 4010.

MAE 4363* Advanced Methods in Design. Lab 2. Prerequisite(s): Admission to MAE professional school; 3113 and 3323. Analytical and experimental techniques for the analysis of vibration, stress, force and motion. The finite element analysis method is introduced. Strain gages, photoelasticity, force gages, deflection gages, accelerometers and other transducers and methods are used in the laboratory. Projects involve the combined use of advanced analytical and experimental methods to realize optimal designs.

MAE 4374* Aerospace System Design. Prerequisite(s): Admission to MAE professional school, MAE 4243, 4283 and 4513. Multidisciplinary design of aerospace vehicles. Multidisciplinary teams that work on a semester-long project that includes the design, construction, and a flight test of an aerospace vehicle optimized for a given set of requirements. Teamwork, leadership and presentation skills emphasized. Students from all appropriate disciplines who wish to participate in this course are encouraged to do so by enrolling in MAE 4010.

MAE 4513* Aerospace Structures I. Prerequisite(s): Admission to MAE professional school; 3323. Design and analysis of flight structures. Topics from two and three-dimensional elasticity. Behavior of composite materials. Stress and deflection analysis of thin-skinned stiffened structures. Introduction to the finite element method and its applicability in the design process.

MAE 4623* Biomechanics. Prerequisite(s): Admission to MAE professional school; MATH 2163 and ENSC 2143 and ENSC 3233. To introduce non-bioengineering students to the field of biomechanics. This class will serve as a foundation for further biomechanics investigation at senior undergraduate and graduate level. At the end of this class students will be able to apply engineering principles to describe the mechanical properties of biological systems.

MAE 4703* Design of Indoor Environmental Systems. Prerequisite(s): Admission to MAE professional school; 3223 and 3233. Design of heating, ventilating and air conditioning systems. Calculation of heating and cooling loads.

MAE 4713* Thermal Systems Design, Simulation and Optimization. Prerequisite(s): ENSC 3233 and MAE 3233 and 3223 and 3403; admission to MAE professional school. Design, modeling, simulation and optimization of thermal systems. Analysis and modeling of components such as fans, pumps, ducts, pipes, fittings, heat exchangers, compressors, thermal storage equipment.

MAE 4733* Mechatronics Design. Prerequisite(s): Admission to MAE professional school; 3113 and 3403. Design of mechanical and electrical components, including sensors and actuators into an integrated environment using microcontrollers. Software design using an easy-to-program microcontroller embodies the importance of software implementation into the overall engineering system. Design practice with given design projects to build up skills plus an open-ended term design project of the student's choosing.

MAE 5000* Master's Thesis. 1-9 credits, max 9. Prerequisite(s): Graduate standing in MAE and consent of student's adviser. A student studying for a master's degree who elects to write a thesis must enroll in this course.

MAE 5003* Advanced Biomaterials Science and Engineering. Prerequisite(s): Graduate standing or consent of instructor. Engineering issue that are implicit in understanding the interactions of living tissue and processed materials will be introduced. Emphasis is on identifying the processes in which cells interact with surfaces and particulate matter and the outcome of these interactions. Highlighted biological responses will include inflammation and coagulation. Also, biomaterial issues related to drug delivery and tissue engineering will be discussed. (Same course CHE 5263)

MAE 5010* Mechanical and Aerospace Engineering Projects. 1-8 credits, max 8. Project in research assigned by the student's adviser. This course may also be used as a temporary number for new graduate course offerings (3 credit hours).

MAE 5013* Physiological System Analysis for Engineers. Prerequisite(s): Graduate standing or consent of instructor. Introduce the basic physiology concepts used widely in biomedical engineering research; and introduce and develop engineering concepts and approaches for quantitative analysis of physiological systems. Engineering principles of mechanical properties of various tissue and organ systems under normal and diseased conditions. (Same course as CHE 5273)

MAE 5023* Advanced Biofluid Mechanics. Prerequisite(s): Graduate standing or 3233 (or equivalent). From sub-cellular to the organ level, life is supported by mass transfer processes, which encompass everything from free diffusion to the convection of bulk fluids. Therefore, to understand the body's functions, it is necessary to apply the fundamental fluid mechanics and heat transfer laws to physiological systems. Special emphasis will be placed on different length

scales in physiological system, biorheology, conservation laws, mechanical coupling to vessel deformation and relevant physiology.

MAE 5030* Engineering Practice. 1-12 credits, max 12. Prerequisite(s): Graduate standing in MAE and consent of student's adviser. Solution of real-life engineering design and development problems in an actual or simulated industrial environment. Activities include application of design and testing procedures, economic evaluation and periodic oral and written reporting on one or more assigned problems. Activities must be approved in advance by the adviser.

MAE 5033* Advanced Biomedical Engineering. Prerequisite(s): Consent of instructor. Principles and engineering analysis of biomedical processes. Artificial organs, biomaterials, tissue engineering, transport in biological systems, biomedical imaging and drug delivery systems. (Same course as CHE 5293)

MAE 5053* Design of Engineering Experiments. Prerequisite(s): Graduate standing. The purpose of this course is to teach graduate students how to apply statistical methods to the solution of biological and engineering problems. They will learn how to use statistical methods to design experiments, present and analyze experimental data.

MAE 5063* Soft Tissue Mechanics. Prerequisite(s): 3323 or an equivalent course with the consent of the instructor. Introduction to the most commonly used computational techniques for investigating and analyzing the behavior of biological soft tissues. Application of computational methods such as elasticity, viscoelasticity, and poroelasticity for numerically modeling the properties of biomaterials.

MAE 5073* Advanced Mechanical Vibrations. Prerequisite(s): 4063 or consent of instructor. Analysis of nonlinear vibrations, classical analysis of continuous systems and numerical methods.

MAE 5083* Engineering Acoustics. Prerequisite(s): Graduate standing or consent of instructor. Acoustical analysis and measurement techniques, with emphasis on design applications for noise and vibration control in machinery and in buildings.

MAE 5093* Numerical Engineering Analysis. Prerequisite(s): Undergraduate course in computer programming and consent of professor. Practical digital methods for obtaining steady-state and transient solutions to lumped and distributed mechanical, fluid and thermal problems.

MAE 5113* Diffraction in Materials. Prerequisite(s): Graduate standing or consent of instructor. Introduction to crystallography and diffraction with an emphasis on X-ray diffraction, some exposure to Neutron diffraction, radiography and tomography. Applications will focus on mechanical properties measurements. New methods will be surveyed with an emphasis on current research.

MAE 5123* Advanced Material Removal Processes. Prerequisite(s): ENSC 3313 and MAE 3123 and graduate standing or consent of instructor. Understanding the fundamental principles and practice (mechanics and material aspects) of machining and grinding of materials. Historical aspects; physics of metal cutting, mechanics of machining (orthogonal and oblique); shear stress and shear strain in machining, dynamometry; tool materials, tool wear, tool life, and machinability; vibrations in machining; thermal aspects of machining, cutting fluids; economics; surface finish accuracy and surface integrity, and grinding.

MAE 5133* Mechanical Behavior of Materials. Prerequisite(s): ENSC 3313 or equivalent. A unified approach to the behavior and response of engineering materials to applied loads. Mechanical and metallurgical fundamentals of deformation processes. Spatial scales of atomic physics, micromechanics and continuum mechanics.

MAE 5143* Tribology. Prerequisite(s): Graduate standing or consent of instructor. The principles of tribology. Definition of tribology, contact of solids, surface topography, real area of contact, friction of various materials, basic mechanisms of friction, mechanisms of wear (adhesion, abrasion, fatigue, erosion, and fretting), hardness of solids, frictional heating and surface temperatures, material properties that influence surface interactions, surface roughness measurement, surface integrity residual stresses and subsurface deformation, application of tribology to manufacturing, wear resistant materials, wear-resistant coatings, experimental methods in tribology, surface analytical tools in tribology, scanning tunneling microscopy/atomic force microscopy, wear monitoring and wear prevention, and systems approach to tribology.

MAE 5153* Precision Engineering I. Prerequisite(s): Graduate standing or consent of instructor. An integrated approach to underlying engineering principles governing product and process designs requiring accuracies typically better than 1 part in 106. Design and control of precision machines and instruments, dimensional and surface metrology, scanning probe microscopy, ultra-precision machining and grinding, and precision assembly.

MAE 5183* Nanostructured Materials. Prerequisite(s): Graduate standing and basic undergraduate materials science course or equivalent. Size and shape dependence of material properties at the nanoscale. Interaction, surface energy, functionalization, binding, and immobilization of nanostructures. Top-down and bottom-up nanofabrication, atomic processes and self assembly. Lithography, thin fills, functional coating, Langmuir-Blodgett films, layer-by-layer growth. Properties, applications and synthesis of well-studied building blocks; quantum dots (semiconductor nanocrystals), carbon nanostructures (nanotubes and fullerenes), semiconductor nanowires, metal nanoparticles and nanowires.

MAE 5233* Advanced Fluid Dynamics 1. Prerequisite(s): ENSC 3233. Introduction to fluid flows. Governing equations for mass, momentum and energy. Exact solutions of Navier-Stokes' equations. Dimensional analysis and similitude. Potential flows. Boundary layer theory. Low Reynolds number flows. Introduction to vorticity dynamics.

MAE 5243* Micro Flows. Prerequisite(s): Graduate standing or consent of instructor. Fundamentals and simulation of micro flows including governing equation, slip models, shear- and pressure-driven micro flows. Thermal effects in micro scales. Applications; MEMS and micro propulsion. Numerical methods for continuum simulation and atomistic simulation.

MAE 5253* Multiphase Flow. Prerequisite(s): Graduate standing. Theory, methods and practical experience for studying complex transient multiphase flows: basic concepts and definition, dynamics of bubbles, drops and rigid particles, gas-liquid transport in ducts, fluid-solid transport in ducts, aerosol and spray systems, foam, fluidization, particle separation systems multiphase flow in porous media, breakup of liquid sheets and jets, modeling, advanced experimental techniques for multiphase flow.

MAE 5273* Advanced Fluid Dynamics II. Prerequisite(s): 5233. Application of advanced fundamental concepts and methods to vorticity dynamics, gravity waves, instability, and an introduction to turbulence. Specialty topics (e.g. geophysical flows, compressible flows, biofluids) will also be discussed.

MAE 5403* Computer-Aided Analysis and Design. Prerequisite(s): Undergraduate course in computer programming and consent of professor. Theory, application and implementation of digital-computer-oriented algorithms for the synthesis, simulation, analysis and design of engineering systems. Advanced FORTRAN methods for optimization, simulation and data analysis. Implementation of these methods uses program libraries, batch processing, remote terminals and graphic display units.

MAE 5413* Optimal Control. Prerequisite(s): 5713 or ECEN 5713. Optimal control theory for modern systems design. Specification of optimum performance indices. Dynamic programming, calculus of variations and Pontryagin's minimum principle. Iterative numerical techniques for trajectory optimization. (Same course as ECEN 5413)

MAE 5433* Robotics, Kinematics, Dynamics and Control. Prerequisite(s): 4053 or ECEN 4413 or consent of instructor. Kinematic and dynamic analysis of robot manipulators. Inverse kinematics, motion planning and trajectory generation. Industrial practice in robot servo control. Dynamics and control in the presence of constraints. Actuators and sensors. Force sensors and vision systems. Robotic force control and its applications in industry. Passivity based control algorithms. Advanced control techniques for motion and force control. (Same course as ECEN 5433)

MAE 5463* Nonlinear System Analysis and Control. Prerequisite(s): 4053 or ECEN 4413. Failure of superposition of effects; phase-plane analysis; limit-cycles; Lyapunov stability; hyperstability and input-output stability; controllability and observability of nonlinear systems; feedback linearization; robust nonlinear control system design. (Same course as ECEN 5463)

MAE 5473* Digital Control Systems. Prerequisite(s): 4053 or ECEN 4413. Input output and state space representations of linear discrete-time systems. Approximate methods in discrete-time representation. Stability methods. Controllability, observability, state estimation, and parameter identification. Design and analysis of feedback control system using frequency-domain and state-space methods. Introduction to optimal control. (Same course as ECEN 5473)

MAE 5483* Advanced Mechatronics Design. Prerequisite(s): 4733 or similar course and consent of instructor. Continuation of topics covered in the undergraduate course MAE 4733 Mechatronics Design. Optimizing C programming code for microcontrollers using the assembly language instruction set, RS-232 microcontroller communication protocol, Controller Area Network (CAN) communication protocol plus hands-on CAN bus development boards, advanced topics which could include but are not limited to sensor design, real time operating systems, and advanced communication protocols. (Same course as ECEN 5483)

MAE 5503* Mechanics of Advanced Composites for Structural Design. Prerequisite(s): ENSC 2113, ENSC 2143 or consent of instructor. Basic principles governing the micro-mechanics of a lamina, and the macro-mechanics of a laminate are discussed in detail. Analysis of continuous fiber, short-fiber, and woven-fiber polymer matrix composites. A computer program for a analysis and design of composite laminates is developed.

MAE 5513* Stochastic Systems. Prerequisite(s): ECEN 3513 and 4503 or STAT 4033 or MAE 4053 or MAE 4063 or consent of instructor. Theory and applications involving probability, random variables, functions of random variables, and stochastic processes, including Gaussian and Markov processes. Correlation, power spectral density, and non-stationary random processes. Response of linear systems to stochastic processes. State-space formulation and covariance analysis. (Same course as ECEN 5513)

MAE 5523* Estimation Theory. Prerequisite(s): 5513 or ECEN 5513. Stochastic model development, parameter estimation and state estimation. The linear model, model order determination, least squares, estimation, maximum likelihood estimation, Bayesian estimation. Gaussian random vectors, estimation in linear and Gaussian models, state estimation, the Kalman filter, prediction and smoothing. (Same course as ECEN 5523)

MAE 5533* Theory of Elasticity. Prerequisite(s): 3323 or consent of instructor. Basics of tensor calculus, field equations (strain-displacement, compatibility, equilibrium, and constitutive relation), solution of plane elastrostatics problems in cartesian and polar coordinates, potential function formulation, introduction to 3D problems.

MAE 5543* Modern Materials. Prerequisite(s): ENSC 3313. Properties, applications and recent innovations of structural engineering materials. Metals, ceramics, polymers and composites considered.

MAE 5553* Fatigue and Fracture Mechanics. Prerequisite(s): 4333 or consent of instructor. Fracture processes in engineering materials including design considerations, failure avoidance and predictability. Fatigue processes and high-strength, toughness-limited materials.

MAE 5563* Finite Element Methods. Prerequisite(s): Graduate standing or consent of instructor. Introduction to the finite element method in mechanical engineering. Numerical and mathematical formulations including an introduction to variational methods. Computer applications in solid mechanics, heat transfer and fluid mechanics.

MAE 5573* Continuum Mechanics. Prerequisite(s): Consent of instructor. Principles governing the mechanics of continua. Kinematics of deformation, including the Lagrangian and Eulerian descriptions. Development of stress and strain tensors. Conservation principles to derive field equations describing solid and fluid mechanics. Application to problems in linear elasticity and viscous fluid flow.

MAE 5583* Corrosion Engineering. Lab 2. Prerequisite(s): ENSC 3313. Modern theory of corrosion and its applications in preventing or controlling corrosion damage economically and safely in service.

MAE 5593* Theory of Viscoelasticity. Prerequisite(s): Consent of instructor. Advanced stress analysis in solids exhibiting time-dependent behavior. Material characterization and thermodynamic foundation of the constitutive behavior of time-dependent materials such as polymers, solid propellants and metals near their melting points; time-temperature; superposition principle for thermo-rheologically simple materials; correspondence principle for linearly viscoelastic and associated linearly elastic solutions; integral formulation for quasistatic boundary value problems; treatment of time-varying boundary conditions such as moving boundaries and moving loads; linearly viscoelastic stress waves and approximate methods of linearly viscoelastic stress analysis.

MAE 5633* Advanced Thermal Systems. Prerequisite(s): 3223, 3233, ENSC 3233. Analysis, design, simulation and optimization of thermal systems. Engineering applications to HVAC systems, refrigeration systems, ground-source heat pump systems.

MAE 5653* Refrigeration. Prerequisite(s): 3223. Thermal engineering of refrigeration and heat pump systems, vapor compression systems, absorption refrigeration cycles, cryogenics, compressors, heat exchangers, flow control devices, laboratory simulators and measurements, socioeconomics and environmental impact of systems and refrigerants. A general-purpose computer software program is used for analysis and design of several refrigeration systems and components.

MAE 5663* Advanced Finite Element Analysis. Prerequisite(s): 5563 or consent of instructor. Development of three-dimensional isoparametric solid elements using Lagrange and serendipity family of elements, solution of three-dimensional thermoelasticity problems, linear time dependent problems, variational formulation and computer implementation of structural dynamics analysis using implicitly operators, implementation of three-dimensional diffusion and heat transfer analysis, solution of a nonlinear system of equations, and finite element analysis using commercial software packages.

MAE 5673* Mechanics of Fracture, Contact and Friction. Prerequisite(s): Graduate standing or consent of instructor. Rigorous derivation and presentation of the equations of fracture mechanics, contact and friction. Equations of solid mechanics and mathematical preliminaries, elastic stress field near a crack tip, stress intensity factors, fracture toughness, Griffith solution and J-integral, elastic-plastic fracture, fatigue, Dugdale model and cohesive zone laws, experimental techniques in fracture mechanics, contact mechanics, friction modeling. More advanced topics and projects will be chosen from interfacial crack growth, subsonic and intersonic dynamic fracture, rate- and state-dependent friction laws, fracture and friction at the small scales (nanomechanics), and finite-element analysis using commercial packages.

MAE 5683* Thermodynamics and Thermostatistics of Materials. Prerequisite(s): ENSC 3313 or equivalent. Notions of energy, entropy, equilibrium, macrostates, and microstates and their relation to material processes and properties. Deriving material properties from equations of state: Maxwell relations. Statistical thermodynamics: predicting material properties from microstates. Partition function. Phase transformations. Thermodynamics of surfaces and defects. Electrochemistry.

MAE 5693* Phase Transformations in Materials. Prerequisite(s): Graduate standing or consent of instructor. Principles of phase transformations in material. Structure of materials, phase diagrams, diffusion, solidification, and diffusional and diffusionless transformations will be covered. Recent developments in materials research relevant to phase transformations.

MAE 5703* Optimization Applications. Prerequisite(s): Graduate standing. A survey of various methods of unconstrained and constrained linear and non-linear optimization. Applications of these methodologies using hand-worked examples and available software packages. Intended for engineering and science students. (Same course as CHE 5703*, ECEN 5703* & IEM 5023*)

MAE 5713* Linear Systems. Prerequisite(s): Graduate standing or consent of instructor. Introduction to the fundamental theory of finite-dimensional linear systems with emphasis on the state-space representation. Mathematical representations of systems; linear dynamic solutions; controllability, observability, and stability; linearization and realization theory; and state feedback and state observer. (Same course as ECEN 5713*)

MAE 5733* Neural Networks. Prerequisite(s): Graduate standing. Introduction to mathematical analysis of networks and learning rules, and on the application of neural networks to certain engineering problems image and signal processing and control systems. (Same course as CHE 5733* & ECEN 5733*)

MAE 5753* Advanced Experimental Mechanics of Solids. Prerequisite(s): 5573 or consent of instructor. Application of advanced experimental mechanics techniques to investigate and characterize response of solid materials. Course material includes use of at-a-point and full-field techniques, characterizing rate- and time-dependent material response, and techniques for finite deformation.

MAE 5763* Wave Motion and Vibration of Continuous Media. Prerequisite(s): 5573 or consent of instructor. Fundamentals of the formulation and solution of the problem of wave motion and vibration in continuous media. Propagation of stress waves and the implication of high-rate loading on mechanics problems.

MAE 5773* Intelligent Systems. Prerequisite(s): 5733 or ECEN 5733. Introduction to the state-of-the art intelligent control and system successfully deployed to industrial and defense applications. Emerging intelligent algorithms (e.g., bottom-up, top-down, seminotics); reinforcement learning and hybrid systems; and case studies and design projects. (Same course as ECEN 5773*)

MAE 5783* Principles of Autonomous Decision Making. This course will provide a detailed overview of the fundamental principles of autonomous decision making and their applications to various engineering and computer-science domains. This coure will survey popular and emerging techniques in reasoning and perception as well as optimal decision making methodologies. Learning and reasoning paradigms include support vector machines, Gaussian Processes, and Bayesian Nonparametric Learning. Optimal decision making techniques include Markov Decision Processes, Planning and reinforcement learning.

MAE 5803* Advanced Thermodynamics I. Prerequisite(s): 3223. A rigorous examination of the fundamental principles of engineering thermodynamics to include the First Law, Second Law and availability, thermodynamics equations of state for single phase and multi-phase systems, chemically reactive systems, and equilibrium. A general-purpose computer software program is used for examination of case studies of thermodynamic processes.

MAE 5813* Intermediate Heat Transfer. Prerequisite(s): 3233 or equivalent. Continuation of the topics covered in the undergraduate heat transfer course (3233) with the addition of mass transfer. This course covers problems of heat and mass transfer in greater depth and complexity than is done in the undergraduate heat transfer course and incorporates the subjects that are not included or are treated lightly in that course. Analysis will be given greater emphasis than the use of correlations.

MAE 5823* Radiation Heat Transfer. Prerequisite(s): 3233 or equivalent and graduate standing or consent of instructor. The mechanism of the transfer of energy by thermal radiation; radiant properties of materials, energy transfer prediction methods and solar energy topics.

MAE 5843* Conduction Heat Transfer. Prerequisite(s): ENSC 3233. Advanced heat transfer analysis and design, with primary emphasis on conduction.

MAE 5853* Computational Heat Transfer. Prerequisite(s): 3233, graduate standing, knowledge of FORTRAN. Computational techniques for the solution of two-dimensional heat transfer, fluid flow and related processes in problems of practical interest. A general-purpose computer program used to demonstrate the capabilities of the numerical method through a wide variety of engineering problems.

MAE 5863* Building Heat Transfer and Simulation. Prerequisite(s): 3223, 3233, ENSC 3233. Conduction, convection and radiation heat transfer applied to building thermal simulation. Solar radiation.

MAE 5873* Advanced Indoor Environmental System. Prerequisite(s): 4703. Heating, air-conditioning, ventilation and refrigeration systems. System and component analysis, design and simulation.

MAE 5913* Advanced Aerodynamics. Prerequisite(s): ENSC 3233 or equivalent. Aerodynamics of the subsonic, transonic, supersonic, and hypersonic flow regimes. Derivation of governing equations and fundamental principles. Analytical and computational analysis methods. Recent developments.

MAE 5923* Guidance and Control of Aerospace Vehicles. Prerequisite(s): 4053 or ECEN 4413 or equivalent. Navigation, guidance and attitude control of aircraft, launch vehicles and spacecraft. Inertial navigation mechanizations and error analysis. Stability augmentation systems.

MAE 5933* Aeroelasticity. Prerequisite(s): Graduate standing or consent of instructor. Interaction between fluid dynamic, inertial and elastic forces. Development of analytical and computational methods for analysis. Application to a broad range of problems in engineering.

MAE 5943* Unsteady Aerodynamics and Aeroacoustics. Prerequisite(s): ENSC 3233 or equivalent. Development of governing fluid dynamic equations for unsteady flows; linear unsteady aerodynamics for isolated and cascaded lifting surfaces; acoustics in moving media; three-dimensional duct acoustics; sound generation from isolated airfoils, cascaded airfoils, rotor-stator interactions, multiple pure-tone sources, propellers and jets.

MAE 5953* Aerospace Systems Engineering. Prerequisite(s): 3253 or equivalent. Aircraft and spacecraft design from a systems perspective, covering basic systems engineering, cost and weight estimation, basic vehicle performance and trade study analysis, safety and reliability, lifecycle analysis, subsystem integration, risk analysis and management, system realization, and multi-disciplinary optimization (MDO). Additional topics include requirements identification and development, and program planning and control.

MAE 5963* Unmanned Aerial Systems Design and Analysis. Prerequisite(s): Graduate standing or permission of instructor. This course covers concepts related to design and operation of unmanned systems focusing on unmanned aircraft, including remotely piloted and autonomous vehicles. History of unmanned systems. Design of unmanned air systems including concepts of operations, communications, payloads, control and navigation, multiple air vehicle architectures, cooperative control and ISR. Design requirements for unmanned versus manned vehicles. Operation in conflicted airspace. Aspects of other unmanned systems, including ground, surface, underwater and space vehicles.

MAE 5973* Unmanned Aerial Systems Propulsion. Prerequisite(s): Graduate standing or permission of instructor. This course will cover propulsion topics used on Unmanned Aerial Systems (UAS). These will include: Historical perspective on UAS propulsion systems; Classification of propulsion types; Propulsion requirements for UAV; Propeller performance and design; Internal combustion engine; Heavy-Fuel ICE; ICE Muffler design; Electric motor; Hybrid-Electric engine; Fuel Cell engine; Flapping Wing propulsion; Jet engine; Propulsion system integration and installation effects.

MAE 5983* Aircraft Certification and Test. Prerequisite(s): Graduate standing or consent of instructor. Exploration of the major engineering processes for airworthiness certification of manned and unmanned aircraft. Assessment of civil and military airworthiness regulations and their impact on certification program management and testing. Development of foundational concepts and processes for laboratory, ground and flight testing for airworthiness.

MAE 5993* Microstructural Mechanics. Prerequisite(s): Graduate standing or consent of instructor. Build a framework to understand the various microstructures of materials with their respective roles in controlling mechanical properties. Grain size, orientation, surface facets, compositional gradients, and second or multiple phases, in combination with the three-dimensional arrangement of the various types of imperfections, together constitute the microstructure of a material. An emphasis will be placed on new research areas and exposure to methods for controlling and probing microstructures.

MAE 6000* Doctoral Dissertation. 1-15 credits, max 30. Prerequisite(s): Admission to MAE PhD program and consent of the student's dissertation adviser. Independent research under the direct supervision of the student's doctoral dissertation adviser.

MAE 6010* Advanced Study. 1-12 credits, max 12. Prerequisite(s): Approval of the student's advisory committee. Study and investigation under the supervision of a member of the faculty along lines of interest well advanced of and supported by the 5000-series courses.

MAE 6123* Advanced Processing of Materials. Prerequisite(s): Graduate standing or consent of instructor. Rationale for non-traditional machining; various non-traditional machining processes, including electro-discharge machining, electro-chemical machining, plasma arc-, microwave-, and laser assisted processing, waterjet (abrasive) cutting, ultrasonic machining, chemical machining, thermal assisted processing and electron beam machining.

MAE 6133* Surface Mechanics. Prerequisite(s): Consent of instructor. Models and solutions basic to surface studies. Equations of continuum mechanics, thermal field solutions at sliding interfaces, elasticity, plasticity. Applications of solution techniques to surface, surface layer and interface phenomena.

MAE 6143* Thermal Analysis of Manufacturing Processes. Prerequisite(s): Graduate standing and consent of instructor. Thermal analysis of various moving heat source problems encountered in a variety of manufacturing processes, including machining, grinding, polishing, casting, welding, energy beam cutting and other tribological applications such as meshing of gears, cams, bearings. Analysis of both transient and steady state conditions.

MAE 6233* Turbulent Fluid Dynamics. Prerequisite(s): 5233. Isotropic turbulence, turbulent wakes and jets, bound turbulent shear flows, transition, hydrodynamic stability and integral calculation methods for turbulent boundary layers.

MAE 6263* Computational Fluid Dynamics. Prerequisite(s): Graduate standing and 5233. Steam function-vorticity and pressure-velocity simulations of incompressible and compressible flows. Temperature and concentration solutions. Applications to various external and internal flow problems.

MAE 6423* System Identification. Prerequisite(s): 5473 or 5713 or ECEN 5473 or ECEN 5713. Linear and nonlinear system modeling of random systems. Models of linear time-invariant systems, nonparametric methods and preliminary model development, parameter estimation methods, convergence and consistency, asymptotic distributions of parameter estimates, nonlinear modeling. (Same course as ECEN 6423*)

MAE 6453* Adaptive Control. Prerequisite(s): 5473 or ECEN 5473 or ECEN 5713 or MAE 5713. Analysis and design of control techniques which modify their performance to adapt to changes in system operation. Review of systems analysis techniques, including state variable representations, linearization, discretization, covariance analysis, stability, and linear quadratic gaussian design. On-line parameter estimation, model reference adaptive systems, self-tuning regulators, stable adaptive systems. (Same course as ECEN 6453*)

MAE 6483* Robust Multivariate Control Systems. Prerequisite(s): 5713 or ECEN 5713. Introduction to multivariable systems: SISO robustness vs. MIMO robustness; multivariable system poles and zeros; MIMO transfer functions; multivariable frequency response analysis; multivariable Nyquist theorem; performance specifications; stability of feedback systems; linear fractional transformations (LFT's); parameterization of all stabilizing controllers; structured singular value; algebraic ricatti equations; H2 optimal control; H-infinity controller design. (Same course as ECEN 6483*)

MAE 6843* Convection Heat Transfer. Prerequisite(s): 5233 or equivalent. Advanced convective heat transfer in laminar and turbulent flows over external surfaces and inside channels. Heat transfer at high velocities, free convection boundary layers, and mass transfer.

Mechanical Engineering Technology (MET)

MET 1103 Introduction to Mechanical Engineering Technology. Lab 2. Introduction to mechanical engineering technology, analytical techniques, and data presentation. Orientation to the mechanical engineering technologist's profession.

MET 1223 Industrial Computer-Aided Design. Lab 2. Prerequisite(s): GENT 1153. Computer-aided design (CAD) generation of engineering drawings including three-dimensional product design and modeling.

MET 2103 Industrial Materials. Prerequisite(s): CHEM 1314 or CHEM 1215 or CHEM 1414. A survey of the properties, characteristics and applications of metals, polymers, ceramics and other industrial materials. Terminology, concepts and principles involved in material selection, specification and processing. Laboratory activities include data collection and report generation, determination of material properties, and evaluation of material characteristics.

MET 2313 Fundamentals of Hydraulic Fluid Power. Lab 2. Prerequisite(s): PHYS 1114 or 2014. Basic fluid power concepts. Standard hydraulic symbols, component design and application, fluid power system considerations, design and operation.

MET 3003 Dynamics. Prerequisite(s): GENT 2323 or ENSC 2113 and MATH 2123 or 2144 and PHYS 1114 or 2014. Plane motion of particles and rigid bodies. Force-acceleration, work-energy, and impulse-momentum principles. Graphical analysis, mechanisms and vibrations.

MET 3113 Basic Instrumentation. Lab 2. Prerequisite(s): GENT 3323 or ENSC 21143, MATH 2123 or 2144 and PHYS 1214 or 2114. Data analysis. Theory, operational characteristics and application of transducers for measurement of strain, force, velocity, acceleration, displacement, time, frequency, temperature, pressure.

MET 3313 Applied Fluid Mechanics. Prerequisite(s): GENT 2323 or ENSC 2113 and MATH 2123 or 2144 and PHYS 1114 or 2014. Practical analysis of fluid systems including static forces, the Bernoulli and general energy equations, laminar and turbulent flows, measurements of flow and pressure, lift and drag, pumps, and fans.

MET 3343 Physical Metallurgy. Lab 3. Prerequisite(s): 2103. Analysis and evaluation of the properties of metals commonly used in product design. Property change caused by hot and cold working, and by heat treatment. Laboratory activities including metallographic specimen preparation, inspection and testing; and standard tests of tensile properties, hardenability, hardness and toughness.

MET 3413 Fundamentals of Pneumatic Fluid Power. Lab 2. Prerequisite(s): 2313. Basic pneumatics concepts, gas laws, component design and application, system design considerations. Air logic.

MET 3423 Intermediate Hydraulic Fluid Power Prerequisite(s): MET 2313. Review of fundamentals of hydraulic fluid power. Energy-efficient hydraulic systems, cartridge valves, dynamics of hydraulic systems, special topics associated with mobile hydraulic equipment.

MET 3573 Advanced Production Processes. Lab 3. Prerequisite(s): 1223, GENT 1223. Advanced manufacturing and production processes including polymers and plastics, powder metallurgy, foundry, welding and metal forming. Design for assembly (DFA) and design for manufacture (DFM).

MET 4003 Machine Design I. Prerequisite(s): GENT 3323 or ENSC 2143 and MATH 2123 or 2144. Applications of statics and strength to the design of machine components. Problems of choosing materials, impact and fatigue loading.

MET 4013 Parametric Computer-Aided Modeling. Lab 2. Prerequisite(s): GENT 1153 and MET 1223. Computer-aided drafting and design using parametric, feature-based solid modeling techniques.

MET 4023 Advanced Mechanical Computer-Aided Design. Lab 2. Prerequisite(s): 1223 or equivalent. Computer-aided design methodologies and processes. State-of-the-art technologies and methodologies in 3D modeling and design processes.

MET 4033 Applied Vibration and Acoustics. Prerequisite(s): MET 3003 or equivalent. Free and forced vibration of mechanical systems with an emphasis on practical applications. Introduction to sound wave generation and propagation. Mechanical system design methods for noise and vibration mitigation.

MET 4050 Advanced Mechanical Design. 1-3 credits, max 6, Lab 0-2. Prerequisite(s): junior standing and consent of instructor. Special problems in mechanical engineering technology.

MET 4123 Senior Design Projects. Lab 6. Prerequisite(s): 1223, 4003 and ENGL 3323 (can be concurrent enrollment in ENGL 3323). Selected problems in design integrating principles of drafting, analysis, materials and manufacturing. Design projects are typically supplied by industry.

MET 4203* Finite Element Methods. Prerequisite(s): 4003. Application of Finite Element Methods to machine component design. Problems involving stress, strain, temperature and vibration will be solved using state of the art Finite Element Software.

MET 4303 Computer Integrated Manufacturing. Lab 2. Prerequisite(s): GENT 1223, MET 1223. Introduction to programming techniques and manufacturing applications of computer numerical control (CNC) and robotics. Machine capabilities and tooling requirements with programs being prepared manually and with COMPACT II computer assistance.

MET 4313 Electrohydraulics and Motion Control. Lab 2. Prerequisite(s): 2313, EET 3104 (can be concurrent enrollment in EET 3104). Principles of electronics as applied to fluid power controls. Trends in modern fluid power systems. Solenoid systems, proportional control, servosystems, programmable controllers, and robotics. Lab includes design, fabrication and operation of practical systems.

MET 4413 Ground Source Heat Pump Systems. Prerequisite(s): 3313 and GENT 3433 and 4433. Design and applications of ground sourced heat pump systems. Heat pump performance, borehole heat transfer, pressure loss calculations and installation methods.

MET 4453 Applied Thermodynamics. Prerequisite(s): ENSC 2213 or GENT 3433. Mixtures, psychrometrics, combustion, heat engine cycles, heat pumps cycles, internal and external combustion engines. Refrigeration.

MET 4463 Thermal Fluids Laboratory. Lab 3. Prerequisite(s): 3313 or ENSC 3233 and GENT 3433 or ENSC 2213 and GENT 4433. Experimental study of topics in fluid mechanics, thermodynamics, and heat transfer. Interpretation of experimental data and technical report writing.

MET 4883 Tool Design. Lab 3. Prerequisite(s): 2213, 3343. Basic design and development of special tools for processing or manufacturing engineering materials. Design and specification and inspection tools using appropriate techniques of engineering graphics and analysis.

MET 4993 Mechanical Engineering Technology Practice. Prerequisite(s): Junior standing and consent of department head. Supervised industrial experience in mechanical engineering technology practice with minimal continual duration of eight weeks. Comprehensive journal, written report, and oral presentation.

Mechanized Agriculture (MCAG)

MCAG 1413 Introduction to Engineering in Agriculture. Prerequisite(s): MATH 1513 or concurrent enrollment. Application of the physical and engineering sciences to agricultural problems. Energy; energy conversion; thermal, electrical, mechanical and fluid systems; equipment calibration; environmental control of agriculture buildings and irrigation system requirements.

MCAG 2313 Surveying. Lab 3. Prerequisite(s): MATH 1613.A study of the equipment and practices used in surveying for small areas. Common practices of plane surveying: differential, profile, and topographic leveling; field notes, accuracy and precision, error and error control, and land measurement.

MCAG 3011 Ag Structures. Lab 2. Prerequisite(s): MATH 1513. Study of types of agricultural structures, building materials, construction tools and methods. Laboratory will provide opportunity to apply and develop associated skills.

MCAG 3211 Engines and Power. Lab 2. Prerequisite(s): MATH 1513. Theory, operation, performance and diagnostics of internal combustion engines for mobile applications.

MCAG 3222 Metals and Welding. Lab 2. Welding safety and the principles and applications of gas, stick and MIG welding, and cutting.

MCAG 3232 Lab Management and Project Construction. Lab 2. Prerequisite(s): 3222. Theory and practice of managing secondary school Ag Mechanics laboratories including safety, organization, design, project construction and evaluation of student projects.

MCAG 4101 Ag Electrification. Lab 2. Prerequisite(s): MATH 1513. A study of electrical theory and electrical applications in agricultural environments.

MCAG 4112 Land Measurement and Site Analysis. Lab 2. Prerequisite(s): MATH 1513 or equivalent. Methods and techniques used to locate sites and evaluate physical conditions. Includes map interpretation and land description, use of Global Positioning Systems, Rectangular System of Land Description and determination of land elevations, areas and slopes. (Same course as ENVR 4112)

MCAG 4123* Principles of Food Engineering. Prerequisite(s): MATH 1513. For non-engineers. Application of the engineering approach to solving heat and mass transfer problems in food processing. An introduction to the basic concepts of the conservation laws, fluid flow, heat transfer, refrigeration, freezing, psychrometrics, and energy conservation. (Same course as FDSC 4123)

MCAG 4200* Topics in Mechanized Agriculture. 1-4 credits, max 4. Investigations in specialized areas of mechanized agriculture.

MCAG 4203* Irrigation Principles. Prerequisite(s): MATH 1513. Sources, measurement and efficient use of irrigation water. Selection of pumping plants and power units. Layout and management of surface and sprinkler systems.

MCAG 4212 Safety and Health in Agribusiness. Lab 2. Prerequisite(s): Junior standing or above. Study of the causes and prevention of accidents in agribusinesses. Investigations including the acute and chronic risks of machinery, animals, gases, confined spaces, outdoor and hazardous materials.

MCAG 4220* Advanced Methods in Agricultural Mechanics. 1-6 credits, max 6. Prerequisite(s): 4222. Developing agricultural mechanics programs for vocational agriculture and technical schools. Application of agricultural mechanics methods, practices and skills to advanced projects.

MCAG 5413* Fundamentals of Conversion. Prerequisite(s): Graduate standing. Principles involved in converting biomass to useful products, including biomass properties, pretreatment, separation, and biochemical and thermochemical conversion. Course available online only through AG*IDEA consortium.

Microbiology (MICR)

MICR 1513 Inquiry-Based Biology. Lab 4. Directed inquiry and hands-on study of biological principles. Restricted to elementary education majors or related fields as model course to learn and teach science.

MICR 2002 Science Literacy. Prerequisite(s): Consent of instructor. An introduction to skills needed to identify, read and critically evaluate scientific literature and to manage and communicate research data in written oral and poster formats.

MICR 2123 Introduction to Microbiology. Prerequisite(s): BIOL 1114. Prerequisite or concurrent enrollment: CHEM 1215 or CHEM 1314. General principles of the biology of microorganisms, including bacteria, viruses, algae, fungi, protozoa and archea.

MICR 2132 Introduction to Microbiology Laboratory. Prerequisite(s): 2123 or concurrent enrollment. Laboratory safety, aseptic technique, microscopy, staining and culture techniques, collection of microbial samples, isolation and identification of microorganisms, microbial growth and basic principles of metabolism, environmental microbiology, other discipline specific laboratory skills.

MICR 3033 Cell and Molecular Biology. Prerequisite(s): 2123 and 2132 or BOT 1404 or ZOOL 1604 and CHEM 1225 or CHEM 1515 or equivalent. The cell concept and cell morphology, cell macromolecules, organelles, enzymes, energetics, movement of water and materials across membranes, influence of external environment, cellular synthesis, growth and maintenance, control and integration of function, replication, differentiation, origin, and evolution of cells.

MICR 3103 (N) Microbes: Friends or Foes. Explores the impact of microorganisms on human life, the environment, and world history. This course is designed for non-science majors.

MICR 3143 Medical Mycology. Lab 4. Prerequisite(s): 2123, 2132. Examination of fungi as animal pathogens; laboratory techniques used in the identification of human and animal pathogens, and differentiation from common contaminants.

MICR 3154 Food Microbiology. Lab 4. Prerequisite(s): 2123, 2132 and CHEM 3015 or 3053. Relationship of microorganisms to food manufacture and preservation, to food spoilage and microbial food poisoning and to various aspects of primary food production. (Same course as FDSC 3154)

MICR 3223 Advanced Microbiology. Prerequisite(s): 2123, 2132; Co-requisite(s): CHEM 3015 or CHEM 3053. Subcellular structure and function of microorganisms. Synthesis, translocation, and metabolism of cellular macromolecular constituents. Substrate transport and metabolism.

MICR 3253 Immunology. Prerequisite(s): 2123 and 2132. Vertebrate host's ability to defend itself against foreign intrusion. Chemistry and biology of the acquired immune response.

MICR 4000 Honors in Microbiology. 1-4 credits, max 4. Prerequisite(s): Consent of departmental honors committee. Supervised study and research in microbiology.

MICR 4001 Professional Transitions in Microbiology and Cell and Molecular Biology. Prerequisite(s): Declared microbiology major with minimum 70 hours earned and consent of instructor. Understanding major areas and

employment activities in microbiology, cell biology and molecular biology fields. Evaluating and understanding scientific and professional literature, and making the transition from undergraduate education to postgraduate education or employment.

MICR 4012 Molecular Microbiology Laboratory I. Lab 4. Prerequisite(s): 3223, 4233. Emphasis on good laboratory practices in microbiology and molecular biology; isolation and enumeration of microorganisms; physiological, biochemical, and molecular characterization of aerobic and anaerobic microorganisms. Must be taken in conjunction with 4112 the following semester. No credit for students with credit in 5012.

MICR 4112 Molecular Microbiology Laboratory II. Lab 4. Prerequisite(s): 4012. Continuation of 4012. Molecular characterization of prokaryotic and eukaryotic microorganisms utilizing nucleic acids, proteins, cell fractionation, cytology, and antigen-antibody reactions. No credit for students with credit in 5112.

MICR 4117 Clinical Microbiology. Lab 12. Prerequisite(s): Concurrent internship in affiliated hospital and all degree requirements for BS in microbiology except 30 hours clinical laboratory science. The theory and laboratory study of pathogenic bacteria, viruses, rickettsiae, fungi, and parasites. Includes isolation, identification, antimicrobial susceptibility testing, and medical significance.

MICR 4123 Virology. Prerequisite(s): 3033 or BIOC 3653; BIOL 3023; Co-requisite(s): 3223. Virus-host interactions, including structure-function of animal, plant and bacterial viruses. Discussion of the molecular biology of virus infection and development. No credit for students with credit in 5123.

MICR 4125 Clinical Chemistry I. Lab 9. Prerequisite(s): Concurrent internship in affiliated hospital and all degree requirements for BS in microbiology except for 30 hours clinical laboratory science. The theory and laboratory methodology of analytical biochemistry, clinical microscopy, routine and special procedures, and medical significance.

MICR 4133 Molecular and Microbial Genetics. Prerequisite(s): 2123, 2132, BIOL 3023, CHEM 3015 or 3053; Co-requisite(s): 3223. The properties of macromolecules, from the structure of proteins and nucleic acids to molecular mechanisms of DNA replication and recombination, transcription, protein synthesis, and gene regulation. Gene transfer mechanisms in bacteria and their viruses. Fundamentals of recombinant DNA technology. *No credit for students with credit in 5133.*

MICR 4134 Pathogenic Microbiology. Lab 3. Prerequisite(s): 2123, 2132. Co-requisite(s): 3223. Examination of pathogenic bacteria as they relate to humans, other animals, plants and insects. *No credit for students with credit in 5134.*

MICR 4203 Bioinformatics. Prerequisite(s): 3033 or BIOC 3653 or equivalent. Fundamental concepts of biological sequence information and inferential techniques to assign structure, function, and evolutionary relationship among genes and proteins. No prior programming necessary, but familiarity with computers assumed. *No credit for students with credit in 5203.*

MICR 4214 Microbial Ecology. Lab 4. Prerequisite(s): 2123, 2132 and CHEM 3015 or 3053. Co-requisite(s): 3223. Fundamentals of microbial physiology and genetics of microbial populations under various redox conditions. Species and functional guilds in natural habitat. Community structure and diversity of niches. Population interactions, competition and ecosystem stability. Metabolic activities in natural and managed systems. Microbial capacities and elemental cyclings. Genes and genetic exchange in the environment. Modern nucleic acid tools in microbial identification and evolutionary phylogeny. *No credit for students with credit in 5214.*

MICR 4233 Advanced Cell and Molecular Biology. Prerequisite(s): 3033. Advanced topics in cell and molecular biology including regulatory mechanisms of gene expression, protein function, cell structure and organization, cell division, and development. *No credit for students with credit in 5233.*

MICR 4236 Clinical Hematology. Lab 12. Prerequisite(s): Concurrent internship in affiliated hospital and all degree requirements for BS in microbiology except for 30 hours of clinical laboratory science. Systematized study of diseases, cell maturation and function, principles of homeostasis; methodology used in routine and special hematology studies; and correlation of hematological findings with physiological conditions.

MICR 4246 Clinical Immunology. Lab 12. Prerequisite(s): Concurrent internship in affiliated hospital and all degree requirements for BS in microbiology except for 30 hours clinical laboratory science. Immunologic responses and procedures used in serological determinations; immunohematology, fundamentals of antigen-antibody reactions, blood groups and types, compatibility testing, blood components, and the lab methods used as they relate to the medical significance of immunology and infectious diseases.

MICR 4253 Concepts in Medical Genetics. Prerequisite(s): BIOL 3023. Application of genetic principles in the study of human diseases, including the inheritance, molecular mechanisms, detection, characterization, and discovery of human genes. *No credit for students with credit in 5253.*

MICR 4263 Eukaryotic Genetics. Lab 4. Prerequisite(s): 3033. Integration of genetics and genomics principles, the basic processes of gene transmission, molecular biology of gene expression and evolutionary genetics by gaining social and historical context in which genetics are developed. Focus on the dramatic change in our understanding of human genetics and the role such information has in our view of disability and disease. *No credit for students with credit in 5263.*

MICR 4323 Bioenergetics. Prerequisite(s): 3033 or BIOC 3653. Bioenergetic reactions and mechanisms involved in energy production in plants, animals and microbial systems. *No credit for students with credit in 5323.*

MICR 4325 Clinical Chemistry II. Lab 9. Prerequisite(s): Concurrent internship in affiliated hospital and all degree requirements for BS in microbiology except for 30 hours clinical laboratory science. The theory and laboratory methodology of analytical biochemistry, instrumentation, lab mathematics, routine and special procedures and medical significance.

MICR 4351 Topics in Clinical Laboratory Science. Prerequisite(s): Concurrent internship in affiliated hospital and all degree requirements for BS in microbiology except for 30 hours clinical laboratory science. Principles and practices of the medical laboratory including basic management, quality assurance, education methodology, computer applications, laboratory safety, and special projects in selected areas.

MICR 4353 Photobiology. Prerequisite(s): 3033 or BIOC 3653. The proteins and processes involved in biological photosynthesis, photosensing, and photodamage, including their biological relevance. Involves critical reading of primary literature and examination of protein structures using bioinformatics tools. *No credit for students with credit in 5353.*

MICR 4423 Bacterial Cell Walls: Form and Function. Prerequisite(s): 2123, 2132, and 3223. Topics will include structure and synthesis of membrane and cell wall components (including lipids, peptidoglycan and membrane proteins), mechanisms of transport across the cell wall, roles components of the cell wall play in the survival of the cell (and in the case of pathogens, the ability to cause disease), and antimicrobial agents that affect the cell wall and the mechanisms used to eliminate these agents from the cell. *No credit for students with credit in 5423.*

MICR 4524* Biological Laboratory Instrumentation. Prerequisite(s): CHEM 1515 and BOT 1404 or MICR 2123 or ZOOL 1604 or equivalents or consent of instructor. Lecture and laboratory course in biological instrumentation use, theory, experimental design, maintenance, and troubleshooting. Topics include liquid handling systems, pH/ISE meters, electrophoresis, spectrophotometers, centrifuges, chromatography, thermocyclers, and DNA sequencers. *No credit for students with credit in MICR 5524.* (Same course as BIOL 4524)

MICR 4531 Chemical Biology. Prerequisite(s): CHEM 3053, 3112, 3153. Chemistry explains many properties of biological macromolecules and also provides research tools to study these molecules. This course will examine how both of these aspects help explain the molecular processes at the basis of life, and will cover (1) basic knowledge of chemistry needed to understand life, (2) chemical reactions as they occur in the cell, (3) chemical methods that are valuable to research in the life sciences.

MICR 4990 Special Problems. 1-3 credits, max 12. Prerequisite(s): Consent of instructor. Investigations in the field of microbiology.

MICR 4993 Senior Honors Project. Prerequisite(s): Departmental invitation, senior standing, Honors Program participation. A research project under the direction of a faculty member resulting in a written report to be judged by a second faculty member as well. Required for graduation with departmental honors in microbiology.

MICR 5000* Thesis. 2-6 credits, max 6. Prerequisite(s): Consent of major professor. A student studying for the MS degree enrolls in this course for six hours credit.

MICR 5002* Professionalism for the Microbiologist. Prerequisite(s): Microbiology graduate student or permission of instructor. Introduces the microbiology graduate student to the standards of the microbiology professional and to basic skills in communication and data retrieval needed by all microbiologists. It is required of all and limited to MS and PhD students in Microbiology & Molecular Genetics.

MICR 5012* Molecular Microbiology Laboratory I. Lab 4. Prerequisite(s): 3223, 4233. Emphasis on good laboratory practices in microbiology and molecular biology; isolation and enumeration of microorganisms; physiological, biochemical, and molecular characterization of aerobic and anaerobic microorganisms. Must be taken in conjunction with 5112 the following semester. *No credit for students with credit in 4012.*

MICR 5052* Techniques in Molecular Biology. Lab 2. Prerequisite(s): Graduate student and permission of instructor. Provides the basic skills for scientific thinking and analysis in molecular microbiological research.

MICR 5112* Molecular Microbiology Laboratory II. Lab 4. Prerequisite(s): 5012. Continuation of 5012. Molecular characterization of prokaryotic and eukaryotic microorganisms utilizing nucleic acids, proteins, cell fractionation, cytology, and antigen-antibody reactions. *No credit for students with credit in 4112.*

MICR 5113* Advanced Immunology. Prerequisite(s): 3253. Advanced studies with emphasis on the regulation of vertebrate immune responses.

MICR 5123* Virology. Prerequisite(s): 3033 or BIOC 3653, BIOL 3023. Co-requisite(s): 3223. Virus-host interactions including structure-function of animal, plant, and bacterial viruses. Discussion of the molecular biology of virus infection and development. *No credit for students with credit in 4123.*

MICR 5133* Molecular and Microbial Genetics. Prerequisite(s): BIOL 3023, CHEM 3015 or CHEM 3053, MICR 2123 and 2132. Co-requisite(s): 3223. The properties of macromolecules, from the structure of proteins and nucleic acids to molecular mechanisms of DNA replication and recombination, transcription, protein synthesis, and gene regulation. Gene transfer mechanisms in bacteria and their viruses. Fundamentals of recombinant DNA technology. *No credit for students with credit in 4133.*

MICR 5134* Pathogenic Microbiology. Prerequisite(s): 2123 and 2132. Co-requisite(s): 3223. Examination of pathogenic bacteria as they relate to humans, other animals, plants and insects. *No credit for students with credit in 4134.*

MICR 5142* Techniques in Molecular Biology. Lab 4. Prerequisite(s): Consent of instructor. Comprehensive laboratory course in research techniques involving classical genetics and molecular biology.

MICR 5153* Emerging Infectious Agents. Prerequisite(s): 4123 or 4134 or consent of instructor. An in-depth discussion of the importance of emerging infectious agents, the molecular basis for their emergence, and the broad spectrum of host-microbe interactions favoring the evolution of new infectious agents.

MICR 5160* Seminar. 1 credit, max 2. Prerequisite(s): consent of instructor. Required of and limited to all MS and PhD students majoring in microbiology, cell and molecular biology.

MICR 5203* Bioinformatics. Prerequisite(s): 3033 or BIOC 3653 or equivalent. Fundamental concepts of biological sequence information and inferential techniques to assign structure, function, and evolutionary relationship among genes and proteins. No prior programming necessary, but familiarity with computer desktop assumed. *No credit for students with credit in 4203.*

MICR 5213* Environmental Microbiology. Prerequisite(s): 3223, BIOL 3653 or equivalent. Microbial processes and diversity. Fundamental and applied aspects of microbial ecology, physiology, energetics, and mechanisms of energy conservation. Microbial transformation of organic, inorganic, and pollutant compounds, and bioremediation. Study of modern molecular tools for the detection of microbes in the natural environment.

MICR 5214* Microbial Ecology. Lab 4. Prerequisite(s): 2123 and 2132 and CHEM 3015 or 3053; Co-requisite(s): 3223. Fundamentals of microbial physiology and genetics of microbial populations under various redox conditions. Species and functional guilds in natural habitat. Community structure and diversity of niches. Population interactions, competition and ecosystem stability. Metabolic activities in natural and managed systems. Microbial capacities and elemental cyclings. Genes and genetic exchange in the environment. Modern nucleic acid tools in microbial identification and evolutionary phylogeny. *No credit for students with credit in 4214.*

MICR 5233* Advanced Cell and Molecular Biology. Prerequisite(s): 3033. Advanced topics in cell and molecular biology including regulatory mechanisms of gene expression, protein function, cell structure and organization, cell division, and development. *No credit for students with credit in 4233.*

MICR 5253* Concepts in Medical Genetics. Prerequisite(s): BIOL 3023. Application of genetic principles in the study of human diseases, including the inheritance, molecular mechanisms, detection, characterization, and discovery of human genes. *No credit for students with credit in 4253.*

MICR 5263* Eukaryotic Genetics. Prerequisite(s): 3033. Integration of genetics and genomics principles, the basic processes of gene transmission, molecular biology of gene expression and evolutionary genetics by gaining social and historical context in which genetics are developed. Participants are expected to comprehend the dramatic change in our understanding of human genetics and the role such information has in our view of disability and disease. *No credit for students with credit in 4263.*

MICR 5323* Bioenergetics. Prerequisite(s): 3033 or BIOC 3653. Bioenergetic reactions and mechanisms involved in energy production in plants, animals and microbial systems. *No credit for students with credit in 4323.*

MICR 5333* Controversies in Vaccinology. Prerequisite(s): OSU graduate student status or permission of instructor. Public misconceptions about science abound, however, these misconceptions have a major impact on perception of research and public policy. Examples of themes in science as portrayed, for example, in film will be explored and critically discussed. Ways to improve communication between the scientist and the general public will be evaluated.

MICR 5353* Photobiology. Prerequisite(s): 3033 or BIOC 3653. The proteins and processes involved in biological photosynthesis, photosensing, and photodamage, including their biological relevance. Involves critical reading of primary literature and examination of protein structures using bioinformatics tools. *No credit for students with credit in 4353.*

MICR 5423* Bacterial Cell Walls: Form and Function. Prerequisite(s): 2123, 2132, and 3223. Topics will include structure and synthesis of membrane and cell wall components (including lipids, peptidoglycan and membrane proteins), mechanisms of transport across the cell wall and the roles components of the cell wall play in the survival of the cell (and in the case of pathogens, the ability to cause disease). In addition, antimicrobial agents that affect the cell wall and the mechanisms used to eliminate these agents from the cell will also be discussed. *No credit for students with credit in 4423.*

MICR 5513* Grant Proposal Preparation. Prerequisite(s): Admission into Microbiology graduate program. Formats, strategies, and styles of research grant proposal writing. Activities include hypothesis development and critical evaluation of research proposals.

MICR 5524* Biological Laboratory Instrumentation. Lab 4. Prerequisite(s): CHEM 1515 and BOT 1404 or MICR 2123 or ZOOL 1604 or equivalents or consent of instructor. Lecture and laboratory course in biological instrumentation use, theory, experimental design, maintenance, and troubleshooting. Topics include liquid handling systems, pH/ISE meters, electrophoresis, spectrophotometers, centrifuges, chromatography, thermocyclers, and DNA sequencers. *No credit for students with credit in MICR 4524.* (Same course as BIOL 5524.).

MICR 5990* Special Problems. 1-4 credits, max 10. Prerequisite(s): Permission of instructor. Investigations in the field of microbiology.

MICR 6000* Dissertation. 1-15 credits, max 45. Prerequisite(s): Consent of major adviser. Research in microbiology for the PhD degree.

MICR 6112* Molecular Biology of Bacterial Viruses. Prerequisite(s): 4123 and 4133. Advanced study of bacteriaphages.

MICR 6120* Recent Advances in Microbiology. 1 credit, max 6. Prerequisite(s): One graduate course in biochemistry. Discussion and evaluation of recent scientific contributions in terms of the living organism.

MICR 6133* Cellular Microbiology. Prerequisite(s): A strong undergraduate level background in microbiology, biochemistry or cell biology is expected. The molecular interactions between intracellular parasites and their host cells will be explored, emphasizing the manipulation of normal cellular processes to the benefit of the parasite. The course will involve critical reading of the current literature and development of an understanding of molecular microbe and cell biology research techniques.

MICR 6143* Advanced Microbial Physiology. Lab 3. Prerequisite(s): 3223 or consent of instructor. Discussion of selected topics in microbial physiology. Critical analysis of research papers.

MICR 6153* Advanced Molecular Genetics. Prerequisite(s): 4133. Structure, function and regulation of nucleic acids. Gene transfer mechanisms, genetic recombination and plasmid biology. Recent developments in recombinant DNA technology.

MICR 6163* Quantum Microbiology. Prerequisite(s): OSU graduate student or permission of instructor. This class will provide an in-depth introduction into fundamental principles that apply to any microorganism and will provide an intellectual framework to understand all cells. The fundamentals discussed will be illustrated through a combination of classical and recent scientific breakthroughs. It will provide a solid, deep foundation for a successful academic career in microbiology.

MICR 6213* Molecular Microbial Ecology. Prerequisite(s): 3223 or consent of the instructor. Current questions and recent advances in molecular microbial ecology methodologies and approaches, examination of the phylogenetic and metabolic diversity of Bacteria, Archaea, and microeukaryotics in various ecosystems, microbial community composition and ecophysiology in selected habitats, identification of rare members of the microbial community.

MICR 6253* Microbial Evolution. Prerequisite(s): 2123, 2132, BIOC 3653, BIOL 3023. The mechanisms and results of microbial evolution in nature and in the laboratory, with emphasis on microbes as model evolutionary systems, molecular evolution, classification and phylogeny, and discussion of protobiology and the probable fate of engineered microbes.

MICR 6304* Genetics of Simple Eukaryotes. Prerequisite(s): Solid understanding of basic cellular maintenance and propagation processes and consent of instructor. In-depth discussion of lessons learned from simple eukaryotes such as S. cerevisiae (yeast), A. nidulans (fungus), D. melanogaster (fly) and C. elegans (worm).

MICR 6323* Current Topics in Prokaryotic and Eukarytic Signal Transduction and Gene Regulation. Prerequisite(s): A strong undergraduate level background in microbiology, biochemistry or cell biology is expected. Discussion of current literature on the mechanisms of prokaryotic and eukaryotic signal transduction and gene regulation.

Military Science (MLSC)

MLSC 1000 Leadership Laboratory. 1 credit, max 2, Lab 2. Prerequisite(s): Concurrent enrollment in 1112 and 1212. Learning and practicing basic skills such as rappelling, drill and ceremony, land navigation, individual first aid, individual training in small unit tactics.

MLSC 1112 Foundations of Officership. Team study and activities in basic drill, physical fitness, rappelling, leadership reaction course, first aid, presentations and basic marksmanship. Fundamentals of leadership. Optional weekend exercise. Concurrent enrollment in MLSC 1000 recommended.

MLSC 1212 Basic Leadership. Principles of effective leading, communication skills, and organizational ethical values. Concurrent enrollment in MLSC 1000 recommended. Optional weekend exercise.

MLSC 2122 Leaders' Training Course. For students who have not completed all of basic ROTC. A four-week summer camp similar to Army Basic Training. No military obligation incurred. Completion of MLSC 2122 qualifies a student for entry into the Advanced Course.

MLSC 2130 Military Physical Conditioning. 1 credit, max 2, Lab 3. Prerequisite(s): Must be enrolled in MLSC theory classes. Participation in and learning to plan and lead a physical fitness program. Development of an individual fitness program and the role of exercise and fitness in person's life.

MLSC 2233 Individual Leadership Studies. Lab 2. Ethics-based leadership skills that develop individual abilities and contribute to the building of effective teams. Skills in oral presentation, writing, planning, coordinating groups, land navigation and basic military tactics.

MLSC 2313 Leadership and Teamwork. Lab 2. Prerequisite(s): 2233. Individual and team aspects of military tactics in small unit operations. Safety assessment, movement techniques, planning for team safety and security and methods of pre-execution checks. Training techniques for continued leadership development.

MLSC 3113 Leadership and Problem Solving. Lab 2. Prerequisite(s): Completion of lower-division MLSC or equivalent, and approval of professor of military science. Practical opportunities to lead small groups in situations of increasing complexity receiving personal assessments and encouragement. Use of small unit defensive tactics and opportunities to plan and conduct training for lower-division students both to develop such skills and as vehicles for practicing leading.

MLSC 3223 Leadership and Ethics. Lab 2. Prerequisite(s): 3113. Analysis of tasks; preparation of written or oral guidance for team members to accomplish tasks. Delegating tasks and supervising. Planning and adapting to the unexpected in organizations under stress. Examination and application of lessons from leadership case studies. Examination of importance of ethical decision-making in setting a positive climate that enhances team performance.

MLSC 4014 Leader Development and Assessment Course. Lab 8. Prerequisite(s): 3113 and 3223. A five-week camp conducted at an Army post. Individual leadership and basic skills performance.

MLSC 4123 Leadership and Management. Lab 2. Prerequisite(s): 3113 and 3223. Planning conducting and evaluating activities of the ROTC cadet organization. Articulating goals, putting plans into action to attain them. Assessing organizational cohesion and developing strategies to improve it. Developing confidence in skills to lead people and manage resources.

MLSC 4223 Officership. Lab 2. Prerequisite(s): 3113 and 3223. Continuation of the methodology from MLSC 4123. Identification and resolution of ethical dilemmas. Refining counseling and motivating techniques. Examination of aspects of tradition and law as related to leading as an officer in the Army.

MLSC 4422 The Tactical Planning Process. Prerequisite(s): ROTC advanced course status or consent of department head. The tactical planning process and its components. Computer tactical simulations used to organize and synchronize the process.

Multimedia Journalism (MMJ)

MMJ 3153 Fundamentals of Audio and Video Production. Lab 2. Prerequisite(s): MC 2003 and MC 2023 with a grade of "C" or better in both; and a minimum grade of 70 on the Language Exam. Theory and practice of basic audio and video production techniques leading to later applications in radio, television and multi-media production.

MMJ 3203 News Writing. Lab 2. Prerequisite(s): MC 2003 and MC 2023 with a grade of "C" or higher in both; and a minimum grade of 70 on Language Exam. The basics of news writing, grammar and Associated Press will be stressed. Students will learn the basics of structuring news stories and how to write basic stories including fire, crime, accidents, obituariers, etc.

MMJ 3263 Multimedia Reporting. Lab 2. Prerequisite(s): MC 2003 and MC 2023 with a grade of "C" or better in both; and a minimum grade of 70 on the Language Exam. Introduces the basic sources, documents and reporting techniques needed to cover typical government beats. Real-world assignments provide practical experience reporting and writing on deadline across media platforms such as print, broadcast and web. News judgment as well as interviewing, time- management and writing skills will be addressed. Gathering news in an ethical manner and telling substantive, multi-media stories that encompass the community's diversity are emphasized.

MMJ 3293 Information Graphics. Lab 2. Prerequisite(s): 3263 and 4423 with "C" or better and 4393 with "C" or better or concurrent, and minimum grade of 70 on Language Proficiency Exam. Using computer-designed charts, maps, graphs, diagrams and other visual representations of information to tell the news. Combines theories of non-verbal communication and practical application. Includes the basic design concepts and techniques for creating TV and video graphics.

MMJ 3313 Editing in a Multimedia Environment. Lab 2. Prerequisite(s): 3263 with a grade of "C" or better; and a minimum grade of 70 on the Language Proficiency Exam. Principles and practice in editing copy for print, broadcast and web, selecting pictures and video, and writing headlines, cutlines, blurbs, teases and promos. Strong emphasis placed on language usage and ethical decision-making.

MMJ 3553 Advanced Reporting. Lab 2. Prerequisite(s): 3263 with "C" or better, 3153 or concurrent enrollment, and minimum grade of 70 on Language Proficiency Exam. News writing and reporting techniques combined with newsgathering technology to enable students to produce stores that can be featured across all media platforms.

MMJ 3623 Internet Communication. Lab 2. Prerequisite(s): 2003 and 2023 with grade of "C" or better in each, minimum grade of 70 on Language Exam. Theoretical and practical understanding of how the Internet is changing the way mass media and media-related organizations communicate with audiences.

MMJ 3773 Voice Production and Performance. Prerequisite(s): MC 2003 and MC 2023 with a grade of "C" or better in both; and a minimum grade of 70 on the Language Exam. Covers the physical aspects of voice production and how to train and maintain the voice for effective communication. Students will improve their interviewing skills and become more effective communicators, with emphasis on conducting live interviews, ad-libbing and working with a teleprompter.

MMJ 3823 Photography I. Lab 2. Prerequisite(s): MC 2003 and 2023 with grade of "C" or better in each, minimum grade of 70 on Language Exam. Expression of visual communications through photography. Creating and producing photographs using digital equipment and understanding lenses, exposures, color and composition. Manipulation, color and tone correction of photography using photo-editing software. For students who want an elementary understanding of photography or to prepare for advanced work in photography or photojournalism.

MMJ 3873 Audio Production. Lab 2. Prerequisite(s): 3153 with a grade of "C" or better; and a minimum grade of 70 on the Language Exam. Prepares students to work in radio and internet audio production and imaging. Students prepare and present materials in a broadcasting situation.

MMJ 3900 Multimedia Journalism Internship. 1-3 credits, max 6. Prerequisite(s): 3153 and 3263 with a grade of "C" or better and consent of instructor; and a minimum grade of 70 on the Language Exam. Internship practice for qualified multimedia journalism students who wish creative communications experience beyond that available in the classroom.

MMJ 3913 Field Production. Lab 2. Prerequisite(s): 3153 with a grade of "C" or better; and a minimum grade of 70 on the Language Exam. Video production techniques, including camera, audio, lighting, staging, producing, post production, graphics and on-camera performance. Project-driven and emulates actual client-based productions. Emphasizes constant planning and evaluation of productions.

MMJ 3943 Photojournalism. Lab 2. Prerequisite(s): MC 2003 and 2023 with grade of "C" or better in each, minimum grade of 70 on Language Exam. Theory and practice in the digital techniques of photojournalism. Intermediate concepts of lighting, composition, action and storytelling via digital photography. A basic understanding of photography and photo developing necessary. Must have access to 35mm single reflex or digital camera.

MMJ 4093 Extreme Digital Persuasion. Lab 2. Prerequisite(s): 3913 with a grade of "B" or better and instructor approval. Broadcast post-production techniques at an advanced level utilizing AfterEffects, Adobe CS3/4, Final Cut Pro Studio, Dreamweaver, and others. Special topics/projects in areas such as commercial productions, corporate communication productions, political digital media, web & broadcast, and topical productions. This course has been designed to be project driven and to emulate actual client based productions.

MMJ 4243 Programs and Audiences. Prerequisite(s): MC 2003 with a grade "C" or better; and a minimum grade of 70 on the Language Exam. Audience analysis, proper construction of programs for greatest appeal and use of appeals to attract the desired audience. Program types, rating systems, program selection and audience attention. Design and discussion of programs to reach specific audiences.

MMJ 4313 Public Affairs Reporting. Lab 2. Prerequisite(s): 3263 with a grade of "C" or better; and a minimum of 70 on the Language Exam. Reporting techniques empowering journalists to fulfill their watchdog role in a democracy. Practical experience in accurately reporting and writing on deadline. Focus on a multimedia mindset to tell the news of government through people. Emphasizes importance of human diversity and cultivating sources ethically. Stresses the use of government documents.

MMJ 4393 Data Journalism. Prerequisite(s): 3263 with a grade "C" or better, minimum grade of 70 on the Language Exam; STAT 2013 or 2023 or 2053. Provides practical experience using the computer as a tool for data analysis while focusing on social science research methods. Combines the scientific method with the process approach to news writing. Teaches how to find and import data into a spreadsheet and systematically analyze it using basic and advanced techniques. The data analysis will generate an idea for a story for print or broadcast, which must be followed up with reporting and writing that stresses how people are affected.

MMJ 4413 Advanced Reporting and Writing. Prerequisite(s): 4313 with a grade of "C" or better; and a minimum grade of 70 on the Language Exam. Enhancement of writing style and reporting techniques; evaluation of sources and polling practices, and investigative coverage of newsmakers and events.

MMJ 4423 Graphic Design in Multimedia. Lab 2. Prerequisite(s): MC 2003 and MC 2023 with "C" or better, and a minimum grade of 70 on Language Proficiency Exam. Design principles, techniques and practices for a converging media. Includes photo editing and introduction to type for print and online. Emphasizes ethical decision-making in content selection and placement.

MMJ 4433 Feature Writing for Newspaper and Magazine. Prerequisite(s): 15 credit hours of English or journalism course work. Newspaper features and

special articles for general circulation magazines, business and trade journals; sources, materials, markets and other factors pertinent to nonfiction writing.

MMJ 4540 Specialized Multimedia Journalism Applications. 3 credits, max 6. Prerequisite(s): 3153 or 3263 with a grade of "C" or better and consent of department; and a minimum grade of 70 on the Language Exam. Professional journalism at an advanced level. Special topics in areas such as announcing, performance; political, business and investigative reporting; advanced layout and design or audio production; feature, column and editorial writing. Course content varies by semester. *Meets with MC 5540. No credit for students in MC 5540.*

MMJ 4553 News Production. Lab 2. Prerequisite(s): 3153 and 3553 each with a grade of "C" or higher; and a minimum grade of 70 on the Language Exam. Advanced skills in reporting, news producing, editing and anchoring. Students will assemble a video newscast or newsmagazine with content that is usable across various media platforms.

MMJ 4573 Broadcast Documentary. Prerequisite(s): 3553 and 3913 with a grade of "C" or better in both; and a minimum grade of 70 on the Language Exam. Student-written and produced broadcast and cablecast mini-documentaries; analysis of selected programs.

MMJ 4753 Media and Elections. Prerequisite(s): MC 2003 and MC 2023 with a grade of "C" or better in both; and a, minimum grade of 70 on the Language Exam. Examination of media's role in the political process with primary emphasis on print and broadcast journalism practices. *Meets with MC 5753. No credit for students with credit in MC 5753.*

MMJ 4773 Censorship. Prerequisite(s): MC 2003 and MC 2023 with a grade of "C" or better in both; and a minimum grade of 70 on the Language Exam. A critical examination of historical and contemporary occurrences of censorship from legal, philosophical, political, religious and sociological perspectives. The course will explore the definition of censorship, the common elements found in all forms of censorship, the rationalizations and justifications for censorship, and the consequences and unintended results of censorship. *No credit for students with credit in MC 5773.*

MMJ 4863 Media Management. Prerequisite(s): 3263 with a grade of "C" or better; and a minimum grade of 70 on the Language Exam. Basic issues, concepts, operational procedures and strategies associated with effectively managing media corporations. Examines management operations related to media convergence. Emphasis is placed on making ethical decisions and administrative choices in staffing and content that reflect a community's diversity. *No credit for students with credit in MC 5863.*

MMJ 4953 Advanced Production Practices. Lab 2. Prerequisite(s): 3913 and 3263 with "C" or better, minimum grade of 70 on Language Proficiency Exam. Advanced professional television production. Student produced and directed television programs, including "specials," for distribution on cable or other professional media.

MMJ 4960 Live Field Production. 3 credits, max 6. Prerequisite(s): 3153 with a grade of "C" or better; and a minimum grade of 70 on the Language Exam or consent of instructor. Develop a live, in-the-field production from writing a program proposal to an actual live broadcast. Students determine what equipment is needed; conduct a site survey to develop a location plot for the site; determine the best location for the cameras and master control area; write a facilities request; and create scripts for the pre-parade show and the Homecoming parade broadcast. Students also learn proper techniques of in-the-field videography, switching (live editing), and audio.

MMJ 4973 Multimedia Journalism Capstone. Prerequisite(s): 3553; 4393 or 4953 with a grade of "C" or better in each; and a minimum grade of 70 on the Language Exam. Separate, concurrent lectures teach advanced principles and techniques to students specializing in reporting or digital production. Students come together as teams to create multimedia news products.

Music (MUSI)

MUSI 0500 Student Recital Attendance. Graduation requirement for music degree or certificate candidates. *Graded on a pass-fail basis.*

MUSI 1001 Percussion Techniques. Lab 2. Methods for playing and teaching percussion instruments.

MUSI 1011 Piano Class Lessons. Prerequisite(s): Music major status or consent of instructor. For students with no previous experience.

MUSI 1021 Piano Class Lessons. Prerequisite(s): Music major status or consent of instructor.

MUSI 1031 Voice Class Lessons.

MUSI 1071 Single Reed Techniques. Lab 2. Methods for playing and teaching the clarinet and saxophone.

MUSI 1081 Double Reed Techniques. Lab 2. Methods for playing and teaching the oboe and bassoon.

MUSI 1091 High Brass Techniques. Lab 2. Methods for playing and teaching the trumpet and French horn.

MUSI 1110 Elective Organ. 1-2 credits, max 8.

MUSI 1120 Elective Piano. 1-2 credits, max 8.

MUSI 1130 Elective Voice. 1-2 credits, max 8.

MUSI 1140 Elective Brass. 1-2 credits, max 8.

MUSI 1150 Elective Strings. 1-2 credits, max 8.

MUSI 1160 Elective Woodwinds. 1-2 credits, max 8.

MUSI 1170 Elective Percussion. 1-2 credits, max 8.

MUSI 1180 Secondary Organ. 1-2 credits, max 8.

MUSI 1190 Secondary Piano. 1-2 credits, max 8.

MUSI 1200 Secondary Voice. 1-2 credits, max 8.

MUSI 1210 Secondary Brass. 1-2 credits, max 8.

MUSI 1220 Secondary String. 1-2 credits, max 8.

MUSI 1230 Secondary Woodwind. 1-2 credits, max 8.

MUSI 1240 Secondary Percussion. 1-2 credits, max 8.

MUSI 1260 Major Piano. 1-4 credits, max 8.

MUSI 1270 Major Voice. 1-4 credits, max 8.

MUSI 1280 Major Violin. 1-4 credits, max 8.

MUSI 1290 Major Viola. 1-4 credits, max 8.

MUSI 1300 Major Cello. 1-4 credits, max 8.

MUSI 1310 Major Double Bass. 1-4 credits, max 8.

MUSI 1340 Major Flute. 1-4 credits, max 8.

MUSI 1350 Major Oboe. 1-4 credits, max 8.

MUSI 1360 Major Clarinet. 1-4 credits, max 8.

MUSI 1370 Major Saxophone. 1-4 credits, max 8.

MUSI 1380 Major Bassoon. 1-4 credits, max 8.

MUSI 1390 Major Trumpet. 1-4 credits, max 8.

MUSI 1400 Major French Horn. 1-4 credits, max 8.

MUSI 1410 Major Trombone. 1-4 credits, max 8.

MUSI 1420 Major Euphonium. 1-4 credits, max 8.

MUSI 1430 Major Tuba. 1-4 credits, max 8.

MUSI 1440 Major Percussion. 1-4 credits, max 8.

MUSI 1531 Sight Singing and Aural Skills I. Lab 2. Development of skills in sight singing and aural perception. *Taken concurrently with MUSI 1533.*

MUSI 1533 Theory of Music I. Lab .5. Choral and instrumental writing and analysis correlated with keyboard skills. *Taken concurrently with MUSI 1531.*

MUSI 1541 Sight Singing and Aural Skills II. Prerequisite(s): 1531 and 1533. A continuation of 1531. *Taken concurrently with 1543.*

MUSI 1543 Theory of Music II. Lab .25. Prerequisite(s): 1531 and 1533. *A continuation of 1533. Taken concurrently with 1541.*

MUSI 1623 Introduction to Music Business. Prerequisite(s): Music major status or consent of instructor. A survey of music business procedures, opportunities, technologies and trends.

MUSI 1631 Introduction to Diction for Singers. Designed for Music Education majors. Introduces and develops skills in pronunciation and diction for singing in English, Italian, French and German.

MUSI 2010 Piano Class Lessons. Prerequisite(s): 1021 and music major status. Class lessons for music majors (non-keyboard concentration) preparing for the piano proficiency examination.

MUSI 2052 String Instrument Techniques. Methods for playing and teaching the violin, viola, cello and double bass.

MUSI 2071 Flute Techniques. Methods for playing and teaching the flute.

MUSI 2091 Low Brass Techniques. Methods for playing and teaching the trombone, euphonium, and tuba.

MUSI 2260 Major Piano. 1-4 credits, max 8. Prerequisite(s): 1260.

MUSI 2270 Major Voice. 1-4 credits, max 8. Prerequisite(s): 1270.

MUSI 2280 Major Violin. 1-4 credits, max 8. Prerequisite(s): 1280.

MUSI 2290 Major Viola. 1-4 credits, max 8. Prerequisite(s): 1290.

MUSI 2300 Major Cello. 1-4 credits, max 8. Prerequisite(s): 1300.

MUSI 2310 Major Double Bass. 1-4 credits, max 8. Prerequisite(s): 1310.

MUSI 2340 Major Flute. 1-4 credits, max 8. Prerequisite(s): 1340.

MUSI 2350 Major Oboe. 1-4 credits, max 8. Prerequisite(s): 1350.

MUSI 2360 Major Clarinet. 1-4 credits, max 8. Prerequisite(s): 1360.

MUSI 2370 Major Saxophone. 1-4 credits, max 8. Prerequisite(s): 1370.

MUSI 2380 Major Bassoon. 1-4 credits, max 8. Prerequisite(s): 1380.

MUSI 2390 Major Trumpet. 1-4 credits, max 8. Prerequisite(s): 1390.

MUSI 2400 Major French Horn. 1-4 credits, max 8. Prerequisite(s): 1400.

MUSI 2410 Major Trombone. 1-4 credits, max 8. Prerequisite(s): 1410.

MUSI 2420 Major Euphonium. 1-4 credits, max 8. Prerequisite(s): 1420.

MUSI 2430 Major Tuba. 1-4 credits, max 8. Prerequisite(s): 1430.

MUSI 2440 Major Percussion. 1-4 credits, max 8. Prerequisite(s): 1440.

MUSI 2450 Major Harpsichord. 1-4 credits, max 8.

MUSI 2551 Sight Singing and Aural Skills III. Prerequisite(s): 1541 and 1543. Further development of skills in sightsinging and aural perception. *Taken concurrently with 2553.*

MUSI 2553 Theory of Music III. Lab .5. Prerequisite(s): 1541 and 1543. Choral and instrumental writing correlated with sightsinging, melodic and harmonic dictation and keyboard skills. *Taken concurrently with 2551.*

MUSI 2561 Sight Singing and Aural Skills IV. Prerequisite(s): 2551 and 2553. *A continuation of 2551. Taken concurrently with 2563.*

MUSI 2563 Theory of Music IV. Lab .5. Prerequisite(s): 2551 and 2553. *A continuation of 2553. Taken concurrently with 2561.*

MUSI 2573 (H) Introduction to Music. Instruments, musical forms and styles, and major composers from the 16th century to the present. For non-majors; no prior musical experience required.

MUSI 2610 University Bands I. 1 credit, max 6, Lab 3-5.

MUSI 2620 Symphony Orchestra I. 1 credit, max 6, Lab 4. (Same course as 3620 & 5620*)

MUSI 2630 University Choral Ensembles I. 1 credits, max 6, Lab 3-5. (Same course as 3630 & 5630*)

MUSI 2722 Introduction to Music Education. Prerequisite(s): 1533, 1543. An entry level course designed to socialize the music education major to the role of the music education teacher within U.S. schools. Topics include motivation and management, learning theories, micro teaching, music advocacy, portfolio introduction, and early field experience.

MUSI 2773 (H) History of Jazz. Elements and stylistic features of jazz, its evolution and its impact on society.

MUSI 2832 Elementary Music Methods. Prerequisite(s): 2722. An overview of effective methods, techniques and materials for teaching music to children in the elementary grades. Theories of child development and implications on music learning; current philosophies or approaches for teaching music (Kodaly, Orff, and Dalcroze); designing and teaching musical activities through which children learn musical concepts and develop musical skills.

MUSI 2842 Intermediate Music Methods. Prerequisite(s): 2832. Second in a series of two vocal method courses for vocal music education majors. Field experience and peer teaching activities. Curriculum design and evaluation; technology for music instruction; multicultural music in the classroom; music for exceptional children; and music in an integrated curriculum.

MUSI 3022 Piano Skills for Vocal Music Education Majors. Prerequisite(s): 2010 or consent of instructor. Development of skills in sight-reading, score reading, and general ensemble accompaniment for vocal music education majors.

MUSI 3110 Elective Organ. 1-2 credits, max 8. Prerequisite(s): 1110.

MUSI 3120 Elective Piano. 1-2 credits, max 8. Prerequisite(s): 1120.

MUSI 3130 Elective Voice. 1-2 credits, max 8. Prerequisite(s): 1130.

MUSI 3140 Elective Brass. 1-2 credits, max 8. Prerequisite(s): 1140.

MUSI 3150 Elective String. 1-2 credits, max 8. Prerequisite(s): 1150.

MUSI 3160 Elective Woodwind. 1-2 credits, max 8. Prerequisite(s): 1160.

MUSI 3170 Elective Percussion. 1-2 credits, max 8. Prerequisite(s): 1170.

MUSI 3180 Secondary Organ. 1-2 credits, max 8. Prerequisite(s): 1180.

MUSI 3190 Secondary Piano. 1-2 credits, max 8. Prerequisite(s): 1190.

MUSI 3200 Secondary Voice. 1-2 credits, max 8. Prerequisite(s): 1200.

MUSI 3210 Secondary Brass. 1-2 credits, max 8. Prerequisite(s): 1210.

MUSI 3220 Secondary String. 1-2 credits, max 8. Prerequisite(s): 1220.

MUSI 3230 Secondary Woodwind. 1-2 credits, max 8. Prerequisite(s): 1230.

MUSI 3240 Secondary Percussion. 1-2 credits, max 8. Prerequisite(s): 1240.

MUSI 3260 Major Piano. 1-4 credits, max 8. Prerequisite(s): Upper-division examination, 2260.

MUSI 3270 Major Voice. 1-4 credits, max 8. Prerequisite(s): Upper-division examination, 2270.

MUSI 3280 Major Violin. 1-4 credits, max 8. Prerequisite(s): Upper-division examination, 2280.

MUSI 3290 Major Viola. 1-4 credits, max 8. Prerequisite(s): Upper-division examination, 2290.

MUSI 3300 Major Cello. 1-4 credits, max 8. Prerequisite(s): Upper-division examination, 2300.

MUSI 3310 Major Double Bass. 1-4 credits, max 8. Prerequisite(s): Upper-division examination, 2310.

MUSI 3340 Major Flute. 1-4 credits, max 8. Prerequisite(s): Upper-division examination, 2340.

MUSI 3350 Major Oboe. 1-4 credits, max 8. Prerequisite(s): Upper-division examination, 2350.

MUSI 3360 Major Clarinet. 1-4 credits, max 8. Prerequisite(s): Upper-division examination, 2360.

MUSI 3370 Major Saxophone. 1-4 credits, max 8. Prerequisite(s): Upper-division examination, 2370.

MUSI 3380 Major Bassoon. 1-4 credits, max 8. Prerequisite(s): Upper-division examination, 2380.

MUSI 3390 Major Trumpet. 1-4 credits, max 8. Prerequisite(s): Upper-division examination, 2390.

MUSI 3400 Major French Horn. 1-4 credits, max 8. Prerequisite(s): Upper-division examination, 2400.

MUSI 3410 Major Trombone. 1-4 credits, max 8. Prerequisite(s): Upper-division examination, 2410.

MUSI 3420 Major Euphonium. 1-4 credits, max 8. Prerequisite(s): Upper-division examination, 2420.

MUSI 3430 Major Tuba. 1-4 credits, max 8. Prerequisite(s): Upper-division examination, 2430.

MUSI 3440 Major Percussion. 1-4 credits, max 8. Prerequisite(s): Upper-division examination, 2440.

MUSI 3460 Secondary Harpsichord. 1-2 credits, max 8.

MUSI 3543 (H,I) Music and Culture of Northern Italy. Study of northern Italy's contributions to culture through music and composers, instrument makers, architecture, and visual arts.

MUSI 3573 (D,H) America's Ethnic Music. A survey of the ethnic settlers of America and their musical traditions and literatures. Particular emphasis is given to settlers indigenous to Oklahoma. Students will examine their individual ethnic roots in music, family traditions, and life passages (births, deaths, celebrations).

MUSI 3582 Music of Non-Western Cultures. Prerequisite(s): 1543 or consent of instructor. Survey of musical styles, forms, genres, performance practices, philosophies, and social impact of music from non-Western cultures, focusing on an examination of how these differ from Western European musical practices and culture, and their influence on the global music community of the 21st century. Knowledge of Western musical terminology and notational practice required.

MUSI 3583 (H,I) Traditional World Music. Survey of the richly diverse music of non-western cultures emphasizing traditional musical practices prior to contact with western media. Exploration of the wide parameters of musical possibilities and the distinct priorities of various musical cultures, in order to gain insight and appreciation of distinctly non-western music. Historical recordings supplemented by video tapes. Knowledge of western classical music notation helpful. Intended for students having earned at least 40 credit hours. (Same course as 5583*)

MUSI 3592 Introduction to Music Technology. Prerequisite(s): 1543. Introduction to specialized computer applications in music, including music notation, digital audio recording, processing and editing.

MUSI 3610 University Bands II. 1 credit, max 8, Lab 3-5. Prerequisite(s): 4 hours of 2610. (Same course as 2610 & 5610*)

MUSI 3620 Symphony Orchestra II. 1 credit, max 8, Lab 4. (Same course as 2620 & 5620*)

MUSI 3630 University Choral Ensembles II. 1 credit, max 8, Lab 3-5. Prerequisite(s): 4 hours of 2630. (Same course as 2630 & 5630)

MUSI 3640 Rehearsal Practicum. 1 credit, max 3, Lab 1-3. Prerequisite(s): 3722 and 3732 or permission of instructor is required. Designed for Music Education majors who are within two semesters of student teaching. This course prepares future teachers with classroom skills using one of the choral or instrumental ensembles or lab groups as their rehearsal medium.

MUSI 3642 English and Italian Diction and Vocal Literature. Prerequisite(s): 1631. Course is designed for vocal performance majors, vocal music education majors and other serious voice students to assist them in mastering correct pronunciation and diction for singing standard English and Italian through the study and use of the international phonetic alphabet, and to familiarize them with many of the composers and songs which comprise the standard English and Italian vocal literature.

MUSI 3652 French Diction and Vocal Literature. Prerequisite(s): 1631. Course is designed for vocal performance majors, vocal music education majors and other serious voice students to assist them in mastering correct pronunciation and diction for singing in French through the study and use of the international phonetic alphabet, and to familiarize them with many of the composers and songs which comprise the standard French vocal literature.

MUSI 3662 German Diction and Vocal Literature. Prerequisite(s): 1631. Course is designed for vocal performance majors, vocal music education majors and other serious voice students to assist them in mastering correct pronunciation and diction for singing in German through the study and use of the international phonetic alphabet, and to familiarize them with many of the composers and songs which comprise the standard German vocal literature.

MUSI 3712 Basic Conducting. Principles of conducting choral and instrumental groups.

MUSI 3722 Advanced Ensemble Conducting. Prerequisite(s): 3712. Studies in advanced physical conducting techniques and score orientation, score reading, score analysis, and score interpretation.

MUSI 3732 Secondary Choral Methods. Prerequisite(s): 3712. Repertoire, rehearsal procedures, and vocal techniques for the public school choral teacher.

MUSI 3741 Survey of Rock and Roll I. An examination of the cultural and musical elements that led to the advent of Rock and Roll, through an exploration of the evolution of the music from its inception to 1980 through lecture, reading and musical recordings.

MUSI 3743 Foundations of Music Education. Prerequisite(s): Full admission to Professional Education. Interdisciplinary approach including aspects of philosophy, aesthetics, sociology and psychology as they are applied in music in post-elementary public schools.

MUSI 3751 Survey of Rock and Roll II. An examination of the cultural and musical elements that led to the advent of Rock and Roll, through an exploration of the music from 1980 to the present.

MUSI 3753 (H) History of Music to 1600. Prerequisite(s): 1543 or consent of instructor. Aids music majors and other qualified students in understanding the musical styles, forms, schools, composers and instruments that developed in Western civilization from antiquity through the Renaissance period.

MUSI 3763 History of Music from 1600-1800. Prerequisite(s): 1543 or consent of instructor. Aids music majors and other qualified students in understanding the musical styles, forms, schools, composers and instruments that developed in Western civilization from the Baroque period through to the Classical period.

MUSI 3772 Counterpoint. Prerequisite(s): 2563 and satisfactory upper-division examination. Analysis and application of contrapuntal techniques of the 18th century.

MUSI 3783 Form and Analysis. Prerequisite(s): 2563 and satisfactory upper-division examination. Analysis of standard repertoire with emphasis on form and structural harmonic analysis.

MUSI 3842 Marching Band Methods. Prerequisite(s): 1723 and 2832 and concurrent enrollment in 2610 or 3610 (marching band). Organizational responsibilities and charting for public school marching bands. *Must be taken concurrently with 2610 or 3610 (marching band).*

MUSI 3852 Secondary Instrumental Methods. Prerequisite(s): 2832; 3712. This course is designed to give instrumental music education majors an in-depth look at administering a public school band program, including history and wind literature, literature selection, preparing budgets, preparing commissioning projects, working with administration, school boards and parent groups, organizational responsibilities, and charting for public school marching bands.

MUSI 3873 History of Music from 1800-Present. Prerequisite(s): 1543 or consent of instructor. Aids music majors and other qualified students in understanding the musical styles, forms, schools, composers and instruments that developed in Western civilization from the Romantic period through to the present.

MUSI 3901 Junior Recital. Prerequisite(s): Junior standing and consent of major applied music teacher.

MUSI 4042 Collaborative Piano. Prerequisite(s): Music major status or consent of instructor. This course introduces piano majors to the vast collaborative piano repertoire and helps them develop skills for future performing and/or teaching. Through coaching sessions and weekly reading and listening assignments, students will learn the difficult and rewarding art of collaborating with other performers. The course will focus on both vocal and instrumental accompanying repertoire. *No credit for students with credit in 5042.*

MUSI 4100 Music Industry Internship. 1-8 credits, max 8. Prerequisite(s): 90 credit hours and minimum 2.50 GPA in all music and business courses. Directed practical experiences in an approved work situation related to the music industry.

MUSI 4260 Major Piano. 1-4 credits, max 8. Prerequisite(s): 3260 and successful completion of recital attendance requirements.

MUSI 4270 Major Voice. 1-4 credits, max 8. Prerequisite(s): 3270 and successful completion of recital attendance requirements.

MUSI 4280 Major Violin. 1-4 credits, max 8. Prerequisite(s): 3280 and successful completion of recital attendance requirements.

MUSI 4290 Major Viola. 1-4 credits, max 8. Prerequisite(s): 3290 and successful completion of recital attendance requirements.

MUSI 4300 Major Cello. 1-4 credits, max 8. Prerequisite(s): 3300 and successful completion of recital attendance requirements.

MUSI 4310 Major Double Bass. 1-4 credits, max 8. Prerequisite(s): 3310 and successful completion of recital attendance requirements.

MUSI 4340 Major Flute. 1-4 credits, max 8. Prerequisite(s): 3340 and successful completion of recital attendance requirements.

MUSI 4350 Major Oboe. 1-4 credits, max 8. Prerequisite(s): 3350 and successful completion of recital attendance requirements.

MUSI 4360 Major Clarinet. 1-4 credits, max 8. Prerequisite(s): 3360 and successful completion of recital attendance requirements.

MUSI 4370 Major Saxophone. 1-4 credits, max 8. Prerequisite(s): 3370 and successful completion of recital attendance requirements.

MUSI 4380 Major Bassoon. 1-4 credits, max 8. Prerequisite(s): 3380 and successful completion of recital attendance requirements.

MUSI 4390 Major Trumpet. 1-4 credits, max 8. Prerequisite(s): 3390 and successful completion of recital attendance requirements.

MUSI 4400 Major French Horn. 1-4 credits, max 8. Prerequisite(s): 3400 and successful completion of recital attendance requirements.

MUSI 4410 Major Trombone. 1-4 credits, max 8. Prerequisite(s): 3410 and successful completion of recital attendance requirements.

MUSI 4420 Major Euphonium. 1-4 credits, max 8. Prerequisite(s): 3420 and successful completion of recital attendance requirements.

MUSI 4430 Major Tuba. 1-4 credits, max 8. Prerequisite(s): 3430 and successful completion of recital attendance requirements.

MUSI 4440 Major Percussion. 1-4 credits, max 8. Prerequisite(s): 3440 and successful completion of recital attendance requirements.

MUSI 4450 Major Harpsichord. 1-4 credits, max 8.

MUSI 4490* Lessons in Applied Music (Major Field). 1-4 credits, max 4. Prerequisite(s): Bachelor's degree or equivalent performing level in applied major field. Major applied music field.

MUSI 4600 Chamber Ensembles. 1 credit, max 12, Lab 1-3. Combinations of voice, keyboard, and orchestral instruments for performing chamber music, music theater and duo piano repertoire.

MUSI 4810* Problems in Musical Composition. 1-2 credits, max 8. Prerequisite(s): 1543 and consent of instructor. Practical experience in musical composition.

MUSI 4840* Special Studies in Music Literature. 2 credits, max 4. Prerequisite(s): Junior standing or consent of instructor. Survey of music literature suitable for teaching various levels in applied music.

MUSI 4842 Choral Literature for the Classroom. Prerequisite(s): 3732. Exploration of the vast amount of choral literature available to the choral conductor. Includes repertoire for all ages and all voices.

MUSI 4890* Special Studies in Music Pedagogy. 2 credits, max 4. Prerequisite(s): Junior standing or consent of instructor. Survey of music pedagogical methods suitable for various levels and types of applied music.

MUSI 4901 Senior Recital. Prerequisite(s): Senior standing and permission of major applied music teacher.

MUSI 4912 Orchestration and Arranging. Prerequisite(s): Upper-division standing as a music major or consent of instructor. Orchestrating for instrumental ensembles and arranging for choral ensembles.

MUSI 4940 Student Teaching in Public School Music. 6-10 credits, max 10. Prerequisite(s): Full admission to Professional Education. Directed observation, seminars, and supervised student teaching in selected elementary and secondary music programs. *Graded on a pass-fail basis.*

MUSI 4952* Music in the School Curriculum. Aims, content and motivation of the music education program in elementary and secondary schools from the standpoint of the classroom teacher, music specialist and administrator.

MUSI 4962* Music Education Seminar. Research into latest developments of public school choral and instrumental music.

MUSI 4972 Post Tonal Analysis. Prerequisite(s): 2553 and successfully pass the Upper-Division Theory Barrier Exam. Techniques for the analysis of music from the 20th and 21st centuries, including set analysis.

MUSI 4990* Selected Studies in Music and Music Education. 1-3 credits, max 8. Short-term area studies in music and music education.

MUSI 4993 Senior Honors Project. Prerequisite(s): Departmental invitation, senior standing, Honors Program participation. A guided program in musicological research, music composition, or music performance, ending with an honors project under the direction of a faculty member with a second faculty member to complete an examining committee. Required for graduation with departmental honors in music.

MUSI 5002* Final Degree Performance. Prepare and perform or conduct a public concert or recital of significant repertoire.

MUSI 5012* Final Degree Project and Oral Examination. Final capstone project in performance or conducting as assigned by disciplinary area, and cumulative oral examination before a designated committee of faculty. Detailed information on acceptable projects are found in the Graduate Music Student Handbook.

MUSI 5022* Graduate Theory Review. Designed as a review of musical analysis materials and techniques necessary to prepare students for further studies in music analysis at the graduate level. Enrollment is mandated or encouraged based on entrance exam scores.

MUSI 5042* Collaborative Piano. Prerequisite(s): Music major status or consent of instructor. This course introduces piano majors to the vast collaborative piano repertoire and helps them develop skills for future performing and/or teaching. Through coaching sessions and weekly reading and listening

assignments, students will learn the difficult and rewarding art of collaborating with other performers. The course will focus on both vocal and instrumental accompanying repertoire. *No credit for students with credit in 4042.*

MUSI 5113* Introduction to Graduate Studies in Music. Prerequisite(s): Admission to Master of Music program. Understanding of the resources available for research in the field of music. Explanation of the types of research materials needed for classes in the Master of Music degree program, as well as providing the groundwork for success in the professional world as a music educator and performer.

MUSI 5480* Lessons in Applied Music (Minor Field). 1-4 credits, max 12. Prerequisite(s): Bachelor's degree or equivalent performance level in applied major field.

MUSI 5490* Lessons in Applied Music (Major Field). 1-4 credits, max 12. Prerequisite(s): Bachelor's degree or equivalent performing level in applied major field. Private Lessons.

MUSI 5512* Advanced Studies in Music Literature and Pedagogy I. Prerequisite(s): 3753, 3763 or equivalent. Techniques of successful programming, teaching and performance of ensemble literature through a survey of repertoire appropriate to the student's chosen medium.

MUSI 5522* Advanced Studies in Music Literature and Pedagogy II. Prerequisite(s): 3753, 3763 or equivalent. A continuation of 5512, with emphasis upon music of the 20th century and its attendant specialized performance techniques.

MUSI 5583* Traditional World Music. Survey of the richly diverse music of non-Western cultures emphasizing traditional musical practices prior to contact with Western media. Historical recordings supplemented by video tapes. Knowledge of Western classical music notation helpful. *Taught in conjunction with 3583.* (Same course as 3583)

MUSI 5600* Chamber Ensembles. 1-2 credits, max 6, Lab 1-3. Combinations of voice, keyboard, orchestral instruments for performing chamber music, music theater and duo piano repertoire.

MUSI 5610* University Bands. 1-2 credits, max 12, Lab 3-5. Large ensembles. (Same course as 2610 & 3610)

MUSI 5620* Symphony Orchestras. 1-2 credits, max 12, Lab 4. Large ensembles. (Same course as 2620 & 3620)

MUSI 5630* University Choral Ensembles. 1-2 credits, max 12, Lab 3-5. Large ensembles. (Same course as 2630 & 3630)

MUSI 5712* Advanced Studies in Conducting I. Prerequisite(s): 3712 and 3722 or equivalent. Acquisition of an expressive conducting gestural vocabulary as it relates to the student's chosen medium.

MUSI 5722* Advanced Studies in Conducting II. Prerequisite(s): 5712. A continuation of 5712 focusing upon the gestural vocabulary as it relates to the specific complexities of contemporary music.

MUSI 5733* Techniques of Pedagogy and Performance. Prerequisite(s): 3712 and 3722 or equivalent. Advanced techniques and modes for preparing music for performance.

MUSI 5742* Conducting Practicum. Prerequisite(s): 5712, 5722. Supervised conducting opportunities with major OSU ensembles or approved off-campus ensembles.

MUSI 5750* Seminar in Music History. 3 credits, max 9. Prerequisite(s): 3753 and 3763 or equivalent. Major European musical genres and pedagogical methods of a specified time in musical history. Acquaintance with source materials from the specified period to facilitate a knowledge of performance of genres studied. Topics vary.

MUSI 5842* Music Repertory. Survey of music literature suitable for teaching various levels in applied music.

MUSI 5962* Analytical Techniques in Music I. Prerequisite(s): Passing score on Graduate Theory Placement Exam or 5022. A critical survey of important analytical approaches to tonal and post tonal music.

MUSI 5972* Analytical Techniques in Music II. Prerequisite(s): Passing score on Graduate Theory Placement Exam or 5022. A continuation of MUSI 5962. Topics will include Schenkerian analyses, set theory and other contemporary analytical approaches to post tonal music.

Natural Resource Ecology and Management (NREM)

NREM 1012 Introduction to Natural Resource Ecology and Management. Introduction to the wide variety of natural resources found globally with a focus on Oklahoma ecoregions. Overview of the ecology and management of natural resources in the pine-hardwood forest, the Cross Timbers, and the tallgrass, mixed-grass and shortgrass prairies. Academic and career options presented through guest speakers.

NREM 1014 (L,N) Introduction to Natural History. Lab 2. The study of living organisms especially their origins, life histories, behaviors, conservation, and unique adaptations for reproducing and relating to their environment. Laboratory emphasis is on observation and investigation of the diversity and adaptations of living organisms.

NREM 1113 Elements of Forestry. Lab 3. Survey of forestry as an art, science and profession including forestry resource management theory, forest distribution and ownership, history of forest resource policy development, forest protection, wildlife interactions, forest ecosystem process, current issues, and career opportunities. *One required two-day field trip.*

NREM 1213 Introduction to Wood Properties and Products. Lab 2. Anatomical, physical and mechanical properties of solid wood and wood products. Macroscopic and microscopic identification of wood. Principles of manufacture of lumber, plywood and wood composites. Biological deterioration of wood and main wood preservation techniques. *One weekend field trip required.*

NREM 2013 Ecology of Natural Resources. Prerequisite(s): BIOL 1114 or PLNT 1213. Introductory focus on understanding and applying general ecological principles to agricultural and natural ecosystems. Emphasis on relationships between climate, soils, agricultural, and natural ecosystems. Topics include nutrient cycles, energy flow, species interactions, biological diversity, productivity, sustainability, and landscape and ecosystem management.

NREM 2103 Forest Measurements I. Lab 2. Prerequisite(s): 1113; MATH 1715 (or MATH 1513 and 1613); STAT 2013 (or concurrent). An introduction to the measurements of forests, forest products, standing trees, growth, and the application of mensurational techniques to timber valuation and analysis. Measurement techniques of non-timber components of forest resources.

NREM 2112 Timber Harvesting. Lab 3. Theory and strategies of planning and management of timber harvesting. Harvesting techniques including felling, bucking, skidding operations, and cable yarding. Timber harvest cost analysis, safety aspects of harvesting, and principles of forest road building. Field practices in road design and surveying. Field trips to industrial timber harvesting operations.

NREM 2134 Dendrology. Lab 4. Identification, taxonomy and distribution of forest trees and shrubs of the United States; their environmental requirements and utilization.

NREM 3012 Applied Ecology Laboratory. Lab 2. Prerequisite(s): 3013 or concurrent. Field experience aimed at navigating and working effectively and safely in the natural environment. Identification, measurement and interpretation of abiotic and biotic components to understand and describe ecosystem function and current natural resource management tools and issues. Focus on representative forest, grassland and aquatic ecosystems.

NREM 3013 Applied Ecology and Conservation. Prerequisite(s): BOT 1404 or ZOOL 1604; SOIL 2124 preferred. Development of critical thinking for conservation and land management through the application of ecological concepts and theory. Principles of population, community, ecosystem and landscape ecology, with applications to management of wildlife, fisheries, forest and rangeland resources. Application of scientific method and literature to natural resource ecology and management.

NREM 3063 Natural Resource Biometrics. Lab 2. Prerequisite(s): STAT 2013; and MATH 1513 or 1483. Application of statistical concepts to problems in natural resource sampling and estimation including simple random sampling, stratified sampling, regression analysis, double sampling and ratio and regression estimation. Statistical analysis using spreadsheets. Applications to forest, range and wildlife management.

NREM 3073 Ecological Genetics. Prerequisite(s): BOT 1404 or ZOOL 1604, STAT 2013 and any ecology course. Physical basis and principles of inheritance and genetic variation in populations, and how they arise, are quantified, and manipulated by nature and man. Concepts in population and quantitative genetics and their relationship to the evolution of natural and managed populations.

NREM 3083 Geospatial Technologies for Natural Resources. Lab 3. Prerequisite(s): MATH 1483 or 1493 or 1513. Principles and application of geospatial technologies for natural resource ecology and management including remote sensing (aerial photography and satellite data), geographic information systems (GIS) and global positioning system (GPS) technologies.

NREM 3101 Forest Resource Field Studies. Lab 2. Prerequisite(s): 2134 and BOT 1404 and SOIL 2124. One-week summer presession field experience at an off-campus site. Field study in the dynamics of forest ecosystems and related components including trees, soils, water, fauna, and associated flora as they relate to site productivity and the production of resource outputs, products, and services.

NREM 3102 Forest Measurements II. Lab 4. Prerequisite(s): 2103. Two-week summer presession field experience at an off-campus site. Land, tree, stand and forest-level measurements, and the use and care of measurement equipment. Emphasis on statistical and tactical design of forest inventory methods, and their implementation in the field.

NREM 3103 Natural Resource Field Studies. Lab 6. Three-week summer presession field experience at an off-campus site. Field study, analysis, and assessment of natural resource ecosystems at multiple scales with application to integrated management of forest, wildlife, range, water, soil, and recreation resources to sustain a broad array of uses and values, and to understand associated ecological, social, policy, and ethical issues. Includes visitations to

private and public natural resource lands and projects.

NREM 3113 Wood Properties. Lab 2. Prerequisite(s): 1213. Cellular and microscopic structure of wood. Properties of cellulose, lignin and hemicellulose. Wood and water relationship; wood drying and treatment systems. Stress-strain systems, rheological characteristics of wood, and assignment of design stresses in structural uses.

NREM 3213 Forest Ecology. Lab 2. Prerequisite(s): BOT 1404. Study of the forest ecosystem, its structure, function, physical environment, biotic components, change over time and management implications.

NREM 3224 Silviculture. Lab 2. Prerequisite(s): 3213 or 2013. Theory and practice of controlling forest establishment, composition, structure, and growth to meet multiple objectives. Principles and techniques of natural and artificial regeneration, intermediate cultural treatments, and silvicultural systems applicable in various forest cover types. Two-day field trip is required.

NREM 3323 Forest Economics and Finance. Prerequisite(s): AGEC 1114. Economic factors and analytical methods influencing decisions in forest resource management; factors affecting the production of wood products; arithmetic of interest and investment criteria; economics of non-market goods.

NREM 3343 (N) Forest Environmental Science. Overview and analysis of forests, their related environments, their associated natural resources, and their tangible and intangible values, emphasizing basic principles of scientific forest management, the use of forest resources by society, natural resource administration and policy, and current issues in forestry. *No credit for NREM in Forestry options.*

NREM 3502 Wildlife Law Enforcement. Prerequisite(s): Junior standing and consent of instructor. Survey of state and federal wildlife laws with emphasis on Oklahoma statutory and regulatory laws pertaining to wildlife. Lectures, guest lectures, videotapes and field exercises.

NREM 3503 Principles of Wildlife Ecology and Management. Prerequisite(s): BIOL 3034 or NREM 3213. An introduction to the biological basis of the management of wildlife habitats and populations.

NREM 3513 Principles of Conservation Biology. Prerequisite(s): 60 credit hours including BIOL 3034. Application of ecological principles to the maintenance and restoration of biological diversity at genetic, population, and community levels. (Same course as ZOOL 3513)

NREM 3523 Fish and Wildlife Population Biology. Prerequisite(s): BIOL 3034 or concurrent enrollment. Dynamics of fish and wildlife populations resulting from reproduction, competition, predation, movement, and exploitation. Effects of life history patterns on population growth and management strategies. Methods for measuring distribution, abundance, survival, and growth of fish and wildlife populations. Management strategies for fish and wildlife populations.

NREM 3613 Principles of Rangeland Management. Prerequisite(s): 2013 or 3213 or BIOL 3034. Overview of the science of applying ecological principles to managing rangeland resources, including rangeland characteristics; goods and services provided by rangelands; primary threats to rangelands; North American rangeland resources; principles of grazing management and current topics in range management.

NREM 3713 Wildland Fire Ecology and Management. Prerequisite(s): 2013 or any ecology course; and BIOL 1114. Fundamentals of wildland fire including chemistry and physics of fire, fuel and weather influences on fire behavior, ecological effects of fire, interaction of fire and vegetation, history of humans and fire, fire management and suppression, and prescribed fire.

NREM 4001 Issues in Global Change. Student led discussion to learn the causes and consequences of global change and practical implications for natural resource ecology and management.

NREM 4023 Restoration Ecology. Prerequisite(s): 2013 or BIOL 3034. Application of ecological theory to the practice of ecological restoration to improve populations, communities, and ecosystems degraded directly or indirectly by human activities.

NREM 4033 Ecology of Invasive Species. Prerequisite(s): BIOL 1114; and BOT 1404 and ZOOL 1604 recommended. Ecological principles and their application to invasive species. Population level characteristics; community and ecosystem level effects of a wide variety of taxa including microbial, fungal, plant, invertebrate, and vertebrate examples. Global consequences and governmental policies/programs designed to limit the spread of invasives.

NREM 4043* Natural Resource Administration and Policy. Prerequisite(s): Senior standing. Natural resource policy and legislation; ethics relating to natural resources; natural resource organizations and how they function to include structure, supervision, and financing of federal, state, and private natural resource enterprises.

NREM 4053* Natural Resource Recreation. Ecological, historical, social and policy basis for recreational use and management of natural resources, including an analysis of planning, management, and administrative frameworks for providing a diversity of recreational opportunities, benefits, and resource values.

NREM 4063 Ecotourism and Wilderness Management. Principles, applications, management approaches, case-studies and issues associated with ecotourism and wilderness use for a diversity of values and benefits. Historical, social, cultural, economic, political, and ecological foundations and implications of nature-based tourism and wilderness recreation.

NREM 4093 (I) Natural Resources, People and Sustainable Development. Prerequisite(s): Consent of instructor. Relationship between people, the land, and associated natural resources in the developing world, including the ecological and cultural basis for resource use and development. Examines issues of traditional agriculture and deforestation, and explores sustainable strategies for land use, resource management, and community development. Includes two-week study abroad component.

NREM 4213 Forest Biology. Prerequisite(s): BOT 1404. The response of trees and forest ecosystems to environmental, cultural and genetic factors. Application of physiological and ecological principles in predicting the effects of biotic and abiotic factors on tree growth and community interactions.

NREM 4323* Timber Management. Prerequisite(s): 3323 or AGEC 3213, and 3224. Regulation of forest growing stock to meet management objectives. Land and timber appraisals. Organization of the forest enterprise to meet financial objectives of management.

NREM 4333* Forest Resource Management: Planning and Decision-Making. Lab 2. Prerequisite(s): 4323. Integrated problem solving, to apply biological, quantitative, economic, political, and administrative principles in solving forest resource management problems.

NREM 4403 Wetland Ecology and Management. Lab 3. Prerequisite(s): 3213 or 3513 or BIOL 3034 or consent of instructor. Ecology, classification, restoration, and management of wetlands. Adaptations of wetland plants and animals, structure and function of wetlands, field identification of wetland plants, restoration techniques, wetland classification systems, management and conservation of wetlands, and regulatory processes.

NREM 4411* Water Quality Laboratory. Lab 3. Prerequisite(s): 4443, previous or concurrent. Techniques to monitor surface water for non-point source pollution. Water sampling strategies, chemical and physical analysis for nutrients, sediment and other constituents, biological analysis, quality control and interpretation of results. One required field trip.

NREM 4414* Fisheries Management. Lab 4. Prerequisite(s): BIOL 3034. Techniques and principles involved in management of fishes. Field trip fee required.

NREM 4424 Fisheries Techniques. Lab 4. Prerequisite(s): 4414, BIOL 3034, and ENGL 3323 strongly recommended. Research techniques and methodology in fisheries science, including sampling design, habitat measurements, sampling gears and abundance estimation, age and growth analysis, recreational surveys, data analysis, and report writing. *No credit for students with credit in 5424*.*

NREM 4443 Watershed Hydrology and Water Quality. Lab 2. Processes that comprise the hydrologic cycle and how land use affects those processes and the quantity and quality of water from watersheds, focusing on surface water from forest, range and agricultural watersheds. Measurement and evaluation of water quantity and quality.

NREM 4452 Pond Management. Prerequisite(s): BIOL 1114. Principles and practice of aquatic plant management, pond construction, and maintenance, fish population management, and human factors associated with pond ownership and management. *No credit for students with credit in NREM 5452*.*

NREM 4453 Aquaculture. Prerequisite(s): BIOL 1114. Introduction to the principles of freshwater finfish production with an emphasis on warm water species. *No credit for student having completed NREM 5453.*

NREM 4463 Stream Restoration and Management. Lab 2. Prerequisite(s): 4443 or BAE 4313 or consent of instructor. Streams and associated riparian areas and their functions in maintaining water quantity and quality and providing aquatic habitat. Fluvial geomorphology, stream assessment and classification, riparian area functions and management, and concepts and comparison of methods of stream restoration. Field measurements of stream and riparian characteristics. Two overnight field trips required.

NREM 4464* Ornithology. Lab 2. Prerequisite(s): ZOOL 1604. Classification, evolution, distribution, identification, life histories, and morphological, ecological, and behavioral adaptations of birds. Two weekend field trips required. (Same course as ZOOL 4464*).

NREM 4473 Global Issues of Water and Ecosystem Management. Prerequisite(s): 2013 or 3213 or BIOL 3034 or equivalent with instructor consent. Principles and concepts related to integrated fresh water resource management and its provisions for ecosystem and human needs. Examination of water issues related to ecosystem management practices in geographic locations including Asia, Africa, North America and South America.

NREM 4524 Wildlife Management Techniques. Lab 4. Prerequisite(s): 3503, ENGL 3323 strongly recommended. Research techniques and methodology in wildlife science. Experimental design, wildlife population and habitat analysis, wildlife and vegetation sampling techniques, aging and sexing techniques, and report preparation and presentation.

NREM 4533 Wildlife Management for Game Species. Prerequisite(s): 3503; and BIOL 3034 or concurrent enrollment. Life history attributes and habitat relationships of game species relative to life history strategies; conservation and management strategies for game species; and federal and state policies influencing game species management.

NREM 4543 Wildlife Management for Biodiversity. Prerequisite(s): 3503; and BIOL 3034 or concurrent enrollment. Identification, life history, and conservation management issues affecting non-game species in North America, stressing rare, threatened, and endangered species occurring in Oklahoma. Principles of landscape ecology, wildlife management, and conservation biology applied to management scenarios aimed at recovery of rare species and biodiversity conservation at broad scales.

NREM 4613 Rangeland Resource Planning. Inventory of ranch resources, survey and evaluation of ranch practices, and economic analysis. Development of a comprehensive ranch management plan. Managing rangeland and ranch resources in a social context. Written and oral reports. Field trips required. (Same course as ANSI 4973)

NREM 4783 Prescribed Fire. Lab 3. Prerequisite(s): 3613. When to use prescribed fire and how to use prescribed fire to accomplish specific land management objectives. Writing prescribed fire plans, policy and laws, weather, equipment, conducting burns, and post-burn mop-up. Field trips required.

NREM 4793 Advanced Prescribed Fire. Lab 3. Prerequisite(s): 4783 or consent of instructor. Preparing fire plans and executing prescribed fires as the fireboss. *No credit for both NREM 4793 and NREM 5793.*

NREM 4960 Undergraduate Internship. 1-6 credits, max 6. Prerequisite(s): Consent of instructor. Supervised internship with an approved natural resource business, government agency, or nongovernment organization, including a diversity of learning opportunities in a work environment. For every hour of credit, 45 hours of work are required. *Graded on a pass-fail basis.*

NREM 4980 Undergraduate Research Problems. 1-3 credits, max 3, Lab 1-3. Prerequisite(s): Upper-division standing, GPA of 2.50 or better and consent of instructor. Participation in faculty research or execution of a research problem formulated by the student.

NREM 4990* Special Topics in Natural Resource Ecology and Management. 1-3 credits, max 12. Advanced topics and new developments in natural resource ecology and management.

NREM 5000* Master's Thesis or Report. 1-6 credits, max 6 (Thesis), 2 (Report). Independent research planned, conducted and reported in consultation with a major professor.

NREM 5020* Graduate Seminar. 1 credit, max 10. Special topics in Natural Resource Ecology and Management; philosophy, methods and interpretation of research.

NREM 5030* Special Problems in Natural Resource Ecology and Management. 1-9 credits, max 9. Special problems in areas of natural resource ecology and management other than those covered in the student's thesis research.

NREM 5033* Ecology of Invasive Species. Ecological principles and their application to invasive species. Discussion of population level characteristics and community and ecosystem level effects of a wide variety of taxa including invasive microbial, fungal, plant, invertebrate, and vertebrate examples. Current global consequences and governmental policies/programs designed to limit the spread of invasives. *No credit for students having completed NREM 4033.*

NREM 5043* Ecology and Evolution of Symbiosis. Ecology and evolution of symbiotic and mutualistic interactions in different ecosystems. Theory, current questions, and general patterns involving biotic interactions of plants and animals with other plants, animals, or microbes.

NREM 5053* Global Ecology and Biogeochemistry. Examines key nutrient pools and transformations in the atmosphere, soils, and hydrosphere, with an emphasis on the role of living organisms in nutrient transformations and fluxes. Emphasis placed on processes relevant to biogeochemical cycles at ecosystem and global scales in reference to aspects of global change.

NREM 5063* Production Ecology. Prerequisite(s): 3213 or BIOL 3034. Mechanisms driving the growth and productivity of terrestrial ecosystems in response to resource availability, genetics, disturbance, and climate. Factors affecting the distribution and productivity of biomes, relationship between leaf area and productivity, effects of diversity on productivity, the proximal causes of increased growth associated with resource additions, and using process models to predict growth.

NREM 5073* Ecological Modeling and Synthesis. Prerequisite(s): STAT 5013 or equivalent. Ecological modeling approaches including deterministic, stochastic, state and transition, population matrices, and Bayesian networks. Modeling philosophy, interpretation, and using models for synthesis. Basics of model building, systems of equations, risk analysis, error budgets, constraining models for biological realism, and scaling. Examination of models impacting environmental policy, carbon sequestration, population viability analysis, forest growth and sustainability.

NREM 5083* Applied Landscape Ecology. Advanced ecology and management of grasslands, shrublands, and forests. Understanding the effects of grazing, fire and other disturbances on biotic and abiotic processes. Vegetation dynamics, wildlife habitat evaluation, woody plant encroachment, rangeland monitoring, and landscape ecology. Field trips required at additional cost to students.

NREM 5093* Community Natural Resource Management. Prerequisite(s): Graduate standing. Theoretical frameworks, methodological investigation and applied practices to enhance the ability of community development professionals to work with their communities to plan, develop, and monitor the development of natural resources with multiple functions. Course available online only through distance education.

NREM 5130* Special Topics in Forestry. 1-3 credits, max 9. Advanced study on special topics in forestry.

NREM 5133* Advanced Topics in Forest Biometrics. Prerequisite(s): 3063 or equivalent; STAT 5013 concurrently or equivalent. Quantitative description of forest populations and methods for modeling forest growth and development. Sampling techniques for forest populations.

NREM 5193* Spatial and Non-Spatial Database Management. Prerequisite(s): One course in statistics and programming experience. Methods of acquiring, managing and analyzing spatial data using geographic information systems. Management of non-spatial data using relational database managers. Development of applications using these tools for evaluating and managing natural resources.

NREM 5403* Advanced Wetland Ecology. Prerequisite(s): A course in aquatic ecology or wetland management recommended. Principles and theory of wetland ecology with a focus on wetland processes, functions, and services. Topics include wetland geomorphology, biogeochemistry and hydrology of wetlands, wetland functions and services, wetland development, wetland restoration, water issues, wetland policy, philosophy of wetland management, and educating society about wetlands. (Same course as ZOOL 5403)

NREM 5424* Fisheries Techniques. Lab 4. Prerequisite(s): 4414, BIOL 3034, and ENGL 3323 strongly recommended. Research techniques and methodology in fisheries science, including sampling design, habitat measurements, sampling gears and abundance estimation, age and growth analysis, recreational surveys, data analysis and report writing. *No credit for students with credit in 4424.*

NREM 5433* Fisheries Science. Prerequisite(s): 4414 or equivalent or consent of instructor. Principles of fisheries science as they relate to fish and aquatic biota, their habitats, and the humans who utilize them.

NREM 5443* Watershed Hydrology and Water Quality. Lab 2. Processes that comprise the hydrologic cycle and how land use affects those processes and the quantity and quality of water from watersheds, focusing on surface water from forest, range and agricultural watersheds. Measurement and evaluation of water quantity and quality. Intended for graduate students new to the water resources field. *No credit for students having completed 4443.*

NREM 5452* Pond Management. Prerequisite(s): BIOL 1114. Principles and practice of aquatic plant management, pond construction and maintenance, fish population management, and human factors associated with pond ownership and management. *No credit for students with degree credit in NREM 4452.*

NREM 5453* Aquaculture. Prerequisite(s): BIOL 1114. Introduction to the principles of freshwater finfish production with an emphasis on warm water species. *No credit for student having completed NREM 4453.*

NREM 5463* Stream Restoration and Management. Lab 2. Streams and associated riparian areas and their functions in maintaining water quantity and quality and providing aquatic habitat. Fluvial geomorphology, stream assessment and classification, riparian area functions and management, and concepts and comparison of methods of stream restoration. Field measurements of stream and riparian characteristics. Two overnight field trips required. *No credit for students having completed 4463.*

NREM 5473* Stream Ecology. Prerequisite(s): Course in ecology strongly recommended. Ecology of streams and rivers, physical and chemical properties, biotic assemblages and interactions, ecosystem processes and theories and human impact. Two day field trip required at additional costs to students.

NREM 5483* Ecohydrology. Prerequisite(s): 2013 or 3213 or BIOL 3034 or equivalent with instructor consent. Concepts, framework and challenges in ecohydrology. Soil water control on vegetation structure, function and distribution. Vegetation feedback on water budget in water limited ecosystems. Ecological and hydrological interaction associated with land use, land cover change and climate variability.

NREM 5493* Social Dimensions in Aquatic Ecology. Prerequisite(s): consent of instructor. Role of humans as implementers of policy, as users of resources, and as scientists in aquatic ecology.

NREM 5523* Population Ecology. Lab 2.5. Prerequisite(s): BIOL 3034, MATH 1513. Theory and principles of predicting and analyzing population abundance and dynamics. Life history theory, foraging theory, habitat selection, population genetics, and species interactions. (Same course as ZOOL 5523*)

NREM 5563* Forest Wildlife Ecology. Prerequisite(s): Course in ecology strongly recommended. Vertebrate species diversity in the world's woodland and forested biomes. Changes imposed by land clearing and development and their effects upon wildlife diversity and populations. Options for wildlife conservation, from strict nature reserves to integrating wildlife habitat management into land use practices. *Field trip required.*

NREM 5573* Grassland and Desert Wildlife Ecology. Prerequisite(s): Course in ecology strongly recommended. Ecology of grasslands and deserts with emphasis on vertebrate species diversity, adaptations to semi-arid and arid ecosystems, and management problems associated with such habitats.

NREM 5583* Wetland Wildlife Ecology. Prerequisite(s): A course in wildlife ecology or wetland management recommended. Ecology and management

of wetland dependent wildlife species with an emphasis on the autecology, adaptations for inhabiting wetland systems, and management problems associated with these taxa.

NREM 5660* Special Topics in Rangeland Science. 2-4 credits, max 4. Prerequisite(s): Consent of instructor. Selected topics in rangeland research methods or other rangeland topics.

NREM 5673* Rangeland Resources Watershed Management. Management of anthropogenic activities and physical/biological functions or processes on water and rangeland watersheds. Emphasizes preventative and restorative strategies in a natural resource rangeland setting. *Course available online only through distance education.*

NREM 5682* Grassland Plant Identification. Prerequisite(s): Consent of instructor. Study and identification of plants that have ecological and/or agricultural importance in the Great Plains. Grassland ecosystems and plant characteristics including forage value, palatability, and utilization by both domestic livestock and wildlife. Cultural and historical uses of grassland. *Course available online only through distance education.*

NREM 5692* Grassland Monitoring and Assessment. Vegetation sampling theory and plot selection. Quantitative measures used in vegetation analysis, root growth, and utilization. Use of the similarity index, and plant community health and trends for grassland monitoring and assessment. *Course available online only through distance education.*

NREM 5693* Principles of Forage Quality and Evaluation for Ruminants. Prerequisite(s): Consent of instructor. Chemical characteristics of forage components and the laboratory procedures used to evaluate forages for grazing livestock. Interactions with ruminant physiology and digestion that influence forage feeding value. Students should have a strong background in the basic principles of chemistry, ruminant nutrition, and plant physiology. *Course available online only through distance education.*

NREM 5713* Grassland Fire Ecology. Ecological effects of fire on grassland ecosystems. Examination of the history of fire, societal use of fire, fire behavior in relation to fuel and weather, and conducting and safety of prescribed burns. *Course available online only through distance education.*

NREM 5723* Ecology of Fire Dependent Ecosystems. Prerequisite(s): Any ecology course. Role of fire and the interactions with land use, weather, and climate change in fire-dependent ecosystems. Responses of species composition, diversity, annual net primary productivity, nutrient cycling, and ecosystem management in diverse ecosystems.

NREM 5783* Prescribed Fire. When to use prescribed fire and how to use prescribed fire to accomplish specific land management objectives. Writing prescribed fire plans, policy and laws, weather, equipment, conducting burns, and post-burn mop-up. *Field trips required.*

NREM 5793* Advanced Prescribed Fire. Lab 3. Prerequisite(s): 4783 or consent of instructor. Preparing fire plans and executing prescribed fires as the fireboss. *No credit for both 4793 and 5793.*

NREM 6000* Doctoral Dissertation. 1-15 credits, max 45. Independent research planned, conducted and reported in consultation with major professor.

NREM 6010* Advanced Topics and Conference. 1-6 credits, max 6. Prerequisite(s): MS degree. Supervised study of advanced topics. A reading and conference course designed to acquaint the advanced student with fields not covered in other courses.

Natural Science (NATS)

NATS 5050* Report. 1-2 credits, max 2. Prerequisite(s): Enrollment in program leading to MS in natural science. Guidance in reading and research required for MS in natural science degree.

NATS 5990* Topics in Natural and Applied Sciences. 1-3 credits, max 9. Prerequisite(s): Graduate standing. Special topics in the natural and applied sciences for students interested in topics not normally covered in existing course work.

Nutritional Sciences (NSCI)

NSCI 2111 Professional Careers in Nutritional Sciences. Prerequisite(s): For students interested in Allied Health, Community Nutrition or Nutrition and Exercise or consent of instructor. Career opportunities in health professions. Roles and responsibilities of health care professionals. Routes to professional memberships and current issues in professionalism.

NSCI 2114 (N) Principles of Human Nutrition. Functions of the nutrients in human life processes. Nutrient relationship to health as a basis for food choices. Open to all University students.

NSCI 2211 Professional Careers in Dietetics. Prerequisite(s): For students interested in Dietetics and Dietetics and Exercise options or consent of instructor. Career opportunities in Dietetics. Roles and responsibilities of Dietitians. Routes to professional memberships and current issues in professionalism.

NSCI 2850 Special Topics in Nutritional Sciences. 1-3 credits, max 4. Study of specific consumer education issues or topics in nutritional sciences.

NSCI 3011 Nutrition and Evidence-based Practice I. Prerequisite(s): 2114 and STAT 2013 (or equivalent) or concurrent. Understanding of human nutrition and the development of evidence-based practice recommendations for healthy individuals. Basic research methods and interpretation. Ethics in research.

NSCI 3021 Nutrition and Evidence-based Practice II. Prerequisite(s): 3011 and ZOOL 3204 or concurrent. Understanding the pathophysiology of chronic disease and the role of nutrition in the prevention and treatment of these diseases. Course builds on an understanding of physiology and of nutrition research from ZOOL 3204 and NSCI 3011. Ethics in research.

NSCI 3133 Science of Food Preparation. Lab 3. Prerequisite(s): HRAD 1114, NSCI 2114, CHEM 3015. Scientific principles underlying functions of food ingredients, recipe/menu modification, diet management for disease states and food safety.

NSCI 3223 Nutrition Across the Life Span. Prerequisite(s): 2114 or equivalent. Nutritional needs and dietary concerns of individuals from conception through old age.

NSCI 3440 Nutritional Sciences Pre-Professional Experience. 1-3 credits, max 3. Prerequisite(s): HS 1112 or 3112 (or concurrent). Student arranged, instructor approved, job shadowing, work or volunteer experience in professional settings related to the Nutritional Sciences options. Forty hours of experience required per credit hour.

NSCI 3543 (I,S) Food and the Human Environment. Impact of the various factors that affect food availability, production, processing, distribution and consumption of food in the world. International cultures and foods. Challenges of and solutions to the world food crisis.

NSCI 3813 Nutrition Assessment and Counseling Skills. Lab 2. Prerequisite(s): 2114 and 3223 and HDFS 2113 and PSYC 1113; or consent of instructor. Theory and practice of counseling and interviewing skills as applied to nutrition counseling. Collection and interpretation of anthropometric, biochemical and dietary data necessary to determine nutritional status.

NSCI 3991 Dietetics Career Experience. Observational career experience in various settings with practicing registered dietitians.

NSCI 4013* Experimental Foods. Lab 3. Prerequisite(s): 3133 or consent of instructor. Investigations in physical, chemical and sensory, and functional properties of foods and their ingredients. Research project applying food science and nutrition principles to product development.

NSCI 4021 Nutrition and Evidence-based Practice III. Prerequisite(s): 3011 and 3021. In-depth study of major controversial issues in the field of nutrition. Course builds on understanding of nutrition research from NSCI 3011 and 3021. Review and analysis of current research. Ethics in research.

NSCI 4023 Nutrition in the Pathophysiology of Chronic Disease. Prerequisite(s): 2114, 3223 and ZOOL 3204. Analysis of the role of specific nutrients in health maintenance and disease prevention. Communication of nutrition information to the public.

NSCI 4111 Professional Preparation for Careers in Dietetics. Prerequisite(s): Junior or senior standing or consent of instructor. Dietetic profession current issues, career options and alternative careers. Professional requirements for becoming a registered dietitian and for alternative career paths. Types of supervised practice, graduate or other programs and assistance in the application process. *Graded pass/fail.*

NSCI 4123 Human Nutrition and Metabolism I. Prerequisite(s): NSCI 2114 and CHEM 3015 or 3053 and ZOOL 3204 and senior classification or consent of instructor. Examine the chemical characteristics and functions of macronutrients; digestion, absorption, transport and metabolism of macronutrients; control of intermediary metabolism and metabolic pathways. No credit for students with degree credit in NSCI 5303*.

NSCI 4133 Nutrition for Exercise and Sport. Prerequisite(s): HHP 3114, NSCI 4323 and BIOC 3653 or consent of instructor. Application of principles of nutrient metabolism as they relate to physical activity, sport and health.

NSCI 4143 Human Nutrition and Metabolism II. Prerequisite(s): NSCI 4123 or consent of instructor. Chemical characteristics, absorption, transport, functions, requirements and health implications of vitamins and minerals. Discussion of phytochemicals and supplements in relation to health maintenance and disease prevention. No credit for students with degree credit in NSCI 5353*.

NSCI 4323 Human Nutrition and Metabolism. Prerequisite(s): ZOOL 3204, BIOC 3653 or concurrent and 2114 or consent of instructor. Digestion, absorption and metabolism of nutrients; functions and health implications in the human organism.

NSCI 4331 Quantity Food Production Practicum. Prerequisite(s): 2114 , HRAD 1114, 2021, 3213 or MGMT 3013. Observation and practice in real-life-quantity food production settings. Students will need immunizations, TB tests, and background checks completed before the semester begins.

NSCI 4373 Principles of Nutrition Education. Prerequisite(s): 2114, 3223 or consent of instructor. Analysis of various methods, strategies, theories, resources and evaluation methods for nutrition education. Principles of effective nutrition counseling. Overview of community nutrition programs.

NSCI 4573 Management in Dietetics. Prerequisite(s): ACCT 2103 or HRAD 2152 and HRAD 2282; and HRAD 3213 or MGMT 3013; or consent of instructor. Management practices in the field of dietetics including program, clinical and food systems management.

NSCI 4643 Capstone for Nutritional Sciences. Prerequisite(s): Senior standing in NSCI or consent of instructor. Integration of the body of knowledge in nutritional sciences. Examination of the research basis for defining and solving critical issues. *Oral and written reports.*

NSCI 4733 Community Nutrition. Prerequisite(s): 2114 and 3223 or consent of instructor. Application of nutrition, education and communication principles to community nutrition programs and services. *Field work required.*

NSCI 4850* Special Unit Studies in Nutritional Sciences. 1-3 credits, max 6. Special units of study in nutritional sciences.

NSCI 4854 Medical Nutrition Therapy I. Prerequisite(s): 3223, 3813, 4323 or concurrent enrollment. Physiological and metabolic bases for dietary modifications in disease states.

NSCI 4864 Medical Nutrition Therapy II. Prerequisite(s): 4854. A continuation of 4854, Medical Nutrition Therapy I.

NSCI 4900 Honors Creative Component. 1-3 credits, max 3. Prerequisite(s): College of Human Sciences Honors Program participation, senior standing. Guided creative component for students completing requirements for College Honors in the College of Human Sciences. Thesis, creative project or report under the direction of a faculty member in the major area, with second faculty reader and oral exam.

NSCI 5000* Master's Thesis. 1-6 credits, max 6. Prerequisite(s): Consent of adviser. Individual research and thesis that will fulfill the requirements for the master's degree.

NSCI 5011* Special Topics in Nutritional Sciences. Prerequisite(s): NSCI graduate standing. Orientation to graduate study and research in nutritional sciences.

NSCI 5012* Public Policy Development in Food, Nutrition and Related Programs. Rationale underlying governmental programs in food and nutrition and human sciences and assessment of the effectiveness of the programs.

NSCI 5013* Cost Control in Food Service Systems. Prerequisite(s): Admission to Great Plains IDEA online MS in Dietetics. An overview of accounting, cost controls, and financial management in food service. Special emphasis placed on understanding the topics and applying them to the theoretical and/or practical research for food service systems. Web-based instruction.

NSCI 5023* Advanced Nutrition in the Pathophysiology of Chronic Disease. Prerequisite(s): BIOC 3653 and NSCI 4323/5333 or equivalent or consent of instructor. In-depth analysis of the role of specific nutrients in health maintenance and disease prevention.

NSCI 5033* Macronutrients in Human Nutrition. Prerequisite(s): BIOC 3653 and NSCI 4323/5333 or equivalent or consent of instructor. Characteristics, biological roles, transport and metabolism of macronutrients at the cellular and tissue levels.

NSCI 5043* Micronutrients in Human Nutrition. Prerequisite(s): 5033 or consent of instructor. In-depth study of vitamins and minerals and their interrelationships in metabolism.

NSCI 5053* Functional Foods for Chronic Disease Prevention. Prerequisite(s): Admission to Great Plains IDEA MS in Dietetics or consent of instructor. Integrate and evaluate the regulatory principles, food science, nutrient science and nutritional metabolism for the development of functional foods, nutraceuticals, and dietary supplements for chronic disease prevention. *Web-based instruction.*

NSCI 5103* Grant Writing for the Professional. Prerequisite(s): Admission to the Great Plains IDEA online MS in Dietetics or consent of instructor. Grant proposal preparation experience including written critique of proposals and budget planning. Designed for the working professional. *Web-based instruction.*

NSCI 5123* Research Methods in Nutritional Sciences. Basic components of the research process and application of research methods to nutritional sciences.

NSCI 5133* Advanced Nutrition for Exercise and Sport. Prerequisite(s): Intro nutrition and biochemistry or consent of instructor. Advanced study of nutrition and metabolism relating to physical activity, sports and health.

NSCI 5203* Nutrition in Wellness. Prerequisite(s): Admission to the Great Plains IDEA online MS in Dietetics or consent of instructor. Wellness promotion through nutrition. Nutritional risk and protective factors will be examined as they relate to public health and individual nutrition. *Web-based instruction.*

NSCI 5210* Contemporary Issues in Food Service. 3-9 credits, max 9. Prerequisite(s): Admission to the Great Plains IDEA online MS in Dietetics program or consent of instructor. Contemporary issues in food service in dietetics; formulation of innovative solutions and processes to enhance effectiveness in the work place.

NSCI 5213* Entrepreneurship in Food Service and Dietetics. Prerequisite(s): Admission to Great Plains IDEA online MS in Dietetics. An overview of entrepreneurship, characteristics of entrepreneurs and small business development within the context of food service and dietetics. *Web-based instruction.*

NSCI 5223* Advanced Nutrition Across the Life Span. Prerequisite(s): Admission to the Great Plains IDEA online MS in Dietetics. Examination of the influence of normal physiological stresses on nutritional needs throughout the life span. *Web-based instruction.*

NSCI 5240* Contemporary Issues in Nutrition. 3-9 credits, max 9. Prerequisite(s): Enrolled in Great Plains IDEA online MS in Dietetics. Contemporary issues in nutrition. *Web-based instruction.*

NSCI 5303* Human Nutrition and Metabolism I. Prerequisite(s): Introductory nutrition, organic chemistry, physiology or consent of instructor. Examine the chemical characteristics and functions of macronutrients; digestion, absorption, transport and metabolism of macronutrients; control of intermediary metabolism and metabolic pathways. No credit for students with degree credit in NSCI 4123.

NSCI 5313* Dietary and Herbal Supplements. Prerequisite(s): Human Physiology or consent of instructor. Explore the safety and efficacy of botanical/herbal and dietary supplements in health applications including dietary supplementation in the prevention and treatment of chronic disease. *Web-based instruction.*

NSCI 5323* Nutrition and Physical Activity in Aging. Basic physiological changes during aging and their impact in health and disease. Successful aging with emphasis on physical activity and nutrition. Practical application to community settings. *Web-based instruction.*

NSCI 5333* Human Nutrition and Metabolism. Prerequisite(s): Intro nutrition, organic chemistry, biochemistry and physiology. Digestion, absorption and metabolism of nutrients; functions and health implications in the human organism.

NSCI 5353* Human Nutrition and Metabolism II. Prerequisite(s): Introductory nutrition, organic chemistry, biochemistry and physiology. Chemical characteristics, absorption, transport, functions, requirements and health implications of vitamins and minerals. Discussion of phytochemicals and supplements in relation to health maintenance and disease prevention. No credit for students with degree credit in NSCI 4143.

NSCI 5363* Maternal and Infant Nutrition. Prerequisite(s): 2114 or equivalent. Nutritional needs and dietary concerns during pregnancy, lactation and the first year of life. Implications for nutrition intervention, education and policy.

NSCI 5373* Childhood Nutrition. Prerequisite(s): 2114 or consent of instructor. Normal nutritional needs of children, preschool through grade 12. Dietary implications for child care programs, school food service and parent education.

NSCI 5393* Nutrition and Aging. Prerequisite(s): 2114 or equivalent. Nutritional needs, and dietary concerns of the elderly. Implications for food and nutrition programs, policies, research and education.

NSCI 5403* Contemporary Issues in Dietetics Practice. Prerequisite(s): Acceptance as a dietetic intern. Contemporary issues in the practice of dietetics; innovative solutions and processes to enhance effectiveness in the workplace.

NSCI 5412* Dietetic Internship Management Practicum. Prerequisite(s): Acceptance as a dietetic intern. Supervised learning experiences in approved food service management for the achievement of performance requirements for entry level dietitians. *Graded on a pass-fail basis.*

NSCI 5422* Dietetic Internship Clinical Practicum. Prerequisite(s): Acceptance as a dietetic intern. Supervised learning experiences in approved clinical for the achievement of performance requirements for entry level dietitians. *Graded on a pass-fail basis.*

NSCI 5423* Food Writing for Professionals. Prerequisite(s): Admission to Great Plains IDEA MS in Dietetics or consent of instructor. Writing skills needed by the food professional in order to communicate effectively in writing about food and food-related topics. Includes hands-on projects in research and writing for various audiences and types of publications. *Web-based instruction.*

NSCI 5432* Dietetic Internship Community Nutrition. Prerequisite(s): Acceptance as a dietetic intern. Supervised learning experiences in approved community nutrition settings for the achievement of performance requirements for entry level dietitians. *Graded on a pass-fail basis.*

NSCI 5453* Nutrition and Health Disparities. Prerequisite(s): Admission to Great Plains IDEA MS in Dietetics or consent of instructor. Examination of nutrition and health disparities in the U.S. Identification of sociocultural determinants of health and their influence on nutrition and health outcomes. Exploration of interdisciplinary strategies to reduce nutrition and health disparities. Web-based instruction.

NSCI 5473* Pediatric Clinical Nutrition. Prerequisite(s): Admission to Great Plains IDEA MS in Dietetics or consent of instructor. Examination of the physiological, biochemical and nutritional aspects of disease processes relevant to infants and children up to 18 years of age. Medical nutrition therapy for a variety of medical conditions found in this population including inborn errors of metabolism, food hypersensitivity, obesity and diseases of the major organ systems. *Web-based instruction.*

NSCI 5543* Obesity Across the Life Span. Prerequisite(s): Admission to Great Plains IDEA MS in Dietetics or consent of instructor. Obesity in the population from childhood to the adult age groups. Examination of the impact of obese conditions on disease development throughout the life span. Critical analysis of interventions used in the behavioral and clinical management of

overweight and obese individuals in community and clinical settings. *Web-based instruction.*

NSCI 5553* Global Nutrition and Food Security. Advanced study of the magnitude, causes, and nature of hunger and under-nutrition in low income countries; emphasis on programs, policies and planning directed toward alleviating hunger and malnutrition.

NSCI 5563* Nutritional Assessment. Prerequisite(s): 3223, 4323, or equivalent. Dietary, physical, and biochemical assessment techniques and their application to patient or client nutritional status assessment in health care systems.

NSCI 5613* Advanced Nutrition Education and Counseling. Prerequisite(s): Consent of instructor. Analysis of various learning and behavior change theories and application in nutrition education.

NSCI 5643* Advanced Medical Nutrition Therapy. Prerequisite(s): Admission to dietetic internship or consent of instructor. Physiological and metabolic bases for nutritional support in disease.

NSCI 5673* Human Resources. Prerequisite(s): Admission to Great Plains IDEA online MS in Dietetics or consent of instructor. Future role, focus, practices and governance of human resources in health care.

NSCI 5683* Fundamentals of Leadership in Dietetics. Prerequisite(s): Admission to Great Plains IDEA online MS in Dietetics or consent of instructor. Study of the key issues in the theory, research, and application of leadership within the context of dietetics practice. Includes defining leadership, understanding situational characteristics that facilitate/hinder effective leadership, understanding effective/dysfunctional leadership, and gaining greater insight into one's own leadership style and functioning. Web-based instruction.

NSCI 5713* Advanced Community Nutrition. Prerequisite(s): 2114, 3223 and 4733 or equivalent or consent of instructor. Current issues in community nutrition with emphasis on program development and evaluation of community nutrition programs. Analysis of the impact of economic, political, legislative and cultural diversity factors in the field of community nutrition.

NSCI 5743* Advanced Laboratory Techniques in Nutritional Sciences. Prerequisite(s): A course in biochemistry and a course in statistics. An integrated lecture and laboratory course examining the basic theories and techniques used in experimental nutritional sciences. Application of a range of biochemical and molecular biological techniques as they are currently applied to modern biomedical research.

NSCI 5753* Health Care Administration. Prerequisite(s): Consent of instructor. Overview of U.S. and international health care systems. Administrative roles of health care professionals and how they affect patient health and health care delivery in various settings.

NSCI 5783* Food Technology. Prerequisite(s): Consent of instructor; graduate standing. Principles and pertinent issues in food technology, including concepts, experimental and product design, process development, evaluation, packaging and marketing. Web-based instruction.

NSCI 5843* Non-Thesis Creative Component. Prerequisite(s): Final semester and consent of instructor. A guided course serving as the final requirement for graduate students in NSCI's Master of Science degree, non-thesis option. Not recommended for students interested in pursuing a PhD.

NSCI 5863* Sensory Evaluation of Food. Lab 2. Prerequisite(s): 4013 or consent of instructor. Basic principles of physiology and psychology as they pertain to sensory evaluation, importance of sensory evaluation to the food industry, organization and operation of a sensory program or facility, test strategies, design of experiments and testing instruments, discrimination testing, descriptive analysis, and affective testing.

NSCI 5870* Problems in Nutritional Sciences. 1-4 credits, max 6. Analysis of emerging problems and trends in nutritional sciences.

NSCI 5960* Master's Seminar in Nutritional Sciences. 1 credit, max 2. Prerequisite(s): NSCI graduate students. Individual and group seminars on current issues and research in nutritional sciences.

NSCI 5963* Environmental Scanning and Analysis. Prerequisite(s): Admission to Great Plains IDEA online MS in Dietetics or consent of instructor. Discussion of changes in the economic, social, ethical, political, legal, technological, and ecological environments in which dietitians practice. Implications of these changes for education, practice and research within the field with particular emphasis on the healthcare industry. Web-based instruction.

NSCI 6000* Doctoral Dissertation. 1-12 credits, max 45. Prerequisite(s): Consent of major professor.

NSCI 6033* Phytochemicals. Prerequisite(s): 4323/5333 or equivalent or consent of instructor. Identification of basic structural, functional and metabolic properties of phytochemicals (substances in plants that have been linked to reducing chronic disease). Special attention placed on health benefits and chronic disease risk reduction.

NSCI 6223* Nutrition in Immunology. Prerequisite(s): 5043 or consent of instructor. Principles and issues related to nutrition and immunology. Impact of nutrients and nutritional status on integrity of the immune system.

NSCI 6243* Nutrition and Cancer. Examination of basic cancer biology and methodology used to study nutrition and cancer relationships. The role of nutrition in specific cancers, cancer prevention and cancer treatment will be explored.

NSCI 6453* Advanced Research Methods in Nutritional Sciences. Components of the research process for students who have completed an advanced degree. Development, application and interpretation of research methodology.

NSCI 6643* Clinical Aspects of Nutrition Support. Prerequisite(s): Consent of instructor. Specialized nutrition assessment and support. Review of energy expenditure and substrate utilization in specific disease states. Current methods for the initiation and management of enteral and parenteral nutrition therapy including access, metabolic and mechanical complications. Evaluation of nutrition support methodology in selected disease states. *Web-based instruction.*

NSCI 6870* Independent Study in Nutritional Sciences. 1-3 credits, max 6. In-depth analysis of research issues in nutritional sciences.

NSCI 6960* Seminar: Emerging Topics in Nutrition. 1 credit, max 4. Critical evaluation of research in nutritional sciences. Individual and group seminars on selected topics.

Occupational Education (OCED)

OCED 5000* Thesis or Report. 2-10 credits, max 10. Students studying for a master's degree may enroll for a total of two credit hours if they write a report or six hours if they write a thesis. Students working on a specialist's degree may earn a maximum of 10 hours credit.

OCED 5010* Seminar. 1-3 credits, max 6. Graduate student seminars focusing on current and critical issues and common problems relevant to occupational education.

OCED 5113* Principles of Leadership in Workforce Education. Principles and analysis of leadership in today's workforce education organizations and the effect of leadership practices on organizational climate and governance. Understanding today's labor market and the connection among education, government, and workforce development policy.

OCED 5123* Evaluation of Occupational and Workforce Education Programs and Instruction. Principles of evaluation applied to instructional programs in occupational and workforce education. Techniques and strategies for designing, conducting, reporting, and applying evaluations of programs in occupational/technical schools, government agencies, and public or private sector workplaces.

OCED 5133* Internationalism, Globalization and Occupational Education. Prerequisite(s): Graduate standing. Preparing a globally competitive workforce. Analysis of comparative international occupational/technical education systems, and critical issues in internationalism and globalization in workforce education development.

OCED 5153* Curriculum Planning in Occupational Education. Principles and procedures for curriculum planning, development and management in occupational and adult education with analyses of current trends and practices and their implications for program quality.

OCED 5223* Program Planning for Occupational and Technical Educators. Approaches to program planning designed around continuous improvement methods for problem solving, flow charting, budgeting, gaining program support, and Lifelong Education Program Planning (LEEP) model.

OCED 5232* Teaching Related Information. Selection of job-related topics common to most occupational programs; procedures for incorporating those topics into the regular curriculum.

OCED 5233* Advanced Instructional Procedures in Trade and Industrial Education. Advanced methods and procedures for effective teaching and learning in occupational education classrooms and laboratories. Teaching basic education and employment skills and the selection of job-related topics common to most occupations with procedures for incorporating those topics into the regular curriculum.

OCED 5313* History, Principles and Organization of Workforce Education. Prerequisite(s): Graduate standing. History, underlying principles and evolving social, political and economic forces acting upon workforce education. In-depth with critical analysis of educational programs and service areas and resulting implications for leadership development and program responsibility.

OCED 5333* Administration and Supervision of Workforce Education Programs. Understanding and critically analyzing the quality of workforce education courses and the value they hold.

OCED 5340* Special Problems in Occupational Education. 1-6 credits, max 6. Prerequisite(s): Consent of instructor. Directed independent study of special topics involving assigned readings, library research, field work or a combination of these.

OCED 5423* Individualized Competency-Based Instruction and Customized Training. Principles, techniques, and technologies for creating and delivering individualized competency-based instruction and customized workplace training. Includes LAP systems and customizing for industry.

OCED 5443* Interpreting Research in Occupational Education. Seminar on the methods of research, review, synthesis and interpretation with application

to particular fields of occupational and adult education.

OCED 5483* Digital and Virtual Environments in Technical Education. Current and emerging digital technologies and virtual environments for technical and workforce education and their instructional implications. Mastery of hardware and software systems, research on new technologies, and development of digital and virtual materials.

OCED 5673* Principles and Practices of Distance Learning in Occupational Education. Prerequisite(s): Graduate student standing. Issues, methods, tools and techniques of facilitating learning at a distance. Development of skills in designing and delivering instruction via current synchronous and asynchronous technologies such as video conferencing and Internet, fostering analysis of current research in distance learning, and encouraging real-world applications of acquired skills and knowledge.

OCED 5720* Workshop. 1-3 credits, max 10. Professional workshops of various topics and lengths. Each workshop designed to meet unique or special needs of individuals concerned with adult education and human resource development.

OCED 5880* Internship in Occupational Education. 3-6 credits, max 6. Prerequisite(s): Consent of instructor. Supervised experience working in business, industry, human service, or education settings.

OCED 5910* Developing and Analyzing Teaching Content. 1-3 credits, max 6. Provides opportunity for experienced teachers to incorporate the latest industrial technology into their course of study.

OCED 6000* Doctoral Dissertation. 1-25 credits, max 25. Required of all candidates for the Doctor of Philosophy degree. Credit is given upon completion of the dissertation.

OCED 6103* Philosophy of Occupational Education. Alternative perspectives for developing a philosophic position in occupational and adult education.

OCED 6110* Graduate Reading in Occupational Education. 1-6 credits, max 6. Prerequisite(s): Graduate standing and consent of supervising professor. Supervised readings of significant literature not included in regularly scheduled courses.

OCED 6113* Supervision of Workforce Education Instruction. Theoretical and practical application of current instructional supervision in a workforce education setting. Strategies for effective supervision are learned through practice in analyzing teacher instruction for provisional and standard certifications and for industry certified instructors.

OCED 6233* Managing Knowledge in Learning Organizations. Analyze the knowledge management concepts of informal learning, communities of practice, knowledge/learning transfer, organizational learning, and knowledge creation in learning organizations and workplaces. Conduct self-directed research projects on course-related topics and develop a conceptual map of learning outcomes.

OCED 6333* Strategic Planning in Workplace Learning and Organizational Performance. Theory, trends, and competency model development performance areas.

OCED 6343* Financing Occupational Education. Prerequisite(s): Graduate standing. Development of conceptual and legal bases for funding public occupational education programs. Sources of funds, distribution strategies, local, state and federal accountability requirements, and fraud and abuse funds.

OCED 6353* Future of Technology, Work, and Society. Complex interrelationships among emerging and future technologies, human society, and the definition and evolution of work in a global society. Traditional and emerging theoretical frames for technology and the future.

OCED 6871* Doctoral Seminar: Level 1. Orientation to doctoral program in OCED. May be taken prior to program application; required of all applicants.

OCED 6880* Doctoral Internship in Occupational Education. 1-8 credits, max 8. Prerequisite(s): Consent of instructor. Directed field experiences related to the participant's area of concentration. Practice and testing ideas, theories and concepts learned in graduate study.

OCED 6882* Doctoral Seminar: Level 2. Preparation for completion of doctoral degree program, examination, proposal, and dissertation. Refinement of skills and developing components of proposal and dissertation. Required for OCED doctoral students.

Philosophy (PHIL)

PHIL 1013 (H) Philosophical Classics. Basic works by great thinkers, including Plato, Descartes and Hume.

PHIL 1113 (H) Introduction to Philosophy. Selected philosophical problems: the nature of reality, knowledge, value, social ideals and religion.

PHIL 1213 (H) Philosophies of Life. Introductory ethics and social philosophy. Moral decision-making, the good life, social values, freedom, and responsibility.

PHIL 1313 (A) Logic and Critical Thinking. Formal and informal reasoning, common fallacies, definitions and language functions, patterns of explanation. Practical criticism and development of everyday arguments.

PHIL 3003 (A) Symbolic Logic. Propositional logic and predicate logic with identity. Formal analysis of language.

PHIL 3113 (H) Ancient Greek Philosophy. Historically-based introduction to the philosophical ideas and works of Plato and Aristotle. Begin by reading excerpts and commentary on the Pre-Socratics and Sophists. End the course with readings from the Hellenistic schools of philosophy: Stoics, Skeptics, and Epicureans.

PHIL 3213 (H) 17th and 18th Century Philosophy. Major philosophers and problems in Western thought from the 17th through the 18th century. Emphasis on Descartes, Hume and Kant.

PHIL 3313 (H) 19th and 20th Century Philosophy. Major philosophers and problems in Western thought from Hegel to the present.

PHIL 3413 (H) Ethical Theory. Contemporary and classical views on the nature of moral judgments, moral value, relativity and objectivity, freedom and responsibility.

PHIL 3513 (H) Social Philosophy. Major social thinkers and contemporary issues. Social authority, human rights, political forms and justice. Emphasis on Aristotle, Locke, Mill and Marx.

PHIL 3523 (H) Medieval Philosophy. The central focus is on the philosophical and theological problems that engaged the minds of medieval thinkers from Christian, Islamic, and Jewish traditions, including Abelard, Avicenna, Averroes, Maimonides, Aquinas, Scotus, and Ockham.

PHIL 3613 (H) Philosophy of Religion. Nature of religion, religious experience and religious language. God-concepts, theistic arguments, God and evil, God and immortality.

PHIL 3623 (DH) Philosophy of Race. Philosophy of Race investigates race discourse within the texts of contemporary philosophers. The course begins with an examination of the concept of race from antiquity through postmodernity. Course discussion focuses on the biological veracity of race, the rise of race as a sociopolitical concept, and the role of modern philosophers in shaping the prevailing perception of people of non-European descent in the West and the implicit justification of slavery, which pervades their texts.

PHIL 3723 (H) Philosophy of Film. Philosophy of Film uses films and some literature as tools to investigate standard philosophical issues such as: a) current ethical and social topics; b) Epistemology; c) Metaphysics; d) Social and Political Philosophy; e) Philosophy of Science; f) Philosophy of Race & Gender; and g) Philosophy of Mind. The primary focus is the use of various media (primarily film) as a way to introduce and explore philosophical issues. Different instructors may emphasize different films and/or philosophical topics.

PHIL 3743 (H) Patterns in Science: Historical and Value Dimensions of Western Science. A general introduction to the history of western science, stressing cultural values affecting scientific innovations, as well as the affects of scientific innovations on cultural values. Important examples from the history of astronomy and physics and from the history of evolutionary biology will be examined. Students will critically examine the relationship(s) between scientific work and broader cultural concerns.

PHIL 3803 (H) Business Ethics. Ethical issues in business, such as employer-employee duties and loyalties, advertising uses, preferential treatment practices. Analytic grounding in basic theories of ethics.

PHIL 3813 (H) Recent American Philosophy. Dominant trends in American philosophy during the last 100 years, with emphasis on pragmatism.

PHIL 3833 (H) Biomedical Ethics. Moral problems brought about by recent developments in scientific research and medical technology. Abortion, euthanasia, genetic engineering, and human experimentation.

PHIL 3843 (H) Philosophy of Law. Prerequisite(s): Upper-division standing. Philosophical issues related to U.S. law. The relationship between law and morality, the nature and functions of law and grounds of liability.

PHIL 3913 (H) Existentialism. Selected writings and themes in the development of existentialism and related intellectual movements. Subjectivity, phenomenological description, hermeneutics, freedom and value; and such writers as Kierkegaard, Nietzsche, Heidegger, Sartre, Marcel and Buber.

PHIL 3920 Contemporary Philosophical Problems. 3 credits, max 9. Selected contemporary problems and discussions.

PHIL 3933 (H) Creation and Evolution. Critical examination of claims that various Creationist/Intelligent Design models offer better scientific explanations for selected biological phenomena than does the current dominant view of Darwinian Evolution.

PHIL 3943 (H,I) Asian Philosophy. Three main streams of Asian thought: Indian, Chinese and Buddhist. How various thinkers in the three traditions have dealt with questions of being and becoming, knowledge, ethics, and society.

PHIL 4003* Mathematical Logic and Computability. Prerequisite(s): 3000 or 3003 or MATH 3613 or consent of instructor. The basic metatheorems of first order logic: soundness, completeness, compactness, Löwenheim-Skolem theorem, undecidability of first order logic, Gödel's incompleteness theorem. Enumerability, diagonalization, formal systems, standard and nonstandard models, Gödel numberings, Turing machines, recursive functions, and evidence for Church's thesis. (Same course as MATH 4003)

PHIL 4013 (H) Perspectives on Death and Dying. Issues that arise as individuals confront the fact of mortality. Dying patients, the ethical issues of

euthanasia and suicide, the process of grief, death in literature and the arts, and philosophical and religious views on immortality.

PHIL 4113 (H) Philosophy of Art and Literature. Nature of aesthetic objects and experiences; form, meaning and value in the arts; the function of art in society; criteria of criticism of the arts.

PHIL 4313 (H) Philosophy of Mind. Problems in philosophical psychology. Mind and body, freedom and determinism, personal identity and survival, self-knowledge, analysis of mental concepts.

PHIL 4453 (H) Philosophy in Literature. Selected literary works examined for philosophical ideas and themes. Attention to the interrelation of form and content. Thematic approach.

PHIL 4543* Philosophy of Language. Prerequisite(s): 1313 or 3003. A survey of the development of the philosophy of language, including works of philosophers such as Frege, Wittgenstein, Russell, Strawson, Searle, Donnellan, Grice, and Kripke.

PHIL 4553* Contemporary Ethical Theory. Debate in ethical theory since Moore. The naturalistic fallacy, intuitionism, and value realism.

PHIL 4713 (H) Philosophy of Science. Philosophical issues related to science and its role in society. Topics include science and common sense, laws and theories, causality, nature of scientific progress.

PHIL 4733 (H) Philosophy of Biology. Selected philosophical topics, such as Darwinism and other theories of evolution, physical reductionism, and issues of genetic engineering.

PHIL 4943* Indian Philosophy. Prerequisite(s): 3943 or consent of instructor. Study of texts and themes in two main traditions of Indian Philosophy: Hinduism and Buddhism. How these schools present the fundamental nature and knowledge of reality, human existence, the divine, and enlightenment.

PHIL 4953* East Asian Philosophy. Prerequisite(s): 3943 or consent of instructor. Study of texts and themes in the Chinese and Japanese traditions: Confucianism, Daoism and Zen. How these schools present the fundamental nature and knowledge of reality, human existence, community and enlightenment.

PHIL 4983* Metaphysics and Epistemology. Prerequisite(s): 12 credit hours of philosophy. The study of the fundamental nature of reality and human knowledge of it.

PHIL 4990 Special Studies in Philosophy. 1-3 credits, max 10. Selected philosophical topics or works.

PHIL 4991* Contemporary Philosophy Research. Prerequisite(s): Upper-division standing, at least 12 hours in philosophy completed. Study of leading edge research in philosophy through presentation and discussion of current philosophy journal articles with faculty.

PHIL 4993 Senior Honors Thesis. Prerequisite(s): Departmental invitation, senior standing, Honors Program participation. A guided reading and research program ending with an honors thesis under the direction of a faculty member, with second faculty reader and oral examination. Required for graduation with departmental honors in philosophy.

PHIL 5000* Master's Thesis in Philosophy. 1-6 credits, max 6. Supervised individual work on a thesis for a master's degree.

PHIL 5203* Proseminar. Introduction to professional oral and written communication in philosophy.

PHIL 5210* Seminar on a Major Philosopher. 3 credits, max 9. Prerequisite(s): Three courses in philosophy. The writings of a major philosopher and related material.

PHIL 5303* Topics in Philosophy of Religion. An examination of central topics in the philosophy of religion, such as the existence of God, the problem of evil, divine attributes, miracles, revelation, faith and reason, religious pluralism and exclusivism, and morality.

PHIL 5310* Seminar on a Field of Philosophy. 3 credits, max 9. Prerequisite(s): Three courses in philosophy. Selected topics in one field of philosophy.

PHIL 5313* Topics in Social Political Thought. Consideration of a single topic (e.g. justice), topics (e.g. distributive justice and citizenship) of a single philosophical school, or movement (e.g. Marxism) or several movements and schools (e.g. Marxism and liberalism).

PHIL 5323* Seminar in Ancient Philosophy. Prerequisite(s): 3113. Philosophical problems that characterize ancient Philosophy: form and matter, one and many, universal and particular, actuality and potentiality, stability and change, substance and accidents, first principles and elements. Close reading of Plato and Aristotle.

PHIL 5333* Seminar in Modern Philosophy. Prerequisite(s): 3213 or 3313. Examination of the metaphysical and epistemological systems of philosophers over 17th-19th century Europe such as Descartes, Spinoza, Locke, Leibniz, Berkeley, Hume, Kant and Hegel.

PHIL 5343* Seminar in East and West Comparative Philosophy. Prerequisite(s): 3943. Critical comparison between West European and East Asian traditions of philosophy, such as being and non-being, the nature of truth, self, human being, ethics, human rights, community, and religion.

PHIL 5353* Seminar in Contemporary Continental Philosophy. Prerequisite(s): 3213 or 3313. Themes such as presence and absence, intentionality and constitution, meaning and "being," identity and difference, history and consciousness, practice and power, construction and deconstruction. Philosophers such as Merleau, Husserl, Heidegger, Sartre, Derrida, and Faucault.

PHIL 5363* Topics in Metaphysics. Prerequisite(s): 3113 or 3213 or 4983. Selected topics that may be approached from an historical or contemporary standpoint, such as idealism, realism, causation, time, universals, personal identity, possibility and free will.

PHIL 5373* Contemporary Epistemology. Prerequisite(s): 3213 or 3113 or 4983. Recent approaches to the theory of knowledge. Origin and justification of belief and certainty, roles of the senses and the mind, and the nature of truth.

PHIL 5383* Seminar in American Philosophy. Selected philosophical schools or traditions influential in American thought, such as transcendentalism, pragmatism, or naturalism.

PHIL 5393* German Idealism. Prerequisite(s): 3113 or 3213. Selected major works of post-Kantian German Philosophy, such as the nature of a philosophical system, identity, and self-consciousness.

PHIL 5423* Topics in Ethical Theory. Prerequisite(s): 3413. Central problems in ethical theory, such as ethical realism/anti-realism, motivational internalism/externalism, and problems within specific normative systems.

PHIL 5433* Topics in Philosophy of Law. Prerequisite(s): 3843. In-depth examination of selected topics in philosophy of law, such as punishment, jurisprudence, and principles of legislation. Seminar format.

PHIL 5443* Topics in Biomedical Ethics. Prerequisite(s): 3833. In-depth examination of selected topics in biomedical ethics, such as implications of the Human Genome Project, ethics of human reproduction, and research ethics. Emphasis on contemporary philosophical thought. Seminar format.

PHIL 5510* Research Topics in Philosophy. 1-3 credits, max 10. Prerequisite(s): Consent of graduate adviser or department head. Individual research on topics related to the student's interests and/or Thesis topic(s).

PHIL 5610* Philosophical Issues in Education. 2-3 credits, max 3. Contemporary issues in educational theory and practice. The relation of education to political thought, religion, public law and culture.

PHIL 5910* Research Problems in Philosophy. 1-3 credits, max 10. Prerequisite(s): Consent of instructor and department head. Individual or group research on specific philosophical problems.

Physics (PHYS)

PHYS 1001 Frontiers of Physics. Student and faculty discussions of current research topics in physics as presented in popular journals. *Graded on pass-fail basis.*

PHYS 1014 (N) Descriptive Physics. A survey course presenting the basic concepts and principles of physics with a minimum of mathematics. Motion, waves, temperature, electricity, magnetism, optics, atomic structure, and nuclear energy.

PHYS 1114 (L,N) General Physics. Lab 2. Prerequisite(s): MATH 1613 or MATH 1715 with a grade of "C" or better, or an acceptable placement score (see placement.okstate.edu). Algebra-based introductory course covering the basic concepts of physics appropriate for a range of science and preprofessional majors. Practical examples of the role of physics in other disciplines. Newtonian mechanics, fluids, heat, thermodynamics, waves, sound.

PHYS 1214 (L,N) General Physics. Lab 2. Prerequisite(s): 1114 or 2014 with a "C" or better. Continuation of 1114. Electricity, magnetism, optics, quantum physics, atomic and nuclear structure.

PHYS 1313 (L,N) Inquiry-Based Physics. Lab 3. Properties of matter, motion, light and color, electrical circuits and energy conservation. Recommended for elementary education majors as model course to learn and teach science.

PHYS 2014 (L,N) General Physics. Lab 2. Prerequisite(s): MATH 2144 or concurrent enrollment. Calculus-based introductory course for science, math and engineering majors. Mechanics, waves, heat, and thermodynamics.

PHYS 2020 Special Topics in Physics. Topics of current interest in physics appropriate for the lower-division level, such as the role of physics in modern society.

PHYS 2114 (L,N) General Physics. Lab 2. Prerequisite(s): 2014 or 2314 with a "C" or better. Continuation of 2014. Electricity, magnetism, and optics.

PHYS 2314 (L,N) General Physics for Science Majors I. Lab 2. Prerequisite(s): MATH 2144. Calculus-based introductory course for science and math majors. Conservation of energy and momentum, energy transfer, Newton's Laws, kinematics, relativity.

PHYS 2414 (L,N) General Physics for Science Majors II. Lab 2. Prerequisite(s): 2014 or 2314. Continuation of 2314. Electrostatics, electric fields and currents, circuits, waves, physical optics, modern physics, nuclear physics, and thermodynamics.

PHYS 3013* Mechanics I. Prerequisite(s): 2114 or equivalent, and MATH 2233

or concurrent enrollment. Mechanics of particles, systems of particles and rigid bodies.

PHYS 3113* Heat. Prerequisite(s): 2114 or equivalent and MATH 2163 or concurrent enrollment. Thermometry, heat transfer, elementary theory of specific heat and the three laws of thermodynamics.

PHYS 3213* Optics. Prerequisite(s): 2114 or 2414 and 3513, or consent of the instructor. Geometrical optics; interference, diffraction, dispersion, absorption, and polarization of light.

PHYS 3313 Introduction to Semiconductor Device Physics. Prerequisite(s): 2114 or equivalent. An introduction to crystal structure, the quantum theory of solids, the physics of semiconductor materials and the pn junction, with an emphasis on applications to semiconductor devices. (Same course as ECEN 3903)

PHYS 3323 Modern Laboratory Methods I. Lab 6. Prerequisite(s): 2014, 2114. Introduction to electric and electronic measurements and computer applications in experimental control, data collection and laboratory computation. Experiments on test instruments, integrated electronics, signal processing, computer interfacing, and data acquisition.

PHYS 3513* Mathematical Physics. Prerequisite(s): 1214, 2114 or 2414 and MATH 2163. Physical applications of vectors, vector calculus and differential equations. Fourier analysis. Orbit geometry, coordinate systems and transformation of coordinates. Matrices and determinants.

PHYS 3623 Modern Laboratory Methods II. Lab 6. Prerequisite(s): 2014, 2114 or equivalent. Introduction to the operating principles and applications of modern physical methods used in research. Laboratory experiments with lasers, wave propagation, thermometry, radiation detection, optical interferometry, and spectroscopy.

PHYS 3713 Modern Physics I. Prerequisite(s): 2114. Atomic physics, special theory of relativity, and introduction to solid state and nuclear physics.

PHYS 4003* Computer Simulation Methods in Physics. Prerequisite(s): 3013, 3113, 3313 or consent of instructor. Introduction to computer simulation methods used in the physical sciences. Linear systems, nonlinear systems, molecular dynamics, Monte Carlo methods, cellular automata, simple quantum systems. Some knowledge of either C, FORTRAN, Pascal, or BASIC required.

PHYS 4010* Special Problems. 1-3 credits, max 9. Prerequisite(s): Consent of instructor. Individual laboratory work of an advanced nature.

PHYS 4113* Electricity and Magnetism. Prerequisite(s): 2114 and MATH 2233, or their equivalents. Electrostatic fields, magnetic fields of steady currents, induced EMFs, Maxwell's equations and introduction to electromagnetic wave theory. Vector analysis used.

PHYS 4213* Introduction to Nuclear and Particle Physics. Prerequisite(s): 2114 and 3713 or consent of instructor. Survey of phenomenological aspects of nuclear and particle physics, photon and charged particle interactions with matter, particle detectors, particle accelerators, electromagnetic, strong and weak interactions, models of the nucleus, quark model of mesons and baryons, elementary particles, and symmetries in the Standard Model.

PHYS 4263 Introduction to Solid State Physics. Prerequisite(s): 3013, 3713 or consent of instructor. Structure, specific heat, dielectric properties, lattice vibrations, free electron theory, band structure, and superconductivity of solids.

PHYS 4313* Molecular Biophysics. Prerequisite(s): 1214 or 2114. Survey of experimental and computational methods for determining the structure and function of biomolecular assemblies such as proteins and membranes. Techniques to be discussed include: X-ray diffraction, nuclear and electron spin resonance, optical spectroscopy, photobiophysics, kinetic modeling, molecular dynamics, Monte Carlo and homology modeling.

PHYS 4413* Modern Physics II. Prerequisite(s): 3013 and 3713. Atomic and X-ray spectra; one-dimensional Schroedinger equation; nuclear structure; introduction to statistical mechanics and elementary quantum statistics.

PHYS 4423* Mechanics II. Prerequisite(s): 3013. Lagrangian and Hamiltonian dynamics, calculus of variations, constrained systems, coupled oscillators, continuous systems and waves.

PHYS 4513* Introductory Quantum Mechanics. Prerequisite(s): 3713. Uncertainty principle, setting up Schroedinger equation (time dependent as well as time independent) and solving it for linear oscillator, hydrogen atom, periodic, and other potentials.

PHYS 4663* Radioactivity and Nuclear Physics. Prerequisite(s): 3713 or consent of instructor. Natural and artificial radioactivity, decay laws; absorption, detection and measurement of radiations; nuclear transformations.

PHYS 4712* Senior Project. Lab 6. Advanced individual experimental projects. Project proposal, formal laboratory report, and oral presentation are required.

PHYS 4813* Electromagnetic Radiation. Prerequisite(s): 3213, 3513, 4113. Electromagnetic wave theory, reflection and refraction of electromagnetic waves; resonant cavities, wave guides, fiber propagation of electromagnetic waves; radiation sources; relativistic description of electromagnetic fields.

PHYS 4993 Senior Honors Thesis. Prerequisite(s): Departmental invitation, senior standing, Honors Program participation. A guided reading and research program ending with an honors thesis under the direction of a faculty member, with second faculty reader and oral examination. Required for graduation with departmental honors in physics.

PHYS 5000* Master's Thesis Research or Report. 1-9 credits, max 9. Prerequisite(s): Consent of major professor. Thesis research or report for master's degree.

PHYS 5110* Seminar. 1-5 credits, max 20. Prerequisite(s): Graduate standing in physics. Special topics in physics.

PHYS 5113* Statistical Thermodynamics and Kinetic Theory. Prerequisite: 3113. Fundamental concepts of thermodynamics: first, second and third laws; thermodynamic potentials. Statistical physics: Maxwell-Boltzman, Fermi-Dirac, Bose-Einstein distribution functions. Kinetic theory: transport phenomena, Boltzman H Theorem, the approach to thermodynamic equilibrium.

PHYS 5123* Geometrical Optics. Prerequisite(s): 3213 or consent of instructor. Foundations of geometrical optics, geometrical theory of optical imaging, geometrical theory of aberrations, image forming instruments. (Same course as ECEN 5803)

PHYS 5133* Laser Spectroscopy. Prerequisite(s): 5163. Principles of different types of laser spectroscopy based on fluorescence, absorption, saturated absorption, absorption in a cavity: Infrared, Raman, light scattering, four wave mixing, CARS, phase conjugation, two photon absorption, double resonance, and multiphoton ionization.

PHYS 5163* Lasers. Prerequisite(s): 4813 or equivalent. Semi-classical description of absorption and emission of light by matter; effects of cavities and optical elements; theory of lasers—gas, liquid, solid state and semiconductor. Electro-optics. Techniques of mode-locking, Q-switching, phase conjugation, Fourier transform optics. An introduction to non-linear optics.

PHYS 5213* Statistical Mechanics. Prerequisite(s): 5113 and 5613 or consent of instructor. Classical and quantum mechanical distribution functions for independent particles; interacting classical and quantum systems, superfluidity, phase transitions and critical phenomena, approximation methods.

PHYS 5220* Physics Topics for Teachers. 1-6 credits, max 6. Prerequisite(s): Teaching experience or consent of instructor. Special topics for elementary and secondary science teachers to improve their subject matter competence. Content varies, depending on the needs of specific groups of teachers.

PHYS 5263* Particle Physics. Prerequisite(s): 5613 or consent of instructor. Phenomenology of elementary particles: quark model, electromagnetic, weak, and strong interactions of quarks, leptons, and gauge bosons, Feynman diagram techniques, parton model, gauge symmetries, spontaneous symmetry breaking, Standard model, experimental tests.

PHYS 5303* Physical Optics. Prerequisite(s): 3213 or consent of instructor. Multiple beam interference, diffractions, imaging, near field optical probes of matter, surface plasmons, light scattering from random media, optical coherence tomography - biomedical applications, negative materials, perfect lenses and super resolution. (Same course as ECEN 5823*)

PHYS 5313* Electromagnetic Theory. Prerequisite(s): 5453. Electric and magnetic fields in free space and in matter. Boundary value problems, Green's functions, stress tensors, multipole expansions, thermodynamics; electromagnetic waves.

PHYS 5350* Special Problems. 1-3 credits, max 3. Prerequisite(s): Graduate standing in physics. Special problems of experimental or theoretical nature. Largely individual work with written report required.

PHYS 5413* Classical Mechanics. Prerequisite(s): 4423 or consent of instructor. Generalized coordinates and advanced dynamics; coupled systems, wave motion; theory of elasticity.

PHYS 5453* Methods of Theoretical Physics. Prerequisite(s): 3513. Introduction to the various methods and techniques used in theoretical physics.

PHYS 5523* Radiation Detection and Measurement. Prerequisite(s): 3713 or 4212. Overview of radiation detection and measurement. Instrumentation, statistics of radiation measurements, review of atomic and nuclear physics, review of radiation interaction with matter, nuclear electronics, gas-filled and scintillation detectors, semiconductor detectors, radiation counting and spectroscopy.

PHYS 5533* Dosimetry and Radiation Protection. Prerequisite(s): 4663 and 5523 or consent of instructor. Radiation Dosimetry Quantities, effects of ionizing radiation on the human body, basic radiation protection concepts, x-ray and y-ray interaction and attenuation with matter, charged particle and neutron interaction with matter, charged particle equilibria, Bragg-Gray Cavity Theory, quantifying dose from radionuclide sources, survey of dosimetric instrumentation, dosimetry with ionization chambers, integrating dosimeters and personal dosimetry.

PHYS 5563* Radioactivity and Nuclear Physics Laboratory. Lab 4. Prerequisite(s): 4663 and 5523 or consent of instructor. The primary objective of this course is to provide students with hands-on experience in a range of experimental techniques and with a variety of instrumentation routinely used in radiation detection and dosimetry, nuclear and particle physics, and in radiotherapy and medical imaging. The course content can be thought of as being of two types: 1) general experimental methods in physics and 2) methods of radiation detection and measurement.

PHYS 5573* Radiation Biophysics. Prerequisite(s): 5533 or consent of

instructor. Introduction to radiation biophysics, structure of DNA and its relationship to carcinogenesis, stochastic nature or radiation interaction with matter, radiation chemistry, cell survival curves, radiation damage models, DNA damage response.

PHYS 5583* Physics of Medical Imaging. Prerequisite(s): 4663 and 5523 or consent of instructor. Review of radiation interaction with matter, x-ray imaging, Magnetic Resonance Imaging, Ultrasound, Scintillation Imaging. Single photon emission computed tomography (SPECT), Positron Emission Topography (PET).

PHYS 5593 Physics of Radiation Therapy. Prerequisite(s): 5533 or consent of instructor. Overview of Radiation Therapy, dosimetry in radiation therapy, megavoltage x-ray and electron therapy, manual treatment planning, computer-based treatment planning, brachytherapy, proton therapy.

PHYS 5613* Quantum Mechanics I. Prerequisite(s): 5453. Postulates of quantum mechanics. Operators, commutation relations, eigenfunctions. Schroedinger, Heisenberg and interaction formalisms, angular momentum and central field problems; nondegenerate perturbation theory.

PHYS 5663* Solid State Physics I. Prerequisite(s): 4513. Crystal structure, cohesive energy of ionic crystals and metals, specific heats, free electron theory of metals, band theory, Brillouin zones, insulators and alloys; magnetic properties, optical properties and thermal and electrical conductivity of solids.

PHYS 5693* Clinical Studies in Medical Physics. Prerequisite(s): 5583, 5593 and consent of instructor. Students will perform a clinical rotation within a hospital-based radiation therapy treatment clinic, during which they will shadow a medical physicist and observe and participate in (when appropriate) the physicists daily clinical activities. The student will learn the technical aspects of CT and MR imaging, radiotherapy treatment planning and delivery, and routine and patient specific calibration/quality assurance procedures.

PHYS 5713* Solid State Physics II. Prerequisite(s): 5663 or equivalent. Symmetry, dielectric properties, ferroelectrics, magnetic properties, mechanical properties, and defects of solids.

PHYS 5813* General Relativity. Prerequisite(s): 5453 or consent of instructor. Theory and applications of general relativity: the principle of equivalence, general coordinate invariance, tensors, affine connections, Einstein's field equations, classic tests, application to stellar dynamics, black holes, and cosmology.

PHYS 5960* Problems in Chemical Physics. 3-6 credits, max 6. Prerequisite(s): Consent of instructor. Intermolecular forces, interaction of radiation with matter in bulk form, dielectric properties of matter, polymer physics and quantum theory of biopolymers.

PHYS 6000* Doctoral Dissertation Research. 1-15 credits, max 60. Prerequisite(s): Admission to candidacy and permission of major professor.

PHYS 6010* Advanced Graduate Seminar. 1-3 credits, max 15. Prerequisite(s): Consent of instructor. Special topics of an advanced nature in physics.

PHYS 6113* Advanced Theory of Solids. Prerequisite(s): 5663. Many-body techniques, transport processes, band theoretical techniques, superconductivity, dynamics of electrons in a magnetic field, and alloys.

PHYS 6213* Group Theory for Physics. Prerequisite(s): 5453. Group theory and imperfections in crystals. Dislocation theory and color centers.

PHYS 6243* Semiconductors I. Prerequisite(s): 5113, 5613, 5663. The first part of a survey of the physics of semi-conductors. Bonding and structure, crystal growth, epitaxial growth, band theory, phonons, photons, defects, intrinsic and extrinsic statistics, trapping and recombination.

PHYS 6260* Special Topics in High Energy Physics. 1-3 credits, max 9. Prerequisite(s): 5263 or consent of instructor. Advanced topics of current interest in high-energy physics: collider physics, supersymmetry, unification, flavor physics, string phenomenology, extra dimensions.

PHYS 6313* Quantum Mechanics II. Prerequisite(s): 5613. Scattering theory, many-particle quantum mechanics and application to atomic and molecular systems; degenerate and time-dependent perturbation theory.

PHYS 6323* Quantum Field Theory. Prerequisite(s): 6313 or consent of instructor. Relativistic Quantum Mechanics: Klein-Gordon field, path integral formulation of Quantum Mechanics, Feynman diagrams, Quantum Electrodynamics, relativistic scattering radiative corrections, renormalization and critical exponents, non-Abelian gauge theories, spontaneous symmetry breaking.

PHYS 6343* Semiconductors II. Prerequisite(s): 6243. The second part of the semiconductors sequence. Transport phenomena, junctions, devices, heterostructures, and optical properties.

PHYS 6413* Nonlinear Optics. Prerequisite(s): 5163, 5313, and 5613. The response of matter at high radiation powers; nonlinear susceptibilities. Wave propagation in nonlinear medium; three wave and four wave interactions; saturated absorption, optical switching and limiting; two photon and stimulated Raman processes; Self focusing; solitons.

PHYS 6423* Quantum Optics. Prerequisite(s): 5163, 5613 or consent of instructor. Quantization of Electromagnetic Fields, coherence, quantum entanglement, parametric down conversion, two photon interferometry, Bell's inequalities, quantum teleportation and cryptography, cavity QED.

PHYS 6513* Advanced Topics in Solid State Physics. Prerequisite(s): 5663 or equivalent. Interaction of radiation and matter, neutron scattering, phase transitions, magnetic resonance and cooperative phenomena.

PHYS 6613* Advanced Nuclear and Particle Physics. Prerequisite(s): 5263, 6313; or consent of instructor. Renormalization of quantum field theories, spontaneous symmetry breaking, Standard model, flavor physics, grand unification, super-symmetry.

PHYS 6713* Advanced Electromagnetic Radiation. Prerequisite(s): Consent of instructor. Radiation theory, wave guides, scattering and dispersion relations; relativity.

PHYS 6803* Photonics I: Advanced Optics. Lab 9. Prerequisite(s): ECEN 3213 or 3813. Advanced optics including spectral and time characteristics of detectors, characteristics of lasers, time, spectral and spatial parameters of laser emission, interferometric techniques, and nonlinear effects such as two-photon absorption and second and third harmonic generations. Ultrashort laser pulses. (Same course as CHEM 6803* & ECEN 6803*)

PHYS 6810* Photonics II: THz Photonics and THz-TDS. 1 credit, max 4, Lab 1. Prerequisite(s): 6803. THz photonics and THz time-domain spectroscopy (THz-TDS). Concepts and techniques of driving electronic circuitry with ultrashort laser pulses to generate and detect freely propagating pulses of THz electromagnetic radiation using several operational research systems. (Same course as CHEM 6810* & ECEN 6810*)

PHYS 6820* Photonics II: Spectroscopy II. 1 credit, max 4, Lab 1. Prerequisite(s): 6803. Operating principles and applications of laser spectroscopy of atoms, molecules, solids and complex fluids. Absorption, emission, photon correlation, coherence, time resolved Fourier transform. Raman spectroscopy and non-linear optical. (Same course as CHEM 6820 & ECEN 6820)

PHYS 6830* Photonics II: Spectroscopy III. 1 credit, max 4, Lab 1. Prerequisite(s): 6803. Advanced spectroscopic instruments and methods used for investigation of semi-conductors and solid state material. Stimulated emission characterized both in wavelength and in time. Time-resolved fluorescence measurements. Multiphotonic excitations. Fast measuring techniques including subnanosecond detectors, picosecond streak cameras, and ultrafast four-wave mixing and correlation techniques. Time-dependent photoconductivity measurements. (Same course as CHEM 6830 & ECEN 6830)

PHYS 6840* Photonics III: Microscopy I. 1 credit, max 4, Lab 1. Prerequisite(s): CHEM 3553 or consent of instructor. The structure and imaging of solid surfaces. Basics of scanning probe microscopy (SPM). Contact and noncontact atomic force microscopy (AFM). Scanning tunneling microscopy (STM) in air. (Same course as CHEM 6840* & ECEN 6840*)

PHYS 6850* Photonics III: Microscopy II. 1 credit, max 4, Lab 1. Prerequisite(s): 3553 or consent of instructor. Advanced techniques of scanning probe microscopy (SPM). Magnetic force microscopy, Kelvin force microscopy, scanning, tunneling microscopy (STM) in vacuum. Characterization of materials with SPM. Nanolithography with SPM. Device manufacturing and analysis. (Same course as CHEM 6850* & ECEN 6850*)

PHYS 6860* Photonics III: Microscopy III and Image Processing. 1 credit, max 4, Lab 1. Prerequisite(s): ECEN 5793. Digital image processing, including projects. Image acquisition and display, image enhancement, geometric operations, linear and nonlinear filtering, image restoration, edge detection, image analysis, morphology, segmentation, recognition, and coding and compression. (Same course as CHEM 6860* & ECEN 6860*)

PHYS 6870* Photonics IV: Synthesis and Devices I. 1 credit, max 4, Lab 1. Prerequisite(s): 6803 and 6840. Preparation of functional nanostructures and related optical and electronic devices. Physical and chemical methods of thin film deposition. Engineering of prototypes of light emitting diodes, sensors, optical limiting coatings, lithographic patterns. (Same course as CHEM 6870* & ECEN 6870*)

PHYS 6880* Photonics IV: Semiconductor Devices, Testing and Characterization. 1 credit, max 4, Lab 1. Prerequisite(s): 6803. Test and characterization of semiconductor and optoelectronic devices. Hall effect, four point probe, CV and IV measurements, optical pump-probe, photoluminescence, and electro-optics sampling. (Same course as CHEM 6880* & ECEN 6880*)

PHYS 6890* Photonics IV: Semiconductor Synthesis and Devices III. 1 credit, max 4, Lab 1. Prerequisite(s): 6803. Processing, fabrication and characterization of semiconductor optoelectronic devices in class 100/10000 cleanrooms. Cleanroom operation including general procedure for material processing and device fabrication. Device processing using a variety of processing such as mask aligner, vacuum evaporators and rapid thermal annealer. Testing using optical and electrical testing apparatus such as I-V, C-V Hall, and optical spectral measurement systems. (Same course as CHEM 6890* & ECEN 6890*)

Plant Pathology (PLP)

PLP 2143 Global Issues in Agricultural Biosecurity and Forensics. Biosecurity, biosafety, bioterrorism, microbial forensics, emerging organisms, invasive species, quarantine, response, surveillance, detection, diagnostics, and how all system components integrate to science and to agricultural specialties, economics and defense. (Same course as ENTO **2143)**

PLP 3343 Principles of Plant Pathology. Lab 2. Prerequisite(s): BOT 1404 or BOT 3463 or MICR 2125 or PLNT 2013. Introduction to basic principles and concepts of plant pathology, including the nature, cause and control of biotic and environmentally induced plant diseases, with emphasis on principles and methods of disease management. *Offered in combination with PLP 5343. No credit for both 3343 and 5343.*

PLP 3553 Fungi: Myths and More. Lab 1. Prerequisite(s): BIOL 1114. Explores the impact of fungi on beliefs, culture and society via the colorful folklore and myths of fungi and their role in the environment and human affairs, including diseases of plants, animals and humans exemplified by the Great Bengal famine of 1943, The Irish potato famine, 1840's and the Salem witch trials 1692. Laboratory instruction on use of microscopes, mushroom identification, mechanisms of dispersal, and genetic recombination. (Same course as BOT 3553)

PLP 3663 Turfgrass Integrated Pest Management. Lab 2. Prerequisite(s): 3343, ENTO 2993. The biology, ecology and identification of fungal, nematode and insect turfgrass pests. Contemporary concepts and applications of integrated control practices available for managing turfgrass pests presented along with decision-making tools for use in turfgrass pest management programs. (Same course as ENTO 3663)

PLP 4400 Special Topics. 1-3 credits, max 3. Prerequisite(s): Consent of instructor. Special topics in Plant Pathology, Entomology or related fields. (Same course as ENTO 4400)

PLP 4923* Applications of Biotechnology in Pest Management. Prerequisite(s): BIOL 1114 and CHEM 1215 or equivalent. Applications of biotechnology in controlling arthropod pests of plants and animals, plant pathogens, and weeds. Introduction to underlying technology, products being developed and deployed, their effectiveness and associated problems or concerns resulting from their use. (Same course as ENTO 4923 and PLNT 4923)

PLP 5000* Research. 1-6 credits, max 6. Research for the MS degree.

PLP 5003* Plant Nematology. Lab 2. Prerequisite(s): 3343 or concurrent enrollment. General morphology, taxonomy and bionomics of nonparasitic and plant parasitic nematodes. Plant parasitic nematode assay techniques, subfamily identification, symptomology, pathogenicity and control.

PLP 5012* Plant Virology Laboratory. Lab 4. Methods of investigating plant viruses.

PLP 5013* Plant Virology. Prerequisite(s): 3343 or equivalent; one course in biochemistry or physiology. Transmission, characterization, differentiation, replication, and control of plant viruses; discussion of current literature.

PLP 5104* Mycology. Lab 2. Prerequisite(s): Graduate standing. A systematic study of the fungi, with emphasis on taxonomy, comparative morphology and fungal biology. Taught in the Department of Plant Pathology. (Same course as BOT 5104*)

PLP 5304* Phytobacteriology. Lab 3. Prerequisite(s): 3343. Bacteria as plant pathogens, with examination of the taxonomy, genetics, ecology, physiology, host-parasite interaction, and control of phytobacteria.

PLP 5343* Principles of Plant Pathology. Lab 2. Prerequisite(s): BOT 1404 or BOT 3463 or MICR 2125 or PLNT 2013. Introduction to basic principles and concepts of plant pathology, including the nature, cause and control of biotic and environmentally induced plant diseases. Offered in combination with PLP 3343. No credit for both 3343 and 5343. Graduate students will be expected to complete extra assignments.

PLP 5413* Plant Disease Epidemiology. Lab 3. Prerequisite(s): 3343 or 5043. Introduction to methodology and technical equipment used in epidemiological research and application of epidemiological principles in plant disease control.

PLP 5524* Integrated Management of Insect Pests and Pathogens. Lab 4. Prerequisite(s): 3343, ENTO 2993 or equivalent or consent of instructor. Modern theory and practices for management of insect pests and pathogens in plant production systems, emphasizing an ecologically-based, integrated approach. Basic concepts of pest management, decision-making, cost/benefit analysis, and risk/benefit analysis. (Same course as ENTO 5524)

PLP 5560* Problems in Plant Pathology. 1-5 credits, max 10. Prerequisite(s): Consent of instructor.

PLP 5613* Host Plant Resistance. Lab 2. Prerequisite(s): 3343 and ENTO 2993 or equivalent and a general genetics course; or consent of instructor. Interactions of plants and the herbivorous insects and pathogenic micro-organisms that attack them. Development and deployment of multiple-pest resistant cultivars in crop management systems. (Same course as ENTO 5613)

PLP 5623* Advanced Biotechnology Methods. Lab 3. Prerequisite(s): BIOC 3653, BIOL 3023 or equivalent or consent of instructor. Overview of current theory and principles of biotechnology and laboratory experience with contemporary techniques and experimental methods used in biotechnology, including genome analysis, gene transfer, identification and isolation of genes and their products, and regulation of gene expression in plants and arthropods. (Same course as ENTO 5623*)

PLP 5700* Teaching Practicum in Plant Pathology. 1-6 credits, max 6. Prerequisite(s): Graduate student standing. Variable credit offering for graduate students who wish to develop skills in teaching, assessment and course development working in conjunction with a primary instructor.

PLP 5724* Physiology of Host-Pathogen Interactions. Lab 4. Prerequisite(s): 3343 and BIOC 3653. Physiology of the interactions between plants and pathogens. Mechanisms by which pathogens infect and by which plants resist infection.

PLP 5860* Colloquium. 2 credits, max 2. Prerequisite(s): 3343. Concepts and principles of plant pathology through discussions of pertinent literature.

PLP 5870* Scientific Presentations. 1 credit, max 5. Prerequisite(s): Consent of instructor. Preparation and delivery of scientific presentations, including 50-minute seminars, 10-minute talks, and posters. (Same course as ENTO 5870*)

PLP 5992* Career Skills and Professionalism for Scientists. Prerequisite(s): Graduate standing. For graduate students majoring in science-based fields, especially those nearing graduation. Skills needed for effective job application and interviewing, career development and advancement, communication with professional colleagues and the public, and personal professional development. (Same course as ENTO 5992*)

PLP 6000* Research. 1-12 credits, max 36. Research for the PhD degree.

PLP 6303* Soilborne Diseases of Plants. Lab 3. Prerequisite(s): 3343. Soilborne diseases, their reception and importance, the pathogens involved, rhizoplane and rhizosphere influences, inoculum potential, specialization of pathogens, suppressive soil effects, and disease management. Lecture and discussion sessions will emphasize in-depth understanding of problems and complexities associated with studies of soilborne pathogens.

Plant Science (PLNT)

PLNT 1101* Orientation to Plant and Soil Sciences. Introduction to areas of study, professional activities and career opportunities in plant and soil sciences.

PLNT 1213 Introduction to Plant and Soil Systems. Introduction to the concepts of plant and soil systems including cropland, rangeland and pastureland. A systems approach to the importance of plant and soil resources to the producer, consumer and citizen; modern management and production practices; maintenance of natural resources.

PLNT 1223 Plants, Genes and the Consumer. Issues of plant-based food production from both a scientific and a social perspective. The fundamental principles of plant growth and development; how plants function in an agroecosystem and how to utilize these principles to grow food in an environmentally and socially sound manner. The role of genetics and biotechnology. *No credit for Plant and Soil Sciences or Horticulture majors.*

PLNT 2013 Applied Plant Science. Lab 2. Prerequisite(s): 1213 or BOT 1404 or FOR 1123 or HORT 1013. Application of agronomic principles to the management, improvement and use of plants. Structure and growth of crop plants relating to management strategies and adaptation to varying abiotic and biotic factors. Hands-on identification of crops, weeds, and seed quality factors; application of tools and techniques.

PLNT 2041 Career Development in Plant and Soil Sciences. Prerequisite(s): Sophomore standing in plant and soil sciences. Develop personal goals in plant and soil sciences through identification of personal values, skills building, exploring professional opportunities, and networking. *Graded on pass-fail basis.*

PLNT 3113 Principles of Weed Science. Lab 2. Prerequisite(s): 1213 or HORT 1013. Basic principles of weed biology and ecology and methods for cultural, mechanical, chemical, and biological weed management in crop production and turf grass systems.

PLNT 3554* Plant Genetics and Biotechnology. Lab 2. Prerequisite(s): BIOL 1114. Basic principles of heredity. Interrelationship between classical genetics and molecular genetics emphasized. Mendelian genetics, cytogenetics, mutations, gene regulation and genetic engineering.

PLNT 3782 Seed Technology. Prerequisite(s): 1213. Factors determining seed quality and utilization during growth, harvest, and storage. Modern techniques to determine seed quality for optimum processing and utilization of seed crops. Minimum of two field trips required.

PLNT 3790 Seed and Plant Identification. 1 credit, max 2, Lab 3. Prerequisite(s): 1213. Identification and classification of agronomically important crop and weed species from seed and from seedling, vegetative, flowering or mature plants.

PLNT 4080 Professional Internship. 1-6 credits, max 6. Prerequisite(s): Consent of instructor. Internship must be at an approved agribusiness or other agency serving agronomy, plant science or soil science. Requires written reports and a final presentation.

PLNT 4113* Advanced Weed Science. Prerequisite(s): 3111 and 3221. Integrated approach for weed management. Weed life cycles and biology, weed crop interferences, herbicide families and their characteristics, and finally a systematic and integrated weed management system. Methods of conducting and interpreting research results in appropriate topics.

PLNT 4123* Plant-Environment Interactions. Prerequisite(s): BOT 1404. Environmental impact on plant life cycle; (i.e. germination, flowering and senescence); plant growth responses (e.g. photosynthesis, phototropism,

biomass production) to light quality, precipitation, temperature, and population or community changes.

PLNT 4353* Plant Breeding. Prerequisite(s): 3554 or equivalent. Basic principles dealing with the improvement of plants through application of genetic principles.

PLNT 4470* Problems and Special Study. 1-3 credits, max 12, Lab 1-3. Prerequisite(s): Consent of instructor. Problems in plant science selected from topics in range and turf, plant breeding and genetics, crop management and physiology, and weed control.

PLNT 4571 Professional Preparation in Plant and Soil Sciences. Prerequisite(s): Senior standing in plant and soil sciences. Preparation for professional certification exams and career opportunities in plant and soil sciences. (Same course as SOIL 4571)

PLNT 4573* Bioenergy Feedstock Production. Prerequisite(s): 1213. Understand production and management practices for potential bioenergy feedstocks. Distinguish feedstock sources and end products. Identify physiological mechanisms to improve yield and quality under current and future climates. Use simulation and GIS tools to project biomass and ethanol yields.

PLNT 4613* Forage and Grazinglands Resource Management. Prerequisite(s): 1213 or BOT 1404. Designing forage systems that optimize yield potential, economical livestock production and pasture system development.

PLNT 4673* Cropland Ecosystems. Lab 2. Prerequisite(s): 2013. Designing sustainable cropping systems that optimize yield potential, economic and environmental benefit based upon climatic and social conditions.

PLNT 4783* Cotton Production. Prerequisite(s): 1213. Production, utilization and improvement of cotton. Several other agronomic fiber crops briefly discussed.

PLNT 4923* Applications of Biotechnology in Pest Management. Prerequisite(s): BIOL 1114 and CHEM 1215 or equivalents. Applications of biotechnology in managing arthropod pests of plants, animals, plant pathogens, and weeds. Introduction to underlying technology, products being developed and deployed, effectiveness and associated problems or concerns resulting from their use. (Same course as ENTO 4923 and PLP 4923)

PLNT 4990 Senior Thesis in Plant and Soil Sciences. 1-6 credits, max 6. Prerequisite(s): Consent of instructor. Supervised undergraduate research in topics related to plant and soil sciences. Completion of an approved research project based on a thesis topic in plant or soil science will include submission of a written report and a public defense of the work.

PLNT 5000* Master's Thesis. 1-6 credits, 6 max total credits under Plan I, and 2 max total credits under Plan II. Prerequisite(s): Consent of adviser. Research planned, conducted and reported in consultation with a major professor.

PLNT 5020* Graduate Seminar. 1 credit, max 3. Prerequisite(s): Graduate standing. Discussions of research philosophy, methods, interpretation, and presentations. Profession development and contributions to the scientific community. (Same course as SOIL 5020).

PLNT 5110* Problems and Special Study. 1-4 credits, max 12. Prerequisite(s): Consent of instructor. Supervised study of special problems and topics not covered in other graduate courses.

PLNT 5112* Herbicide Fate in the Environment. Prerequisite(s): 4113. Processes involved in the behavior and fate of herbicides in air, soil, and water. Reaction, movement, and dissipation of herbicides in soil.

PLNT 5230* Research. 1-4 credits, max 8. Prerequisite(s): Consent of a faculty member supervising the research. Supervised independent research on selected topics.

PLNT 5293* Plant Response to Water Stress. Prerequisite(s): BIOC 3653, BOT 3463. Physiological ramifications of water deficit stress on cells, tissues, plants and canopies. Discussion of the soil/plant/atmosphere continuum, and avoidance and tolerance mechanisms leading to drought resistance. Photosynthesis, transpiration, and water-use efficiency and their relationship to biomass accumulation and crop yield.

PLNT 5313* Simulation Models in Research, Management and Policy. Prerequisite(s): 1213. Use crop simulation models (CSM) and decision support systems to address challenges associated with food, fuel, feed and fiber production. Utilize CMS as research, management, and policy tools. Evaluate CSM as surrogates to field studies and to design experiments to fill in knowledge gaps.

PLNT 5403* Physiological Action of Herbicides. Prerequisite(s): BOT 3463. The mode of action, uptake and translocation, and metabolism of herbicides in crops and weeds.

PLNT 5412* Plant Breeding Methods. Prerequisite(s): 3554 or 4353 or consent of instructor. Development and application of genetic principles to breeding methodology of self- and cross-pollinated crops; emphasis on selection methods pertinent to plant improvement; methods of new cultivar development, release, and commercialization.

PLNT 5433* Biotechnology in Plant Improvement. Prerequisite(s): 3554, 4353, and BIOL 3014 or consent of instructor. Use of emerging technologies in cell biology and molecular genetics to study and manipulate plants. Emphasis on genetic systems which influence productivity and end-product utilization. The integration of biotechnology into plant breeding programs and issues concerning the release of genetically engineered organisms into the environment.

PLNT 5443* Advanced Genetics. Prerequisite(s): 3554; BIOC 3653. Concepts of eukaryotic genetics with emphasis on classical, molecular, and quantitative genetics.

PLNT 5452* Cytogenetics. Prerequisite(s): 5443 or concurrent enrollment in BOT 5232. Behavior of chromosomes, cellular organelles and cytoplasm in relation to genetic behavior.

PLNT 5453* Applied Plant Genomics. Prerequisite(s): Graduate standing and 3554 or BIOL 3023 or consent of instructor. Use and application of genomic knowledge and technology to improve agriculturally important plants. Major topics include structural and comparative genomics and their application in molecular breeding of agronomic crops. Extensive laboratory practice provided.

PLNT 5863* International Agricultural Research Systems. Organization, management and budgeting of agricultural research systems with emphasis on developing countries. Analysis of research and training priorities, budgeting, staffing and management of projects.

PLNT 6000* Doctoral Thesis. 1-6 credits, max 36. Prerequisite(s): Consent of adviser. Independent research to be conducted and reported with the supervision of a major professor as partial requirement for the PhD degree.

PLNT 6010* Advanced Topics and Conference. 1-6 credits, max 12. Prerequisite(s): MS degree. Supervised study of advanced topics. A reading and conference course designed to acquaint the advanced student with fields not covered in other courses.

PLNT 6410* Topics in Plant Breeding and Genetics. 1-3 credits, max 6. Prerequisite(s): Consent of instructor. Selected topics in the statistical and experimental analysis of quantitative traits, evolutionary development of domesticated plants and animals, and techniques used in breeding crop plants.

Political Science (POLS)

POLS 1010 Studies in American Government. 1-2 credits, max 2. Special study in American government to allow transfer students to fulfill general education requirements as established by Regents' policy.

POLS 1113 American Government. Organization, processes and functions of the national government of the United States. Satisfies, with HIST 1103 or 1483 or 1493, the State Regents requirement of six credit hours of American history and American government before graduation.

POLS 2013 (S) Introduction to World Politics. Analysis of the major concepts in international relations - power, sovereignty, self-help, cooperation, dependency, and introduction to the dominant theoretical approaches to its study realism, pluralism, Marxism, and feminism.

POLS 2023 The Individual and the Law. Introduction to the U.S. Constitution, legal reasoning, legal research techniques, and topical issues of U.S. public law.

POLS 2033 Introduction to Public Administration. Public administration, including administration, administrative organization, decision-making, governmental public relations and administrative responsibilities.

POLS 2113 (S) Introduction to Comparative Politics. A comparative study of the political processes and institutions of contemporary societies. Introduction to the concepts and methods of comparative politics.

POLS 2993 Honors Tutorial in Political Science. Prerequisite(s): 1113. Honors standing, and invitation by head of department. For the special needs of the sophomore-level honors student majoring in political science who wishes to study individualized topics at an accelerated pace in a tutorial format. After mastering basic principles in an area of interest the student will conduct independent research under close faculty supervision and prepare a report or reports.

POLS 3003 (I,S) The Soviet Union: History, Society and Culture. A comprehensive view of the Soviet Union, stressing those issues in the political, economic, technological, geographical and cultural spheres which are most relevant to the current situation. Accessible to beginning undergraduates. (Same course as HIST 3003 & RUSS 3003)

POLS 3033* International Law. The nature and scope of public international law, with emphasis on problems related to the recognition of states and governments, jurisdiction over nationals and aliens, and state responsibility in cases of expropriation and revolutionary damage.

POLS 3053 (I,S) Introduction to Central Asian Studies. A comprehensive view of newly-emerged Central Asian states examining the history, politics, economics, geography, and culture of Azerbaijan, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan as reflected in their thoughts, religion, literature, and architecture, in the past, and the strategic importance of their natural wealth for the present and future. (Same course as GEOG 3053, HIST 3053 & RUSS 3053)

POLS 3090 Teaching Practicum. Prerequisite(s): Consent of instructor. For outstanding students. Students will work with a faculty instructor and assist in many aspects of teaching including guest lecturing, offering study sessions, office hours, among other duties as determined by instructor. May involve meetings and written paper(s).

POLS 3100 Political Science Internship. 1-6 credits, max 6. Prerequisite(s): Consent of department. Internship education experience in a specific subfield in

the discipline of political science.

POLS 3103 Introduction to Political Inquiry. Prerequisite(s): 60 credit hours or 45 hours with GPA of 3.25, including 2113. The scope and methods of political science. Scientific methodology applied to political phenomena, hypothesis, measurement, literature review, research designs, introductory data analysis and writing in political science.

POLS 3123 (I) Politics of Russia/Former Soviet Union. Political processes, governmental institutions and public policies of post-Soviet Russia. Parties, elections and citizen participation in government.

POLS 3143 (I) Politics of Western Europe. State-society relations in key West European countries, including political processes, governmental institutions, cultural pluralism and gender relations.

POLS 3163 (I) Politics of Africa. Analysis of processes, institutions and contemporary trends in the politics of selected African countries, including political development, democratization, conflict, political role of the military, political economy, and social movements.

POLS 3193 (I,S) Politics of Latin America. Analysis of processes, institutions and contemporary trends in the politics of selected Latin American countries; political development, democratization, political role of the military, political economy and social movements.

POLS 3223 Politics of East Asia. Political processes, governmental institutions and administration in China, Japan, and Korea.

POLS 3313 Politics of the Middle East. Analysis of political institutions and processes with emphasis on selected countries of the Middle East; the social and economic basis of politics; nationalism, political development and factors of instability and change.

POLS 3353 Parties and Interest Groups. Political parties and interest groups as institutions; their role in elections and government.

POLS 3423 Voting and Elections. Electoral systems and their relationship to political development, political socialization, issue emergence, voting patterns and electoral cycles.

POLS 3443 Political Campaigns and Candidacy. Planning, fundraising, targeting, public opinion, support operations, voter contact, the mass media and candidate activities.

POLS 3453 The Legislative Process. The power and organization of legislatures, as well as the selection and behavior of legislators. Special attention given to the U.S. Congress.

POLS 3483 The American Presidency. The politics of presidential selection, removal and succession; formal and informal powers of the president; relations with Congress, the national judiciary and national executive branch; proposed reforms and the vice-presidency.

POLS 3493* Public Policy. Prerequisite(s): Any one of 1013, 2033, 2113, ECON 1113, 2123, SOC 1113, PHIL 2113. Identification of policy options open to policy makers and examination of measurements and rationales underlying governmental programs.

POLS 3513 Public Opinion and Polling. The nature of public opinion. Public opinion polling, the factors influencing opinion formation, and the effects of public opinion on policy and policy makers.

POLS 3523 Money, Media and Politics. Prerequisite(s): 1113. Techniques used by successful candidates for elective office to present their positions to the voting public. Beginning with the basic elements of fundraising exploration of current campaign finance laws, funding techniques and campaign budgeting. Message development, media production and ad placement. Preparation of a fundraising strategy.

POLS 3533 Political Lobby and Grassroots Organization. Prerequisite(s): 1113. Traditional special interest lobbying and the rapidly emerging local grassroots constituent movement. New federal laws pertaining to lobbying and rules that govern the conduct of state lobbying. The implications of technology and the potential advent of a plebiscite form of government. Development of complete grassroots strategy on an issue either at the federal or state level.

POLS 3613* State and Local Government. Political processes, government and administration of American states, cities and counties; special emphasis on Oklahoma.

POLS 3663 Introduction to Political Thought. The teachings of the three lasting traditions of Western political thought: classical, Christian and modern.

POLS 3683 Politics in Contemporary Film. Prerequisite(s): 1113. The effect of politics on contemporary film. Exploration of the often subtle political imagery and symbolism contained in film.

POLS 3733 Incident Management and Tactical Operations. Strategic management of an emergency incident through the use of the Incident Management System. A thorough study of the IMS system and tactical decision-making forming the base for case study analysis and emergency operations simulations.

POLS 3763 Mitigation and Recovery. Prerequisite(s): 3813. Introduction to recovery and mitigation activities for emergency managers. Covers components, policies, programs and organizations related to recovery and mitigation, illustrates course concepts with case studies.

POLS 3813 Aim and Scope of Emergency Management. An overview of the history and philosophy of the current emergency management system. Concepts, issues and programs associated with the development of an emergency management program. Local, state and federal roles and responsibilities for responding to disasters and emergencies with emphasis on man-made natural and technological hazards.

POLS 3893 Terrorism and Emergency Management. A general introduction to the basic concepts for preparedness, response and command functions at the scene of a potential terrorist incident.

POLS 3953 (D,S) Minorities in the American Political System. Prerequisite(s): 1113. Examination of mass and elite level behavior of minorities in the contemporary U.S. political system.

POLS 3973 (D) Race, Politics and Sports. Prerequisite(s): 1113. Historical, as well as the contemporary relationship, between race, politics and sports in the U.S. political system.

POLS 3983 (S) Courts and Judicial Process. The American judiciary and legal process from a political perspective with particular emphasis on judicial organization and powers, recruitment, fact-finding, decision-making, impact of decisions, the legal profession and relations among courts. Oklahoma judicial organization.

POLS 3993 Legal Research and Analysis. Prerequisite(s): 2023 or HONR 2013. Introduction to legal research methods, including state and federal reported cases, digests, annotated codes, state and federal administrative regulations, and computerized legal research, as well as an introduction to legal reasoning and analysis and the preparation of case briefs and memoranda.

POLS 4000* Topics in American Politics. 3 credits, max 6. Prerequisite(s): 1113 and 45 earned hours or consent of instructor. In-depth examination of critical topics and issues in American politics, including American political behavior and political leadership. May be repeated with different topics.

POLS 4010* Topics in International Relations. 3 credits, max 6. Prerequisite(s): 2013 or 2113 or consent of instructor. In-depth examination of critical topics and issues in International Relations. May be repeated with different topics.

POLS 4013* American Foreign Policy. Major problems and policies of American foreign relations since World War II and description of foreign formulation and aid administration.

POLS 4020* Topics in Comparative Politics. 3 credits, max 6. Prerequisite(s): 2013 or 2113 or consent of instructor. In-depth examination of critical topics and issues in Comparative Politics. May be repeated with different topics.

POLS 4043 Politics of the Global Economy. Theory and practice of international political economics. The patterns of association between political and market-based processes among nation states. Emphasis on interactions among advanced industrial states, transnational phenomena, and opportunities and pitfalls in north-south relations. *No credit for credit in INTL 5043.*

POLS 4053 (I) War and World Politics. Foreign policies of major powers, areas of tension and sources of international conflict.

POLS 4100* Problems of Government, Politics and Public Policy. 1-6 credits, max 6. Prerequisite(s): 60 credit hours, or 45 hours with GPA of 3.25, including 1013. Special problem areas of government, politics and public policy concentrating on topics not covered in other departmental course offerings.

POLS 4113* International Institutions. The organization, procedures, functions and role of international institutions, with emphasis on the United Nations and related agencies.

POLS 4223 Comparative Political and Social Movements and the Politics of Protest. Prerequisite(s): 1113. The origins, activities and impact of political and social movements. Concepts and theoretical approaches related to political and social movements and these concepts and approaches to case studies of several contemporary movements in the United States, Latin America, and Europe.

POLS 4353* Administrative Law. Legal powers, limits, and procedures of administrative agencies with emphasis on federal and state administrative procedure acts.

POLS 4363* Environmental Law and Policy. Statutory law, case law, and administrative practices relating to regulation of the environment including environmental impact statements, pollution, public lands, and preservation law.

POLS 4403* Urban Politics and Management. Problems of governing and managing American metropolitan areas.

POLS 4413* Government Budgeting. The politics, planning and administration of government budgets. (Same course as 5320*)

POLS 4453* Public Personnel Administration. Problems, processes, and procedures of public personnel administration. (Same course as 5333*)

POLS 4553 American Political Thought. A survey of the major developments in American political thought from the Colonial period to the present, followed by a topical analysis of important recent theoretical developments in political science.

POLS 4573 Democratic Theory. Investigates the origins, development, and continuing challenges of theories of democratic government, with particular emphasis on the American political tradition. Topics include citizenship, accountability, voting and elections, federalism, and institutional design.

POLS 4593* Natural Resources and Environmental Policy. Current issues in the law, politics and administration of energy, land, water, mineral and other natural resources policy with particular emphasis on relations to environmental policies and law.

POLS 4623 (S) Oklahoma Politics. Prerequisite(s): 1113. Introduction to Oklahoma Politics. Topics include the evolution of Oklahoma political institutions; the struggle to shape the Oklahoma political culture with special attention to the role of race and woman suffrage; political issues; the structure of Oklahoma political institutions at the state and local levels; and elections.

POLS 4653 (H) Contemporary Political Thought. An analysis of 19th and 20th century political ideas, with emphasis on the rise and fall of ideologies along side controversies over relativism, positivism, pragmatism, and resurgent religious faiths.

POLS 4670* Topics in Political Theory. 3 credits, max 6. In-depth examination of critical topics and issues in classic, modern, or American political theory. May be repeated with different topics.

POLS 4693 Women in Politics. Changing role of women in government and politics. Voting behavior, public opinion, women in government, and the women's movement.

POLS 4963 U.S. Constitution: Civil Rights and Liberties. Prerequisite(s): 2023 or 3983 recommended. Development of principles of constitutional law by the Supreme Court concerning individual and group rights, with particular emphasis on equal protection of the laws concepts in matters of race, gender, wealth, citizenship, legislative reapportionment and voting rights, government employment and affirmative action programs. Legal research techniques.

POLS 4973* U.S. Constitution: Civil Liberties. Prerequisite(s): 2023 or 3983 recommended. Development of principles of constitutional law by the Supreme Court concerning freedom of speech expression, religious liberty, property rights, 5th and 14th amendments due process concepts and procedure requirements at national and state level.

POLS 4980* Topics in Public Law. 3 credits, max 6. Prerequisite(s): 2023 and 3983 or 3993 or consent of instructor. In-depth examination of critical topics and issues in Public Law. May be repeated with different topics.

POLS 4990* Independent Study. 1-3 credits, max 9. Application of major relevant theoretical perspectives to selected case studies of political problems and issue areas. Theories and attendant case studies selected by visiting faculty members.

POLS 4993 Political Science Honors Thesis. Prerequisite(s): Departmental invitation, senior standing, Honors Program participation. A guided reading and research program ending with an honors thesis under the direction of a faculty member, with second faculty reader and oral examination. Required for graduation with departmental honors in political science.

POLS 5000* Thesis. 1-6 credits, max 6.

POLS 5013* Quantitative Methods of Political Analysis. Required of all graduate students. Fundamental methodological issues in the scientific study of politics. Logic of science, principles of research design and computer data manipulation and analysis.

POLS 5020* Creative Component. 3 credits, max 6. Individually supervised research.

POLS 5023* Foundation of Political Science. Overview of the foundational works, theories and approaches that define the discipline of political science and serve as bridges across its subfields.

POLS 5030* Internship in Public Administration and Government. 1-6 credits, max 6. Individually supervised internships in administrative and governmental career areas. Paper required.

POLS 5040* Readings in Politics, Public Policy or Public Administration. 1-6 credits, max 6. Prerequisite(s): Consent of supervising professor. Readings in the student's major area of study.

POLS 5100* Directed Study. 3 credits, max 6. Directed study for master's level students.

POLS 5103* Research Design. Prerequisite(s): Graduate standing. Overview of research design, including conceptualization and operationalization, literature review, deductive and inductive theorizing, hypothesis testing, quantitative and qualitative data collection and analysis.

POLS 5113* Seminar in Public Program Evaluation. Methodology of evaluation research in public programs. Emphasis will be placed on designing and interpreting evaluative studies rather than the mastery of particular mathematical, statistical or computer skills.

POLS 5133* Politics and Political Economy in the European Union. The institutions and policy-making process of the European Union (EU) and the theoretical traditions in the study of European integration. The institutional form of the EU and the type of European policy that is emerging.

POLS 5143* Social and Political Perspectives in Europe. Examination of the current and historical social, cultural and political landscapes of European societies. Material related to identity politics, citizenship, democratization and collective memory feature regularly in the course.

POLS 5203* ProSeminar in International Relations. A general survey intended to introduce students to major theoretical paradigms, applications, and debates in the field of international relations.

POLS 5210* Topics Seminar in International Relations. 3 credits, max 6. In-depth examination of critical topics and issues in International Relations. May be repeated up to 6 hours with different topics.

POLS 5213* Seminar in the International Political Economy. Prerequisite(s): Graduate standing. Research on the mechanics and theories of interaction between economic and political phenomena. (Same course as INTL 5213*)

POLS 5300* Special Topics Seminar in Fire and Emergency Management. 1-3 credits, max 9. Specialized topics in fire and emergency management.

POLS 5303* Introduction to Fire and Emergency Management. Prerequisite(s): Graduate standing. Examines the content and historical evolution of fire and emergency management including terminology, concepts, theories, and methods employed.

POLS 5313* Public Management. Introduction to the general principles of management as they are applied in the public sector. Systems theory, organization design, and techniques of supervision.

POLS 5320* Seminar in Public Budgeting and Finance. 3 credits, max 6. Major processes and practices involved in governmental budgeting in the United States at national, state and local level. (Same course as 4413*)

POLS 5323* Urban Politics and Management. Introduction to the concepts, processes and techniques of managing urban political systems to include problems of leadership, decision-making, general management and group behavior.

POLS 5333* Seminar in Public Personnel Administration. Current practices, problems and issues in public sector personnel administration, including merit system, civil service reform collective bargaining, and equal opportunity and affirmative action.

POLS 5343* Seminar in Fire and Emergency Services Administration. Introduction to policies, procedures and administrative process required to deliver fire and emergency services; detailed examination of the social, political and economic issues that have an impact on service delivery and organizational approaches.

POLS 5353* Seminar in Design, Structure and Processes of Public Organizations. Administration in the public sector, stressing traditional and emerging organization structures. Awareness of administrative processes and environment that include program design, implementation, and administrative accountability.

POLS 5363* Public Sector Dispute Resolution. Prerequisite(s): Senior or graduate standing. Labor relations and employment issues in the public sector, and the various methods for resolving government personnel conflicts without resort to violence or litigation. Focus on labor law, employment law and Alternative Dispute Resolution as they apply to government employment.

POLS 5383* Disaster Recovery. Prerequisite(s): 5683. Processes, conditions and components of recovery in disaster contexts. Topics include environmental, economic, housing, infrastructure, and policy. Roles of voluntary organizations; securing and managing resources.

POLS 5393* Politics of Disaster. Prerequisite(s): Graduate standing and 5303 or consent of instructor. Situates disaster phases in the political context at the local, national, and international levels. Examines research on specific events and their interactive effects between the political system and various phases of disaster.

POLS 5403* ProSeminar in Comparative Politics. Designed as a graduate seminar to familiarize graduate students with the core research traditions and theoretical developments in the field of comparative politics.

POLS 5410* Topics Seminar in Comparative Politics. 3 credits, max 6. In-depth examination of critical topics and issues in Comparative Politics. May be repeated up to 6 hours with different topics.

POLS 5510* Seminar in Political Behavior. 1-3 credits, max 6. Examination of contemporary theories of political behavior with emphasis on empirical studies.

POLS 5513* Seminar in Political Psychology. Examination of psychological theories as they pertain to political behavior, including attitude change, political cognition, public opinion and decision-making.

POLS 5613* Public Policy Analysis. Analytical methods for evaluating public policies and examination of the public process including policy design, implementation and evaluation.

POLS 5620* Seminar in Natural Resource Policy, Law and Administration. 3 credits, max 9. Analysis of the legal and public policy aspects of environmental regulation, including special emphasis on one of three components: environmental law, administrative law, and national resource law and policy.

POLS 5633* Practical Environmental Compliance. Environmental decision-making, reading and understanding environmental statutes and regulations, and effectively dealing with the EPA. Environmental permitting and enforcement, policies and procedures. Review of hazardous waste regulations with emphasis

on ground water problems.

POLS 5643* Regulatory Risk Analysis. Risk-based decision making, government's risk analysis paradigm, risk analysis policy, and social aspects of risk assessment. Review of the RCRA corrective action, CERCLA (Superfund) remedial action, and NEPA environmental impact study programs.

POLS 5653* Risk Assessment in Emergency Management Planning. Risk assessment for the emergency manager and fire department manager. Concepts of risk assessment, its use in emergency management planning, and its limitations. Applications to emergency management. Specifically designed for FEMP students, but of interest to students in environmental management.

POLS 5663* Community Relations in Environmental and Emergency Management. Preparation for the environmental manager, emergency manager, and fire department manager to communicate and negotiate with the public and media concerning environmental threats to human health routine and non-routine releases of chemicals and radioactive materials. Strategies for community-based planning, emergency preparedness, environmental response, site damage, and conflict management.

POLS 5673* Understanding and Responding to Terrorism. Exploration of the experience of non-state terrorism in the U.S. and Western European democracies in the late 20th century. Understanding terrorism as a political, social, and historical phenomenon; the current and future threat of terrorism, both foreign and domestic; governmental choices in responding to terrorism in democratic societies and; U.S. anti-terrorism policies and considerations that emergency responders face in preparing for and responding to terrorist incidents.

POLS 5683* Emergency Management and Public Policy in the United States. Examination of natural and man-made disasters in the U.S. along with the policies and programs intended to prevent, respond to, mitigate, and recover from such events. The evolution of the U.S. Emergency Management System, the emergency management profession, and future directions in emergency policy.

POLS 5693* Emergency Management in the International Setting. Introduction to emergency management in the international setting. Provides background for students who may work with international assistance programs or who may become involved in the delivery of emergency management services abroad as part of an international assistance effect.

POLS 5703* ProSeminar in American Politics. Overview of a wide range of classic works in American institutions and Political Behavior. It examines not only the classic works in each area of these subfields, but a sampling of current work being done in the field.

POLS 5710* Topics Seminar in American Politics. 1-3 credits, max 6. In-depth examination of critical topics and issues in American Politics. May be repeated up to 6 hours with different topics.

POLS 5713* Seminar in Public Law. Literature of public law in the United States. Overview of the approaches that shape the theoretical and empirical contours of the public law field and contribute to multidisciplinary law and social science studies.

POLS 5720* Topics in Political Science. 3 credits, max 6. In-depth examination of critical topics and issues in Political Science. May be repeated up to 6 hours with different topics.

POLS 5743* Seminar in Political Communication. Examination of recent theories within politics and the media, including effects of media on opinion, role of media as a political institution and the role of media during elections.

POLS 5810* Seminar in Women and Politics. 3 credits, max 9. Prerequisite(s): Graduate standing. Research on a variety of topics concerning women and politics, including women's movements, women and elections, and public opinion.

POLS 5903* Practicum in Fire and Emergency Management Administration. Prerequisite(s): Consent of instructor. Supervised practicum in fire and emergency management administration.

POLS 5923* Preparedness and Planning. Prerequisite(s): Graduate standing and 5303 or consent of instructor. Planning and training for hazards and disaster management at the organizational level; review of public education and preparedness efforts at the household and community level, review of research on disaster planning.

POLS 5933* Disaster Response. Prerequisite(s): Graduate standing and 5303 or consent of instructor. Review of scientific literature on human and organizational behavior in response to disasters. Identification of actors involved in emergency response, their roles and responsibilities. Examination of human response in context of organizational structures and resources including emergency operating centers. Review of local and national government response policies.

POLS 6000* Doctoral Dissertation Research. 1-12 credits, max 60. Prerequisite(s): Consent of major professor. Research for PhD dissertation.

POLS 6003* Proseminar in Fire and Emergency Management. Prerequisite(s): Graduate standing. Examines scope of the fire and emergency management field as an area of academic inquiry.

POLS 6013* Qualitative Methods for Fire and Emergency Managers. Prerequisite(s): Graduate standing. Qualitative methods for collecting and analyzing data from fire and emergency management field.

POLS 6040* Directed Readings in Fire and Emergency Management. Prerequisite(s): Graduate standing or consent of instructor. Directed readings for doctoral students in specialized areas of fire and emergency management.

POLS 6123* Quantitative Methods for Fire and Emergency Managers. Prerequisite(s): Graduate standing and 5013 or consent of instructor. Descriptive, inferential, and non-parametric statistics with collection and analysis of data from fire and emergency management field.

POLS 6133* Seminar in Fire and Emergency Management Research Survey. Prerequisite(s): Graduate standing and 5103, 6013, and 6123. Survey of the academic literature in the fields of fire and emergency management. Development of a research article for submission to a professional journal or conference.

POLS 6143* Methods for Disaster Research. Prerequisite(s): Graduate standing and 5303; 5013 or 5103. History and scope of methods for disaster research.

POLS 6153* Pedagogical Methods for Fire and Emergency Management Instruction. Prerequisite(s): Graduate standing. History of FEMA education, review of instructional methods, and research on educational methods in field.

POLS 6203* Comparative and International Dimensions of Fire and Emergency Management. Prerequisite(s): Graduate standing and 6003 or consent of instructor. Comparative analysis of the organization, management, and policies of fire and emergency response services in other countries.

POLS 6213* Political Context of Fire and Emergency Management. Prerequisite(s): Graduate standing and 5343 or consent of instructor. Analysis of political environment impacting fire service including federalism and intergovernmental relations, interest groups, other public agencies, and private sector organizations.

POLS 6300* Advanced Special Topics Seminar in Fire and Emergency Management. Prerequisite(s): Graduate standing or consent of instructor. Specialized topics in fire and emergency management for doctoral students.

POLS 6303* Populations at Risk. Prerequisite(s): Graduate standing or consent of instructor. Describes populations at risk for increased injury, death and property loss. Identifies policies, programs and resources for risk reduction. Applies research for purposes of planning and capacity building.

POLS 6313* Mitigation. Prerequisite(s): Graduate standing and recommended 5303, 6143 and 6153. Structural and non-structural mitigation approaches to hazard reduction; description of policies, programs, and planning methods relevant to all governmental levels; and review of research and case studies of mitigation efforts.

POLS 6343* Organizational Behavior in Disaster. Prerequisite(s): Graduate standing and 5303 or consent of instructor. Theoretical overview of organizational behavior in a disaster context. How organizations respond, adapt, fail and succeed when disrupted by disaster. Role of formal and informal organizational structures in confronting disasters.

Psychology (PSYC)

PSYC 1113 (S) Introductory Psychology. Principles, theories, vocabulary and applications of the science of psychology.

PSYC 2313 Psychology and Human Problems. Prerequisite(s): 1113. Personality dynamics and their application to personal, cultural and vocational experience.

PSYC 2443 Clinical Child Psychology. Prerequisite(s): Psych 1113 with grade of "C" or better. This course will present information from empirical research, key theories, and concepts that shape the current understanding of developmental psychopathology, and clinical child and adolescent psychology.

PSYC 2583 (S) Developmental Psychology. Prerequisite(s): 1113. The nature of pertinent studies, causes, and theories of human developmental phenomena across the life span.

PSYC 2593 Psychology of Human Sexuality. Prerequisite(s): 1113. Survey of behavioral, personality and psychophysiological components of human sexuality, with special emphasis on the delineation of facts from sexual myths.

PSYC 2743 (S) Social Psychology. Theories and applications of social cognition, the self, pro-social and aggressive behavior, groups, attitudes and the environment.

PSYC 3013 Psychology of Motivation. Prerequisite(s): 1113. Examines the initiation, persistence and achievement of goal-directed behavior. Theory, research and applications of these concepts are emphasized.

PSYC 3033 Psychology of Humor. Prerequisite(s): PSYC 1113. The course will examine theoretical perspective on the topic of humor, including cross-cultural and individual a well as the development of humor.

PSYC 3073 (N) Neurobiological Psychology. Prerequisite(s): 1113. Neural bases of human experience and behavior. Topics include sensation and perception, motivation and emotion, learning and thinking.

PSYC 3113 (N) Comparative Psychology. Prerequisite(s): 1113. Comparative study of behavior characteristics of selected samples of the animal kingdom from protozoa to humans.

PSYC 3120 Special Topics in Psychology. 1-6 credits, max 6. Prerequisite(s):

1113. Special topics in psychology to be determined by faculty.

PSYC 3173 (N) Introduction to Cognitive Science. Introduction to the study of human and artificial intelligence. The course will survey contributions to the understanding of intelligence from psychology, neuroscience, computer science, philosophy, and linguistics.

PSYC 3214 Quantitative Methods in Psychology. Lab 2. Prerequisite(s): 1113, MATH 1513 or consent of instructor. Design and evaluation of research in psychology including scales of measurement, basic research designs, and quantitative procedures for data analysis, with emphasis on problems encountered in psychological research.

PSYC 3413 Psychology of Social Behaviors. Prerequisite(s): 1113, 3214. Contemporary theoretical and methodological issues in social psychology with special emphasis on the social psychology of the experiment and experimentation with the social aspects of human behavior.

PSYC 3443 (S) Abnormal Psychology. Prerequisite(s): 1113, and 60 credit hours or 45 hours with GPA of 3.25. Review of major approaches to conceptualizing abnormal behavior including dynamic, social and learning-based theories. Discussion and illustration of the major forms of mental illness such as neuroses, psychoses and character disorders.

PSYC 3513 Psychology of Learning. Prerequisite(s): 1113, 3413. Behavior change as a function of experience from relatively simple learning processes such as classical and instrumental conditioning to relatively complex processes such as verbal learning and concept identification.

PSYC 3713 Psychology of Memory. Prerequisite(s): 1113 and three additional hours of psychology. Body of contemporary research on human memory and the process of knowledge acquisition with a focus on processes and strategies inside the human mind.

PSYC 3823 Cognitive Psychology. Prerequisite(s): 1113, 3214 or equivalent. Cognitive processes. Thinking, problem solving, visual imagery, attention, and memory search. Both theory and application emphasized.

PSYC 3914 Experimental Psychology: Introduction to Research Methods in Psychology. Lab 2. Prerequisite(s): 1113 and 3214 with a grade of "C" or better. Examination of fundamentals of the scientific method as applied to research in psychology. Research design, sampling, measurement, analytical, evaluative, and interpretive skills needed to understand the professional research literature. Includes a laboratory component in which students conduct research, use SPSS for data analysis, and write APA style papers.

PSYC 3990 Teaching Practicum. 1-6 credits, max 6. Prerequisite(s): Consent of instructor. For outstanding students. Students will work with a faculty instructor and assist in many aspects of teaching including guest lecturing, offering study sessions, office hours, among other duties as determined by instructor. May involve meetings and written paper(s).

PSYC 4023 (N) Evolutionary Psychology. Prerequisite(s): Introductory Psychology. Evolutionary psychology is the scientific study of human nature that focuses on understanding the psychological adaptations that evolved to solve ancestral survival and reproductive problems. The course begins with a brief historical review of key themes in psychology and evolutionary biology. The adaptive problems of survival, long-term mating, sexuality, parenting, kinship, cooperation, aggression and warfare, conflict between the sexes, status, prestige, and social dominance are covered in this course.

PSYC 4123 (D,S) Psychology of Women. Prerequisite(s): 1113. Sex differences and the development of sex role behavior. Encompasses the psychological dynamics of developmental and social issues for women.

PSYC 4133 (D,S) Multicultural Psychology. Prerequisite(s): 1113. Psychological theories and research pertinent to multicultural psychology.

PSYC 4143 Psychology and Law. Lab 1. The new psycho-legal literature reviewed with emphasis on the psychological basis of voir dire, eyewitness behavior, courtroom persuasion, jury deliberation and mental health issues.

PSYC 4153 Psychology and Mass Media. Prerequisite(s): 1113. Examination of the role of mass media in shaping public perceptions of mental illness and mental health treatment with a focus on the role of popular films. Students will learn to critically evaluate the veracity of film portrayals as well as common themes involving mental health. Also, aspects of social and cognitive psychology in film.

PSYC 4163 (D) Psychology of Prejudice and Discrimination. Prerequisite(s): PSYC 1113. Explores the nature and causes of stereotyping, discrimination and minority experience, mainly from a psychological perspective. Examines how these issues impact social group members, especially members of low status or minority groups.

PSYC 4183* Current Issues in Clinical Psychology. Prerequisite(s): 1113, 3443 and three additional credit hours in psychology. Problems of the individual in contemporary society and various clinical approaches that have been proposed as possible solutions to these problems.

PSYC 4213 (S) Conflict Resolution. Prerequisite(s): 1113. Interpersonal conflict studied from psychological perspectives. Types and uses of conflict, and conditions for constructive dispute settlement.

PSYC 4223* Decision Making and Problem Solving. Prerequisite(s): 1113 or consent of instructor. An examination of the research literature on individual decision-making and problem solving with dual emphases on theory and application. A thorough prior understanding of the human cognitive system is desirable, but not required.

PSYC 4233 The Nature of Leadership. Prerequisite(s): 1113 or consent of instructor. The study of current psychological approaches to leadership, including trait, behavioral, and psychodynamic approaches. Psychological approaches to research and applied aspects of leadership.

PSYC 4243* Psychology of Aging. Prerequisite(s): 1113 and 2583. This course aims to increase your understanding of the human aging process through traditional classroom experiences focusing on knowledge of the physical, cognitive, and social changes that are part of late adulthood. Additionally, students will learn more actively by working with older adults who are living in our community. Our overall goal is to enhance our understanding of the psychology of aging by integrating our classroom-acquired knowledge with our community service experiences.

PSYC 4333* Personality. Prerequisite(s): 1113 or consent of instructor. Basic assumptions, research, and clinical issues relating to the major personality theories.

PSYC 4343 (S) Language Development. Prerequisite(s): 1113 or consent of instructor. Current theory and research on the development of language throughout the lifespan. The nature of language, first language acquisition, second and third language acquisition, brain and language, language processing, social aspects of language, gender differences in language use and language processing, language use by older adults, language use directed at older adults, language disorders, and language use in special populations.

PSYC 4483 (S) Psychology of Parent Behavior. Prerequisite(s): 1113. Historical and contemporary conceptions of parent-child relationship and approaches to communication and discipline; special problems in parenting.

PSYC 4493* History of Psychology. Prerequisite(s): 1113. History of psychology as an aspect of European intellectual history. Psychological thought from early philosophical roots to modern conceptions of psychology as a science.

PSYC 4770 Undergraduate Senior Thesis. 1-6 credits, max 6. Prerequisite(s): 1113, 3214, 3914, junior or senior standing and consent of instructor. Supervised independent research for the bachelor's degree.

PSYC 4813* Psychological Testing. Prerequisite(s): 1113 and 3214. Quantitative aspects of measurement and testing, with emphasis on scaling, standardization, reliability and validity. Basic principles of construction and the ethics of use.

PSYC 4880 Senior Honors Thesis. 1-6 credits, max 6. Prerequisite(s): 3214, departmental invitation, senior standing, Honors College participation. A guided reading and research program ending with an honors thesis under the direction of a senior faculty member. Required for graduation with departmental honors in psychology.

PSYC 4883 Current Issues in Psychology. Prerequisite(s): 3214, 3914. A capstone course examining current issues in psychology, their relationship to current issues in other academic disciplines, and their relevance in an educated society.

PSYC 4990* Special Problems. 1-6 credits, max 6. Prerequisite(s): 1113, 3214 and consent of instructor. Supervised research experiences in psychology with a faculty member. May involve meetings and written paper(s).

PSYC 5000* Thesis. 1-6 credits, max 6. Required of all graduate students majoring in psychology and writing a thesis.

PSYC 5113* Psychopathology. Prerequisite(s): Graduate standing in psychology or consent of instructor. Principles of diagnosis and treatment of major disorders.

PSYC 5120* Psychology Workshop. 2-6 credits, max 6. Provides an opportunity to study specific psychological problems, both applied and theoretical.

PSYC 5153* Cognitive Assessment. Lab 1. Prerequisite(s): 3443, 4813; graduate standing in the clinical program of the Department of Psychology or consent of instructor. Issues of psychological testing and assessment, psychometric theory, and ethics of testing as well as fundamental skills of and cognitive and intellectual assessment, including administration, scoring, and interpretation of cognitive tests and report writing. Application of cognitive tests to specific clinical problems.

PSYC 5193* Ethics and Professional Development in Psychology. Prerequisite(s): Graduate standing in the Department of Psychology. Principles of ethics with a focus on the guidelines and standards for psychology. Legal and ethical issues for the practice of clinical psychology.

PSYC 5233* Introduction to Clinical Methods. Prerequisite(s): Consent of instructor. Introduction to a variety of topics relevant to clinical psychology training and professional development. Course will provide a foundation for subsequent training experiences. A special emphasis is placed upon developing the common therapy skills that will form a foundation for future clinical training experiences.

PSYC 5304* Quantitative Methods in Psychology I. Lab 2. Prerequisite(s): 3214 or equivalent. Hypothesis testing, chi-square, student's t, bivariate correlation and linear regression in psychology. Critical thinking regarding the

application of statistical methods is stressed. The use of contemporary statistical software for analyses is covered.

PSYC 5314* Quantitative Methods in Psychology II. Prerequisite(s): 5304. Higher-order analysis of variance designs, correlation and regression techniques, and analysis of covariance, with emphasis on applications to psychological experimentation. Computer applications of all procedures using SPSS and/or SAS during the lab.

PSYC 5333* Systems of Psychotherapy. Prerequisite(s): 5113; graduate standing in the clinical program of the Department of Psychology or consent of instructor. The major approaches to psychotherapy. Methods for creating multiple impact for behavioral change, including interpersonal, social, community and preventative interventions.

PSYC 5380* Research. 1-12 credits, max 24. Prerequisite(s): Consent of instructor. Research project on some psychological problem.

PSYC 5620* Seminar in Psychology. 1-12 credits, max 12. Prerequisite(s): Consent of instructor. Consideration of special topics that are particularly timely or technical in nature.

PSYC 5660* Teaching Practicum. 1-2 credits, max 2. Prerequisite(s): Consent of instructor. Primarily for graduate students with well-defined new teaching responsibilities.

PSYC 5813* Lifespan Cognitive Developmental Psychology. Prerequisite(s): Consent of instructor. Examines theory and basic research related to the age-related changes in human cognition that occur for a typically developing individual during infancy, childhood, early adulthood, middle age and late adulthood.

PSYC 5823* Cognitive Processes. Theory and experimental research findings dealing with human thought processes from a developmental and functional standpoint.

PSYC 5913* Lifespan Social Developmental Psychology. Prerequisite(s): Consent of instructor. Examines theory and basic research in social, emotional, and personality development in infancy, childhood, adolescence, and adulthood.

PSYC 6000* Dissertation. 1-16 credits, max 60. Research and report thereon by graduate students in partial fulfillment of requirements for the Doctor of Philosophy degree.

PSYC 6083* Principles of Behavior Therapy. Prerequisite(s): Graduate standing in the clinical program of the Department of Psychology or consent of instructor. Principles and procedures of behavior therapy and modification.

PSYC 6133* Ethnic and Cultural Diversity in Psychotherapy. Prerequisite(s): Six credit hours of psychology and consent of instructor. Increasing understanding and appreciation of ethnic and cultural diversity in the psychotherapy context. Critical examination of theory and research related to psychotherapy with multicultural populations.

PSYC 6143* The Psychology of Substance Abuse. Prerequisite(s): Consent of instructor. Introduction to psychological classification of psychoactive substance (alcohol and drug) use disorders. Theory and research on psychological, biological, and environmental factors that are concomitants of substance abuse. Overview of major research techniques and treatment modalities in this area.

PSYC 6173* Child Psychopathology and Treatment. Prerequisite(s): 2583, 3443 or equivalent; graduate standing in the clinical program of the Department of Psychology, the doctorate school psychology program or the psychometry program, or consent of instructor. Theoretical positions and issues in child psychopathology. Procedures used in the treatment of psychological disorders of children.

PSYC 6223* Research Design. Prerequisite(s): 3914 and doctoral level standing. Experimental techniques in psychophysics, sensory processes, attention and perception, motivation and emotion, and learning and memory.

PSYC 6233* Clinical Research Design. Prerequisite(s): 5304 and 5314 or consent of instructor. Methodology and research practices in clinical psychology, including experimental design, research practice, data analysis and interpretation, ethics, and dissemination of research findings.

PSYC 6253* Seminar in Human Development. Prerequisite(s): Consent of instructor. Behavioral aspects of development from the prenatal period to senescence. Normal development contrasted to exceptional development.

PSYC 6353* Psychology of Motivation. Prerequisite(s): 3914. Outline of theory and research in human and animal motivation.

PSYC 6393* Language Development. Review of data and theories of language development. Laboratory techniques and experimental designs will also be reviewed to emphasize understanding of past and contemporary research in language development.

PSYC 6443* Behavioral Medicine. Prerequisite(s): Graduate standing in the clinical program of the Department of Psychology; consent of instructor. An advanced graduate course for students in training for a PhD in clinical psychology. General considerations for psychophysiological disorders, general intervention strategies in behavioral medicine, including biofeedback and specific consideration and intervention strategies for specific disorders.

PSYC 6453* Pediatric Psychology. Prerequisite(s): Graduate standing in the Department of Psychology; consent of instructor. Overview of the field of pediatric psychology, including historical perspectives, theoretical underpinnings, and application to a variety of child health problems. Childhood chronic illness, injury prevention, pain management, and consultation and intervention in medical contexts.

PSYC 6483* Neurobiological Psychology. Prerequisite(s): 3073 and 3914 or consent of instructor. Physiological, neuroanatomical, and neurochemical underpinnings of human behavior. Emphasis on effects of central nervous system dysfunctions on behavioral processes ranging from sensation to concept formation.

PSYC 6523* Family Treatment Methods. Prerequisite(s): Graduate standing in the clinical program of the Department of Psychology or the doctorate counseling psychology program. Introduction to techniques and philosophies of family treatment. Includes marital counseling and emphasis on family dynamics.

PSYC 6563* Advanced Social Psychology. Prerequisite(s): 2743. History, theory and experimentation of dynamic interaction of group membership and individual behavior.

PSYC 6583* Developmental Psychobiology. Prerequisite(s): 3073 or equivalent; consent of instructor. An exploration of the biological aspects of human development with particular emphasis on the physiological, ethological, and genetic perspectives.

PSYC 6613* Experimental Learning Theories. Prerequisite(s): Nine credit hours of psychology. Basic concepts and empirical findings in animal and human learning.

PSYC 6640* Clinical Practicum. 1-12 credits, max 17. Prerequisite(s): Graduate standing in the clinical program of the Department of Psychology. Practicum experience for graduate students in the clinical psychology program.

PSYC 6650* Practicum. 1-16 credits, max 16. Prerequisite(s): Graduate standing in the clinical program of the Department of Psychology. For the marriage and family practicum only, doctoral level counseling psychology students may also enroll. Practicum experience for graduate students in the clinical program of the Department of Psychology who are doing supervised practicum in specific clinical areas of specialization.

PSYC 6723* Child Diagnostic Methods. Prerequisite(s): 5153, graduate standing in the clinical program in psychology or the doctoral school psychology program or consent of instructor. Administration and interpretation of diagnostic instruments used specifically with children.

PSYC 6753* Assessment of Personality. Prerequisite(s): Graduate standing in the clinical program or consent of instructor. Personality assessment and training in the practice of clinical assessment. Trait theory and assessment, techniques of test construction, contemporary assessment techniques including the MMPI-2, test result interpretation and communication, and behavioral methods of assessment.

PSYC 6813* Multivariate Statistics for Psychology. Prerequisite(s): 5304 and 5314 or permission of instructor. A variety of multivariate statistical methods are covered with emphasis on their application to psychological research. Factor analysis, MANOVA, CANONA, Generalized Procrustes Analysis, as well as other topics are covered. Matrix algebra is also reviewed, and the geometric approach to multivariate statistics is introduced.

PSYC 6913* Multilevel Modeling in Psychology. Prerequisite(s): 5304 and 5314; or permission of instructor. Trains students in the theory and application of multilevel models for nested and repeated measures data in psychology.

PSYC 6990* Advanced Internship in Clinical Psychology. Prerequisite(s): Graduate standing in the clinical psychology program or consent of instructor. Designed to provide advanced clinical training in preparation for receipt of the Ph.D.

Recreation Management and Therapeutic Recreation (RMTR)

RMTR 2403 Leisure and Society. The leisure phenomenon, the leisure services industry, and societal views of leisure in the United States. Exploration of personal and social views of leisure and how those views impact individuals, families and social groups.

RMTR 2413 Introduction to Leisure Services. The nature, scope and significance of leisure and recreation. Delivery systems for leisure services, major program areas and the interrelationship of special agencies and institutions serving the recreation needs of society.

RMTR 2433 Introduction to Therapeutic Recreation. Theory and application of therapeutic recreation with emphasis on types of illnesses and disabilities, delivery systems, programming and services.

RMTR 2443 (D,S) Contemporary Issues in Diversity. Exploration of the primary and secondary dimensions of diversity and their impact on society. Individual and institutional responses to cultural diversity.

RMTR 2463 Laboratory in Leisure Services. Lecture, discussion and experiential learning of recreation and leisure activities. Adapted activities, small and large group games, sports, arts and crafts, music, drama and cultural

events. Utilization of areas and facilities for leisure activities and development of activities across the lifespan. Fee required.

RMTR 2473 Foundation of Leisure Service Leadership. Introduction to the principles and practical applications of group leadership techniques, problem solving, supervision and evaluation of personnel.

RMTR 3010 Leisure Services Workshop. 1-3 credits, max 6. Intensive training program on a specialized topic in leisure services.

RMTR 3212 Lifeguard Training. Theory and practice of water safety and rescue skills essential for lifeguards. May obtain American Red Cross Lifeguard Training Certification.

RMTR 3313 Camp Operations and Programs. Operations and programming for day and resident camps. Includes all camp settings and camper populations.

RMTR 3413 Therapeutic Recreation and Mental Illness/Developmental Disabilities. Prerequisite(s): 2433. The role of Therapeutic Recreation (TR) specialists in working with individuals diagnosed with mental illness and/or developmental disabilities. Topics include terminology, etiology, prognosis, assessment, and program development in TR.

RMTR 3423 Therapeutic Recreation in Geriatric Practices. Prerequisite(s): 2433. The role of Therapeutic Recreation (TR) specialists working with the geriatric population. Topics include terminology, etiology, prognosis, assessment, and program development in TR.

RMTR 3431 Leisure Services Practicum I. Prerequisite(s): 2413. Supervised practical experience with leadership responsibilities for planning, conducting and evaluating activities and programs. *Graded on a pass-fail basis.*

RMTR 3432 Leisure Services Practicum II. Supervised practical experience with leadership responsibilities for planning, conducting and evaluating activities and programs. *Graded on a pass-fail basis.*

RMTR 3433 Therapeutic Recreation and Physical Disabilities. Prerequisite(s): 2433. The role of Therapeutic Recreation (TR) specialists in the rehabilitation of individuals with physical disabilities. Topics include terminology, etiology, prognosis of specific problems, assessment, and program development in TR.

RMTR 3441 Warm Water Therapy Lab. This aquatic lab course is designed to give students valuable hands-on experience with participants with disorders ranging from pre-school through senior citizen population.

RMTR 3463 Program Design in Leisure Services. Prerequisite(s): MATH 1513, MATH 1483 or equivalent. Emphasis on organization, supervision, promotion and evaluation of programs.

RMTR 3473 Medical Procedures for Recreational Therapy. The course covers the basic knowledge documentation including vocabulary, abbreviations, symbols, prefixes, and suffixes typically used in clinical settings in which Recreational Therapists practice. Taken concurrently with Junior Internship Courses.

RMTR 3480 Junior Internship. 3-6 credits, max 6. Prerequisite(s): 2413, 2473, 3431, and one course in emphasis area of study (Therapeutic Recreation or Leisure Service Management). Supervised practical experience (minimum 200 to 400 contact hours based upon credit hours enrolled) with leadership responsibilities for planning, conducting and evaluating activities and programs. *Graded on a pass-fail basis.*

RMTR 3491 Pre-Internship in Leisure Services. Preparation for internship in therapeutic recreation and leisure services management.

RMTR 4010 Directed Studies in Leisure. 1-3 credits, max 6. Prerequisite(s): Consent of instructor and program head. Supervised readings, research or study of trends and issues related to leisure studies.

RMTR 4213 Water Safety Instructorship. Methods of teaching swimming and aquatic safety with practical application of knowledge, principles and analysis of skills. May obtain American Red Cross Water Safety Instructor's Certification (WSI).

RMTR 4433 Evaluation of Leisure Services. Prerequisite(s): STAT 2013. Methods, techniques and application of the evaluation process related to a wide variety of leisure service functions: clientele, programs, personnel, facilities and organization.

RMTR 4453* Outdoor Education. Development of a holistic approach to teaching and learning in the outdoors. Learning in, about, and for, the out-of-doors as a process for acquiring skills with which to enjoy outdoor pursuits.

RMTR 4463* Areas and Facilities in Leisure Services. Prerequisite(s): 3463 or consent of instructor. Planning, design and development of areas and facilities in leisure service delivery systems.

RMTR 4473* Recreation in the Natural Environment. Theory and practical application of outdoor recreation concepts with emphasis on philosophies, principles, policies, economics, trends and problems.

RMTR 4480 Internship in Therapeutic Recreation. 1-9 credits, max 9. Prerequisite(s): Last semester senior year with cumulative GPA of 2.5 and completion of 3480, 4481 and co-requisite of 4483. Supervised fieldwork experience in therapeutic recreation. *Graded on a pass-fail basis. Must be taken concurrently with 4483.*

RMTR 4481 Senior Seminar in Leisure Services. Prerequisite(s): Leisure major; completion of a minimum of 15 hours of Leisure Studies core courses. Culmination of course work in leisure studies. Examination of current issues, professional practices and personal philosophy of leisure.

RMTR 4483 Administrative Documentation in Internship for Therapeutic Recreation. Prerequisite(s): Last semester senior year with cumulative GPA of 2.5 and 3480, 4481 and co-requisite of 4480. Assignment based course that complements 4480 Internship in Therapeutic Recreation. *Must be taken concurrently with 4480.*

RMTR 4493 Administration of Leisure Services. Decision-making, problem solving, personnel policies, legal issues, fiscal policies and budget procedures related to the delivery of leisure services.

RMTR 4513* Leisure Education. Prerequisite(s): 3463. Models of leisure education discussed and practiced in conjunction with enhancing student's ability with basic skills of leisure counseling to facilitate optimal leisure pursuits.

RMTR 4553* Tourism in Recreation Settings. Theory and foundations of the philosophy, principles and practices that associate tourism with recreation agencies and settings.

RMTR 4563* Entrepreneurial Leisure Services. Prerequisite(s): 3463 or consent of instructor. Introduction to the scope, characteristics and management aspects of the commercial recreation industry from an entrepreneurial perspective.

RMTR 4680 Internship in Leisure Services Management. 1-9 credits, max 9. Prerequisite(s): Last semester senior year with cumulative GPA of 2.5 and 500 verified experience hours. 4481 and co-requisite of 4683. Supervised fieldwork experience in Leisure Services Management. *Graded on a pass-fail basis.* Must be taken concurrently with 4683.

RMTR 4683* Administrative Documentation in Internship for LSM. Prerequisite(s): Last semester senior year with cumulative GPA of 2.5 and 500 verified experience hours. 4481 and co-requisite of 4680. Assignment based course that complements 4680 Internship in Leisure Services Management. Must be taken concurrently with 4680.

RMTR 4933* Advanced Methods in Therapeutic Recreation. Prerequisite(s): 3483 and consent of instructor. Theoretical and practical examination of contemporary implementation procedures used in therapeutic recreation practice.

RMTR 4943* Grant Writing and Nonprofit Management. Methods and techniques used in grant writing as well as the establishment of a nonprofit agency.

Religious Studies (REL)

REL 1103 (H,I) Introduction to World Religions. Major world religions such as Hinduism, Buddhism, Judaism, Christianity and Islam with a view to understanding the general nature of religion and its various dimensions.

REL 2013 (H) Hebrew Scriptures. A study of the Hebrew Scriptures with emphasis upon content, historical background, the history of its study and the critical analysis and theological interpretation of selected passages.

REL 2023 (H) The New Testament and Its Study. A study of the writings of the New Testament in their historical contexts and the methods used in their study. Emphasis interpreting selected New Testament passages.

REL 3223 (H) The Teachings of Jesus in Historical Context. Prerequisite(s): 2023. The teachings of Jesus in light of modern historical research. Emphasis on interpreting selected passages from the Gospels.

REL 3243 (H) Paul and the Early Church. Prerequisite(s): 2023. The letters of Paul in their historical context with special emphasis on his theology and ethics.

REL 3573 (D,H) The Religions of Native Americans. Prerequisite(s): 1103. Selected tribal worldviews, belief systems and religious ceremonies as depicted in oral traditions, songs, and literature. Emphasis on Northern and Southern Plains Indians.

REL 3713 Religion, Culture and Society. Prerequisite(s): 1103, ANTH 2353, SOC 1113. An introduction to the scientific study of religion. Religious activity in both tribal and technological societies studied in the light of contemporary interpretations of culture and of social behavior. (Same course as SOC 3713)

REL 4033 (H) American Christianity through the Colonial Period. A study of the planting, development and spread of Christianity in America, beginning with the European roots and continuing through the colonial period up to c.1800.

REL 4050 Studies in Religion. 1-6 credits, max 9. Independent studies, seminars and courses on selected topics in religion.

REL 4113 (H,I) The World of Islam: Cultural Perspectives. The cultural heritage of the world of Islam explored through its expression in the art, architecture, and literature of the Muslim peoples.

REL 4213 (H,I) Understanding Global Islam. A study of the history of Islam starting from Prophet Muhammad to the spread of the Islamic Empire. How Islam moved from Arabia to the world. Introduction to the Islamic divisions, where they are now, why they are similar and different in terms of laws, schools, countries, literature, sciences, Arabic script, the Shia, the Sunna, and different Islamic countries' practices. Also, debatable issues on Muslim women in American and other countries and why those are different from others.

REL 4223 (H,I) Religions and Sects in the Middle East. A study of the religions of the Middle East and their diverse sects, focusing on how culture and religion shape the Middle East.

REL 4330 Seminar in Biblical Studies. 3 credits, max 9. Prerequisite(s): Two courses in Biblical studies. Selected topics in the academic study of the Bible.

REL 4413 Classic Christian Writings. A study of the primary source material from representative Christian authors scattered throughout two thousand years of church history, focusing on understanding the backgrounds from which the writings emerged, and grasping the writers' key ideas.

Research (RES)

RES 5013* Principles of Writing and Evaluating Scientific Research. Fundamentals of effective scientific writing. Instruction focuses on the process of writing and publishing scientific manuscripts as well as reviewing scientific research.

RES 5023* Introduction to Clinical Epidemiology. Introduction to the principles of epidemiology. This course covers causation, epidemiological research designs, measures of disease frequency and association, detection of confounders and interaction, ethics and issues pertaining to the validity and applicability of research in medicine.

RES 5033* Clinical Trials. Fundamentals of clinical trials, including design, conduct, analysis and interpretation of trial results. Topics will include commonly used designs, methods for randomization, blinding and sample size determination, choice of controls, collaborative/multicenter trial requirements and operational issues.

RES 5043* Introduction to Clinical Research. Intro to clinical research process and its history and development. Clinical trial development phases, overview of the development of regulatory protections for human subjects, roles and responsibilities of the clinical research team and research organization. Overview of Good Clinical Practice and Institutional Review Board.

RES 5052* Grant Writing. Expertise to prepare, write and submit a research grant proposal. This course will assist in identifying relevant resources in order to find funding sources.

RES 5063* Meta-Analysis and Systematic Reviews. Study selection and quality assessment, effect size estimates and conversions, handling publication bias, fixed and random effects models, heterogeneity of effects, analysis of meta-analytic data, data presentation, and use of meta-analysis software.

RES 5073* Research Compliance. Fundamentals of all areas of clinical research and research compliance including clinical trials, human subject research, environmental health and safety, and other areas of research compliance administration.

Research, Evaluation, Measurement and Statistics (REMS)

REMS 5000* Master's Thesis. 1-6 credits, max 6. Prerequisite(s): Consent of instructor.

REMS 5013* Research Design and Methodology. An introduction to the concepts of research design, methodology, sampling techniques, and internal/external validity and the scientific method in educational problem solving. Critical analysis of educational research studies and the writing of proposals.

REMS 5320* Seminar in Research, Evaluation, Measurement and Statistics. 3-6 credits, max 6. Prerequisite(s): Consent of instructor. In-depth exploration of contemporary problems of research, evaluation, measurement, and statistics.

REMS 5373* Educational Measurements. Appropriate applications of tests in the schools. Development of teacher-made tests, selection of standardized tests, interpretation of test results, understanding of the statistics reported in testing literature, uses of test results, and recent developments in educational measurement.

REMS 5953* Statistical Methods in Education. Statistical methods needed by conductors and consumers of research in education and the behavioral sciences. Introduction to interpretation and application of descriptive and inferential statistics.

REMS 5963* Computer Applications in Nonparametric Data Analyses. Presents popular nonparametric statistical methods as applied to educational and behavioral research. Emphasis on conceptual, rather than mathematical development, application, use of computer for data analysis, and substantive interpretation.

REMS 6000* Doctoral Dissertation. 1-25 credits, max 25. Prerequisite(s): Consent of instructor. Required of all candidates for doctorate in applied behavioral studies. Credit given upon completion and acceptance of dissertation.

REMS 6003* Analyses of Variance. Prerequisite(s): 5013 and 5953 and admission to a doctoral level program or consent of instructor. A thorough examination of analysis of variance procedures as they relate to principles of experimental design in education and behavioral sciences.

REMS 6013* Multiple Regression Analysis in Behavioral Studies. Prerequisite(s): 6003 or consent of instructor. Applications of multiple regression as a general data analysis strategy for experimental and non-experimental research in behavioral sciences.

REMS 6023* Psychometric Theory. Prerequisite(s): 6013 or consent of instructor. Theoretical basis for applying psychometric concepts to educational and psychological measurement. The Classical True Score model and applications to instrument development and design of studies for evaluating instrument quality.

REMS 6033* Factor Analysis in Behavioral Research. Prerequisite(s): 6013 or equivalent. In-depth analysis of principal components and factor analysis methods, including maximum likelihood methods. Confirmatory factor analysis methods are also introduced.

REMS 6320* Doctoral Seminar in REMS. 1-3 credits, max 9. Prerequisite(s): Permission of instructor. Theory and applications of selected advanced research and evaluation methods.

REMS 6373* Program Evaluation. Prerequisite(s): 5013 and admission to a doctoral level program or consent of instructor. Contexts, purposes and techniques of evaluating educational programs. Evaluation design, information collection, analysis, reporting and uses of results for programs ranging from individual lessons to nationwide multi-year projects. Special emphasis on evaluation requirements of federally funded programs.

REMS 6383* Program Evaluation II. Prerequisite(s): 6373. Practical application of principles and standards by conducting a program evaluation.

REMS 6663* Applied Multivariate Research in Behavioral Studies. Prerequisite(s): 6013 or consent of instructor. An overview and analysis of multivariate procedures commonly applied to educational and behavioral research. Emphasis on conceptual design and application of these procedures.

REMS 6850* Directed Reading. 1-6 credits, max 6. Prerequisite(s): Consent of instructor. Directed reading for students with advanced graduate standing.

Russian (RUSS)

RUSS 1115 Elementary Russian I. Lab 1.5. Understanding, speaking, reading, and writing. Method of instruction is audio-lingual. *Not for native speakers per University Academic Regulation 4.9.*

RUSS 1225 Elementary Russian II. Lab 1.5. Prerequisite(s): 1115 or equivalent. Continuation of 1115. *Not for native speakers per University Academic Regulation 4.9.*

RUSS 2115 Intermediate Russian I. Prerequisite(s): 1225 or equivalent. Continuation of 1225. Russian grammar, composition and conversation. *Not for native speakers per University Academic Regulation 4.9.*

RUSS 2225 Intermediate Russian II. Prerequisite(s): 2115 or equivalent. Continuation of 2115. *Not for native speakers per University Academic Regulation 4.9.*

RUSS 3003 (I,S) The Soviet Union: History, Society and Culture. A comprehensive view of the Soviet Union, stressing those issues in the political, economic, technological, geographical, and cultural situation. Accessible to beginning undergraduates. (Same course as HIST 3003 & POLS 3003)

RUSS 3053 (I,S) Introduction to Central Asian Studies. A comprehensive view of newly-emerged Central Asian states examining the history, politics, economics, geography, and culture of Azerbaijan, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan as reflected in their thoughts, religion, literature, and architecture, in the past, and the strategic importance of their natural wealth for the present and future. (Same course as GEOG 3053, HIST 3053 & POLS 3053)

RUSS 3113 Russian Conversation. Prerequisite(s): 2225 or equivalent. Development of conversational skills in formal and informal Russian language; study of oral communication and idioms; vocabulary enhancement.

RUSS 3123 (H) Russian Culture and Civilization. Art, literature, music, architecture, and contemporary life of Russia. Course taught in English.

RUSS 3223 Russian Composition. Prerequisite(s): 2225 or equivalent. The development of all forms of written communication in Russian through practice in writing compositions, letters, reports, and other documents in Russian.

RUSS 4013 Survey of Russian Literature I. Prerequisite(s): 20 credit hours of Russian or equivalent. Survey of Russian literature from its beginning to late nineteenth century with readings in Russian of representative texts. Course conducted in Russian.

RUSS 4023 Survey of Russian Literature II. Prerequisite(s): 20 credit hours of Russian or equivalent. Survey of Russian literature from late nineteenth century to post-Soviet era with readings in Russian of representative texts. Course conducted in Russian.

RUSS 4113 (H) Russian Literature in Translation I. Russian literature from its beginning to mid-19th century: Pushkin, Lermontov, Goncharov, Gogol, Turgenev, and Dostoevsky. Readings in English. Classes conducted in English.

RUSS 4123 Russian Literature in Translation II. Russian and Soviet literature from mid-19th century to present: Tolstoy, Chekhov, Gorky, Zamiatin, Sholokhov, Pasternak, Bunin, Solzhenitsyn, Arzhak (Daniel), Tertz (Sinyavsky),

Voznesensky, and Evtushenko. Readings in English. Classes conducted in English.

RUSS 4133 (I) Gay and Lesbian Literature in Russia. This course treats the precarious situation of sexual minorities in Russia, as reflected in prose, poetic and dramatic literary texts invoking alternative lifestyles/sexualities. It brings into focus the unique features of Russian society (a state once governed by a divinely ordained monarch, later by a totalitarian despot, and now reaching in the direction of democracy), as they relate to the real and imagined lives of gay and lesbian literary characters and poetic personae.

RUSS 4223 Russian Reading Skills. Prerequisite(s): 20 hours. Russian or equivalent proficiency. Acquisition of skills in vocabulary enrichment, stylistic analysis and advanced proficiency in reading various styles of contemporary written Russian (newspaper, political, business).

Science and Math Education (SMED)

SMED 1011 Inquiry Approaches to Teaching-Step 1. Prerequisite(s): Interest in exploring teaching as a career. Master teachers introduce students to examples of high-quality inquiry-based lessons and model the educational concepts to which they are being introduced. In Step 1, students prepare and participate in the teaching of three (3) lessons in elementary classrooms.

SMED 2011 Inquiry-Based Lesson Design-Step 2. Prerequisite(s): SMED 1011 and an interest in exploring teaching as a career. Master teachers introduce students to examples of high-quality inquiry-based lessons and model the educational concepts to which they are being introduced. In Step 2, students prepare and participate in the teaching of three (3) lessons in middle school classrooms.

SMED 3013 Knowing and Learning in Mathematics and Science. Prerequisite(s): SMED 1011 and 2011. Expands the prospective teacher's understanding of current theories of learning and conceptual development. Students examine their own assumptions about learning and critically examine the needs of a diverse student population in the classroom.

SMED 4013 Classroom Interactions. Prerequisite(s): SMED 1011, 2011, 3013, and full admission to Professional Education. A close examination of the interplay between teachers, students, and content, and how such interactions enable students to develop deep conceptual understanding. Students will learn how content and pedagogy combine to create effective teaching.

SMED 4023 Problem-Based Learning in Mathematics and Science. Prerequisite(s): SMED 1011, 2011, 3013, 4013, CIED 4613 or 4003, and full admission to Professional Education. Explores authentic, important, and meaningful questions of real concern to students. Students will work in teams to formulate questions, make predictions, design investigations, collect and analyze data, make products and share ideas.

SMED 4723* Senior Seminar in Secondary Mathematics and Science Education. Prerequisite(s): SMED 1011, 2011, 3013, 4013, 4023, CIED 4613 or 4003, and CIED 4713 or 4053, and full admission to Professional Education. Explores classroom management and discipline approaches as well as teacher research, parental involvement, school climate and community relations.

Social Foundations (SCFD)

SCFD 3223 (D) Role of Teacher in American Schools. An introduction for those students wishing to pursue the teaching profession. An overview of teaching and policy in American schools and background in history, theory, and philosophy of education. Topics to be addressed include: diversity in schools; school governance; funding and organization; ethics and professionalism; curriculum; legal issues; pedagogy and current issues in education.

SCFD 4123 (S) History of Education. The development of major educational ideas and programs with emphasis on the growth of public education in the United States from the Colonial period to the present.

SCFD 4913 (I) International Issues and the Role of the School. International issues that shape educational perspectives and practices locally and globally. Consideration of major issues in education, such as the effects of globalization, the purpose of and right to an education, gender, indigenous knowledge, and global citizenship.

SCFD 5000* Master's Report or Thesis. 1-6 credits, max 6. Students studying for a master's degree enroll in this course for a total of 2 credit hours if they write a report, or 6 hours if they write a thesis.

SCFD 5223* Role of Teacher in American Schools. Prerequisite(s): Graduate level standing. An introduction for those students wishing to pursue the teaching profession. An overview of teaching and policy in American schools and background in history, theory, and philosophy of education.

SCFD 5720* Education Workshop. 1-8 credits, max 8. For teachers, principals, superintendents, and supervisors who have definite problems in instruction or administration. Students must register for the full number of credit hours for which the workshop is scheduled for a particular term.

SCFD 5850* Directed Study. 1-3 credits, max 3. Directed study for master's level students.

SCFD 5873* Culture, Society and Education. Cultural assumptions, constructions and social practices in childhood and education in a variety of societies. Children's family, community and school lives. Anthropological and comparative perspective.

SCFD 5883* Educational Sociology. The manner in which social forces and institutions influence education and the educational system in the United States.

SCFD 5913* Introduction to Qualitative Inquiry. Examination of the major approaches and fieldwork techniques of qualitative research as well as the challenges associated with conducting this form of inquiry.

SCFD 5923* Popular Culture and Education. Investigation and analysis of the ways popular culture socializes and educates young people in social and school norms. Considers connections among popular culture, youth identity, relationships, resistance and activism.

SCFD 5990* Problems and Issues in Social Foundations. 1-3 credits, max 3. In-depth exploration of a contemporary problem or issue in the social foundations of education.

SCFD 5998* Urban Education. Examines the historical, political, economic and sociocultural contexts of urban education as it pertains to students, teachers, administrators, and commmunity members.

SCFD 6000* Doctoral Dissertation. 1-25 credits, max 25. Required of all candidates for the Doctor of Philosophy degree. Credit is given upon completion of the dissertation.

SCFD 6023* Comparative Education. A systematic investigation of educational institutions in various nations for the purpose of an enlarged, critical view of American education. Researching specific transnational educational theories.

SCFD 6113* Theoretical Foundations of Inquiry. Exploration of the history and philosophical assumptions undergirding theories, methods and issues of ethics and rigor associated with both qualitative and quantitative research in education and related fields. An in-depth overview of research paradigms through readings and discussions. Foundational doctoral-level research course.

SCFD 6123* Qualitative Research I. Prerequisite(s): 6113 or consent of instructor. The traditions, philosophies, and techniques of qualitative research, including participant observation, interviewing and document analysis. Practice in qualitative techniques and in preliminary data analysis.

SCFD 6190* Qualitative Research: Selected Methods. 3 credits. Designing and conducting a limited study in order to get a "hands-on" feel for the focal method. Methods such as case study, grounded theory, ethnography, biography, historical social science, life history, phenomenology, and discourse analysis.

SCFD 6193* Qualitative Research II. Prerequisite(s): 6123, 6133 or consent of instructor. Various approaches to qualitative data analysis, including the use of computer applications. Additional attention to issues of writing, representation, reflexivity, and reciprocity. Practice in analytic techniques and writing research.

SCFD 6443* Ethics and Moral Education. Interdisciplinary perspective of traditional and contemporary ethical theories, focusing on application to professional practice and moral education. Moral development, the moral life, feminist ethics, and character education.

SCFD 6501* Curriculum and Social Foundations Doctoral Seminar I. Orientation to doctoral study primarily for students in the PhD program in Curriculum and Social Foundations.

SCFD 6511* Curriculum and Social Foundations Doctoral Seminar II. Orientation to the professoriate primarily for students in the PhD program in Curriculum and Social Foundations.

SCFD 6630* Topics in Philosophy Education. 3-6 credits, max 6. Consideration of topic or topics (e.g. childhood and modern subjectivity) that are of great concern to the field of philosophy of education.

SCFD 6823* History of Education. History of elementary, secondary, and higher education with emphasis on Western society and the American schools. Discussion of historiography and historical methods with research emphasis on the impact of institutional development in a pluralistic society.

SCFD 6850* Directed Reading. 1-6 credits, max 6. Directed reading for students with advanced graduate standing to enhance students' understanding in areas where they wish additional knowledge.

SCFD 6853* Cultural Anthropology in Education. Understanding and critically reflecting on educational issues from a cultural anthropological perspective. Developing the knowledge and skills needed to understand cultural influences on teaching and learning.

SCFD 6880* Internship in Education. 1-8 credits, max 8. Directed off campus experiences designed to relate ideas and concepts to problems encountered in the management of the school program.

SCFD 6883* Transforming Pedagogies. Contemporary pedagogical theories and school reform initiatives, including origins, purposes, underlying philosophical assumptions, cultural contexts, and implications for schooling.

SCFD 6910* Practicum. 1-6 credits, max 6. The student carries out an acceptable research problem (practicum) in a local school situation. Credit given upon completion of the written report.

SCFD 6983* Diversity and Equity Issues in Education. Many social, historical and cultural constructions of "difference" and the impact in personal and professional relationships in education and related human service fields.

Categories of race, class, and gender, but may also include ethnicity, sexual orientation, and special needs.

SCFD 6990* Seminar in Social Foundations. 1-3 credits, max 9. In-depth seminar focusing on a contemporary problem or issue in the social foundations of education.

Sociology (SOC)

SOC 1113 (S) Introductory Sociology. Coming to terms with the requirements for living in a complex social world. Sociological concepts used to assist students in understanding the social influences in day-to-day life.

SOC 2123 Social Problems. Exploration in selected social issues in contemporary American society, such as deviance, poverty, sexism, racism and ageism.

SOC 3113 Theoretical Thinking in Sociology. Prerequisite(s): Six credit hours of sociology, including 1113. Sociological theory in three broad areas: the emergence of social theory, the major schools of social theory and the relevance of theory to sociological research.

SOC 3133 (D,S) Racial and Ethnic Relations. The historical and sociological dimensions of race and ethnicity in global society and understanding of the controversies and conflicts that race and ethnicity have generated in the global experience.

SOC 3213 (D,S) American Society and Culture. The social structure and organization of American society. Approaches to our contemporary national experience through the relational character of ideas and the social and historical experience of their producers.

SOC 3223 (S) Social Psychology. Social basis of personality development and behavior, including symbolic environment, self and group motivation, attitudes and opinions, and social roles.

SOC 3323 Collective Behavior and Social Movements. Analyzes panics, crazes, riots and social movements emphasizing institutional and social psychological origins and consequences.

SOC 3423 Urban Sociology. Urbanization as a worldwide process. The demography and ecology of cities and metropolitan regions. Urban planning and future development.

SOC 3523 (D,S) Juvenile Delinquency. Juvenile delinquency behavior in relation to family, school, church, peers, community and institutional structures. The extent of delinquent expressions, varieties of delinquency, comparative international perspectives and new trends of females in delinquency and gang behavior.

SOC 3713 Religion, Culture and Society. Recommended: 1113, ANTH 2353, REL 1103. An introduction to the scientific study of religion. Religious activity in both tribal and technological societies studied in the light of contemporary interpretations of culture and of social behavior. (Same course as REL 3713)

SOC 3953 Applied Sociology. Prerequisite(s): Sociology majors or consent of instructor or adviser. Application of sociological theory and methods to various job situations. Preparation for field experience in a variety of work settings.

SOC 3993 (D,S) Sociology of Aging. Sociological problems of aging, including the analysis of the behavior of the aged within the framework of social institutions.

SOC 4023* Juvenile Corrections and Treatment Strategies. Prerequisite(s): 3523 or 4333. The juvenile justice system, emphasizing the juvenile court, diversion and youth service bureaus as well as the more traditional training schools and foster homes. Experimental treatment strategies with institutionalized delinquents.

SOC 4033 (I,S) Comparative Perspectives of Criminal Justice Systems. Study of criminal justice systems in different nation states and culture context from a different comparative perspective.

SOC 4043 (D,S) Gender and Work. Prerequisite(s): One upper division course. Consideration of unpaid, paid and volunteer work and gender differences. Linkages between economy, work and family with examples from United States and less developed countries.

SOC 4133 Social Research Methods. Prerequisite(s): 1113 and 3113. Applying sociological theory to designing quantitative and qualitative research; methods of data collection, processing and analysis; basic skills in computer analysis of social data. Research project included.

SOC 4153 Sociology of Health and Illness. Critically analyzes the social production of disease and illness in modern society from a sociological perspective. Examines the social organization of Medicare care, including critical issues affecting healthcare and health insurance in the United States. Focuses on the meanings and experiences of illness, as well as on contemporary critical debates such as environmental and health, bioengineering, and bioethics.

SOC 4213 (S) Sexuality in American Society. Prerequisite(s): Junior standing or consent of instructor. Sociological aspects of sexual behavior, attitudes and belief systems in society. Similarities and differences in males and females in all types of sexuality.

SOC 4243 Quantitative Methods in Sociology. Prerequisite(s): 1113, 3113, 4113. Strategies and procedures in the analysis of quantitative sociological data, including the use of statistical computer programs.

SOC 4313 Sociology of Law and Punishment. Focus on issues concerning the relationship between law, punishment and society. Examines both classical and contemporary sociological and legal scholars. Current penal policies will be examined as well.

SOC 4333 (S) Criminology. Summary of sociological and psychological research pertaining to crime causation and crime trends. Modern trends in control and treatment.

SOC 4383 (S) Social Stratification. Systems of class and caste, with special attention to the United States. Status, occupation, income, and other elements in stratification.

SOC 4433 (S) Environmental Sociology. Critical assessment of the social causes and consequences of problems with resource scarcity and environmental degradation. Environmental problems viewed as social problems, requiring an understanding of the structural conditions producing environmental problems and inhibiting resolutions.

SOC 4443 Sociology of Law and Legal Institutions. Prerequisite(s): 3523 or 4333. Criminal and civil law as mechanisms of social control; conflict and consensus models of legislation; legality doctrine and its application by police, prosecution and defense, courts and administrative agencies of control. Decision processes in the criminal justice system, personnel, case loads, and related areas. Native American law; federal policy and trust status, criminal and civil law, tribal jurisdiction, tribal courts.

SOC 4453 (S) Environmental Inequality. Prerequisite(s): 1113. Considers the connection between environmental problems and race/ethnicity and class inequality. Focuses on environmental justice/equity, social movements, health, policy and risk at the local, national and global levels.

SOC 4463 Technology and Society. Exploration of various aspects of the relationship between society and technology. Analysis of arguments about the role of technology in society. Examination of the social contexts within which technology is created and discussion of the mechanisms and processes through which technology is embraced or discarded, such as peer review, politics, religion, and legal frameworks.

SOC 4473 Oklahoma Environmental Sociology. Critical assessment of the social causes and consequences of environmental problems in Oklahoma, both historical and contemporary. Examines the Land Run, the Dust Bowl, the Oil Boom, land ownership and use patterns.

SOC 4533 World Population Problems. Fertility, mortality and migration, and other factors related to population size, density, and composition; the population explosion, worldwide famine, birth control, and other serious social issues.

SOC 4643 (S) Sociology of Gender. Explores the social organization of gender from diverse theoretical and empirical perspectives using a global experience.

SOC 4653 (I,S) Gender and the Middle East. An overview of gender-related issues in the Middle East and North African countries is provided to bridge cultures and build understanding. Specific attention is given to issues of women and how they are connected to changes in culture, economics, politics and society.

SOC 4663 Undergraduate Capstone Seminar in Sociology. Prerequisite(s): Majors; senior standing; 3113, 4133, 4243. Concluding course for Sociology majors. Application of the skills, knowledge and expertise acquired in Sociology, including critical thinking, writing, theory and methods.

SOC 4723 (S) American Marriage, Family and Male-Female Relationships. The sociological relationship between marriage and family and other institutional structures and systems, especially work and the economy. Male and female roles and relationships in mate selection, sexuality, marriage, divorce, and other intimate situations.

SOC 4733 Criminal Behavior Analysis. Prerequisite(s): 3523 or 4333. This course combines various academic disciplines toward a behavioral examination of the violent criminal offender. By examining the crime scene from a behavioral perspective, the psychodynamics of the offender, the sociological forces, and the social psychological dimensions of victim-offender interactions are combined for a more holistic understanding of the violent offender.

SOC 4743 Criminalistics: Introduction to Forensic Sciences. Prerequisite(s): 3523 or 4333. Criminalistics or forensic sciences involve the application of physical and behavioral sciences to social order or more specifically, the relationship between science and law. This course introduces the student to the various aspects of forensic examinations of violent criminal behavior. By examining modern techniques of crime scene analysis, the student learns how theory and technological development impact our social concepts of law and justice.

SOC 4753 Advanced Forensics. Prerequisite(s): 3523 or 4333 and 4743. Forensic sciences involve the application of physical and behavioral sciences to social order and law. This course advances students' understanding of examinations of violent criminal behavior. Students gain an awareness of the interdependent relationships of various physical and social science disciplines and how these issues are operationalized at an actual crime scene.

SOC 4850 Internship in Sociology. 1-4 credits, max 4. Prerequisite(s): 3952,

completion of 12 hours of sociology, or consent of internship coordinator. Field experience in a variety of work settings.

SOC 4923 Sociology of Punishment. An overview of correctional work focusing on probation, parole and institutions. A survey of contemporary alternatives to conventional imprisonment.

SOC 4950 Current Topics in Sociology. 1-12 credits, max 12. Special topics in sociology; topics vary from semester to semester.

SOC 4990* Exploration of Sociological Issues. 1-3 credits, max 6. Prerequisite(s): Consent of instructor. Examines sociologically significant topics and issues.

SOC 4993 Senior Honors Thesis. Prerequisite(s): Departmental invitation, senior standing, Honors Program participation. A guided reading and research program ending with an honors thesis under the direction of a senior faculty member, with second faculty reader and oral examination. Required for graduation with departmental honors in sociology.

SOC 5000* Thesis in Sociology. 1-6 credits, max 6.

SOC 5001* Graduate Proseminar. Prerequisite(s): Admission to Sociology graduate program. Introduction and orientation to the graduate program in the Department of Sociology.

SOC 5013* Creative Component in Sociology. A guided course serving as the final requirement for graduate students in the Department of Sociology's Master of Science degree, non-thesis option.

SOC 5063* Seminar in Social Inequality and Stratification. Prerequisite(s): Graduate standing. Provides comprehensive overview and analysis of theories and research in social inequality and social stratification. Includes: study of classical and contemporary theories, development of research in the field, dynamics of inequalities and current and future perspectives.

SOC 5113* Classical Sociological Theory. Prerequisite(s): 3113 or equivalent. Major trends in sociological thought. The emergence of sociological theory in Europe and America.

SOC 5123* Contemporary Sociological Theory. Prerequisite(s): 3113 or equivalent. Critical examination of significant theoretical formulations, 1920 to the present. Relation between theoretical development and current research emphasis.

SOC 5213* Techniques of Population Analysis. Prerequisite(s): Graduate standing. Examination of primary techniques and statistics employed in studies of population characteristics. Examination of sources of demographic data, methods employed in the collection and analysis of data on population characteristics, composition and change.

SOC 5223* Culture, History and World Systems. Prerequisite(s): Admission to Graduate College and international studies program. The modern world system and its new social formations resulting from increasing globalization. Examination of cultural, socio-economic, and political changes in developed and developing societies. Modern societies, their historical developments, the cultural politics of difference, and the re-emergence of ethnic groups worldwide. Existing theoretical models of change for profit and non-profit organizations. (Same course as INTL 5223*)

SOC 5243* Social Research Design. Prerequisite(s): 3113; 4133 or equivalent; graduate standing. Techniques in design, data collection, and interpretation of data for sociological research.

SOC 5263* Quantitative Analysis of Social Research. Prerequisite(s): 3133; 4133 or equivalent; graduate standing. Advanced techniques in sociological research and data analysis focusing on the formulation of substantive research questions and application of a variety of research procedures to answer such questions.

SOC 5273* Qualitative Research Methods. Examination of ethnographic studies and implementation issues connected with qualitative research. Research project required.

SOC 5283* Advanced Qualitative Sociological Research. Prerequisite(s): SOC 5273 or consent of instructor. Intensive examination of advanced qualitative research in sociology. Requires students to design and implement their own qualitative sociological research projects under the guidance of the instructor.

SOC 5323* Seminar on Collective Behavior and Social Movements. Prerequisite(s): Graduate standing. Examination of major theoretical and empirical approaches employed in the study of social movements. Exploration of problems on the nature and current theories of social movements including individual versus group approaches. Grassroots resistance, community organizing, political conflicts, and revolutions.

SOC 5333* Global Population and Social Problems. Prerequisite(s): Graduate standing. Study in world, regional and national population characteristics, changes and associated problems and cultural influences.

SOC 5343* Sociology of Law and Punishment. Advanced study in the sociology of law and punishment. Focus on both classical and contemporary sociological and legal research. An interdisciplinary and comparative approach is also emphasized.

SOC 5463* Seminar in Environmental Sociology. Critical overview of contemporary developments in environmental sociology. Environment concern, disasters, health issues, risk assessment, and environmental conflict.

SOC 5473* Seminar on the Contemporary Environmental Movement. Critical overview of contemporary theory and research on the environmental movement. Analysis of crucial movements dynamics, including historical development, central organizing themes, strategies and tactics, and movement activities, environmental health movements, and transnational movement campaigns.

SOC 5493* Seminar in Environmental Justice. Considers racial, class and equity implications of environmental degradation and regulation. Includes discussion of controversies over the siting of hazardous facilities in urban and rural areas, the extraction of resources from native lands, national and transnational export of toxic waste to the South and the development of a distinct environmental justice movement.

SOC 5553* Seminar in Medical Sociology. Advanced study in the sociology of medicine, including the doctor-patient relationship, the social meanings of health and illness, epidemiology, health care delivery, and the medicalization of American society. Analysis of the sociology of organic illness and mental illness using readings from both classical and contemporary sources.

SOC 5573* Seminar on Victimology. Critical overview of contemporary theory and research on victimology. Relationships between victim and offenders, social institutions such as media, police, business, advocacy groups, and various social movements.

SOC 5583* Comparative Criminal Justice Systems. Examines crime and criminal justice in a global world. Compares the current major legal traditions with the U.S. criminal justice system.

SOC 5593* Seminar on Organization and Administration in Law Enforcement and Society. Critical overview of contemporary theory and research on administration in law enforcement and society.

SOC 5653* Gender and the Middle East. An overview of gender-related issues in the Middle East and North African countries is provided to bridge cultures and build understanding. Specific attention is given to issues of women and how they are connected to changes in contemporary culture, economics, politics, and society.

SOC 5663* American Pluralism, Race and Ethnicity in American Life. Prerequisite(s): Graduate standing. Analysis of the dynamics of intercultural and intergroup relations in America with special emphasis on the examination of major conceptual perspectives that have characterized the study of race and ethnicity in American life.

SOC 5763* Contemporary Organizational Theory. Prerequisite(s): Graduate standing. Advanced study of contemporary theories used to explain, predict and understand organizations. Behavior of populations of organizations.

SOC 5793* Seminar on Organizational Deviance. Overview of contemporary theory and research on organizational deviance. Defining acceptable risk. Organizational structures, processes, and standard operating procedures that produce mistake, misconduct and disaster.

SOC 5813* Myths and Realities of Organizational Change. Prerequisite(s): Graduate standing. A critical examination of the various theories and models that address change and improvement processes in complex organizations. Theoretical and methodological validity of assumptions underlying such organizational theories and models.

SOC 5950* Seminar in Sociology. 1-3 credits, max 25. Prerequisite(s): Graduate standing. Special seminar; topics vary from semester to semester.

SOC 5980* Internship. 1-6 credits, max 6. Supervised field placement.

SOC 5990* Advanced Problems and Issues in Sociology. 1-9 credits, max 9. Prerequisite(s): Consent of instructor. Group enrollment or individual research enrollment as needed. Graduate level analysis of special problems and issues in sociology not covered in other department offerings.

SOC 6000* Dissertation. 1-12 credits, max 18.

SOC 6213* Theory of Social Structure. Prerequisite(s): Six hours of undergraduate sociology or equivalent. Relationship between human thought and the social context within which it arises.

SOC 6390* Seminar in the Family, Marriage and Male-Female Roles in American Sociology. 2-3 credits, max 6. Analysis of published research in sociology of family, marriage and male-female roles and relationships with special emphasis on American society.

SOC 6460* Advanced Studies in Environmental Sociology. 1-6 credits, max 6. Prerequisite(s): 5463 or consent of instructor. Intensive examination of selected topics in environmental sociology.

SOC 6463* International Issues in Environmental Sociology. Prerequisite(s): Graduate standing. Advanced study of the international context of environmental issues.

SOC 6493* Sociology of Disaster. Critical examination of contemporary theory and research on the social aspects of disasters. Social system response to large-scale crises. Vulnerability, warnings, preparedness, recovery, mitigation, and sustainability.

SOC 6653* Seminar in Social Psychology. Development and critical analysis

of theory and research in social psychology.

SOC 6673* Development of Social Thought. Historical and analytical studies of major contributions to social thought leading toward the works of modern theorists.

SOC 6753* Seminar in Deviance and Criminology. Current research and theory in criminology, penology and deviance in modern society.

SOC 6763* Seminar in Theory of Criminal Behavior Analysis. Critical overview of contemporary theory and research on criminal behavioral analysis.

SOC 6853* Seminar in Symbolic Interactionism. Symbolic interactionism, a major contemporary school of thought in sociology and psychology, emerging from philosophical pragmatism with special emphasis on the thoughts of George H. Mead and its derivatives including dramaturgy, existential social psychology, and phenomenological.

SOC 6950* Seminar in Social Gerontology. 2-3 credits, max 6. A theoretical and practical examination of the sociological implications, both individual and societal, of an aging population.

Soil Science (SOIL)

SOIL 2124 (N) Fundamentals of Soil Science. Lab 2. Prerequisite(s): CHEM 1215. Principal physical, chemical and biological properties of the soil related to plant growth; soil testing and fertilizer usage; formation and classification of soils, rural and urban land use.

SOIL 3433* Soil Genesis, Morphology, and Classification. Lab 3. Prerequisite(s): 2124. Basic principles dealing with how and why soils differ, their descriptions, geographic distributions and modern classification of soils. Soil genesis and classification a prerequisite to sound land use planning and land management.

SOIL 3883 Sustainable Agriculture Concepts and Practice. Principles of sustainable agriculture for improved farm management. Analysis of farming systems for indicators of sustainability.

SOIL 4210* Describing and Interpreting Soils. 1 credit, max 3, Lab 3. Prerequisite(s): 2124. Describe and classify soil properties in the field and interpret for suitable agriculture, urban, and other land uses.

SOIL 4213* Precision Agriculture. Lab 2. Prerequisite(s): MATH 1513, senior standing. Introduction to the concepts of precision agriculture including analysis of spatial variability, relationships of fertility and crop response, geographical information systems, variable rate technology, optical sensing, global positioning systems, and yield monitoring. Case studies included for detailed analyses. (Same course as BAE 4213*)

SOIL 4234* Soil Nutrient Management. Lab 2. Prerequisite(s): 2124. Soil fertility and use of fertilizer materials for conservation, maintenance, and improvement of soil productivity and to minimize environmental concerns.

SOIL 4363* Environmental Soil Science. Prerequisite(s): BIOL 1114 and SOIL 2124. Re-emphasis of soil science concepts vital in the understanding of processes that are within the realms of the ecological regulator function of the soil; discussions on the role of soil as the foundation of forest, rangeland/pastureland, agricultural, urban and suburban, as well as wetland ecosystems; impact of soil processes on global environmental concerns; soil as the ultimate recipient of waste; impact of soil processes on groundwater and surface water quality. (Same course as ENVR 4363*)

SOIL 4463* Soil and Water Conservation. Prerequisite(s): SOIL 2124. Assess the importance, quality and quantity of soil and water as natural resources for ecosystems and societies. Principles of soil erosion processes and management practices to decrease erosion in urban, cropland and rangeland systems. Understand the principles of hydrology cycle to improve water use efficiency of precipitation and irrigation resources. Examine resource mismanagement that have resulted in decertification, salinization and deforestation.

SOIL 4470* Problems and Special Study. 1-3 credits, max 12, Lab 1-3. Prerequisite(s): Consent of the instructor. Problems in soil science selected from topics in soil chemistry and fertility, soil physics, soil biology, soil conservation, and soil morphology.

SOIL 4483* Soil Microbiology. Prerequisite(s): 2124 and BIOL 1114 or consent of instructor. An overview of microorganisms living in the soil and their activities which are significant to agricultural practices and the environment. No credit for both 4483 and 5583.

SOIL 4563* Dynamics of Wetland, Forest and Rangeland Soils. Prerequisite(s): 2124. Dynamics of soils that receive minimal or no production input. Identification of wetland soils and the biogeochemical reactions occurring in wetland soil environments. Nutrient cycling, physical, chemical, and biological properties of forest and rangeland soil systems.

SOIL 4571 Professional Preparation in Plant and Soil Sciences. Prerequisite(s): Senior standing in plant and soil sciences. Preparation for professional certification exams and career opportunities in plant and soil sciences. (Same course as PLNT 4571)

SOIL 4683* Soil, Water and Weather. Prerequisite(s): 2124 and PHYS 1114. Introduction to the physics of the soil-plant-atmosphere continuum. A focus on physical properties of soil and interactions with water and weather in terrestrial ecosystems.

SOIL 4893* Soil Chemistry and Environmental Quality. Prerequisite(s): 2124 and CHEM 1225. Chemical and colloidal properties of clays and organic matter in soil systems, including ion exchange, retention, and precipitation; soil acidity and salinity; mineral weathering and formation; oxidation-reduction reactions; trace and toxic elements, water quality, land application of wastes, and soil remediation.

SOIL 4913* Animal Waste Management. Prerequisite(s): 2124. Aspects of animal waste management related to animal nutrition, system design, land application, socioeconomic issues and environmental impacts. (Same course as ANSI 4913 and ENVR 4913)

SOIL 5000* Master's Thesis. 1-6 credits, 6 max total credits under Plan I, and 2 max total credits under Plan II. Prerequisite(s): Consent of adviser. Research planned, conducted and reported in consultation with a major professor.

SOIL 5020* Graduate Seminar. 1 credit, max 3. Prerequisite(s): Graduate standing. Discussions of research philosophy, methods, interpretation, and presentations. Profession development and contributions to the scientific community. (Same course as PLNT 5020)

SOIL 5110* Problems and Special Study. 1-4 credits, max 12. Prerequisite(s): Consent of instructor. Supervised study of special problems and topics not covered in other graduate courses.

SOIL 5112* Research Methods in Plant and Soil Sciences. Prerequisite(s): Graduate standing. Exploration of various methodologies helpful in field scale research. Application and understanding biometry as it relates to research result interpretation.

SOIL 5223* Soil Chemical Processes and Impact on Environmental Quality. Prerequisite(s): 4893 and CHEM 2113 or CHEM 3324 or equivalent. A comprehensive study of chemical processes applied to fate and transport of contaminants and agricultural productivity. Chemical and physical properties of soil minerals as they pertain to solution and surface chemistry. Nutrient and contaminant availability and speciation as dictated by ion exchange, precipitation/dissolution, and adsorption reactions. Review of current research in soil and environmental chemistry literature.

SOIL 5230* Research. 1-4 credits, max 8. Prerequisite(s): Consent of a faculty member supervising the research. Supervised independent research on selected topics.

SOIL 5353* Advanced Soil Genesis and Classification. Lab 2. Prerequisite(s): 3433. Processes and factors of soil formation. Comparison of world soil morphology and classification systems.

SOIL 5383* Advanced Soil Microbiology. Prerequisite(s): 2124 and BIOL 1114 or consent of instructor. A comprehensive overview of microorganisms living in the soil and their activities which are of agricultural and environmental significance. Provide experience in analytical skills related to soil microbial processes. *No credit for both SOIL 4483 and 5383.*

SOIL 5453* Soil and Water Quality in Bioenergy Feedstock Production Systems. Prerequisite(s): 4573 or instructor consent. Evaluate impact of bioenergy feedstock production systems on soil and water quality. Current research results related to biomass removal and by-product addition to soils will be evaluated. Course available online only.

SOIL 5483* Soil Biodegradation and Bioremediation. Prerequisite(s): 4483. A comprehensive overview of microorganisms living in soil and their activities of agricultural and environmental significance, emphasizing their roles in improving soil quality, and biodegradation and bioremediation of soil.

SOIL 5583* Soil Physics Measurement Techniques. Lab 2. Prerequisite(s): 4683. Training in field and laboratory techniques for physical analysis of soil properties and processes. Develop research proposal and conduct research project related to soil physics.

SOIL 5613* Laboratory Methods of Soil, Plant and Environmental Analysis. Lab 4. Prerequisite(s): SOIL 4893 and CHEM 2113 or 3353 or equivalent. Methods in soil and environmental sample analysis. Presentation and discussion of the theory behind chemical analysis of soils, plants, and waste materials for agricultural and environmental purposes. Hands-on laboratory analysis of personal soil samples. Theory and practices of common laboratory techniques and equipment/instrumentation such as colorimetric spectroscopy, charge analysis of soils, forms of acidity, phosphorus extractions and behavior, ICP-AES. The course is heavily lab based.

SOIL 5813* Soil-Plant Nutrient Cycling and Environmental Quality. Prerequisite(s): 4234 or equivalent. Theory and application of soil plant relationships in production and non-production environments. Nutrient cycling, mass balance, soil nutrient supply and plant response. Methods to reduce the impact of nutrients on environmental quality, soil-plant buffering and response models.

SOIL 5990* Soil Physical Analyses. 1-2 credits, max 2. Prerequisite(s): 4683. Principles and techniques.

SOIL 6000* Doctoral Thesis. 1-6 credits, max 36. Prerequisite(s): Consent of instructor. Independent research to be conducted and reported with the supervision of a major professor as partial requirement for the PhD degree.

SOIL 6010* Advanced Topics and Conference. 1-6 credits, max 12. Prerequisite(s): MS degree. Supervised study of advanced topics. A reading and

conference course designed to acquaint the advanced student with fields not covered in other courses.

SOIL 6583* Soil Physics Theory. Prerequisite(s): 4683 or equivalent and MATH 2233 or equivalent. Theoretical understanding and modeling skills required to analyze and predict mass and energy transport in the soil-plant-atmosphere continuum. Application of analytical and numerical models for diverse transport phenomena including water, heat, and solute transport through soil.

Spanish (SPAN)

SPAN 1115 Elementary Spanish I. Pronunciation, conversation, grammar, and reading. Includes language lab work. Students may not receive credit for both this course and SPAN 1153. *Not for native speakers per University Academic Regulation 4.9.*

SPAN 1153 Accelerated Elementary Spanish I. Prerequisite(s): 1-2 years high school Spanish or equivalent. Accelerated presentation of basic skills of the Spanish language for students with previous experience, but who are not yet ready for SPAN 1225. Students may not receive credit for both this course and SPAN 1115. *Not for native speakers per University Academic Regulation 4.9.*

SPAN 1225 Elementary Spanish II. Prerequisite(s): 1115 or equivalent. Continuation of 1115. Includes language lab work. No credit for students with credit in 1253. *Not for native speakers per University Academic Regulation 4.9.*

SPAN 1253 Accelerated Elementary Spanish II. Prerequisite(s): 3-4 years high school Spanish or equivalent. Accelerated presentation of the second phase of Spanish language skills for students with previous experience, but who are not yet ready for SPAN 2115. No credit for students with credit in 1225. *Not for native speakers per University Academic Regulation 4.9.*

SPAN 2115 Intermediate Spanish I. Prerequisite(s): 1225 or equivalent. Further development of speaking, listening, reading, and writing skills along with short cultural and literary readings. *Not for native speakers per University Academic Regulation 4.9.*

SPAN 2232 Intermediate Reading and Conversation. Prerequisite(s): 2115 or equivalent. Skill consolidation with emphasis on short literary readings ad conversation. May be taken concurrently with 2233. *Not for native speakers per University Academic Regulation 4.9.*

SPAN 2233 Intermediate Composition and Grammar. Prerequisite(s): 2115 or equivalent. Skill consolidation with emphasis on composition and grammar with some conversation. May be taken concurrently with 2232. *Not for native speakers per University Academic Regulation 4.9.*

SPAN 3013 Survey of Latin-American Literature. Prerequisite(s): 20 hours of Spanish or the equivalent. Development of the literature written in Spanish in the new world.

SPAN 3023 Survey of Peninsular Literature I. Prerequisite(s): 20 credit hours of Spanish or equivalent. Development of literature in Spain from the medieval period to 1700.

SPAN 3033 Survey of Peninsular Literature II. Prerequisite(s): 20 hours of Spanish or the equivalent. Development of literature in Spain from 1700 to the present.

SPAN 3053 Introduction to Hispanic Literary Studies. Prerequisite(s): 2232 and 2233 or equivalent. Introduction to techniques of literary analysis and research in Spanish and to Hispanic literary history. Prerequisite for all advanced literature courses in Spanish.

SPAN 3203 Advanced Conversation. Prerequisite(s): 20 credit hours of Spanish or equivalent proficiency. Practice in conversation skills, designed to bring students to a high level of proficiency in speaking and listening. Class conducted in Spanish.

SPAN 3213 Advanced Grammar and Composition. Prerequisite(s): 20 hours of Spanish or equivalent proficiency. Study of advanced grammar and stylistics with emphasis on composition skills, designed to bring students to a high level of proficiency in writing.

SPAN 3463 Advanced Diction and Phonetics. Lab 1. Prerequisite(s): 2232 and 2233, or equivalent. Required course for teacher certification/licensure. Spanish speech sounds and intonation patterns, with practice to improve the student's pronunciation.

SPAN 4123 Hispanic Poetry. Prerequisite(s): 3013 or 3023 or 3033. Detailed study of representative poetry from Spain or Latin America.

SPAN 4133 Hispanic Prose. Prerequisite(s): 3013 or 3023 or 3033. Detailed study of representative prose works from Spain or Latin America.

SPAN 4163 Don Quixote. Prerequisite(s): 3013 or 3023 or 3033. Seminar devoted to Cervantes' novel.

SPAN 4173 Hispanic Drama. Prerequisite(s): 3013 or 3023 or 3033. Reading and interpretation of dramatic works selected from the Hispanic literatures.

SPAN 4183 Spain and Islam. Prerequisite(s): 3013 or 3023 or 3033. An in-depth study of conflict and coexistence among Christian and Islamic cultures in Spain from the eighth century to the present day. The course includes both literary and historical readings.

SPAN 4223 Contemporary Hispanic Literature. Prerequisite(s): 3013 or 3023 or 3033. Major Hispanic writers since 1900.

SPAN 4253 Masterpieces of Hispanic Literature I. Prerequisite(s): 3013 or 3023 or 3033. Reading and analysis of classics selected from the Hispanic literatures.

SPAN 4263 Masterpieces of Hispanic Literature II. Prerequisite(s): 3013 or 3023 or 3033. Reading and analysis of classics selected from the Hispanic literatures.

SPAN 4323 Spanish Peninsular Civilization. Prerequisite(s): 23 credit hours of Spanish or equivalent. Reading and discussion of selected texts outlining the development of contemporary Spanish Peninsular civilization.

SPAN 4333 Latin American Civilization. Prerequisite(s): 23 credit hours of Spanish or equivalent. Reading and discussion of selected texts outlining the development of contemporary Hispanic civilization outside the Iberian peninsula.

SPAN 4413 Advanced Stylistics. Prerequisite(s): 3213. Continuation of 3213, emphasizing further development of grammar and composition in a variety of contexts.

SPAN 4550 Seminar in Spanish. 1-3 credits, max 9. Prerequisite(s): One 3000-level Spanish course, or equivalent. Readings and discussion of vital subjects in Spanish.

SPAN 5110* Advanced Hispanic Studies. 1-3 credits, max 9, Lab TBA. Prerequisite(s): 22 hours of Spanish or graduate standing in foreign language.

Special Education (SPED)

SPED 3202 (D) Educating Exceptional Learners. Lab 2. Learning characteristics, needs and problems of educating the exceptional learner in the public schools. Implications of the learning, environmental and cultural characteristics; planning and program assistance available for accommodating the exceptional learner in regular and special education programs; observation of exceptional learners.

SPED 4723* Transition Into Adulthood for Individuals with Disabilities. Strategies for preparing youth and young adults with disabilities for transitioning into adulthood.

SPED 4753* Techniques of Behavior Management and Counseling with Exceptional Individuals. Techniques to develop and evaluate programs of behavior change for exceptional students including counseling with the exceptional individual and conferencing with professionals and parents.

SPED 5000* Master's Thesis. 1-6 credits, max 6.

SPED 5123* Characteristics and Teaching Methods for Students with Autism Spectrum Disorders. Prerequisite(s): Graduate standing or permission of instructor. Designed to provide a foundation for understanding educational and psychological theory and best practices used in teaching students with Autism Spectrum Disorders (ASD). Characteristics and diagnostic procedures of ASD will be introduced, as well as such teaching methods as incidental teaching, visual supports, workstations, discrete trial teaching, and social stories.

SPED 5150* Seminar in Special Education. 1-6 credits, max 6. Seminar topics will differ depending on interests and topics regarding Special Education.

SPED 5320* Seminar in Applied Behavioral Studies. 3-9 credits, max 9. In-depth exploration of contemporary problems of applied behavioral studies.

SPED 5573* Communication Strategies for Individuals with Severe and Profound Disabilities. Methods for communicating with severely or profoundly disabled persons and for facilitating their communication through speech, sign, assistive devices and technology.

SPED 5620* Practicum with Exceptional Learners. 1-8 credits, max 8, Lab 1-8. Prerequisite(s): Consent of instructor. Supervised individual and group experience with exceptional learners. The particular experience (learning disability, mental retardation, gifted, etc.) determined by the student's field of specialization.

SPED 5623* Characteristics of Students with Mild/Moderate Disabilities. Educational, psychological and physiological characteristics of individuals with mild and moderate disabilities. Professional roles of the teacher, professional ethics, and assessment of children with disabilities.

SPED 5633* Behavior Characteristics of Exceptional Individuals. Individual differences and problems that exceptional individuals experience. Educational programs and resources available to assist administrators, teachers and parents in dealing with unique individual needs.

SPED 5643* Counseling Parents of Exceptional Children. Aiding the classroom teacher and other professional personnel in the understanding of unique activities and interpersonal relations involved in counseling with parents of exceptional children.

SPED 5653* Play Therapy in Special Education. Theories and practices of the principles of play therapy. The application of play therapy for special education children. Supervised clinical experience with children with emotional, social and psychological problems.

SPED 5673* Improving Literacy Skills of Individuals with Disabilities. Normal language development and variations from norms demonstrated by exceptional learner. Assessment techniques and intervention strategies appropriate for exceptional infants and children; theoretical approaches to

language training, formal and informal; assessment techniques and techniques for exceptional individuals.

SPED 5683* Models of Instruction in the Inclusive Classroom. Current techniques, models and approaches used to teach students with mild and moderate disabilities and the theoretical bases for these techniques and approaches in inclusive classrooms. Professional roles of the teacher of students with mild and moderate disabilities, including communication with other teachers.

SPED 5733* Teaching Strategies for Students with Physical and Health Disabilities. Prerequisite(s): 5523 and graduate student standing. Design and implementation of educational programs, collaboration with families and other professionals, and advocacy for students with disabilities.

SPED 5743* Planning and Instruction in Special Education. Knowledge and skills related to research-based, validated "best" practices for determining curriculum and implementing instruction for students with exceptionalities.

SPED 5783* Assessing Students with Disabilities. The practice and practicality of the assessment process used in schools for students with disabilities.

SPED 5883* Classroom and Behavior Management. Classroom and behavior management strategies designed to improve learning and behavior within instructional settings.

SPED 5993* Culturally Responsive Teaching in Special Education. Examination of the influence of ethnic, socioeconomic class, and gender factors on students with disabilities. Ethnographic inquiry through Service-Learning field placements for understanding cultural diversity and special education. Teaching attitudes and expectations, and curricular and instructional strategies for improving students' school performance.

SPED 6000* Doctoral Thesis. 1-25 credits, max 25. Required of all candidates for doctorate in applied behavioral studies. Credit given upon completion and acceptance of thesis.

SPED 6183* Legal Aspects in Special Education. Familiarization and analysis of legal rights and responsibilities of students, educators, and administrators in special education; federal and state mandates, case law and recent legal developments affecting special education.

SPED 6543* School and Interagency Collaboration. Prerequisite(s): Graduate student status or instructor permission. An advanced course to examine models for interdisciplinary teamwork in the design, delivery and evaluation of services for students with disabilities and at risk. Both school-based and interagency collaborative services and strategies for communicating with multiple stakeholders are emphasized.

SPED 6603* Current Trends and Issues in Special Education. Current research and literature regarding the education of exceptional children.

SPED 6743* Single Subject Design in Special Education. Prerequisite(s): Permission of instructor. Conduct research utilizing single subject and single case study design with emphasis on special education. Advanced procedures in single subject research methodology, including design strategies and experimental control are emphasized.

SPED 6850* Directed Reading. 1-6 credits, max 6. Prerequisite(s): Consent of instructor. Directed reading for students with advanced graduate standing.

SPED 6880* Internship in Education. 1-8 credits, max 8, Lab 3-24. Directed off-campus experiences designed to relate ideas and concepts to problems encountered in the management of the school program.

Speech Communication (SPCH)

SPCH 2713 (S) Introduction to Speech Communication. Principles and techniques of preparing for, participating in and evaluating communication behavior in the conversation, the interview, group discussion and the public speech. A competency-based approach.

SPCH 3703 Small Group Communication. General systems approach to small group processes. Special consideration given to group roles, norms, leadership and decision-making. Participation in various types of discussion groups.

SPCH 3723 Business and Professional Communication. Oral communication encounters in business and professional settings. The interview, informative briefing, talking-paper, small group interaction and informative, integrative and persuasive speeches.

SPCH 3733 (S) Elements of Persuasion. Principles and concepts of interpersonal and public persuasive encounters. The instrumental and interactive nature of persuasion. Designing and participating in actual persuasive campaigns.

SPCH 3743 Advanced Public Speaking. The preparation and delivery of various types of public speeches.

SPCH 3793* Communication in Interviews. General principles of interviewing. Specific guidelines for the interviewer in survey, journalistic, counseling, selection, appraisal, legal, medical, and sales interviews.

SPCH 4010 Independent Study in Speech Communication. 1-3 credits, max 3. Prerequisite(s): Consent of instructor. Supervised research projects in speech communication.

SPCH 4710 Topics in Speech Communication. 1-3 credits, max 6. Selected current topics in speech communication.

SPCH 4743* Problems of Interpersonal Speech Communication. Application of communication theory to interactions in person-to-person settings. Identification and management of barriers related to the concepts of perception, attraction, self-disclosure, listening and conflict.

SPCH 4753 (I) Intercultural Communication. Social and cultural differences between individuals from diverse backgrounds as possible barriers to effective communication.

SPCH 4763 Organizational Communication. The interface between communication theory and organizational structure. Nature of communication problems in organizations, strategies for overcoming such problems and the design of effective communication systems in organizational settings.

SPCH 4793 (S) Nonverbal Communication. Nonverbal aspects of speech communication.

Sports Media (SPM)

SPM 2843 Sports and the Media. Prerequisite(s): Departmental majors only. The introductory course for sports media majors. Sports is a major industry in the United States today, and this course is designed to study that industry and the opportunities for and responsibilities of the journalists who cover it. Topics covered include the evolution of the sports media, sports media relations, ethics and the sports media, racial and gender issues in sports and the media, and multimedia sports journalism in the 21st century.

SPM 3500 Sports Media Internship. 1-3 credits, max 6. Prerequisite(s): MMJ 3263 and 3153 or SC 3353 and 3753 with a grade of "C" or better and consent of instructor; and a minimum grade of 70 on the Language Exam. Internship practice for qualified sports media students who wish creative communications experience beyond that available in the classroom.

SPM 3783 Sports Public Relations. Prerequisite(s): 2843 and MC 2003 and MC 2023 and SC 2183 with a grade of "C" or better in each; and a minimum grade of 70 on the Language Exam. Provides an overview and introduction to the practice of public relations within the sport industry. The primary focus of the course is on the role of public relations in all aspects of sport, fundamentals of sport publicity and promotional campaigns.

SPM 3813 Sports Reporting Across the Media. Lab 2. Prerequisite(s): MC 2003 and 2023 with a grade of "C" or higher in both; and a minimum grade of 70 on the Language Exam. This course provides an introductory reporting course specifically for aspiring professionals of major sectors of the sport media industry (i.e., television, internet sites, public relations, newspapers, radio, Twitter and magazines). Students learn the basics of game summaries, keeping accurate statistics, conducting interviews, structuring stories, incorporating quotes in sports media content, all while adhering to AP style and ethical standards of journalism and communications professionals.

SPM 3843 Contemporary Sports Media. Prerequisite(s): MC 2003 and 2023 with grade of "C" or better in both, minimum grade of 70 on Language Proficiency Exam. Contemporary Sports Media will examine ethical and cultural considerations of the sports media as they pertain to sports gambling, drugs in sports, athletes and crime, privacy of athletes, gender and race in sports, international sports, labor issues in sports, and how the Internet is changing sports coverage.

SPM 3853 Advanced Sports Writing. Lab 2. Prerequisite(s): SPM 2843 and 3813 and MMJ 3263 with grade of "C" or better in each; and a minimum grade of 70 on the Language Exam. Advanced sports writing and reporting, which includes a wide variety of writing and reporting assignments, leading to an emphasis on enterprise and investigative reporting, as well as long-form features. Final projects should be of such quality to serve as the lead products in individual student portfolios.

SPM 3863 Electronic Sports Reporting. Lab 2. Prerequisite(s): MMJ 3263 with a grade of "C" or better, MMJ 3153 or concurrent enrollment; and a minimum grade of 70 on the Language Proficiency Exam. Introduces students to various types of radio and television sports stories in the media. Students will learn to write in the aural style for broadcast/Web cast format. The course will emphasize other performance situations, such as producing and anchoring radio and television sportscasts. Students will be graded based on a combination of projects and testing.

SPM 4053 Sports Announcing. Lab 2. Prerequisite(s)): 3153 and 3863 with a grade of "C" or better or concurrent enrollment in both; and a minimum grade of 70 on the Language Exam. Focuses on the theory and practice of electronic media sports coverage, with an emphasis on the role, skills and practices of radio and TV sports announcers and electronic sports media journalism. The class includes play-by-play broadcasts and a class project.

SPM 4560 Specialized Sports Media Applications. 3 credits, max 6. Prerequisite(s): 2843 and SC 3353 or MMJ 3263 or MMJ 3153 with a grade of "C" or better; and a minimum grade of 70 on the Language Exam. Professional sports media at an advanced level. Special topics in areas such as sports media production, announcing, performance; sports feature, column and editorial writing. Course content varies by semester. No credit for students in MC 5560 during same semester or with same subtitle.

SPM 4813 Sports Media Production. Lab 2. Prerequisite(s): 2843 and MMJ 3263 and MMJ 3913 with a grade of "C" or better; and a minimum grade 70 on the Language Exam. After completing this course students will be able to develop, write, pre-produce, produce, perform as talent and post-produce programming for broadcast sports media. By becoming proficient with specific production and performance techniques, you will be qualified to pursue an internship and/or employment with a media organization.

SPM 4883 Sports in the Newsroom. Lab 2. Prerequisite(s): 3863 and either 3853 or 4813 each with a grade of "C" or higher, grade of 70 or better on Language Exam. Capstone course for multimedia sports majors, giving them the opportunity to apply the skills they have learned to a final project that will be coordinated with a media outlet with the goal of publication. In addition, students will work on writing for print and electronic media, multimedia sports programming, management skills, and ethics and cultural issues in sports media.

SPM 4933 Advanced Sports Public Relations. Prerequisite(s): SPM 3783 and SC 3953 and 3353 with "C" or better in each; and a minimum grade of 70 on the Language Proficiency Exam. Capstone course providing a study of relevant issues practitioners face in today's sports industry. Covers the scope and effect of sports on society and culture.

Statistics (STAT)

STAT 2013 (A) Elementary Statistics. Prerequisite(s): MATH 1483 or 1513. An introductory course in the theory and methods of statistics. Descriptive measures, elementary probability, samplings, estimation, hypothesis testing, correlation and regression. No degree credit for students with credit in 2023 or 2053.

STAT 2023 (A) Elementary Statistics for Business and Economics. Prerequisite(s): MATH 1483 or 1513. Basic statistics course for undergraduate business majors. Descriptive statistics, basic probability, discrete and continuous distributions, point and interval estimation, hypothesis testing, correlation and simple linear regression. No degree credit for students with credit in 2013 or 2053.

STAT 2053 (A) Elementary Statistics for the Social Sciences. Prerequisite(s): MATH 1483 or MATH 1513. No credit for business majors. An introductory course in the theory and methods of statistics. Descriptive measures, elementary probability, sampling, estimation, hypothesis testing, correlation and regression. *No degree credit for students with credit in STAT 2013 or 2023.*

STAT 2331 SAS Programming. Prerequisite(s): A different programming language or consent of instructor. SAS as a general purpose programming language, data representation, input/output, use of built-in procedures, report generation.

STAT 3013 Intermediate Statistical Analysis. Prerequisite(s): 2013, 2023 or 2053. Applications of elementary statistics, introductory experimental design, introduction to the analysis of variance, simple and multiple linear regression, nonparametric statistics, survey sampling and time series. Data analysis using Excel included.

STAT 4013 (A) Statistical Methods I. Prerequisite(s): 60 credit hours including MATH 1513. Basic experimental statistics, basic probability distributions, methods of estimation, tests of significance, linear regression and correlation, analysis of variance for data that are in a one way, a two-way crossed, or in a two-fold nested classification. *No degree credit for students with credit in 4053.*

STAT 4023 Statistical Methods II. Prerequisite(s): 3013 or 4013 or 4033 or 4053. Basic concepts of experimental design. Analysis of variance, covariance, split-plot design. Factorial arrangements of treatments, multiple regression in estimation and curvilinear regression, enumeration data. *No degree credit for students with credit in 4063.*

STAT 4033 Engineering Statistics. Prerequisite(s): MATH 2163. Probability, random variables, probability distributions, estimation, confidence intervals, hypothesis testing, linear regression. *No degree credit for students with credit in STAT 4073.*

STAT 4043* Applied Regression Analysis. Prerequisite(s): One of 4013, 4033, 4053, 5013 or equivalent. Matrix algebra, simple linear regression, residual analysis techniques, multiple regression, dummy variables.

STAT 4053 (A) Statistical Methods I for the Social Sciences. Prerequisite(s): MATH 1513. Basic experimental statistics, basic probability distributions, methods of estimation, tests of significance, linear regression, calculation and analysis of variance for one and two-way classifications. *No degree credit for students with credit in STAT 4013.*

STAT 4063* Statistical Methods II for the Social Sciences. Prerequisite(s): 3013 or 4013 or 4033 or 4053. Basic concepts of experimental design. Analysis of variance, covariance, split-plot design. Factorial arrangements of treatments, multiple and curvilinear regression, enumeration data. *No degree credit for students with credit in STAT 4023.*

STAT 4073 Engineering Statistics with Design of Experiments. Prerequisite(s): MATH 2163. Random variables and basic probability distributions, estimation, confidence intervals, hypothesis testing, basic analysis of variance, factorial arrangement of treatments and fractional factorial experiments, elementary quality control. *No degree credit for students with credit in STAT 4033.*

STAT 4091* SAS Programming. Prerequisite(s): 4013 or equivalent. SAS dataset construction, elementary statistical analysis, and use of statistics and graphics procedures available in SAS. *No credit for students with credit in 5091.*

STAT 4203* Mathematical Statistics I. Prerequisite(s): MATH 2163 with a grade of "C" or better. Introduction to probability theory for students who are not graduate majors in statistics or mathematics. Probability, dependence and independence, random variables, univariate distributions, multivariate distributions, moments, functions of random variables, moment generating functions.

STAT 4213* Mathematical Statistics II. Prerequisite(s): 4203 and MATH 3013. Statistical inference for students who are not graduate majors in statistics or mathematics. Sampling distributions, maximum likelihood methods, point and interval estimation, hypothesis testing.

STAT 4910* Special Studies. 1-6 credits, max 6. Prerequisite(s): Consent of instructor. Special subjects in statistics.

STAT 4991 Statistics Capstone. Prerequisite(s): STAT 4023, 4043, 4091, and 4203 or concurrent enrollment. Career skills for statistics undergraduates entering the workforce, communication skills for collaborating with scientists, graduate school preparation.

STAT 4993 Senior Honors Project. Prerequisite(s): Departmental invitation, senior standing, Honors Program participation. A guided reading and research program ending with an honors project under the direction of a faculty member, with a second faculty reader and an oral examination. Required for graduation with departmental honors in statistics.

STAT 5000* Master's Research. 1-6 credits, max 6. Prerequisite(s): Consent of advisory committee. Methods of research and supervised thesis or report.

STAT 5003* Statistics for Medical Residents. Prerequisite(s): Employed as a medical or veterinary resident or permission of instructor. Survey of statistical methodology relevant to health care professionals. Basic understanding of statistics presented in recent medical literature. Hypothesis testing, ANOVA techniques, regression, categorical techniques. *(Same as course BIOM 5003).*

STAT 5013* Statistics for Experimenters I. Prerequisite(s): Graduate standing and MATH 1513. Introductory statistics course for graduate students. Descriptive statistics, basic probability, probability distributions, fundamentals of statistical inference, hypothesis testing, regression, one-way classification, analysis of variance, comparative experiments, correlation and linear regression, introduction to categorical data analysis.

STAT 5023* Statistics for Experimenters II. Prerequisite(s): Graduate standing and 4023 or 5013. Analysis of variance, covariance, use of variance components and their estimation, completely randomized, randomized block and Latin square designs, multiple comparisons.

STAT 5033* Nonparametric Methods. Prerequisite(s): One of 4023, 4043, 5023 or consent of instructor. A continuation of 4013 and 4023, concentration on nonparametric methods. Alternatives to normal-theory statistical methods; analysis of categorical and ordinal data, methods based on rank transforms, measures of association, goodness of fit tests, order statistics.

STAT 5043* Sample Survey Designs. Prerequisite(s): One of 4013, 4033, 5013 or consent of instructor. Constructing and analyzing personal, telephone and mail surveys. Descriptive surveys including simple random, stratified random designs. Questionnaire design, frame construction, non-sampling errors, use of random number tables, sample size estimation and other topics related to practical conduct of surveys.

STAT 5053* Time Series Analysis. Prerequisite(s): 4043. An applied approach to analysis of time series in the time domain and the frequency domain. Descriptive techniques, probability models for time series, autoregressive processes and forecasting. Box-Jenkins methods, spectral analysis and use of computers.

STAT 5063* Multivariate Methods. Prerequisite(s): 4043 and 4023 or 5023. Use of Hotelling's T-squared statistic, multivariate analysis of variance, canonical correlation, principal components, factor analysis and linear discriminate functions.

STAT 5073* Categorical Data Analysis. Prerequisite(s): 5223, 5023 or equivalent or concurrent enrollment. Analysis of data involving variables of a categorical nature. Contingency tables, exact tests, binary response models, loglinear models, analyses involving ordinal variables, multinomial response models. Computer usage for analysis is discussed.

STAT 5083 Statistics for Biomedical Researchers. Prerequisite(s): STAT 5013. Analysis of variance, experimental designs pertaining to medical research, regression and data modeling, categorical techniques and the evaluation of diagnostic tests. No credit for students with credit in STAT 5023.

STAT 5091* SAS Programming. Prerequisite(s): 5013 or equivalent. SAS dataset construction, elementary statistical analysis, and use of statistics and graphics procedures available in SAS. No credit for students with credit in 4091.

STAT 5093* Statistical Computing. Prerequisite(s): 5123 or 4203, 5013 or equivalent, CS 1113 or equivalent. Random variable generation; numerical calculations of maximum likelihood estimators, quasi-likelihood estimators, probabilities, and quantiles; computer intensive exact tests and distributions;

randomized tests; bootstrap and jack knife methods, Monte Carlo simulations Markov Chain Monte Carlo methods for Baysian estimation.

STAT 5123* Probability Theory. Prerequisite(s): MATH 2163 and one other course in MATH that has either 2144 or 2153 as a prerequisite. Basic probability theory, random events, dependence and independence, random variables, moments, distributions of functions of random variables, weak laws of large numbers, central limit theorems.

STAT 5133* Stochastic Processes. Prerequisite(s): 5123 and MATH 2233, MATH 3013. Definition of a stochastic process, probability structure, mean and covariance function, the set of sample functions, stationary processes and their spectral analyses, renewal processes, counting processes, discrete and continuous Markov chains, birth and death processes, exponential model, queuing theory. (Same course as IEM 5133* & MATH 5133*)

STAT 5213* Bayesian Decision Theory. Prerequisite(s): 5223. Statistical spaces, decision spaces, loss and risk, minimum risk decisions, conjugate families of distributions, Bayesian decisions.

STAT 5223* Statistical Inference. Prerequisite(s): 5123 and MATH 3013. Sampling distributions, point estimation, maximum likelihood methods, Rao-Cramer inequality, confidence intervals, hypothesis testing, sufficiency, completeness.

STAT 5303* Experimental Design. Prerequisite(s): 5023 or 4023 with consent of instructor. Review of basic concepts and principles of comparative experiments, the role of randomization in experimentation, interpretation of effects and interactions in multi-factor designs, error term selection principles, multiple comparisons, split-unit experiments, incomplete block designs, confounding of factorial effects in 2n and 3n series of factorials, single and fractional replication optimum seeking designs, pooling of experiments over time and space, crossover and switch back designs.

STAT 5323* Theory of Linear Models I. Prerequisite(s): 5223, and MATH 3013, and one of 4023 or 5023. Multivariate normal distributions of quadratic forms, general linear models, Markov theorem, variance components, general linear hypotheses of full rank models.

STAT 5333* Theory of Linear Models II. Prerequisite(s): 5323. Maximum likelihood estimation; missing data structures; balanced incomplete block design; less than full rank models; general mixed models; intrinsically linear models; sequential estimation.

STAT 5513* Multivariate Analysis. Prerequisite(s): 5323. Multivariate normal distribution, simple, partial and multiple correlation, multivariate sampling distributions. Wishart distribution, general T-distribution, estimation of parameters and tests of hypotheses on vector means and covariance matrix. Classification problems, discriminate analysis, and applications.

STAT 5910* Seminar in Statistics. 1-6 credits, max 12. Prerequisite(s): Consent of instructor. Investigation of special problems in the theory and/or application of statistics using current techniques. Special studies for M.S. level students.

STAT 6000* Doctoral Dissertation. 2-10 credits, max 30. Prerequisite(s): Consent of advisory committee. Directed research culminating in the PhD thesis.

STAT 6001* Statistics Literature. Prerequisite(s): consent of instruct. Published journal articles from statistics or related areas are discussed.

STAT 6013* Genetic Statistics. Prerequisite(s): A one-year graduate level sequence in statistics or with the permission of the instructor. Course provides a statistical basis for modeling genetic evolution in populations and describing variation in quantitative traits. Population genetics principles will be used to study DNA sequence variation and quantitative traits.

STAT 6113* Probability Theory. Prerequisite(s): 5123 and MATH 5143. Measure theoretical presentation of probability, integration and expectation, product spaces and independence, conditioning, different kinds of convergence in probability theory, statistical spaces, characteristic functions and their applications.

STAT 6203* Large Sample Inference. Prerequisite(s): 5223 and 6113. Different types of convergence in probability theory, central limit theorem, consistency, large sample estimation and tests of hypotheses, concepts of asymptotic efficiency, nonparametric tests.

STAT 6223* Advanced Statistical Inference. Prerequisite(s): 6113. Point estimation, maximum likelihood, Cramer-Rao inequality, confidence intervals, Neyman-Pearson theory of testing hypothesis and power of test.

STAT 6910* Special Problems. 1-6 credits, max 12. Prerequisite(s): Consent of instructor. Investigation of special problems in the theory and application of statistics using current techniques. Special studies for PhD level students.

Strategic Communication (SC)

SC 2183 Introduction to Strategic Communications. Prerequisite(s): Departmental majors only. This course provides students with information and insights about strategic communications: how messages are created and framed, why we respond to messages the way we do, and how to employ communications strategies to advance organizational goals. The course will address the media, methods, functions and ethics of institutions' communication and interactions with a variety of audiences with an emphasis on public relations and advertising.

SC 3003 Media Writing for Strategic Communication. Lab 2. Prerequisite(s): ENGL 1213, 1223 or 1413 with a grade of "C" or higher. For SC majors only. Teaches writing skills vital to a career in strategic communication. Emphasizes language skills with a focus on the rules of grammar and the meaning of words. Also teaches the basic strategies of information gathering, including how to glean accurate and useful background information from traditional and online sources. Introduces students to the fundamental writing styles and objectives required to convey information in different media. No credit for students with credit in MC 2003.

SC 3353 Persuasive Writing for Strategic Communicators. Lab 2. Prerequisite(s): MC 2003 and MC 2023 and SC 2013 or 2183 with a grade of "C" or better in each; and a minimum grade of 70 on the Language Exam. An examination of the language of persuasive communication, how persuasion works and the techniques of persuasive message strategy. Application of persuasive writing for traditional media and emerging digital media.

SC 3383 Strategic Communications Management and Strategies. Prerequisite(s): MC 2003 and 2023 with Cs or better, SC 2183 with "C" or better, minimum grade of 70 on Language Exam. The practice and techniques of public relations as a management function in business, industry, agriculture, government, education and other fields.

SC 3443 Social Media. Prerequisite(s): MC 2003 and MC 2023 and SC 2013 or SC 2183 with a grade of "C" or better in each; and a minimum grade of 70 on the Language Exam. The practice and application of social media such as Facebook, MySpace, Twitter and other social networking sites to public relations practice.

SC 3600 Strategic Communications Internship. 1-3 credits, max 6. Prerequisite(s): 3353 and 3753 with a grade of "C" or better in both and consent of instructor; and a minimum grade of 70 on the Language Proficiency Exam. Internship practice for qualified strategic communications students who wish creative communications experience beyond that available in the classroom.

SC 3603 Copywriting and Creative Strategy. Lab 2. Prerequisite(s): 3353 and 3753 with "C" or better in both; and a minimum grade of 70 on the Language Exam. Emphasis on developing creative strategy in the context of an advertising campaign. Focus on the "Big Idea" with in-depth skills development in advertising copywriting across all media and formats.

SC 3753 Graphic Design for Strategic Communication. Lab 2. Prerequisite(s): MC 2003 and MC 2023, and SC 2013 or SC 2183 with a grade of "C" or better in each; and a minimum grade of 70 on the Language Exam. An analysis and application course focused on designing elements used in strategic communication to include both traditional media and new media. Creative and practical aspects of typography, layout and design. Lab component offers hands-on instruction and skills development.

SC 3953 Research Methods for Strategic Communicators. Prerequisite(s): MC 2003 and MC 2023 and SC 2013 or SC 2183 with a grade of "C" or better in each; and STAT 2013 or 2053; and a minimum grade of 70 on the Language Exam. Provides an overview of strategic communication research, with an emphasis on its application to the development and evaluation of the strategic communication message. Audience and media research are studied, and primary and secondary information sources are employed. Procedures for conducting a research project are outlined, and students participate in the research planning process, the gathering of primary data, and the analysis and presentation of results.

SC 4013 Media and Markets. Prerequisite(s): MC 2003 with a grade of "C" or better, 2013 or 2183 with a grade of "C" or better; and a minimum grade of 70 on Language Proficiency Exam. Introduction to the strategic use of media. Major principles of media planning and buying, audience measurement, media research, new media technology, and market segmentation.

SC 4223 Media Sales and Marketing. Prerequisite(s): MC 2003 and MC 2023 with a grade of "C" or better in both; and a minimum grade of 70 on the Language Exam. The primary focus of this course is to learn to sell advertising time and space and gain insight into the professional sales process. Course will explore the role of sales in the marketing mix, the intricacies of the different local media available to advertisers, how to make effective sales presentations and the art of prospecting.

SC 4383 Media Relations. Prerequisite(s): Senior standing, minimum graduation/retention GPA of 2.5. Strategies for dealing with the news media. Students will gain hands-on experience in conducting media news conferences, pitching story ideas and preparing themselves and other for dealing with news media interviews. Meets with MC 5383. No credit for students with credit in MC 5383.

SC 4493 Advanced Public Relations Writing. Lab 2. Prerequisite(s): 3353 and 3753 both courses with "C" or better; minimum grade of 70 on Language Exam. An advanced application course in creating, planning, researching, writing, editing and designing of multimedia materials used in public relations communications.

SC 4520 Specialized Strategic Communication Applications. 3 credits, max 6. Prerequisites: 3353 and 3753 with a grade of "C" or better in both;

and a minimum grade of 70 on the Language Exam. Professional strategic communications at an advanced level. Strategic communications study of non-profit, corporate, agency, international and other specialized applications. Course content varies by semester. *No credit for students with credit in MC 5520 during the same semester or with the same subtitle.*

SC 4603 Integrated Marketing Communication. Prerequisite(s): MC 2003 and MC 2023, and SC 2013 or SC 2183 or MKTG 3213 with a grade of "C" or better in each; and a minimum grade of 70 on the Language Exam. Planning and the value of coordinating the various promotional mix elements within a communication campaign to create maximum clarity and impact. Communication elements including advertising, public relations, direct marketing and sales promotion and examine strategies for combining and integrating them into an effective campaign. Theories, models and tools to make better promotional communication decisions. *No credit for students with credit in MC 5603*.

SC 4653 Electronic Media Advertising. Prerequisite(s): 2013 or 2183 or MKTG 3213 with a grade of "C" or better; and a minimum grade of 70 on the Language Exam. Introduction to the strategic use of entertainment marketing and new media in advertising. Major principles of engagement through current trends in advertising and branding via new technologies, product placement, sponsorship, and cross promotions. All types of new media and entertainment marketing will be explored and analyzed including, but not limited to, Internet advertising, product placement in film, TV and gaming, mobile marketing, and viral marketing.

SC 4663 Professional Portfolio. Lab 2. Prerequisite(s): 3353 and 3753; or MMJ 4423 with a grade of "C" or better in each; or permission of instructor; minimum grade of 70 on Language Proficiency Exam. Designed to help students polish and present their design and creative work in an integrated package coupled with personalized identity materials. Emphasis will be on applying advanced visual and graphic communication theories to present an attractive and persuasive portfolio of creative work. It is intended for students who have completed a significant amount of course work in their field. An intermediate level of experience with desktop design software is assumed.

SC 4843 Strategic Communication Campaigns. Prerequisite(s): 3383, 3953, 4013; and 3603 OR 4493 ALL with "C" or better; and minimum grade of 70 on Language Proficiency Exam. Planning, preparation and presentation of comprehensive integrated strategic communication campaigns for national or local clients. Student teams produce all aspects of the campaign, from conception to presentation. Satisfies capstone requirement for strategic communication majors.

SC 4980 Advertising Competitions. 3 credits, max 6. Prerequisite(s): Consent of instructor. Research and construction of a comprehensive communications marketing campaign for the America Advertising Federation National Student Advertising Competition. Student team members must make application for admission.

Student Development (SDEV)

SDEV 1113 Orientation in Student Athletics. To assist students to better understand and comply with the academic and athletic demands on student-athletes at a NCAA Division I university, including NCAA compliance issues.

SDEV 3013 (S) Leadership Concepts. Prerequisite(s): 12 hours completed course work. Increases undergraduate student competence through the study of leadership concepts. Stresses communications, decision-making, leadership styles and theories and group dynamics. Attempts integration of theoretical concept with reality of application within the university community.

SDEV 3091 Student Development Theory for Orientation Leaders. Prerequisite(s): Consent of instructor. Theories of student development. Topics include helping skills, student leadership community building, communication skills, and multicultural sensitivity. Application of theory to university orientation programs.

SDEV 3092 Student Development Training for Resident Assistant. Theories of student development. Topics include helping skills, community building, communication skills, and multicultural sensitivity. Application of theory to living groups.

SDEV 5000* Master's Thesis. 1-6 credits, max 6. Prerequisite(s): Consent of instructor.

SDEV 5173* Introduction to Student Affairs. History, philosophy, and goals of student affairs units in colleges and universities; emphasis on practitioner roles and responsibilities.

SDEV 5213* Student Development Theory. Examination of theories describing patterns of growth and development during the college years. Implications for the design of education practice on the college campus.

SDEV 5223* Career Development for College Students. In-depth exploration of issues and contemporary theory related to the topic of career development for college students.

SDEV 5233* Advanced Student Development Theory. Prerequisite(s): 5213. Focus is on contemporary and emerging theories of traditionally aged college student development from cognitive, spiritual, gender, racial identity, and student success families.

SDEV 5320* Seminar in Student Development. 3-6 credits, max 6. Prerequisite(s): Consent of instructor. In-depth exploration of contemporary problems of applied behavioral studies.

SDEV 5333* Effective Leadership in Student Services. Prerequisite(s): 6173 or consent of instructor. The organization and management of student services operations in postsecondary institutions. Models for policy and decision-making as well as leadership and supervision issues.

SDEV 5433* Group and Cultural Interventions in Student Affairs. Prerequisite(s): Consent of instructor. Explores group theory, dynamics and cultural dimensions as these factors relate to working with college students and advising student groups in a higher education environment.

SDEV 5463* Legal Issues in Student Affairs. Prerequisite(s): 5173 or 6173. Legal issues confronted by entry-level student affairs practitioners, how to recognize these issues, and how to act within the parameters of the law.

SDEV 5733* Environmental Theory and Student Affairs. Prerequisite(s): Consent of instructor. Examination of campus environmental theory providing an understanding of campus environments approach to student affairs practice.

SDEV 6000* Doctoral Dissertation. 1-9 credits, max 9. Prerequisite(s): Consent of instructor. Required of all candidates for doctorate in applied behavioral studies. Credit give upon completion and acceptance of dissertation.

SDEV 6173* Administrative Issues in Student Affairs. Develops an understanding of the history, philosophy, student life, critical issues and administration of student personnel work in higher education.

SDEV 6213* Higher Education Student Personnel Services. Prerequisite(s): 6173 or consent of instructor. Higher education student personnel services such as: admissions, orientation, student activities, financial aids, housing, and counseling.

SDEV 6220* Internship in Higher Education Student Personnel. 1-3 credits, max 6. Prerequisite(s): 6213 or consent of instructor. Work and study opportunities under supervision in areas of student housing, student activities, financial aid, foreign student advisement, student personnel administration, student union, group facilitation and other appropriate work situations.

SDEV 6850* Directed Reading. 1-6 credits, max 6. Prerequisite(s): Consent of instructor. Directed reading for students with advanced graduate standing.

Telecommunications Management (TCOM)

TCOM 3153 (I) International Telecommunications Business Environment. Prerequisite(s): 2103 or consent of instructor. This course concentrates on understanding the implications and challenges of utilizing telecommunications networks in today's global business environment. Emphasis will be placed on identifying the major players in the global information infrastructure, standards setting bodies and procedures, and the various regulatory processes encountered. Students will research the telecommunications industry in other countries and develop comprehensive written reports.

TCOM 3203 Telecommunications Industry Foundations. Prerequisite(s): Consent of instructor. Emerging trends in the telecommunications industry. Past events, regulatory and legal implications, strategic direction of organizations with respect to telecommunications.

TCOM 3223 Network Design Principles. Prerequisite(s): MSIS 3223. Management science principles applied to telecommunications network design. Specific topics will include mathematical programming, network models, simulation, and queuing theory.

TCOM 5012* Telecommunications Laboratory. Prerequisite(s): ECEN 5553, TCOM 5123 or co-requisite. Familiarization with the hardware used to move voice, data and video traffic. Data network experiments include set up and operation of a small LAN, interconnection of these LANs via bridges or routers, and attachment of voice and video modules to the LANs. Telephone network experiments include installation of small PBXs and interconnection of them to the campus phone system, and interconnection of the lab PBXs with crosspoint switches and fiber. Video experiments include interconnection and operation of a small two-camera studio, and digitizing and transferring the video over the laboratory telephone system. Practical operating aspects and standards of distance transmission devices, switching equipment media for transmitting data, voice and video signals. Handling information problems within selected environments.

TCOM 5113* Industry Overview and Telecommunications Applications. Prerequisite(s): Graduate standing and consent of program director. Overview of telecommunications industry, technology, regulatory environment, and current topics in telephone services (wireless and wireline), business data services, CATV, and Internet services and providers (including JAVA and HTML). Managerial and strategic aspects of telecommunications technologies. Guest speakers from the telecommunications industry.

TCOM 5123* The Upper Layers of Telecommunications Systems. Applied technical coverage of selected topics from the upper layers of the OSI model. Network and Transport layers using, TCP/IP, IPX/SPX, as well as security issues and other multi-layer protocol suites. Other topics include flow control, RSVP, encryption, compression, and LAN/WAN applications.

TCOM 5143* Telecommunications Systems Analysis, Planning and Design I. Prerequisite(s): ECEN 5553 and consent of program director. The

fundamentals behind systems analysis and design of telecommunication systems from a managerial perspective. Financial analysis of telecommunication projects, fundamentals of mathematical modeling and queuing theory, and other management tools that are key to the design and analysis of telecommunication networks.

TCOM 5153* International Telecommunications Management. Prerequisite(s): Graduate standing and consent of program director. Investigation of the institutions that affect the use of telecommunications. The various parts of the federal government involved, such as the Department of Commerce, the FCC and the Department of State. The role of international institutions, including the ITU, UNESCO, and the various satellite organizations such as INTELSAT.

TCOM 5160* Telecommunications Practicum. 1-3 credits, max 3. Prerequisite(s): Graduate standing and consent of program director. Fulfills creative component requirement for TCOM MS. Application of knowledge and skills developed in core courses in an organizational environment to solve telecommunications management problems. Integration of concepts and adaptation of theory to fit organizational reality.

TCOM 5173* Global Telecommunications Regulation. Historical review of the classical "PTT (Post, Telephone and Telegraph) Model", and the development of new competitive environments. Overview of international telecommunications networks and how they are regulated nationally and internationally. Review of the World Trade Organization (WTO) and the telecommunications commitments made by members. Emphasis on the European Union as the largest single telecommunications market, along with analyses of regional emerging markets. Review of challenges for the future for both regulatory agencies and telecommunications operators and providers.

TCOM 5193* Capstone: Telecommunications Systems Analysis and Design. Prerequisite(s): 5113, 5123, ECEN 5553, 23 hours of relevant graduate course work, and consent of program director. Application of knowledge gained throughout the curriculum to basic systems analysis tools and techniques to perform an analyses and designs in a telecommunications context. Knowledge of technology, management, international aspects, and regulatory environment to provide an overall view of impact that a given system may have on an organization. System documentation through use of classical and structured tools and techniques for describing flows, data flows, data structures, file designs, input and output designs, and program specifications may be used.

TCOM 5213* Telecommunications Systems Analysis, Planning and Design II. Prerequisite(s): 5143, ECEN 5553, and consent of program director. The fundamentals behind systems analysis and design of telecommunication systems from an engineering perspective. Advanced mathematical modeling and queuing theory, graph theory, network design algorithms and other tools that are key to the design and analysis of telecommunication networks. An in-depth, technical and quantitative follow-up to TCOM 5143.

TCOM 5223* Information Assurance Management. A broad investigation of the elements of information assurance and security with an emphasis on the management impact to corporations and businesses engaged in information services and electronic commerce. Students should come away from the course with the ability to advise management on the risks and mitigation for all types of threats to information and privacy.

TCOM 5233* Applied Information Systems Security. Prerequisite(s): 5123. An investigation into the various technical aspects of attacking, and of guarding against attacks and failures in various types of information systems. Course content may vary but includes computer, network, and data protection technologies (e.g., firewalls, packet filters, proxy servers, user authentication and validation techniques, encryption, backup methodologies, system and component redundancies, etc.). Various threats and attack methods examined.

TCOM 5243* Information Technology Forensics. Prerequisite(s): 5123, consent of department head. Review of systems for vulnerabilities and analysis of systems that have been breached. This course will cover the many related issues and have a heavy hands-on component.

TCOM 5253* Advanced System Certification and Accreditation. Prerequisite(s): Consent of the MS in MIS director. Preparing information systems for operational status requires significant planning and sound execution. Covers the key components of the certification and accreditation process, including risk assessment and mitigation, system security analysis, controls and system documentation.

TCOM 5273* Legal and Ethical Issues in Information Technology. This course reviews the current status of information systems law in regard to rights of privacy, freedom of information, confidentiality, work product protection, copyright, security, legal liability, ethical issues and a range of additional legal and information policy topics. We will investigate the legal difficulties that technological innovations are causing in all of these areas. Legal options for dealing with the conflicts caused by technological change and likely adaptations of the law over time in response to societal changes will be explored. *No credit for students having completed MSIS 4273.*

TCOM 5283* Operating Systems for Information Assurance. Operating Systems (OS) concepts for security. Vulnerabilities and threats. Security models. User authentication. Smart cards: architectures, technologies, application environments, and case studies. System availability. Software and data integrity. Auditing. Sensitive data confidentiality. Access control. Secure OS development: design principles, design methodologies, security certification. Case studies: Unix/Linux, MS-Windows XP/2000.

TCOM 5310* UNIX Administration Laboratory. 1-3 credits, max 9, Lab 16-48. Prerequisite(s): Must have taken or currently enrolled in 5223 or 5233 and have consent of program director. Common administration level tasks associated with managing systems that run Unix and Unix derivatives. Utilities and resources commonly deployed in support of network infrastructure.

TCOM 5320* Infrastructure Security Lab. 1-3 credits, max 9, Lab 16-48. Prerequisite(s): Must have taken or currently enrolled in 5223 or 5233 and have consent of program director. Hands-on experience with various technical aspects of managing the perimeter of a connected network. Network hardware, such as routers, switches and firewalls. Course content variable, but includes computer, network, and data protection technologies.

TCOM 5330* UNIX Security Lab. 1-3 credits, max 9, Lab 16-48. Prerequisite(s): Must have taken or currently enrolled in 5223 or 5233 and have consent of program director. Hands-on experience with various technical aspects of managing security, protecting information technology assets, and both attacking and guarding against attacks and failures in UNIX and Linux systems. Course content variable, but includes computer, network, and data protecting technologies.

TCOM 5340* Security Lab. 1-3 credits, max 9, Lab 16-48. Prerequisite(s): Must have taken or currently enrolled in 5223 or 5233 and have consent of program director. Hands-on experience with various technical aspects of managing security, protecting information technology assets, attacking and of guarding against attacks and failures in information systems. Course content variable but includes computer, network, and data protection technologies (e.g. firewalls, packet filters, proxy servers, user authentication and validation techniques, data encryption, establishing virtual private networks, creating and using digital certificates for authentication, using encrypted e-mail technologies). Several threats and attack methods explored (e.g. sniffers, password crackers, network scanners, etc.).

TCOM 5350* Advanced Telecommunications Management. Lab. 2-3 credits, max 3, Lab 2-3. Prerequisite(s): 5012 and consent of program director. Advanced state-of-the-art topics in voice, data and video. Hands-on network experiments beyond coverage in the required TCOM 5012 lab.

TCOM 5360* Wireless Communications Laboratory. 1-3 credits, max 9, Lab 16-48 Prerequisite(s): ECEN 4523, ECEN 5553 and consent of program director. Conducting wireless-modem and wireless-networking experiments and analyzing the problems that result in improved designs for wireless systems and networking performance.

TCOM 5370* Windows Security Lab. 1-3 credits, max 9, Lab 16-48. Prerequisite(s): Must have taken or currently enrolled in 5223 or 5233 and have consent of program director. Hands-on experience with various technical aspects of managing security, protecting information assets, and both attacking and guarding against attacks and failures in Windows systems. Course content variable, but includes computer, network, and data protection technologies.

TCOM 5380* System Technologies for Information Assurance. 1-3 credits, max 3, Lab 1-3. Prerequisite(s): 5223, consent of director. The basic parts of an operating system, including memory handling, processing and I/O functions. Areas of the OS most often exploited in information assurance breaches, as well as those that serve as the building blocks for upper-layer attacks. OS structures, process management, memory management, storage management, protection and security, distributed systems, and special purpose systems. For non-computer science majors, and may not be taken for credit if another course in operating systems has already been completed.

TCOM 5410* Advanced Topics in Telecommunications Management. 3 credits, max 3. Prerequisite(s): Graduate standing and consent of program director. Advanced topics in the interdisciplinary field of telecommunications management, such as legal and regulatory issues, electronic commerce, Internet and Intranet development.

TCOM 5990* Directed Studies in Telecommunications Management. 1-6 credits, max 6. Prerequisite(s): Graduate standing and consent of program director. Special advanced topics, projects and independent study in telecommunications management.

Theatre (TH)

TH 1323 Acting I. Ensemble techniques and creative improvisation; vocal and physical development for the actor; theories and techniques of acting; fundamental scene and character analysis; scene performance workshops.

TH 1500 Run Crew Practicum. 1 credit, max 6. Practical application of run crew duties by participation in technical rehearsals and performances for a Theatre Department production.

TH 1663 Stage Technology. Lab 4. Elementary techniques of stagecraft for the stage. Basic stagecraft skills. Practical experience preparing departmental productions.

TH 1673 Costume Technology. Lab 4. Elementary techniques of costume craft for the stage. Basic costuming skills. Practical experience preparing departmental productions.

TH 2213 Stage Speech and Diction. Lab 2. This course will focus on learning

the "General American" or "Broadcast Standard" accent of English. Also the student will be able to read and write in the International Phonetic Alphabet. Lastly articulatory process will be sharpened for better communication skill, no matter what career in which speech is used.

TH 2323 Acting II. Continuation and refinement of 1323. Textual and character analysis, characterization and inner techniques based on Stanislavskian system. Audition techniques and scene work focusing on truthful behavior through work on modern and contemporary plays.

TH 2412 Theatrical Dance: Jazz I. Lab 4. Jazz dance techniques for theatrical performance emphasizing body alignment, coordination, flexibility, rhythm and jazz dance vocabulary in simple dance combinations. Artistic development of dance performers.

TH 2413 (H) Introduction to the Theatre. Character, plot, thematic, historical and production analyses of various types of play scripts; understanding the work of various theatre artists; developing appreciative audiences.

TH 2432 Theatrical Dance: Tap I. Lab 4. Fundamentals of tap dance techniques for theatrical performance emphasizing coordination, rhythm, and dance vocabulary in simple tap combinations. Artistic development of dance performers.

TH 2500 Production Crew Practicum. 1-2 credits, max 6. Prerequisite(s): 1663 or 1673. Laboratory experience in the theatrical production process through participation on a production crew for a department production or semester.

TH 2553 Introduction to Stage Design. Prerequisite(s): 1663 and 1673 or consent of instructor. An integrated overview of the theory and practice of design for the stage.

TH 2563 Play Analysis. Play analysis and writing for the theatre from the point of view of different theatre practitioners and scholars. Course focuses on the techniques necessary for the transfer of dramatic literature to theatrical production.

TH 2633 Movement for the Actor. Lab 2. This is an introductory course to the physical aspects of role creation. It will introduce the student to several methodologies used in analyzing and altering physical performance in theatre and film. The primary method of analysis will be based on the theories of Laban/ Bartinieff and LeCoq. Masking, mime and period movement will be introduced. The students will be evaluated on the application of theories discussed and demonstrated in class.

TH 2833 Transitions to Professions in Design and Technology. Prerequisite(s): 1663 and 1673; and 1500 or 2500. Preparation for transition into the professional world for theatre designers and technicians. Includes career development, national/international theatre organizations, portfolio preparation, websites, resume/application writing and interviewing.

TH 2971 Stage Makeup. Lab 2. Techniques of basic stage makeup. Application of makeup including a study of facial anatomy and character development. Laboratory work in preparation for departmental productions.

TH 3183 Scene Design for Theatre. Prerequisite(s): 2553 and 2563 or consent of instructor. The scenic designer's approach to the script; execution of sketches, models, and working drawings.

TH 3213 Dramaturgy. Investigation of the nature and process of dramaturgy. Emphasis on analytical, research, and writing skills useful to all theatre artists. No credit for students with credit in 5313.

TH 3323 Sound Design and Technology. Prerequisite(s): 2553 and 2563 or consent of instructor. Use and design of sound in theatrical productions, including voice reinforcement, scoring, script analysis, and effects.

TH 3373 Acting III. Lab 2. Prerequisite(s): 1323 and 2323 or consent of instructor. This class explores techniques of classical verse plays through the works of William Shakespeare. Students will begin to acquire the tools to speak Elizabethan verse text and other poetic text.

TH 3400 Upper-Division Projects. 1-3 credits, max 6. Prerequisite(s): Consent of instructor. Individual or group study of techniques, history, or literature of the theatre. Required written survey of the project and self-evaluation of its results, or a term paper. Cannot receive credit for both 3400 and 5400.

TH 3433 Acting for the Camera. Lab 2. The course is designed to introduce the student to acting techniques for electronic media. Emphasis will be on practical application of theory. Through a series of scenes and exercises the student will become aware of the differences and similarities between stage and screen acting. Basic film editing, camera work, lighting and sound will be explored. The course will conclude with a final project, to be screened for the department.

TH 3452 Musical Theatre Dance. Lab 4. Course focuses on training performers in the various dance styles used in Broadway and off-Broadway musicals, demonstrating these dance skills by performing pieces of choreography created by well-known musical choreographers such as Susan Stroman, Gower Champion, Michael Bennett, Agnes de Mille, Joe Layton, Jerry Mitchell, and Bob Fosse.

TH 3500 Theatre Practicum II. 1-2 credits, max 4. Prerequisite(s): Consent of instructor. Advanced laboratory experience in theatre production, design, acting, and/or major crew assignments.

TH 3530 Topics in Performance. 1-3 credits, max 9. Prerequisite(s): Consent of instructor. Specialized topics in acting or directing.

TH 3593 Lighting for Theatre. Lab 2. Prerequisite(s): 2553 and 2563 or consent of instructor. Stage lighting design, elementary electricity, mechanics of lighting instruments. Practical experience in lighting in preparing and running departmental productions.

TH 3633 (D,H) Voices of Diversity. Survey of dramatic literature and theatre created by diverse dramatists and theatre companies in the United States. Course focus may either be a broad investigation of drama across many different identity groups or an in-depth exploration of the theatrical activity of one group of people.

TH 3853 Auditions and the Professional Actor/Director. Prerequisite(s): 1323, 2323, 3373 or permission of instructor. A professional acting studio focusing on the "business" of show business for actors. Networking and career building strategies will be explored and the building of an actor's repertoire of audition material developed. The course will introduce students to writing resumes, selecting headshots, understanding unions, agents, managers, etc. Various guests will be utilized throughout the semester and will culminate in a public jury.

TH 3923 (H) Theatre History I. Aesthetic and social relationships of theatre and civilization from Ancient Greece to the 18th century.

TH 3933 (H) Theatre History II. Aesthetic and social relationships of theatre and civilization from the 19th century to the mid-20th century.

TH 3943 (H) Contemporary Theatre. Aesthetic and social relationships of theatre and civilizations from the late Twentieth Century through the present.

TH 3953 Costume Design. Lab 2. Prerequisite(s): 2553, 2563 or consent of instructor. Approaches to basic costume design including research, conceptual analysis, figure drawing, and executions of sketches and renderings.

TH 4383* Stage Combat. Lab 4. Prerequisite(s): 2633 or consent of instructor. Safe and effective techniques for portraying theatrical representations of stage violence; melding technical aspects of stage; combat with developing use of the actor's craft.

TH 4403 Senior Honors Project. Prerequisite(s): Departmental invitation, senior standing, Honors Program participation. A guided reading and research program ending with an honors thesis or performance under the direction of a faculty member, with second faculty committee member. Required for graduation with departmental honors in theatre.

TH 4563 Senior Project. Prerequisite(s): Senior standing and consent of instructor. A guided reading and research program ending with a thesis or performance under the direction of a faculty member.

TH 4630 Topics in Design and Technology. 1-3 credits, max 9. Prerequisite(s): TH 1663, 1673 and 2553 or consent of instructor. Specialized topics in scenic, costume, sound, or lighting design or technology.

TH 4653 Advanced Stage Technology. Lab 2. Prerequisite(s): 1663. Advanced study in theatrical production techniques, including metalworking, special fabrications, rigging, and advanced carpentry.

TH 4673* Advanced Costume Construction. Prerequisite(s): 1673. Advanced construction techniques for theatrical costumes. Includes period garments, pattern drafting, fabric manipulation, and boning.

TH 4683 Costume and Props Crafts. Lab 2. Prerequisite(s): 1663, 1673 and 2553 or consent of instructor. Use of advanced materials and techniques in the fabrication of specialized stage and costume props.

TH 4753* Stage Management. Prerequisite(s): Consent of instructor. Procedures and skills of effective stage management. Authoritative coordination of performers and technicians during rehearsal and performance periods. Maintenance and use of the production prompt book, notation of ground plan and blocking; scene shifts; cues for lighting, sound, special effects, and performers; opening and calling the show; post-show wrap-up.

TH 4953* Directing. Prerequisite(s): 1323 and 2563 and 4753 or consent of instructor. Play analysis for production, problems in staging, and the role of the director. Planning and direction of scenes in laboratory situations.

TH 4983* Scene Painting. Lab 3. Elementary techniques of scene painting. Individual projects in large scale in representing marble, rock to landscape, interiors. Color theory, forced perspective, ability to paint different styles. Practical experience preparing for departmental productions.

TH 5000* Master's Thesis and Research. 1-6 credits, max 6. Prerequisite(s): Consent of department head. Master's level research in theatre for thesis option graduate students.

TH 5063* Scenography. Investigation of design styles and theories and the designers whose work advances the artform. Special emphasis will be placed on collaboration strategies for developing visual and directorial production concepts.

TH 5100* Master's Creative Component and Research. 1-3 credits, max 3. Master's level research in theatre for creative component option graduate students.

TH 5113* Theatre History and Theory I. Global study of theatre and performance across cultures and multiple theories used to interpret and construct world theatre history, from ancient times to the nineteenth century.

TH 5223* Seminar in Theatre History. Prerequisite(s): Undergraduate degree or instructor consent. Specific topics in theatre history with focus on theatre production in one historical or artistic era (e.g. Russian Silver Age, Post War French Absurdism, Imperial Roman), or the comparative study of theatre and drama in various nations.

TH 5240* Topics in Advanced Acting. 1-3 credits, max 6, Lab 2. Specialized topics in advanced acting.

TH 5313* Dramaturgy. Advanced investigation of the nature and process of dramaturgy. Emphasis on dramaturgical research and writing. No credit for students with credit in 3213.

TH 5400* Seminar in Theatre. 1-3 credits, max 9. Prerequisite(s): Consent of instructor. Individual or group studies of techniques, history or literature of the theatre. A term paper or written report and self-evaluation of the study or project required. Cannot receive credit for both 3400 and 5400.

TH 5500* Individual Theatre Projects. 1-9 credits, max 9. Prerequisite(s): Consent of instructor. Individual projects in directing, acting, or design and technology for a specified theatre production, with concept, realization, and self-evaluation under faculty guidance.

TH 5513* Theatre History and Theory II. Global study of theatre and performance across cultures and multiple theories used to interpret and construct world theatre history, from the nineteenth century to the present.

TH 5600* Seminar in Dramatic Literature. Prerequisite(s): Consent of instructor. Selected topics in dramatic literature. Texts and themes will vary by semester.

TH 5953* Problems in Advanced Directing. Prerequisite(s): 4953, consent of instructor. Problems in directing styles, especially Shakespeare, comedy, and absurdist drama. Preparation, rehearsal and staging of a complete production by each student.

University (UNIV)

UNIV 0023 Concepts of Algebra. Previous study in algebra is not assumed. Linear equations, laws of exponents, factoring, factoring applications, story problems, and substituting data into formulas. A comprehensive review of arithmetic procedures incorporated throughout the course. This course is not acceptable for degree credit at Oklahoma State University. This course alone will not satisfy remediation requirements. *Graded on a satisfactory-unsatisfactory basis.*

UNIV 0113 Developmental Science Process Skills. Study and investigate the natural world. Emphasis on critical thinking processes. Observation, classification, metric measurement, data table construction, graph construction, and interpretation. May be used to fulfill the science remediation requirement as established by State Regents policy. This course is not acceptable for degree credit at Oklahoma State University. *Graded on a satisfactory-unsatisfactory basis.*

UNIV 0123 Intermediate Algebra. Prerequisite(s): One year of high school algebra or equivalent. In-depth coverage of applications of factoring, arithmetic operations with polynomial and rational algebraic expressions, review of laws of exponents (integers, fractions), simplifying radical expressions, equations (linear, radical, quadratic, rational), and graphing linear equations in two variables. May be used to fulfill the mathematics remediation requirements as established by State Regents policy. This course is not acceptable for degree credit at Oklahoma State University. *Graded on a satisfactory-unsatisfactory basis.*

UNIV 0133 Basic Composition. Intensive instruction in sentence and paragraph structure, punctuation, grammar and word usage. May be used to fulfill the English remediation requirements as established by State Regents policy. This course is not acceptable for degree credit at Oklahoma State University. *Graded on satisfactory-unsatisfactory basis.*

UNIV 0143 Improving College Reading Skills. Instruction to improve reading comprehension, vocabulary building, study and reference skills, and critical thinking. May be used to fulfill the reading remediation requirements as established by State Regents policy. This course is not acceptable for degree credit at Oklahoma State University. *Graded on satisfactory-unsatisfactory basis.*

UNIV 1111 University Academic Services Freshman Orientation. Prerequisite(s): Beginning freshman standing in University Academic Services. Designed to help students ease the transition from high school to college; become aware of campus resources and administrative structures; explore various majors and careers; increase awareness of current issues in education; and enhance study skills and attitudes which can contribute to academic success.

UNIV 2001 Academic Assessment and Evaluation. Required for students in University Academic Assessment Program and available campus wide to students on academic probation. Identification of reasons for experiencing academic difficulty; assessment of reading ability and individual learning styles; understanding university policies and procedures and current issues in American education; development of goals, attitudes, and study skills needed to achieve academic success; and exploration of careers, majors, and alternative educational experiences.

UNIV 2510 Innovative Studies. 1-3 credits, max 6, Lab 0-6. May be used for not more than two semesters for new or experimental topics or techniques.

UNIV 2511 Introduction to Health Careers. An introduction to medical professions related to all areas of human and animal health. *Graded on pass-fail basis.*

UNIV 2611 Health Portfolio Development. For students who have selected a specific health career. Explore how to be a competitive applicant to a health professions school, including factors such as prerequisite courses, GPA, admission test, volunteering, job shadowing, personal statements, interviews, and letters of recommendation.

UNIV 2910 Niblack Research Scholars. 1 credit, max 4, Lab 2. Prerequisite(s): Current recipient of the Niblack Research Scholar Award. Scientific research in a laboratory environment at an early stage of an academic career.

UNIV 3001 Academic Assessment for Transfer Students. Required for students in transfer probation program and available campus wide to upper division students on probation. Assessment of individual learning ability and learning styles; understanding university policies and procedures related to transfer students and current issues in American education; development of goals, attitudes, and study skills needed to achieve academic success; and exploration of careers, majors, and alternative education experiences. No credit for student with credit in UNIV 2001.

UNIV 3110 Directed Study. 1-18 credits, max 18. Prerequisite(s): Written application approved by instructor, the department head, and the dean of the student's college. Independent study, research, field work or internship. *Some sections will be graded on a pass-fail basis.*

UNIV 3511 Health Profession School Preparation. Prerequisite(s): Junior/senior pre-health students. This seminar targets the junior/senior pre-health professional primarily pre-medical, pre-dental, and pre-optometry. The seminar will provide the student with the necessary tools needed for the following to apply to their professional program: the application process; interview process, including a mock interview; composition of a personal statement; MCAT, DAT & OAT preparation; shadowing/volunteer experience. *Graded on a pass-fail basis.*

Veterinary Biomedical Sciences (VBSC)

VBSC 5000* Master's Research and Thesis. 1-6 credits, max 6. Prerequisite(s): Graduate standing. Research problem for meeting requirements of the Masters degree.

VBSC 5010* Professional Skills for Biomedical Sciences. 1-3 credits, max 3. Prerequisite(s): Graduate student standing; consent of instructor. Acquiring skills that are usually not taught in other courses but are essential to be successful in the graduate program as well as in a career in science. Writing and publishing a scientific paper, writing a successful grant proposal, preparing effective oral and poster presentations, and understanding professional ethics in the conduct of scientific research.

VBSC 5013* Veterinary Biomedical Sciences I. Prerequisite(s): Graduate standing in Veterinary Biomedical Sciences program OR permission of the department. The course is designed to provide a comprehensive understanding of cellular and molecular biology including protein and DNA structure and function, gene regulation, membrane function and traffic, mitochondria, cytoskeleton, cell communication, cell cycle, cell death, and cell junctions, adhesion and extracellular matrix as well as other relevant topics.

VBSC 5023* Veterinary Biomedical Science II. Prerequisite(s): 5013 or permission of the department. Integrated applied biology and pathobiology of hosts and pathogens of veterinary interest including infectious disease processes; hemodynamic, inflammatory, immune and tissue repair responses; genetic, environmental, nutritional, and neoplastic disorders; and aging.

VBSC 5103* Biochemical Toxicology. Prerequisite(s): Consent of instructor. In-depth overview of biochemical and molecular mechanisms of interactions between exogenous chemicals and living systems. Transport, distribution, elimination and alteration of exogenous chemicals within the body and mechanisms whereby exogenous chemicals disrupt biochemical processes critical for cell/organ/organismal integrity and function. (No credit for students with degree credit in VBSC 5102*) (Same course as ITOX 5103*)

VBSC 5110* Special Problems. 1-6 credits, max 20. Prerequisite(s): Graduate standing and consent of instructor. Special research problems in the various fields of veterinary biomedical sciences.

VBSC 5120* Current Topics in Veterinary and Biomedical Science. 1 credit, max 4. Prerequisite(s): A minimum of one undergraduate introductory course in microbiology. Development of oral presentation skills, critical thinking and deductive reasoning through the use of discussion of current literature from the field of veterinary and biomedical science as it pertains to the study of infectious disease in humans and animals.

VBSC 5123* Veterinary Histology. Lab 3. Prerequisite(s): Graduate standing and consent of instructor. Organization and structure of cells and tissues of domestic animals.

VBSC 5134* Veterinary Physiology I. Lab 4. Prerequisite(s): Graduate standing

and consent of instructor. Molecular, cellular and organ system physiology. Establishing a base of knowledge and understanding requisite to subsequent courses. (Eight week course)

VBSC 5143* Veterinary Physiology II. Prerequisite(s): Graduate standing and consent of instructor. Molecular, cellular and organ system physiology. Establishing a base of knowledge and understanding requisite to subsequent courses. (Eight week course)

VBSC 5155* Veterinary Physiology III. Prerequisite(s): Graduate standing and consent of instructor. Molecular, cellular and organ system physiology. Establishing a base of knowledge and understanding requisite to subsequent courses.

VBSC 5202* Evaluation of Biomedical Research Data. Prerequisite(s): STAT 5013 or consent of instructor. Statistical analysis of biomedical data with emphasis on selection of appropriate biometrical procedures and interpretation of results rather than on computational aspects of procedures. Exploration of experimental design, data collection, and analysis within the context of biomedical investigation methodologies.

VBSC 5223* Veterinary Parasitology I. Lab 2. Prerequisite(s): Graduate standing and consent of instructor. Introduction to the general principles of parasitism and parasites of veterinary medical importance including taxonomy, morphology, biology of parasites, modes of transmission, host-parasite relationships, infectious processes and pathogenicity, diagnostic methods, treatment and control measures and public health importance.

VBSC 5253* Veterinary Immunology. Lab 4. Prerequisite(s): Graduate standing and consent of instructor. Basic principles of immunology and their application to veterinary medicine.

VBSC 5264* General Pathology. Lab 2. Prerequisite(s): Graduate standing and consent of instructor. Cellular and tissue pathology, pigments, inflammation, immunopathology, disturbances of growth and circulation, and neoplasia. Functional disturbances that accompany changes in structures as well as the causes and pathogenesis of diseases.

VBSC 5323* Veterinary Parasitology II. Lab 2. Prerequisite(s): Graduate standing and consent of instructor. Principles of diagnostic, treatment, control and prevention of animal diseases produced by arthropod, protozoan, rickettsial, and helminth parasites. A problem-based approach to parasitic diseases affecting the integumentary, respiratory, hemic-lymphatic, reproductive, urinary, nervous/sensory, musculoskeletal, and alimentary systems with emphasis on diseases of domestic animals.

VBSC 5333* Pharmacology I. Prerequisite(s): Graduate standing and consent of instructor. Introduction of the principles of pharmacodynamics, drug disposition and pharmacokinetics. Pharmacological effects, mechanisms of actions, metabolism, disposition, clinical indications and toxic effects of drugs acting on the autonomic central nervous, cardiovascular, respiratory, and renal systems.

VBSC 5354* Infectious Diseases I. Lab 4. Prerequisite(s): Graduate standing and consent of instructor. Important animal diseases caused by bacteria, fungi and viruses will be covered on a system basis. Mechanisms of infectious disease processes and the relationship of such processes to disease development, diagnosis, treatment and control. The relationship of zoonotic diseases to community and environmental health as well as important zoonoses.

VBSC 5363* Clinical Pathology. Lab 2. Prerequisite(s): Graduate standing and consent of instructor. Basic concepts pertinent to data interpretation and laboratory methods used in evaluation of disease.

VBSC 5404* Techniques in Parasitology. Lab 1. Prerequisite(s): Graduate standing and general parasitology; helminthology or concurrent enrollment. Experimental application of basic research and teaching techniques in helminthology and protozoology. Individual participation and analysis of experimental situations and techniques applicable to all areas of zoology.

VBSC 5432* Pharmacology II. Prerequisite(s): Graduate standing and consent of instructor. Continuation of 5333 that includes the mechanisms of action, disposition, adverse effects, and indications for groups of pharmacological agents used in veterinary medicine.

VBSC 5454* Infectious Diseases II. Lab 4. Prerequisite(s): Graduate standing and consent of instructor. Continuation of Infectious Diseases I (5354).

VBSC 5482* Hemolymphatic and Oncology. Prerequisite(s): Graduate standing and consent of instructor. Pathogenesis, diagnosis, pathology, medical and surgical treatment, and prevention of diseases related primarily to the blood and lymphatic system. (6 week module)

VBSC 5512* Laboratory Animal Medicine. Lab 1. Prerequisite(s): Graduate standing and consent of instructor. Introductory course focusing on the biology and major diseases of commonly used laboratory animals. (One - 3 hour lab per semester)

VBSC 5532* Molecular Genetics. Prerequisite(s): Graduate standing and consent of instructor. The expression, purification, characterization, and application of biological macromolecules in therapeutics and diagnostic relevant to animal and human health.

VBSC 5533* Toxicology. Prerequisite(s): Graduate standing and consent of instructor. Diagnosis and management of intoxications involving plant, chemical, and biological toxins. (Nine week course) (Two - 2 hour labs per 9 weeks)

VBSC 5542* Clinical Endocrinology I. Prerequisite(s): Graduate standing and consent of instructor. Advanced medical endocrinology addressing diagnostic endocrinology and therapeutic endocrinology. Diagnostic endocrinology shall examine the physiological and medical basis for selecting provocative or non-provocative testing procedures as an adjunct to completing a definitive diagnosis. Therapeutic endocrinology involves the use of diagnostic endocrinology to evaluate the efficacy of medical treatment of endocrinopathies and the medical use of hormonal preparations to control animal physiology or endocrinology and non-endocrine diseases.

VBSC 5554* Bacterial Pathogenesis. Prerequisite(s): Undergraduate course in microbiology and consent of instructor. Survey of pathogenic mechanisms of bacteria and host response covering historic prospective; genetic organization of virulence; regulation of virulence factors; attachment, adhesion, an invasion; capsules and outer membrane proteins; intracellular parasitism; endotoxin; exotoxins; iron acquisition and host sequestration; antibiotic resistance mechanisms; innate immunity; acquired immunity; and evasion of host immunity. Lecture and discussion of directed reading of classic and current literature.

VBSC 5563* Musculoskeletal System. Prerequisite(s): Graduate standing and consent of instructor. Pathogenesis, diagnosis, pathology, medical and surgical treatment, and prevention of diseases related primarily to the musculoskeletal system. (Ten week course) (Two - 2 hour labs per 10 weeks)

VBSC 5564* Alimentary System. Prerequisite(s): Graduate standing and consent of instructor. Pathogenesis, diagnosis, pathology, medical and surgical treatment and prevention of diseases related primarily to the alimentary system. (Fourteen week course)

VBSC 5583* Dermatology and Endocrinology. Prerequisite(s): Graduate standing and consent of instructor. Pathogenesis, diagnosis, pathology, medical and surgical treatment, and prevention of diseases related primarily to skin and the endocrine system (nine-week model). (One - 4 hour lab per 9 weeks)

VBSC 5612* Clinical Neurology. Prerequisite(s): Graduate standing and consent of instructor. Pathogenesis, diagnosis, pathology, medical and surgical treatment, and prevention of nervous system diseases. (Four week course)

VBSC 5613* Biology of Parasites. Prerequisite(s): Graduate standing, general parasitology, or consent of instructor. A systematic and ecologic approach to the study of parasitology. Host-parasite relationships, physiology, ecology and behavioral aspects of parasitic organisms.

VBSC 5614* Cardiopulmonary System. Lab 4. Prerequisite(s): Graduate standing and consent of instructor. Pathogenesis, diagnosis, pathology, medical and surgical treatment, and prevention of diseases related primarily to the cardiovascular and respiratory systems. (Nine week course) (Four - 2 hour labs per 9 weeks)

VBSC 5632* Exercise Physiology. Prerequisite(s): Graduate standing and consent of instructor. Current knowledge base pertaining to the acute and chronic adaptations to exercise in domestic animals and current techniques for the evaluation and correction of poor performance.

VBSC 5661* Infectious and Parasitic Diseases of Wild Animals. Prerequisite(s): Graduate standing and consent of instructor. Systematic approach to infectious and parasitic diseases that affect wild animals. Emphasis will be placed on disease recognition in wild species, ecology of transmission, and population management implications of disease diagnosis.

VBSC 5662* Urinary System. Prerequisite(s): Graduate standing and consent of instructor. Pathogenesis, diagnosis, pathology, medical and surgical treatment, and prevention of diseases related primarily to the urinary system. (Three week module)

VBSC 5671* Clinical Endocrinology II. Prerequisite(s): Graduate standing and consent of instructor. Advanced medical endocrinology, focusing on endocrine diseases associated with 1) dysfunction of the endocrine pancreas, 2) selected endocrinopathies of the reproductive system, and 3) therapeutic use of hormones to control reproductive activity of animals.

VBSC 5691* A Focus on Zoonotic Diseases. Prerequisite(s): Graduate standing and consent of instructor. Overview of zoonotic aspects of infectious diseases, including the transmission to main, incidence and prevalence, prevention and control strategies, assessment of risk, and governmental and regulatory aspects of these public health threats. Diseases of all veterinary species will be balances according to various aspects of importance, ease of transmission, incidence, and other current concepts.

VBSC 5702* Whales and Dolphins. Prerequisite(s): Graduate standing and consent of instructor. Overview of functional morphology of living whales, dolphins, and porpoises. Families and species, evolution, skeleton, feeding, diving, reproduction, echoimaging, brain and special senses, thermoregulation, life histories, cultural and environmental perspectives, and human impact. Functional and comparative structural adaptations of

cetaceans to the marine environment and comparisons with terrestrial mammals.

VBSC 5723* Parasitic Protozoa. Lab 3. Prerequisite(s): Graduate standing in zoology or entomology or consent of instructor. Structure, life cycle, physiology, host-parasite relationships, and diagnosis concerned with protozoan parasites.

VBSC 6000* PhD Research and Dissertation. 1-15 credits, max 45. Prerequisite(s): Graduate standing. Research problem for meeting requirements of the PhD degree.

VBSC 6110* Seminar. 1-6 credits, max 6. Prerequisite(s): Graduate standing. Literature and research problems pertaining to veterinary biomedical sciences.

VBSC 6120* Advanced Physiology of Selected Systems. 3-15 credits, max 15. Prerequisite(s): Graduate standing or consent of instructor. Advanced studies in gastrointestinal, cardiovascular, respiratory, excretory and neuroendocrine physiology. Each part of this sequential course may be taken for two hours credit. Student should ascertain the topics before registering for this course a second time.

VBSC 6200* Topics in Advanced Pharmacology and Toxicology. 1-4 credits, max 4. Prerequisite(s): Consent of instructor. Selected topics in advanced pharmacology, including xenobiotic kinetics and dynamics.

VBSC 6203* Advanced Concepts in Veterinary Immunology. Prerequisite(s): 5113 or BIOC 3653 or MICR 3254. Induction of immune responses, host defense mechanisms, immunoregulation, antigen presentation and immune recognition by B and T lymphocytes, using contemporary research publications.

VBSC 6213* Toxicology: From Molecules to Ecosystems. Prerequisite(s): Graduate standing, consent of instructor. An integrated systems-based approach to toxicology from molecular, cellular, organ, organismal, and ecological perspectives.

VBSC 6220* Advanced Topics in Cell Biology. 1-5 credits, max 12. Prerequisite(s): Consent of instructor. Selected topics in cell biology including membrane traffic, cell signaling, ion transport, cytoskeleton, cell cycle, cell junctions, and adhesion.

VBSC 6223* Xenobiotic Disposition. Prerequisite(s): Graduate standing and consent of instructor. Quantitative analysis of xenobiotic absorption, metabolism, and excretion. Analysis of xenobiotic concentration-time data using pharmacokinetic software. (No credit for students with degree credit in ITOX 6223*)

VBSC 6233* Laboratory in Electron Microscopy. Lab 12. Prerequisite(s): Consent of instructor. Student learns to prepare specimens for, and to operate, the electron microscope, and techniques for printing and preparation of electron micrographs for publication.

VBSC 6550* Problems in Functional Morphology. 1-3 credits, max 3, Lab 3-9. Prerequisite(s): Consent of instructor. Investigations in comparative, gross, developmental or histologic morphology for graduate students.

VBSC 6560* Advanced Pathology Techniques and Special Problems. 1-6 credits, max 6. Prerequisite(s): Graduate standing in biological sciences and consent of instructor. Investigations of contemporary techniques and methods used in diagnosis, technical work and research in pathology.

VBSC 6650* Current Topics in Bacterial Pathogenesis. 1-10 credits, max 10. Prerequisite(s): VBSC 5552 or equivalent and consent of instructor. Selected mechanisms in bacterial pathogenesis and host response using recent literature, such as genetic organization of virulence; regulation of virulence factors; attachment, adhesion, and invasion; capsules and outer membrane proteins; intracellular parasitism; endotoxin; exotoxins; iron acquisition and host sequestration; antibiotic resistance mechanisms; innate immunity; acquired immunity; and evasion of host immunity on a rotating basis. Lecture and discussion of directed reading of current literature.

VBSC 6710* Seminar in Veterinary Clinical Sciences. 1-3 credits, max 3. Prerequisite(s): Graduate standing in the College of Veterinary Medicine, or internship or residency training program in the Department of Veterinary Clinical Sciences. Literature and research of problems pertaining to veterinary clinical sciences.

VBSC 6712* Advances in Veterinary Medicine I. Prerequisite(s): Graduate standing in the College of Veterinary Medicine, or internship or residency training program in the Department of Veterinary Clinical Sciences. Special problems course emphasizing organ system physiology, selected diagnostic and therapeutic topics, and requiring a publication-quality paper on an approved subject.

VBSC 6722* Advances in Veterinary Medicine II. Prerequisite(s): Graduate standing in the College of Veterinary Medicine, or internship or residency training program in the Department of Veterinary Clinical Sciences. Special problems course emphasizing organ system physiology, selected diagnostic and therapeutic topics, and requiring a publication-quality paper on an approved subject.

VBSC 6910* Veterinary Pathology Slide Conference. 1-2 credits, max 6. Prerequisite(s): Medical degree. Guided weekly exercises based on veterinary diagnostic microscopy.

VBSC 6920* Diagnostic Pathology. 1-4 credits, max 4, Lab 3-9. Prerequisite(s): Graduate standing in the College of Veterinary Medicine or written consent of department head. Weekly review of current cases submitted to the department and the methods employed in diagnosis. Examination of necropsy reports, specimens, and preparations. Students required to formulate diagnoses.

VBSC 6930* Comparative Anesthesiology. 1-3 credits, max 3. Prerequisite(s): Graduate standing in the College of Veterinary Medicine or consent of the head of the department. Anesthesiology of animals.

VBSC 6950* Advanced Systemic Pathology. 2-4 credits, MS max 6, PhD max 12. Prerequisite(s): VMED 5264, graduate standing, consent of instructor. Total credit not to exceed six for the MS degree and 12 for the PhD Re-enrollment permits the study of two to four different groups of organs and systems of the animal body. A consideration of the pathogenesis and the morphological, biochemical, and comparative aspects of lesions found in organs and tissues of the domesticated animals.

VBSC 6960* Current Topics in Veterinary Clinical Pathology. 1-3 credits, max 9. Prerequisite(s): DVM or equivalent, graduate standing and consent of instructor. Obtaining current knowledge and developing critical thinking and reasoning skills through seminars and discussions of current literature from the field of veterinary clinical pathology and general pathology.

VBSC 6963* Advanced Clinical Pathology. Prerequisite(s): VMED 5362 or equivalent, graduate standing and consent of instructor. Applied clinical biochemistry, organ function tests and related cytologic examination.

VBSC 6973* Advanced Hematology. Prerequisite(s): VMED 5362 or equivalent, graduate standing and consent of instructor. The etiology and pathogenesis of the diseases of the blood and bone marrow.

Veterinary Clinical Sciences (VCS)

VCS 7003 Elective I. Lab 3. Prerequisite(s): Fourth-year standing in the College of Veterinary Medicine. Students required to choose four electives. Two of those electives on-campus. Two electives may be off-campus.

VCS 7013 Elective II. Lab 3. Prerequisite(s): Fourth-year standing in the College of Veterinary Medicine. Students required to choose four electives. Two of those electives on-campus. Two electives may be off-campus.

VCS 7023 Elective III. Lab 3. Prerequisite(s): Fourth-year standing in the College of Veterinary Medicine. Students required to choose four electives. Two of those electives on-campus. Two electives may be off-campus.

VCS 7033 Elective IV. Lab 3. Prerequisite(s): Fourth-year standing in the College of Veterinary Medicine. Students required to choose four electives. Two of those electives on-campus. Two electives may be off-campus.

VCS 7703 Intensive Care Clinic. Lab 3. Prerequisite(s): Fourth-year standing in the College of Veterinary Medicine. Clinical rotation in small animal intensive care/critical and emergency medicine. Letter graded.

VCS 7713 Radiology Clinic. Prerequisite(s): Fourth-year standing in the College of Veterinary Medicine. Diagnostic radiography, ultrasound, and other special imaging modalities.

VCS 7723 Equine Medicine Clinic. Lab 3. Prerequisite(s): Fourth-year standing in the College of Veterinary Medicine. Diagnosis, prognosis, treatment and prevention of equine medical diseases.

VCS 7733 Community Practice. Lab 9. Prerequisite(s): Fourth-year standing in the College of Veterinary Medicine. Receiving and managing emergency and general medical and surgical cases in companion animals.

VCS 7743 Small Animal Internal Medicine. Lab 9. Prerequisite(s): Fourth-year standing in the College of Veterinary Medicine. Diagnosis, prognosis, treatment and prevention of companion animal medical diseases.

VCS 7753 Small Animal Surgery Clinic. Lab 3. Prerequisite(s): Fourth-year standing in the College of Veterinary Medicine. Diagnosis, prognosis, treatment, and prevention of companion animal surgical diseases.

VCS 7763 Food Animal Medicine Clinic. Lab 3. Prerequisite(s): Fourth-year standing in the College of Veterinary Medicine. Diagnosis, prognosis, treatment and prevention of diseases of food animal medical and surgical diseases.

VCS 7773 Large Animal Theriogenology. Lab 2. Prerequisite(s): Fourth-year standing in the College of Veterinary Medicine. Management of breeding cattle and horses at the Center for Veterinary Health Sciences Ranch, including artificial insemination, treatment of infertility, periparturient management, and pediatrics.

VCS 7783 Zoological Medicine Clinical Elective. Lab 2. Prerequisite(s): Fourth-year standing in the College of Veterinary Medicine. Health maintenance, diagnosis and treatment of medical or surgical conditions in zoo, exotic pet and wildlife species.

VCS 7793 Equine Surgery Clinic. Lab 3. Prerequisite(s): Fourth-year standing in the College of Veterinary Medicine. Diagnosis, prognosis,

treatment, and prevention of equine surgical diseases.

VCS 7803 Clinic Pool. Lab 3. Prerequisite(s): Fourth-year standing in the College of Veterinary Medicine. Semi-elective clinical assignment. *Graded on a pass-fail basis.*

VCS 7813 Preceptorship Clinic. Lab 2. Prerequisite(s): Fourth-year standing in the College of Veterinary Medicine. Diagnosis, prognosis, prevention and treatment of diseases of animals presented in the preceptorship program. *Graded on a pass-fail basis.*

VCS 7823 Non-OSU Clinic. Lab 2. Prerequisite(s): Fourth-year standing in the College of Veterinary Medicine. Approved clinical rotations off the OSU campus. *Graded on a pass-fail basis.*

VCS 7833 Special Clinics. Lab 2. Prerequisite(s): Fourth-year standing in the College of Veterinary Medicine or graduate veterinarian. Special assignments for introductory clinical studies in the following: selected species clinic; herd-health program; necropsy, clinic pathology and parasitology; diagnostic laboratory; and special aspects of the basic sciences. *Graded on a pass-fail basis.*

VCS 7843 Anesthesiology. Lab 2. Prerequisite(s): Fourth-year standing in the College of Veterinary Medicine. Management of clinical anesthesia in various domestic species.

VCS 7853 Equine Performance Medicine. Lab 2. Prerequisite(s): Fourth-year standing in the College of Veterinary Medicine and VMED 7771, 7811 and 7821. Common diagnostic techniques used in equine sports medicine will be systematically reviewed in a "hands-on" approach. This will include performing pre-purchase and lameness examinations, diagnostic nerve blocks, ultrasound, and radiology. At least three "field trips" will be utilized to increase exposure to different equine sports including race track, horse show, and endurance competitions. *Graded on a pass-fail basis.*

VCS 7863 Clinical Pathology and Parasitology Elective. Lab 2. Prerequisite(s): Fourth-year standing in the College of Veterinary Medicine. Students will work with clinical pathology residents and laboratory personnel. Emphasis is placed on cytology, hematology, and parasitology. Each student will spend one week in each area. *Graded on a pass/fail basis.*

VCS 7873 Ultrasound. Lab 2. Prerequisite(s): Fourth-year standing in the College of Veterinary Medicine and VMED 7443. Participants will attend radiology rounds daily as well as observing and/or performing diagnostic ultrasound exams on common domestic animal species, and, when not actively participating in a clinical ultrasound study, in library research on the subject of diagnostic ultrasound, including, but not limited to, viewing a CD, reading textbooks and journal articles on the subject and examining prepared ultrasound case studies containing diagnostic challenges and problems to solve.

VCS 7883 Animal Shelter. Lab 3. Prerequisite(s): Fourth-year standing in the College of Veterinary Medicine and VMED 7443 or VMED 7412 and one surgery rotation. The goals of this rotation are to apply basic clinical, surgery and anesthesia skills primarily to pet adoption candidates. *Graded on a pass-fail basis.*

VCS 7893 Field Services (Ambulatory) Elective. Lab 2. Prerequisite(s): Fourth-year standing in the College of Veterinary Medicine. Allows students to gain confidence in various clinical procedures common in field practice; to become familiar with the more common diseases and conditions that occur in the farm species; to learn how to move/direct livestock, study, review, and prepare cases seen or for surgery; actively participate in rounds and "on the road" discussions, and learn to communication with clients.

VCS 7903 Ophthalmology Elective. Lab 2. Prerequisite(s): Fourth-year standing in the College of Veterinary Medicine. This is a three week clinical rotation in small animal, equine, exotic animals, and food animal ophthalmology. Students will take part in outpatient receiving including history taking, ophthalmic examination, forming a problem list and case assessment, and forming a treatment plan. Students will assist in surgery and be responsible for the care of all hospitalized patients. Students will also assist with after-hours ophthalmic emergencies. Ophthalmology students also share EMS and isolation ward duties.

VCS 7912 Grand Rounds. Prerequisite(s): Fourth-year standing in the College of Veterinary Medicine. Presentation and discussion of selected clinical topics by fourth-year students, departmental faculty, and invited experts. Letter graded.

VCS 7913 Cardiology Elective. Lab 2. Prerequisite(s): Fourth-year standing in the College of Veterinary Medicine. This is a three week clinical rotation in cardiology. Students will take part in outpatient receiving including history taking, cardiovascular examination, forming a problem list and case assessment and forming a treatment plan. Students will be responsible for preoperative and postoperative care of patients as well as the care of all hospitalized patients. Students will also assist with after-hours cardiology emergencies. Cardiology students also share EMS and isolation ward duties. *Graded on a pass-fail basis.*

VCS 7923 Oncology Elective. Lab 2. Prerequisite(s): Fourth-year standing in the College of Veterinary Medicine. All three week rotations will provide a clinical, comprehensive, and in-depth learning experience from patients with cancer. Instruction and guidance will be provided by "Instructor of Record" for the course.

Veterinary Medicine (VMED)

VMED 7113 Veterinary Physiology II. Prerequisite(s): First-year standing in the College of Veterinary Medicine or consent of instructor. Molecular, cellular and organ system physiology. Establishing a base of knowledge and understanding requisite to subsequent courses. Continuation of 7114. (8 week course)

VMED 7114 Veterinary Physiology I. Prerequisite(s): First-year standing in the College of Veterinary Medicine. To introduce students to the relevant concepts of cell physiology and cardiovascular physiology, providing a foundation for Physiology II and III, clinical coursework and clinical rotations.

VMED 7123 Veterinary Histology. Lab 1. Prerequisite(s): First-year standing in the College of Veterinary Medicine. Organization and structure of cells and tissues of domestic animals.

VMED 7144 Gross and Developmental Anatomy. Prerequisite(s): First-year standing in the College of Veterinary Medicine or consent of instructor. Embryology and anatomy of domestic mammals using the dog as the primary model. Integrated lecture-dissection-laboratory format. The integration of developmental gross, radiographic and applied aspects of veterinary anatomy as they relate to a topographical appreciation of the living individual. An overview of domestic bird and laboratory animal anatomy.

VMED 7152 Zootechnology. Prerequisite(s): First-year admission to College of Veterinary Medicine or consent of instructor. Animal breeds and identification, animal production and marketing systems and animal handling and restraint as it applies to production and marketing.

VMED 7162 Jurisprudence and Ethics. Prerequisite(s): First-year standing in College of Veterinary Medicine. Introduction to veterinary jurisprudence, ethics, licensing, government regulations, human-animal bond, and evolving issues in animal law and animal welfare.

VMED 7221 Epidemiology and Evidence-Based Medicine. Prerequisite(s): First-year standing in the College of Veterinary Medicine. Principles and uses of evidence-based practice of veterinary medicine; comprehension and utilization of scientific research; interpretation of basic concepts of observational study of disease.

VMED 7223 Veterinary Parasitology I. Lab 2. Prerequisite(s): First-year standing in the College of Veterinary Medicine or consent of instructor. Introduction to the general principles of parasitism and parasites of veterinary medical importance including taxonomy morphology, biology of parasites, modes of transmission, host-parasite relationships, infectious processes and pathogenicity, diagnostic methods, treatment and control measures and public health importance.

VMED 7235 Veterinary Physiology III. Prerequisite(s): First-year standing in the College of Veterinary Medicine or consent of instructor. Molecular, cellular and organ system physiology. Establishing a base of knowledge and understanding requisite to subsequent courses.

VMED 7243 Comparative Anatomy. Prerequisite(s): First year standing in the College of Veterinary Medicine or consent of instructor. Comparative and functional gross anatomy and developmental anatomy of domestic mammals. The integration of developmental, gross, radiographic, and applied clinical aspects of veterinary anatomy as they relate to a topographical appreciation of the living individual. Integrated lecture-dissection-laboratory format.

VMED 7253 Veterinary Immunology. Lab 4. Prerequisite(s): First-year standing in College of Veterinary Medicine or consent of instructor. Basic principles of immunology and their application to veterinary medicine.

VMED 7264 General Pathology. Lab 2. Prerequisite(s): First-year standing in the College of Veterinary Medicine or consent of instructor. Cellular and tissue pathology, pigments, inflammation, immunopathology, disturbances of growth and circulation, and neoplasia. Functional disturbances that accompany changes in structures as well as the causes and pathogenesis of diseases.

VMED 7311 Introduction to Clinics I. Lab 2. Prerequisite(s): Second-year standing in College of Veterinary Medicine. Clinical orientation including rotations in instruction and service units in the College. *Graded on a pass-fail basis.*

VMED 7323 Veterinary Parasitology II. Lab 2. Prerequisite(s): Second-year standing in the College of Veterinary Medicine or consent of instructor. Principles of diagnostic, treatment, control and prevention of animal diseases produced by arthropod, protozoan, rickettsial, and helminth parasites. A problem-based approach to parasitic diseases affecting the integumentary, respiratory, hemic-lymphatic, reproductive, urinary, nervous/sensory, musculoskeletal, and alimentary systems with emphasis on diseases of domestic animals.

VMED 7333 Pharmacology I. Prerequisite(s): Second-year standing in the College of Veterinary Medicine or consent of instructor. Introduction of the

principles of pharmacodynamics, drug disposition and pharmacokinetics. Pharmacological effects, mechanisms of actions, metabolism, disposition, clinical indications and toxic effects of drugs acting on the autonomic, central nervous, cardiovascular, respiratory, and renal systems.

VMED 7342 Clinical Anatomy. Lab 6. Prerequisite(s): Second-year standing in the College of Veterinary Medicine. Aspects of gross anatomy as they relate to clinical applications.

VMED 7354 Infectious Diseases I. Lab 4. Prerequisite(s): Second-year standing in College of Veterinary Medicine or consent of instructor. Important animal diseases caused by bacteria, fungi and viruses covered on a system basis. Mechanisms of infectious disease processes and the relationship of such processes to disease development, diagnosis, treatment and control. The relationship of zoonotic diseases to community and environmental health as well as important zoonoses.

VMED 7363 Clinical Pathology. Lab 1. Prerequisite(s): Second-year standing in the College of Veterinary Medicine. Basic concepts pertinent to data interpretation and laboratory methods used in evaluation of disease.

VMED 7401 Introduction to Beef Production Medicine. Prerequisite(s): second-year or third-year standing in the College of Veterinary Medicine. This course will provide students with an understanding of the beef production industry in the United States. Students will gain an understanding of the importance of beef production to the US and global food production, the structure and function of the US beef industry, and the role of a veterinarian in beef production medicine. The course will be a combination of lecture and discussion format. If possible, the course will also include field trips to visit examples of the various segments of the beef industry.

VMED 7412 Anesthesiology. Lab 6. Prerequisite(s): second-year standing in the College of Veterinary Medicine. Application of the principles of veterinary anesthesiology to incorporate fundamental aspects of physiology and pharmacology in the anesthetic management of important domestic species.

VMED 7413 Food Safety and Public Health. Prerequisite(s): First-year standing in the College of Veterinary Medicine. Approaches and skills for identifying, investigating and mitigating occurrences of disease outbreaks; introduction to zoonotic diseases; role veterinarians play in protecting public health; potential human health hazards in foods of animal origin.

VMED 7432 Pharmacology II. Prerequisite(s): Second-year standing in the College of Veterinary Medicine or consent of instructor. Continuation of 7333 that includes the mechanisms of action, disposition, adverse effects, and indications for groups of pharmacological agents used in veterinary medicine.

VMED 7443 Diagnostic Imaging. Lab 13. Prerequisite(s): Second-year standing in the College of Veterinary Medicine. Radiographic theory, techniques, and interpretation. Introduction to alternate methods, including ultrasonography.

VMED 7454 Infectious Diseases II. Lab 4. Prerequisite(s): Second year standing in the College of Veterinary Medicine or consent of instructor. Continuation of Infectious Diseases I (7354).

VMED 7482 Hemolymphatic and Oncology. Prerequisite(s): Second-year standing in the College of Veterinary Medicine. Pathogenesis, diagnosis, pathology, medical and surgical treatment, and prevention of diseases related primarily to the blood and lymphatic system (six-week module).

VMED 7502 Opthalmology. Prerequisite(s): Third-year standing in the College of Veterinary Medicine. Pathogenesis, diagnosis, medical and surgical treatment, and prevention of ophthalmic disease in small animal and equine patients.

VMED 7510 Research Elective. 1-4 credits, max 8, Lab 30-90. Prerequisite(s): Second-or-third-year standing in the College of Veterinary Medicine. Participation in faculty-directed projects to enhance career development in veterinary biomedical research. Students participate in a process mimicking investigator-initiated research by developing a research proposal, participating in a competitive peer-review process, and reporting on completed research project. Letter grade to be assigned.

VMED 7512 Laboratory Animal Medicine. Introductory course focusing on the biology and major diseases of commonly used laboratory animals and regulatory issues affecting attending veterinarians in biomedical research environments.

VMED 7521 Veterinary Practice Management. Prerequisite(s): Second-or third-year standing in College of Veterinary Medicine. Skills and background for success as an employee in private veterinary practice. Successful practice is defined in terms of the perceived value received in the delivery of veterinary medical services, doctor-client communication skills, and aesthetic quality of the environment in which services are delivered. Business management of private practice, personal finances, and personnel management.

VMED 7522 Signs and Symptoms of the Small Animal Medical Diagnosis. Prerequisite(s): Second-or-third-year standing in the College of Veterinary Medicine. Introduction to clinical problem solving through application of a problem-oriented approach to clinical diagnosis. Discussion of major problems (clinical signs and symptoms) affecting animals, and the pathophysiology of each clinical sign, its differential diagnosis and symptomatic management. Review of key anatomical, pathological and immunological concepts learned in basic science courses.

VMED 7523 Surgery. Lab 48. Prerequisite(s): Third-year standing in the College of Veterinary Medicine. Introduction to fundamental principles of surgery. Didactic material followed by surgical laboratories.

VMED 7531 Avian Biology for Veterinarians. Prerequisite(s): Second- or third-year standing in the College of Veterinary Medicine. Topics in avian biology of value to veterinary students who will be treating birds in their practice or those planning to be active in raptor rehabilitation. Feather anatomy and molt; bill and claw anatomy; characteristics of the avian skeleton; weight saving adaptations; recondition atrophied flight muscles in raptors; anatomy of the digestive system; how birds breathe; avian aerodynamics; taste and olfaction in birds; reproductive biology; raptor natural history; identification, rehabilitation.

VMED 7532 Molecular Genetics. Prerequisite(s): Second-or third-year or higher in good standing in the College of Veterinary Medicine. The expression, purification, characterization, and application of biological macromolecules in therapeutics and diagnostics relevant to animal health.

VMED 7533 Toxicology. Lab 3. Prerequisite(s): Third-year standing in the College of Veterinary Medicine. Diagnosis and management of intoxications involving plant, chemical and biological toxins.

VMED 7541 Introduction to Food Animal Production Systems. Prerequisite(s): second-year or third-year standing in the College of Veterinary Medicine. Consists of a week-long field trip of food animal production operations in Oklahoma and Texas providing exposure to beef cattle, swine and dairy production industries. Includes group presentation of the experience.

VMED 7542 Clinical Endocrinology I. Prerequisite(s): Second or third-year standing in the College of Veterinary Medicine. Advanced medical endocrinology addressing diagnostic endocrinology and therapeutic endocrinology. Diagnostic endocrinology shall examine the physiological and medical basis for selecting provocative or non-provocative testing procedures as an adjunct to completing a definitive diagnosis. Therapeutic endocrinology involves the use of diagnostic endocrinology to evaluate the efficacy of medical treatment of endocrinopathies and the medical use of hormonal preparations to control animal physiology or endocrinology and non-endocrine diseases.

VMED 7551 Food Animal: Advanced Techniques. Prerequisite(s): second-year standing in the College of Veterinary Medicine. This elective is designed to give second year students the opportunity to learn how to perform some of the most commonly performed procedures in food animal medicine in regards to the modalities of treatment, diagnostics, herd health, local anesthesia and Pharmacology. One hour per week will be spent as formal lecture to provide some theory for the procedures and techniques to be performed during the laboratory periods.

VMED 7561 Introduction to Shelter Medicine. Prerequisite(s): second-year or third-year standing in the College of Veterinary Medicine. Introduction course on topics relevant to shelter medicine. Discusses major subjects and issues important to practicing medicine in the shelter setting.

VMED 7562 Avian and Exotic Pet Medicine. Prerequisite(s): Third-year standing in the College of Veterinary Medicine. Clinical diagnosis, management and treatment, prognosis, and prevention of diseases in avian and exotic pets. Introductory material provided to familiarize students with the species discussed and where clinically important; however, student understanding of the basic sciences required and assumed.

VMED 7563 Musculoskeletal Systems. Lab 9. Prerequisite(s): Third-year standing in the College of Veterinary Medicine. Pathogenesis, diagnosis, pathology, medical and surgical treatment, and prevention of diseases related primarily to the musculoskeletal system.

VMED 7564 Alimentary System. Lab 12. Prerequisite(s): Third-year standing in the College of Veterinary Medicine. Pathogenesis, diagnosis, pathology, medical and surgical treatment, and prevention of diseases related primarily to the alimentary system.

VMED 7571 Introduction to Behavioral Medicine. Prerequisite(s): Second- or third-year standing in College of Veterinary Medicine. Introduction to behavioral veterinary medicine. Normal behavior of the dog and cat, basic procedures and methods for diagnosing and treating behavioral problems.

VMED 7581 Zoo and Wildlife Medicine. Prerequisite(s): third-year standing in the College of Veterinary Medicine. Veterinary and preventive management of captive zoo animals, veterinary care and rehabilitation of injured and orphaned free ranging wildlife.

VMED 7583 Dermatology and Endocrinology. Prerequisite(s): Third-year standing in the College of Veterinary Medicine. Pathogenesis, diagnosis, pathology, medical and surgical treatment, and prevention of diseases related primarily to skin and the endocrine system (nine-week module).

VMED 7591 International Veterinary Medicine. Prerequisite(s): second-year or third-year standing in the College of Veterinary Medicine. Overview of the importance of veterinarians and the wide range of activities in which they participate around the world including the military, public health agencies, humanitarian relief agencies, wildlife preservation groups and faith-based agencies.

VMED 7610 Basic Science Elective. 1-8 credits, max 8. Prerequisite(s): Second-or-third-year standing in the College of Veterinary Medicine.

Problems in the basic sciences taught as lecture or lab.

VMED 7611 Applied Pharmacology. Lab 7. Prerequisite(s): Second-or third-year standing in College of Veterinary Medicine. Criteria applicable to the rational selection of pharmacological agents used in the therapy of animal diseases, adverse reactions and interactions that may complicate therapy, and issues relevant to the ethical use of drugs and avoidance of residues in food products.

VMED 7612 Clinical Neurology. Prerequisite(s): Third-year standing in the College of Veterinary Medicine. Pathogenesis, diagnosis, pathology, medical and surgical treatment and prevention of nervous system diseases.

VMED 7614 Cardiopulmonary System. Lab 24. Prerequisite(s): Third-year standing in the College of Veterinary Medicine. Pathogenesis, diagnosis, pathology, medical and surgical treatment, and prevention of diseases related primarily to the cardiovascular and respiratory systems.

VMED 7620 Clinical Science Elective. 1-8 credits, max 8. Prerequisite(s): Second-or-third-year standing in the College of Veterinary Medicine. Problems in the clinical sciences taught as lecture or lab.

VMED 7621 Zoonotic Diseases. Prerequisite(s): Second or third year standing in the College of Veterinary Medicine or consent of instructor. Overview of zoonotic aspects of infectious diseases, including the transmission to man, incidence and prevalence, prevention and control strategies, assessment of risk, and governmental and regulatory aspects of these public health threats. Diseases of all veterinary species will be balanced according to various aspects of importance, east of transmission, incidence, and other current concepts.

VMED 7622 Problem Solving in Internal Medicine. Prerequisite(s): Second-or-third-year standing in the College of Veterinary Medicine. Clinic cases that provide a review of basic pathophysiology.

VMED 7631 History of Veterinary Medicine. Prerequisite(s): Second-or third-year standing in the College of Veterinary Medicine. History of the veterinary medical profession, especially in North America.

VMED 7632 Exercise Physiology. Prerequisite(s): Second-or-third-year standing in the College of Veterinary Medicine. Current knowledge base pertaining to the acute and chronic adaptations to exercise in domestic animals and current techniques for the evaluation and correction of poor performance.

VMED 7642 Veterinary Sports Medicine. Prerequisite(s): VMED 7632 and second-year or third-year standing in the College of Veterinary Medicine. Course will provide the current knowledge pertaining to the diagnosis and treatment of injuries of athletic dogs and horses and causes of poor performance in these species.

VMED 7651 Equine Theriogeneology Laboratory. Lab 3. Prerequisite(s): Third year standing in the College of Veterinary Medicine. Introduction to palpation, ultrasonographic examination and breeding preparation of the mare reproductive tract.

VMED 7652 Introduction to Clinics II. Lab 2. Prerequisite(s): Third year standing in the College of Veterinary Medicine. Rotations through instructional and service areas, including the Veterinary Teaching Hospital of the College of Veterinary Medicine. *Graded on a pass-fail basis.*

VMED 7661 Infectious and Parasitic Diseases of Wild Animals. Lab 11. Prerequisite(s): Second-or-third-year standing in the College of Veterinary Medicine. Systematic approach to infectious and parasitic diseases affecting wild animals. Capture, restraint, and disease recognition in wild species, population management implications of disease diagnosis.

VMED 7662 Urinary System. Prerequisite(s): Third-year standing in the College of Veterinary Medicine. Pathogenesis, diagnosis, pathology, medical and surgical treatment, and prevention of diseases related primarily to the urinary system (2.5 week module).

VMED 7671 Clinical Endocrinology II. Prerequisite(s): Second or third year standing in the College of Veterinary Medicine. Advanced medical endocrinology, focusing on endocrine diseases associated with (1) dysfunction of the endocrine pancreas, (2) selected endocrineopathies of the reproductive system, and (3) therapeutic use of hormones to control reproductive activity of animals.

VMED 7672 Swine Production and Diseases. Prerequisite(s): Second or third-year standing in the College of Veterinary Medicine. Problem-based course related to swine diseases and production systems.

VMED 7674 Theriogenology. Lab 2. Prerequisite(s): Third-year standing in the College of Veterinary Medicine. Pathogenesis, diagnosis, pathology, medical and surgical treatment, and prevention of diseases related primarily to the reproductive system.

VMED 7681 Advanced Neurology. Prerequisite(s): Second or third year standing in the College of Veterinary Medicine. Case based, problem oriented clinical diagnosis, management, treatment and prevention of small animal neurological diseases.

VMED 7682 Small Ruminant Production, Management, Medicine and Surgery. Prerequisite(s): Second or third-year standing in the College of Veterinary Medicine. Production, management, medical and surgical diseases of sheep, goats, and llamas used for production and companion animals.

VMED 7691 A Focus on Zoonotic Diseases. Prerequisite(s): Second or third year standing in the College of Veterinary Medicine or consent of instructor. Overview of zoonotic aspects of infectious diseases, including the transmission to man, incidence and prevalence, prevention and control strategies, assessment of risk, and governmental and regulatory aspects of these public health threats. Diseases of all veterinary species will be balanced according to various aspects of importance, ease of transmission, incidence, and other current concepts.

VMED 7701 Small Animal Diagnostic Ultrasound. Lab 10. Prerequisite(s): Third-year standing in the College of Veterinary Medicine. An introduction to diagnostic ultrasonography, basic physics of ultrasound production, transmission in tissues, image formation and common artifacts. Recognition of normal organs, organ function, and common diseases that can be diagnosed sonographically in small animals.

VMED 7702 Whales and Dolphins. Prerequisite(s): Second- or third-year standing in the College of Veterinary Medicine. Review of functional morphology of whales, dolphins and porpoises. Families and species, evolution, skeleton, feeding, diving, reproduction, echoimaging, brain and special senses, thermoregulation, life histories, veterinary perspectives and human impact. Functional and comparative structural adaptations of cetaceans to the marine environment. Discussion of comparisons with terrestrial mammals.

VMED 7710 Veterinary Study Abroad. Prerequisite(s): Second or Third-year standing in the College of Veterinary Medicine. Participation in international animal health activities having an educational component, either through didactic instruction, service learning, workshop participation, and others.

VMED 7711 Problem-based Ophthalmology. Prerequisite(s): Third-year standing in the College of Veterinary Medicine. Case-based, problem-oriented discussions of small animal and equine ophthalmology cases. Key points in the case history, the significance of signalment in the diagnosis, clinical diagnosis, supportive diagnostic tests, and treatment. General discussion of the specific disease following the case discussion.

VMED 7712 Systemic Pathology: Case Studies and Mechanisms of Disease. Prerequisite(s): Third-year standing in the College of Veterinary Medicine. Selected diseases of major organ systems will be approached as an exercise in critical diagnostics thinking. Review of salient pathological responses for each system. Relevant journal articles to emphasize need for continued, self-guided learning.

VMED 7731 Advanced Small Animal Medicine I: Problem-Based Learning. Lab 3. Prerequisite(s): Third-year standing in the College of Veterinary Medicine. Case-based problem oriented clinical diagnosis, management, treatment, and prevention of internal medicine diseases common to small animals. Small group format will meet one hour per week at a time determined by the individual groups.

VMED 7732 Advanced Oncology. Prerequisite(s): Third-year standing in the College of Veterinary Medicine. Reviews the diagnosis, staging and treatment of common neoplasms in small animal veterinary medicine. The course presents a systemic approach to the cancer patient, proper collection, submission, and evaluation of diagnostic samples, and development of rational therapeutic plans.

VMED 7742 Bovine Theriogenology Laboratory. Lab 4. Prerequisite(s): Third-year standing in the College of Veterinary Medicine. Palpation techniques in cows. An elective restricted to students entering food animal practice.

VMED 7751 Poultry Medicine and Diseases. Prerequisite(s): Third-year standing in the College of Veterinary Medicine. Poultry medicine and common diseases of poultry. Disease diagnosis based in clinical signs and lesions. Disease prevention and treatment. Application of diagnostic techniques through problem oriented case studies.

VMED 7752 Applied Bovine Nutrition. Lab 14. Prerequisite(s): Third-year standing in the College of Veterinary Medicine. Applied nutrition of beef and dairy cows. Restricted to students that wish to enter food animal practice.

VMED 7761 Introduction to Integrative Medicine: An Investigation into Holistic Veterinary Medicine. Prerequisite(s): Third-year standing in the College of Veterinary Medicine. This course will provide an overview of current modalities being utilized as alternative therapies in Veterinary Medicine. The student will gain an appreciation for the importance of complementary medicine, and the evidence available to support its use. Students will also gain an understanding of critically assessing the research available and determining whether the information is clinically relevant.

VMED 7771 Advanced Equine Medicine I. Prerequisite(s): Third-year standing in the College of Veterinary Medicine. Expanded study of topics pertinent to equine practice. Supplements information presented in core sources and aims to provide exposure to basic clinical techniques commonly used in equine practice. A clinical practice perspective will be emphasized. Hands-on laboratories will be used as an adjunct to lectures when appropriate. A companion course will be presented during spring semester. *Graded on a pass-fail basis.*

VMED 7781 Professional Veterinary Medicine. Prerequisite(s): Third year standing in the College of Veterinary Medicine. A capstone course

preparing third-year veterinary students for clinical training. Topics include: non-technical skills, knowledge, aptitudes, and attitudes; veterinary career opportunities in public practice, and preparation for the North American Veterinary Licensing Examination (NAVLE).

VMED 7791 Case Studies in Small Animal Dermatology. Prerequisite(s): Third-year standing in the College of Veterinary Medicine. Clinic conference/ rounds on dermatology cases. Includes histopathology. Computer/multi-media applications will be used.

VMED 7801 Business Management for Veterinary Practice. Prerequisite(s): Third-year standing in the College of Veterinary Medicine. VMED 7521 recommended. Business and financial management of private veterinary practice.

VMED 7811 Advanced Equine Medicine II. Prerequisite(s): Third-year standing in the College of Veterinary Medicine and VMED 7771. A continuation of 7771. Expanded study of topics pertinent to equine practice. Supplements information presented in core sources and aims to provide exposure to basic clinical techniques commonly used in equine practice. A clinical practice perspective will be emphasized. Hands-on laboratories will be used as an adjunct to lectures when appropriate. *Graded on a pass-fail basis.*

VMED 7821 Equine Radiology. Lab 12. Prerequisite(s): Third-year standing in the College of Veterinary Medicine. Diagnostic imaging (radiology, nuclear scintigraphy and ultrasound) of horses.

VMED 7822 Food Animal Production Medicine. Prerequisite(s): Third-year standing in the College of Veterinary Medicine. Production animal agriculture and the veterinarian's present and future role in these enterprises. Cattle production is emphasized. Cycles of production, economics and health programs will be discussed. For students intending to enter mixed animal or exclusive food animal practices.

VMED 7831 Advanced Small Animal Medicine II: Problem-Based Learning. Prerequisite(s): Third-year standing in the College of Veterinary Medicine. Case-based, problem oriented clinical diagnosis, management, treatment, and prevention of internal medicine diseases common to small animals. Small group format will meet one hour weekly at a time determined by the individual groups.

VMED 7841 Food Animal Surgery. Lab 9. Prerequisite(s): Third-year standing in the College of Veterinary Medicine. Detailed examination and review of commonly utilized local anesthetic techniques, injectable anesthetic techniques, and surgical procedures in food animal practice. Major topics include digital, mammary, gastrointestinal, and urethral surgery as well as cesarean section.

VMED 7842 Special Surgical Problems and Technique, Advanced Wound Management and Introduction to Reconstructive Surgery. Lab 9. Prerequisite(s): Third-year standing in the College of Veterinary Medicine. Principles of wound management and reconstructive surgery. Lecture and laboratory format.

VMED 7851 Advanced Small Animal Neurology. Prerequisite(s): Third-year standing in the College of Veterinary Medicine. Elective course with in-depth discussion of diseases affecting the neuromuscular system of dogs and cats. For students intending to enter predominately small animal practice or small animal internships. Lecture and case discussion formats.

VMED 7861 Cytology. Lab 2. Prerequisite(s): Third-year standing in the College of Veterinary Medicine. An introduction to clinical diagnosis using cytology. Topics include sample collection, inflammatory lesions, neoplasia, lymph node cytology, respiratory washes, synovial fluids, and body cavity effusions. The course consists of lectures, multi-head microscope and individual microscope laboratories; cases will be predominantly small animals.

VMED 7871 Advanced Equine Reproduction. Lab 3. Prerequisite(s): Third-year standing in the College of Veterinary Medicine. The practical application of recent research in the breeding management, estrous cycle manipulation, and reproductive disease diagnosis and treatment of the mare. The stallion will be studied with respect to semen quality, endocrine-associated infertility, and breeding accidents and injuries.

VMED 7872 Special Surgical Problems and Techniques, Advanced Small Animal Orthopedics and Neurosurgery. Lab 12. Prerequisite(s): Third-year standing in the College of Veterinary Medicine. Diagnosis and surgical management of small animal orthopedic and neurological diseases. Lecture and laboratory format.

VMED 7891 Equine Surgical Laboratory. Lab 12. Prerequisite(s): Third-year standing in the College of Veterinary Medicine. Surgical techniques directly supervised by the instructor. Fundamental enclosed surgical techniques. Abdominal procedures on live animals. Orthopedic procedures on cadavoric limbs.

VMED 7933 Diagnostics. Lab 9. Prerequisite(s): Fourth-year standing in the College of Veterinary Medicine. Participation in animal necropsy, clinical pathology, clinical parasitology, and other investigative methods to study diagnosis, prognosis, prevention, and treatment of animals.

VMED 7941 Clinical Skills Outcomes Assessment. Prerequisite(s):Fourth year standing in the College of Veterinary Medicine. Assessment of clinical skills using checklists and/or brief case summaries.

Zoology (ZOOL)

ZOOL 1604 Animal Biology. Lab 2. Prerequisite(s): BIOL 1114. Morphology, physiology, ecology, embryological development behavior, life histories and importance to man of representatives of major groups. Evolution of systems and mechanisms which have allowed animals to survive and adapt to diverse habitats.

ZOOL 2111 Opportunities in Zoology. Prerequisite(s): Sophomore standing and BIOL 1114. An overview of biological science disciplines and professional opportunities for Zoology and Physiology majors. Development of critical thinking, scientific writing, and presentation skills in the context of scientific discovery and dissemination.

ZOOL 3023 (N) Freshwater, Concepts, Threats and Management. Freshwater is a critical, non-substitutable resource. Do we have enough? How are we going to manage it? This course will introduce non-biology majors to the concepts, threats, and policy relevant to freshwaters using information published in the popular science press. Issues directly relevant to Oklahoma, and the U.S. will be discussed. Debates modeled using the legal system of policy formulation will promote critical thought and communication skills in an exciting real-world milieu.

ZOOL 3104* Invertebrate Zoology. Lab 4. Prerequisite(s): 1604. Morphology, physiology, reproduction and ecology of major invertebrate groups.

ZOOL 3113 (N) Human Evolution. Prerequisite(s): BIOL 1114 or equivalent strongly recommended. Overview of how evolution shapes human biology. Topics include evolutionary mechanisms, human genetic variation and health, primate diversity, the fossil record, and the origins, dispersal, and behavior of anatomically modern humans.

ZOOL 3114* Vertebrate Morphology. Lab 3. Prerequisite(s): 1604. Comparative morphology of representative vertebrates with emphasis on phylogeny and ontogeny and consideration of histology and function.

ZOOL 3123 (N) Human Heredity. The impact of genetics on human endeavor. No degree credit for students with prior credit in BIOL 3023.

ZOOL 3153 Animal Behavior. Prerequisite(s): Junior standing. Survey of theory and application in basic and applied animal behavior. Interdisciplinary analysis of animal behavior in the field, captive settings and laboratories.

ZOOL 3163 Environmental Biology. Prerequisite(s): Introductory Biology and one course in General Chemistry. Overview of how organisms are influenced by the environment in which they live and how anthropogenic activities impact their environment. Topics include impacts of disturbing energy and material cycles, toxicological disease, and infectious disease.

ZOOL 3204 Physiology. Lab 2. Prerequisite(s): BIOL 1114; CHEM 1215 or 1314. Anatomy and function of the human body. Human and domestic animal physiology considered in laboratories.

ZOOL 3214 Human Anatomy. Lab 3. Prerequisite(s): 1604 or 3204. Gross anatomy of the human body and its systems with a minor emphasis on histology. Laboratory based on human models and comparisons with dissections of nonhuman mammals. ZOOL and PHSL majors may count as elective hours only.

ZOOL 3233 Human Reproduction. Prerequisite(s): BIOL 1114. Overview of human reproduction, including conception, pregnancy, childbirth, sexual maturation, and parental investment in offspring. Draws from multiple fields such as genetics, anatomy and physiology, developmental biology and evolutionary theory.

ZOOL 3513 Principles of Conservation Biology. Prerequisite(s): 60 credit hours including BIOL 3034. Application of ecological principles to the maintenance and restoration of biological diversity at genetic, population, and community levels. (Same course as NREM 3513)

ZOOL 3700 Readings and Special Studies in Zoology. 1-3 credits, max 6. Prerequisite(s): ZOOL 1604 and consent of instructor. Discussion of selected readings.

ZOOL 4104* General Parasitology. Lab 3. Prerequisite(s): 1604. Fundamentals of parasitism with emphasis on: life cycles, disease conditions, epidemiology, diagnosis, treatment, historical significance, terminology, taxonomy, and parasitological techniques.

ZOOL 4113 Conservation Genetics. Prerequisite(s): BIOL 3023 or equivalent, MATH 1513. Principles of population genetics as they pertain to issues in conservation biology. Evolutionary relationships, hybridization, natural selection, factors affecting small populations, gene flow, captive populations, and META populations. No credit for students with credit in 5113. (Same course as 5113*)

ZOOL 4115* Biology of Fishes, Amphibians and Reptiles. Lab 5. Prerequisite(s): ZOOL 1604. Systematics, evolution, and natural history of fishes, amphibians and reptiles; laboratory emphasis on Oklahoma species. Offered spring semester of even-numbered years. Weekend field trips required.

ZOOL 4133* Evolution. Prerequisite(s): BIOL 3023. Development of the evolutionary concept; speciation evolutionary mechanisms and phylogenetic concepts.

ZOOL 4134* Embryology. Lab 2. Prerequisite(s): 3114, MICR 3033. Biochemical basis of development with emphasis on gene regulation. Comparative development of sea urchin, frog, chick and pig. Experiments using frog and mouse, including the molecular level.

ZOOL 4174* Mammalogy. Lab 3. Prerequisite(s): 1604. Taxonomy, identification, evolution, zoogeography, life history traits, and techniques of study of wild mammals. Weekend field trips required.

ZOOL 4215* Mammalian Physiology. Prerequisite(s): ZOOL 3204 and CHEM 3015 or CHEM 3053. Descriptive and functional analysis of the mammalian nervous, cardiovascular, musculoskeletal, respiratory, renal, endocrine, and digestive organ systems. For majors in biological, agricultural, or human environmental (including pre-medical, pre-dental and pre-veterinary) sciences.

ZOOL 4223* Mammalian Physiology Laboratory. Lab 4. Prerequisite(s): 4215. Co-requisite: 4231. Laboratory experiments that illustrate function of organs, organ systems or mechanisms of whole body physiological control.

ZOOL 4231* Seminar in Physiology. Prerequisite(s): 4215. Co-requisite: 4223. Oral and written communication in the physiological sciences; critical review of physiological literature.

ZOOL 4243* Introductory Pharmacology. Prerequisite(s): 3204 or 4215. Major drug classes based on their predominant use or principal activity in the body; basis for drug action; and modification of drugs and their action by physiological processes.

ZOOL 4273 Environmental Physiology. Prerequisite(s): 3204 or 4215. Environmental, comparative and ecological physiology of nonhuman animals, with emphasis on vertebrates. Thermoregulation, osmoregulation, comparative aspects of respiratory, circulatory, digestive, muscle, and sensory physiology, and adaptations to extreme environments. *No credit for students with credit in 5273.* (Same course as 5273*)

ZOOL 4283 Endocrinology. Prerequisite(s): 3204 or 4215 and CHEM 3015 or consent of instructor. Examination of the hormonal control and regulation of physiological processes in vertebrates. Function of the hypothalamus, pituitary, adrenal, thyroid, pancreas, ovary and testes; comparative endocrinology. *No credit for students with credit in 5283.* (Same course as 5283*)

ZOOL 4293 Behavioral Neuroendocrinology. Prerequisite(s): 3204 or 4215. Examination of the influences of nervous and endocrine systems on behavior, and vice-versa, in vertebrates, including humans. Historical roots and current techniques relating to topics, including male and female reproductive behavior patterns, sex differences in behavior and neuroendocrine causation. *No credit for students with credit in ZOOL 5293.* (Same course as 5293*)

ZOOL 4303 Organismal Ecotoxicology. Prerequisite(s): BIOL 1114 or equivalent and CHEM 1215 or 1314 and junior standing. Comparative study of the major groups of environmental contaminants (e.g. heavy metals, PCB's, insecticides) and an introduction to the basic theories, principles and techniques associated with the study of contaminant fate and effects on organisms. (Same course as 5303)

ZOOL 4313 Animal Communication. Prerequisite(s): A course in animal behavior or behavioral ecology recommended. Animal communication explores modes of information transfer across the animal kingdom, including: visual, auditory, chemical, electric, and tactile signals. This course explores signal production and perception, and discusses the evolution, design and reliability of signals. The course covers the theories that attempt to explain signal function and evolution. Ultimately, the student will gain a general appreciation for the basic principles of animal communication. *No credit for credit in 5313.*

ZOOL 4353 Neurophysiology. Prerequisite(s): A course in physiology. Provides an introduction to the neural mechanisms controlling general biological processes and behavior, with discussion focused on basic theories and principles in brain function. No credit for students with credit in 5353.

ZOOL 4413* Biology of Fishes. Lab 1. Prerequisite(s): ZOOL 1604. Ecology and evolution of fishes with particular emphasis on physiology, morphology, behavior, and taxonomy; laboratory emphasis on Oklahoma species. Offered fall semester of even-numbered years. Weekend field trips required.

ZOOL 4434* Limnology. Lab 3. Prerequisite(s): BIOL 3034. Physical, chemical, and biological factors in lakes and streams.

ZOOL 4464* Ornithology. Lab 3. Prerequisite(s): 1604. Classification, evolution, distribution, identification, life histories, and morphological, ecological, and behavioral adaptations of birds. Two weekend field trips required. (Same course as NREM 4464)

ZOOL 4484 Aquatic Entomology. Lab 2. Prerequisite(s): ENTO 2993 or ZOOL 1604. Biology, taxonomy and ecology of insects and other invertebrates inhabiting freshwater environments. Emphasis is placed on identification and biology of individual taxa. Roles of insects in aquatic ecology as a forage base, and as indicators of biotic integrity of aquatic systems. Linkages between aquatic systems and terrestrial systems are also examined. *No credit for students with credit in 5484 or ENTO 5484.* (Same course as ENTO 4484)

ZOOL 4503 Genetics Laboratory Investigations. Lab 6. Prerequisite(s): Completion of BIOL 3023 with a minimum grade of "C" or consent of instructor. Laboratory course to complement BIOL 3023 General Genetics. Experiments on Mendelian, microbial, Drosophila, molecular and population genetics. Techniques including, Drosophila manipulations, DNA isolation, electrophoresis, PRC, DNA sequencing and analyses, cloning and biotechnology.

ZOOL 4700 Undergraduate Research Problems. 1-4 credits, max 4. Prerequisite(s): Consent of instructor. Participation in faculty research or execution of a problem formulated by the student. Project will include the communication of research results in written and/or oral form.

ZOOL 4710 Internships in Zoology. 1-3 credits, max 3. Prerequisite(s): Consent of instructor. Student participation in a research project during an internship in a Zoology-related professional work setting. *Graded on a pass-fail basis.*

ZOOL 4750 Honors Study in Zoology. 1-5 credits, max 5. Prerequisite(s): Honors Program participation. Individual study in the development of zoological concepts. Extensive reading, literature search and special experimentation. An individual problems course for the gifted student.

ZOOL 5000* Research for Master's Thesis. 1-6 credits, max 6. Independent research for the MS thesis under the supervision of graduate faculty member.

ZOOL 5003* Graduate Orientation and Academic Development. Prerequisite(s): Admission to Zoology graduate program or instructor approval. Prepare first year zoology graduate students for success. We address departmental expectations and standards by providing: an introduction to departmental expertise and capabilities, exposure to available tools and resources, a forum for research conceptualization and formulation, instruction on finding and securing funding, guidance on how to convert questions into grant proposals, and a milieu for preparation, submission and peer review of external grant/fellowships.

ZOOL 5010* Graduate Seminar. 1-3 credits, max 10. Discussion of selected topics.

ZOOL 5011* Current, Historical, and Integrative Principles in Zoology. Prerequisite(s): Admission to Zoology graduate program or instructor approval. This course will furnish fundamental concepts in ecology, evolution, and environmental stress for first-year graduate students in zoology (and related departments). More importantly, this course is organized as modules that bring together various elements from the three broadly defined, and fundamentally related disciplines (i.e., ecology, evolution, and environmental stress), that our department views as our core strengths.

ZOOL 5020* Special Problems. 1-4 credits, max 10. Prerequisite(s): Graduate standing and consent of instructor. A report of results obtained is to be placed in department files.

ZOOL 5030* Teaching Zoology. 1-3 credits, max 4. Prerequisite(s): Consent of instructor. Supervised teaching in the department. Attendance at seminar on problems involved in teaching zoology in college.

ZOOL 5112* Advanced Herpetology. Selected advanced aspects of evolution, systematics, biogeography, natural history, physiology, husbandry, nutrition, ecology, behavior, and population biology of reptiles and amphibians as drawn from the primary literature.

ZOOL 5113* Conservation Genetics. Prerequisite(s): Course in genetics strongly recommended. Theory and principles of population genetics as they pertain to issues in conservation biology. Evolutionary relationships, hybridization, natural selection, factors affecting small populations, gene flow, captive populations, META populations, and data analysis. *No credit for students with credit in 4113.* (Same course as 4113)

ZOOL 5123 Behavioral Ecology. Prerequisite(s): Course in ecology strongly recommended. Analysis and description of the behavior of animals in their natural environment, especially in terms of natural selection and adaptation. A synthesis of ethology, population genetics, sociobiology, and evolutionary theory. Largely descriptive and generalized with limited emphasis on mathematical theory.

ZOOL 5133* Evolutionary Ecology. Lab 2. Prerequisite(s): Course in ecology strongly recommended. Ecological concepts dealing with contemporary evolutionary processes, not phylogeny. Life history traits, sociality, kin and group selection, speciation, competition, predation, plant-animal coevolution, niche theory, species diversity and biogeography. General models and mechanisms, with examples drawn from all kingdoms.

ZOOL 5243* Ecological Immunology. The causes and consequences of variation in immunity studies within the context of evolution and ecology. Introduction to grant writing. A combination of lectures and student-led presentations intended for graduate students and advanced undergraduates.

ZOOL 5273* Environmental Physiology. Prerequisite(s): 3204 or 4215 or equivalent. Environmental, comparative and ecological physiology of nonhuman animals with emphasis on vertebrates. Thermoregulation, osmoregulation, comparative aspects of respiratory, circulatory, digestive, muscle, and sensory physiology, and adaptations to extreme environments. *No credit for students with credit in 4273.* (Same course as 4273)

ZOOL 5283* Endocrinology. Prerequisite(s): 3204 or 4215 and CHEM 3015 or consent of instructor. Examination of the hormonal control and regulation

of physiological processes in vertebrates. Function of the hypothalamus, pituitary, adrenal, thyroid, pancreas, ovary and testes; comparative endocrinology. *No credit for students with credit in 4283.* (Same course as 4283)

ZOOL 5293* Behavioral Neuroendocrinology. Prerequisite(s): 3204 or 4215. Examination of the influences of nervous and endocrine systems on behavior and vice-versa, in vertebrates including humans. Historical roots and current techniques relating to topics, including male and female reproductive behavior patterns, sex differences in behavior and neuroendocrine causation. *No credit for students with credit in 4293.* (Same course as 4293)

ZOOL 5303* Organismal Ecotoxicology. Comparative study of the major groups of environmental contaminants (e.g. heavy metals, PCB's, insecticides) and an introduction to the basic theories, principles and techniques associated with the study of contaminant fate and effects on organisms. (Same course as 4303)

ZOOL 5313* Animal Communication. Prerequisite(s): A course in animal behavior or behavioral ecology recommended. Animal communication explores modes of information transfer across the animal kingdom, including: visual, auditory, chemical, electric, and tactile signals. This course explores signal production and perception, and discusses the evolution, design and reliability of signals. The course covers the theories that attempt to explain signal function and evolution. Ultimately, the student will gain a general appreciation for the basic principles of animal communication. *No credit for credit in 4313.*

ZOOL 5343* Population and Community Ecotoxicology. Prerequisite(s): Course in ecology strongly recommended. Examines the exposure of animals to environmental contaminants and resulting effects at the individual through community level. The dynamic nature of exposure to contaminants will be of particular interest in this course. For example, how do the natural history traits of a species either protect it from exposure, or enhance its potential for exposure to contaminants? Topics will range from the historical perspectives to ecotoxicology to study design and risk assessment.

ZOOL 5353 Neurophysiology. Prerequisite(s): A course in physiology. Provides an introduction to the neural mechanisms controlling general biological processes and behavior, with discussion focused on basic theories and principles in brain function. *No credit for credit in 4353.*

ZOOL 5403* Advanced Wetland Ecology. Prerequisite(s): A course in aquatic ecology or wetland management recommended. Principles and theory of wetland ecology with a focus on wetland processes, function, and services. Topics include wetland geomorphology, biogeochemistry and hydrology of wetlands, wetland functions and services, wetland development, wetland restoration, water issues, wetland policy, philosophy of wetland management, and educating society about wetlands. (Same course as NREM 5403)

ZOOL 5423* Techniques in Environmental Toxicology. Lab 4. Prerequisite(s): Organic chemistry or instructor consent. Practical understanding of modern techniques used to quantify exposure and effects of environmental toxicants. Laboratory topics include gas chromatography, HPLC, atomic absorption spectroscopy, immunoassay, and toxicity testing.

ZOOL 5484* Aquatic Entomology. Lab 2. Prerequisite(s): ENTO 2993 or ZOOL 1604. Biology, taxonomy and ecology of insects and other invertebrates inhabiting freshwater environments. Emphasis is placed on identification and biology of individual taxa. Roles of insects in aquatic ecology, as a forage base, and as indicators of biotic integrity of aquatic systems. Linkages between aquatic systems and terrestrial systems are also examined. *No credit for students with credit in 4484 or ENTO 4484.* (Same course as ENTO 5484)

ZOOL 5503* Spatial Ecology and Analysis. Prerequisite(s): Course in ecology strongly recommended. Theory, methods, and models for identifying and quantifying spatial patterns and processes, with a focus on implications for ecological relationships.

ZOOL 5523* Population Ecology. Lab 2.5. Prerequisite(s): BIOL 3034, MATH 1513. Theory and principles of predicting and analyzing population abundance and dynamics. Life history theory, foraging theory, habitat selection, population genetics, and species interactions. (Same course as NREM 5523)

ZOOL 5603* Elements in Integrative Biology. Prerequisite(s): Courses in biology and chemistry. Explores eco-evolutionary processes using the most fundamental currency atoms of various biogenic elements. Such elemental thought enables integration of several key eco-evolutionary processes operating at various levels of organization (e.g. gene expression, cellular metabolism, foraging behavior, life-history) without any phylogenetic boundaries. This view of biology helps build theory that can describe the functioning and evolution of biological systems.

ZOOL 5623* Ecological Data and Alternative Hypotheses. Prerequisite(s): Course in statistics strongly recommended. Emphasizes statistical analyses that start with a set of plausible alternative hypotheses and use likelihoods to quantify the relative support the hypotheses receive from empirical data. Instruction will be done with lectures, computer lab exercises, and in-class presentations.

ZOOL 5633 Ecological and Behavioral Modeling. Prerequisite(s): Course in ecology strongly recommended. This course will provide a general overview of modeling approaches for studying a variety of ecological and environmental problems. It will provide students with a toolbox of techniques, and discuss how they can be used to address questions and generate testable predictions. The course will emphasize modeling individual behavior and population dynamics.

ZOOL 5643* Ecological Niche Modeling and Species' Distributions. Prerequisite(s): Course in ecology strongly recommended. Ecological niche modeling theory and practice. Generation of niche models and distribution predictions to address questions on species' ecology, conservation, biogeography, and phylogeography. Familiarization with ESRI ArcGIS software, as well as environmental GIS data sources.

ZOOL 6000* Research for PhD Dissertation. 1-15 credits, max 60. Independent research for the PhD dissertation under the supervision of a graduate faculty member.