Course Listings

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 book 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 *College of Osteopathic Medicine of OSU College Catalog* for osteopathic medicine course descriptions.)

Explanation of Course Listings

A course listing 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. Courses numbered 3000 and 4000 may be taken for graduate credit if the course number is labeled with an asterisk. Extra work is required of a graduate student in a 3000- or 4000-level course.

General Education Requirement Codes. The capital letters in parentheses preceding some course titles designate courses fulfilling various undergraduate general education requirements. (See "Academic Regulations.")

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, B or C
A *or* B *or* C is acceptable

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. 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 0000*. Credit may not be earned in *both* courses so cross-referenced.

Abbreviations Used

A&S	Arts and Sciences
ABSE	Applied Behavioral Studies in Education
ACCT	Accounting
AERO	Aerospace Studies--Air Force
AG	Agriculture
AGCM	Agricultural Communications
AGEC	Agricultural Economics
AGED	Agricultural Education
AMST	American Studies
ANSI	Animal Science
ANTH	Anthropology
ARCH	Architecture
ART	Art
ASTR	Astronomy
AVED	Aviation Education
BADM	Business Administration
BAE	Biosystems Engineering
BCOM	Business Communications
BHON	Business Honors
BIOC	Biochemistry
BIOL	Biological Science
BIOM	Biomedical Sciences
BOT	Botany
BSPR	Business Professions
CDIS	Communication Sciences and Disorders
CHE	Chemical Engineering
CHEM	Chemistry
CIED	Curriculum and Instruction Education
CIVE	Civil Engineering
CLML	Cell and Molecular Biology
CMT	Construction Management Technology
CPSY	Counseling Psychology
CS	Computer Science
DHM	Design, Housing and Merchandising
ECEN	Electrical and Computer Engineering
ECON	Economics
EDLE	Educational Leadership
EDTC	Educational Technology
EDUC	Education
EET	Electrical Engineering Technology
ENGL	English
ENGR	Engineering
ENSC	Engineering Science
ENTO	Entomology
ENVR	Environmental Science
EPSY	Educational Psychology
ETM	Engineering and Technology Management
FIN	Finance
FLL	Foreign Languages and Literatures
FOR	Forestry
FPST	Fire Protection and Safety Technology
FREN	French
FRNS	Forensic Sciences
GENE	Genetics
GENG	General Engineering
GENT	General Technology
GEOG	Geography
GEOL	Geology
GRAD	Graduate
GREK	Greek
GRMN	German
HDFS	Human Development and Family Science
HES	Human Environmental Sciences
HHP	Health and Human Performance
HIST	History
HONR	Honors College
HORT	Horticulture
HRAD	Hotel and Restaurant Administration
HRAE	Human Resources and Adult Education
IEM	Industrial Engineering and Management
INTL	International Studies
JAPN	Japanese
JB	Journalism and Broadcasting
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
MCAG	Mechanized Agriculture
MET	Mechanical Engineering Technology
MGMT	Management
MICR	Microbiology
MKTG	Marketing
MLSC	Military Science
MSIS	Management Science and Information Systems
MTCL	Medical Technology
MUSI	Music
NATS	Natural Science
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
RLEM	Rangeland Ecology and Management
RUSS	Russian
SCFD	Social Foundations
SDEV	Student Development
SOC	Sociology
SOIL	Soil Science
SPAN	Spanish
SPCH	Speech Communication
SPED	Special Education
STAT	Statistics
TCOM	Telecommunications Management
TH	Theater
TIED	Technical and Industrial Education
UNIV	University
VBSC	Veterinary Biomedical Sciences
VCS	Veterinary Clinical Sciences
VMED	Veterinary Medicine
ZOOL	Zoology

Accounting (ACCT)

2103
Financial Accounting. Prerequisite: 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.

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

3013
Federal Income Taxation. Prerequisite: 2203. 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.

3203
Cost Accounting. Prerequisites: 2203 with a grade of "C" or better and STAT 2023. Cost accumulation systems, allocating product costs, planning and controlling costs, standard costing, and profitability analysis.

3433
Financial Accounting and Reporting Concepts. Prerequisite: 2203 with grade of "C" or better. Theory and concepts underlying financial accounting and reporting.

3603
Accounting Information Systems. Prerequisite: 2203 with a grade of "C" or better. Accounting system design and installation.

3900
Undergraduate Internship in Accounting. 1-3 credits, maximum 3. Prerequisites: accounting major, nine hours of upper-division accounting, and consent of instructor. Supervised internship in public accounting, industry, or not-for-profit organizations. May be counted as elective hours only.

4010
Accounting Projects. 1-6 credits, maximum 6. Prerequisites: consent of instructor and 3203 and 3403. Special topics, projects and independent study in accounting.

4013*
Advanced Federal Income Taxation. Prerequisite: 3013 with a grade of "B" or better. Federal income tax law applicable to individuals, corporations, partnerships, trusts and estates, and other specialized topics.

4203*
Topics in Management Accounting. Prerequisites: 2203 with grade of "C" or better and MSIS 3223. Integrative course in cost and management accounting; use of accounting information for internal decision making.

4403*
Financial Accounting III. Prerequisite: 3403 with grade of "C" or better. Consolidated statements and other financial accounting topics.

4433
Financial Accounting and Reporting Applications and Research. Prerequisite: ACCT 3433 with a grade of "C" or better. Developing financial research skills and applying them to accounting and reporting issues.

4453*
Contemporary Integrated Accounting and Business Systems. Prerequisite**:** 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.

4503*
Auditing. Prerequisites: 3433, 3603. Auditing theory, procedures and practices.

4703
International Accounting. Prerequisites: 2103, 2203. Diversity in financial reporting across countries and its effect on global capital flows. Using corporate financial information across borders. Accounting in energizing markets.

5000*
Thesis. 1-6 credits, maximum 6. For students writing reports and theses in accounting.

5013*
Seminar in Tax Research. Prerequisite: 4013 or consent of instructor. Development and administration of federal tax law with emphasis on the development of tax research skills.

5023*
Seminar in Estate and Gift Taxation. Prerequisite: 5013 or consent of instructor. Federal tax law applicable to estate and gift taxation and income taxation of estates and trusts.

5033*
Seminar in Oil and Gas Taxation. Prerequisite: 5013 or consent of instructor. Federal income tax laws applicable to the petroleum and other extractive industries.

5043*
Seminar in Partnership Taxation. Prerequisite: 5013 or consent of instructor. Federal income tax laws applicable to partners and partnerships.

5053*
Seminar in Corporate Taxation. Prerequisites: graduate standing and 5013 or consent of instructor. Federal income tax law applicable to corporations and to other entities in their capacity as corporate shareholders.

5103*
Financial Accounting and Analysis. Prerequisites: admission to MBA program or consent of MBA director. Development of the ability to read and to analyze financial statements and to use this information along with other types of information in decision making.

5110*
Special Topics and Individual Work in Accounting. 1-10 credits, maximum 10. Prerequisite: consent of instructor. Individual work on special topics, projects or readings selected to acquaint students with significant accounting literature.

5113*
Managerial Accounting. Prerequisite: 5103. Interpretation of accounting data in planning, controlling and decision making.

5123*
Enterprise Resource Planning. Prerequisites: graduate standing and 5103, 5113, MSIS 5643, or consent of director of MIS/AIS. 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. Same course as MSIS 5123.

5133*
International Oil and Gas Accounting. Prerequisite: graduate standing. Financial accounting and reporting for U.S. and international oil and gas operations. Domestic and international joint venture accounting. Accounting for international concession and profit sharing agreements.

5203*
Seminar in Contemporary Accounting Theory I. Prerequisite: 3403. Origin and development of accounting and a critical study of modern accounting theory.

5303*
Seminar in Contemporary Accounting Theory II. Prerequisite: 3403. Critical study of contemporary accounting theory.

5313*
Financial Statement Analysis. Prerequisite: consent of graduate coordinator. A study of the demand and supply of financial data, properties of numbers derived from financial statements, the role of financial information in investment decisions, and features of the decision-making environment.

5400*
Practicum in Professional Accounting. 1-6 credits, maximum 6. Prerequisite: admission to M.S. in accounting program or consent of instructor. Study of accounting policies, retirement policies, tax issues, and other relevant business issues associated with mergers, acquisitions and divestitures.

5503*
Advanced Assurance Services. Prerequisite: 4503 or equivalent, and admission to M.S. in accounting program. Advanced topics in statutory auditing, operational auditing, and investigative services.

5603*
Accounting-based Information Systems. Prerequisite: 18 credit hours of accounting including 4203. Concepts underlying the design and use of an effective accounting information system.

5613*
Information Systems Control, Assurance, and Information Risk Management. Prerequisite: admission to MIS/AIS program or M.S. in accounting program. Controlling and auditing business information systems including management and applications controls, electronic commerce, and inter-related controls. Evaluation of system performance through use of audit software.

5713*
Seminar in International Accounting. Prerequisites: 3403 and consent of graduate coordinator. Accounting issues faced by multinational enterprises and internationally listed companies, including diversity in financial reporting and harmonization.

5803*
Valuation and Business Risk Management. Prerequisite: admission to M.S. program or consent of instructor and 18 credit hours of accounting. Intensive study of valuation models, (including methods to value both business and individual assets and liabilities), risk management (including both financial and operations risk management), and other topics of an advanced nature relating to cost management.

5900*
Graduate Internship in Accounting. 1-3 credits, maximum 3. Prerequisites: admission to master's program; consent of graduate coordinator. Supervised internship in public accounting, industry, or not-for-profit organizations. May be counted as elective hours only.

5902*
Research Report. Prerequisite: consent of supervising professor and coordinator of graduate programs in accounting. 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. Restricted to candidates seeking the M.S. in accounting degree and not available to students who have credit in 5000.

6000*
Research and Thesis. 1-18 credits, maximum 36. Prerequisite: approval of advisory committee. For students working on the doctoral degree.

6110*
Graduate Readings and Special Topics in Accounting. 1- 3 credits, maximum 20. Prerequisite: 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.

6703*
Seminar in Accounting Research. Prerequisites: 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)

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.

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.

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.

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 US air power.

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.

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.

3504
Field Training Encampment Program. Prerequisite: 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.

4103
(S)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.

4203
(S)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.

4402
Summer Professional Development Training Program. Prerequisite: 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.

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

Agricultural Communications (AGCM)

2103
Communications in Agriculture. Lab 2. Prerequisite: ENGL 1113. Fundamentals of agricultural newswriting and other communication methods. Careers in and the role of the media in agriculture and related fields.

3103
Communicating Agriculture to the Public. Prerequisite: 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.

3113
Writing for Agricultural Publications. Lab 2. Prerequisite: 2103. Interviewing, reporting, writing and editing for agricultural publications.

3123
Agricultural Broadcasting. Lab 2. Prerequisites: 3113 or JB 3263. Interviewing, reporting, writing and editing agricultural broadcast programs. Exploration of new technologies in broadcast equipment.

3213
Layout and Design for Agricultural Publications. Lab 4. Prerequisites: 2103 or JB 2003; and major in agricultural communications or consent of instructor. Fundamentals of layout and design as applied to agricultural publications, such as brochures, newsletters and fliers. Practical application of design principles, typography, desktop-publishing software, and printing practices. Opportunity for service-learning experiences.

3223
Web Design for Agricultural Organizations. Lab 4. Prerequisites: 2103 or JB 2003; and 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 visual design, computer software, writing, editing, and project management. Opportunities for service-learning experiences.

3233*
Basic Photography and Photo Editing for Agriculture. Lab 4. Prerequisites: 2103 or JB 2003; and major in agricultural communications or consent of instructor. Beginning course focusing on photographic equipment, related software and photo composition in an agricultural setting.

4203*
Professional Development in Agricultural Communications. Lab 1. Prerequisites: junior standing and agricultural communications major or consent of instructor. Professional preparation and development for careers in agricultural communications. Skills, resume and portfolios, presentations, networking and job interviews. Requirements and procedures for completing required supervised internship related to academic major.

4300
Internships in Agricultural Communications. 1-6 credits, maximum 6. Prerequisites: consent of internship coordinator and adviser. Supervised work experience with approved employers in agricultural communications including agricultural publications, radio stations, television stations, public relations offices, advertising firms, government offices, and other related opportunities. Presentation required following the internship.

4403*
Planning Campaigns for Agriculture and Natural Resources. Lab 4. Prerequisites: AGCM 3113 or JB 3263; AGCM 3213. Communications campaign development for agriculture and natural resources activities and issues, including development of materials, budgets and contracts.

4413*
Capstone for Agricultural Communications. Lab 4. Prerequisites: JB 3263; 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.

4990
Problems in Agricultural Communications. 1-6 credits, maximum 6. Prerequisite: consent of instructor. Small group and individual study and researchin problems relating to communications within the agricultural sector and from the agricultural sector to other constituencies.

5000*
Research and Thesis. 1-6 credits, maximum 6. Prerequisite: graduate standing. Independent research and thesis under the direction and supervision of a major professor.

5100*
Issues in Agricultural Communications. 1-3 credits, maximum 6. Prerequisite: graduate standing. Discussion of issues, problems and trends in agricultural communications.

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

5203*
Theory and Practice in Agricultural Communications. Prerequisite: graduate standing. The study of major communication theories and theorists in the context of agricultural communications.

5990*
Advanced Studies in Agricultural Communications. Prerequisite: consent of supervising professor. Individual and small group study or research in agricultural communications topics and issues.

Agricultural Economics (AGEC)

1114
(S)Introduction to Agricultural Economics. Prerequisite: MATH 1483 or 1513. Economic theory of production, marketing and consumption of agricultural products. The role and structure of agriculture in 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.

3010
Internship in Agricultural Economics. 1-6 credits, maximum 6. Prerequisite: 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 pass-fail basis.

3101
Professional Career Development. Prerequisites: 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.

3213
Quantitative Methods in Agricultural Economics. Lab 2. Prerequisites: 1114, STAT 2023 or equivalent, and MSIS 2103, AG 2112 or equivalent. Indices, graphics, budgeting, discounting, basic statistical measures, use of microcomputers, and price analysis. Basic background methods for some courses involving analysis.

3323
Agricultural Product Marketing and Sales. Prerequisites: 1114, 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.

3333
(S)Agricultural Marketing and Price Analysis. Prerequisite: 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.

3403
Agricultural Small Business Management. Prerequisite: 1114. 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.

3423
Farm and Agribusiness Management. Prerequisites: 1114, ACCT 2103. 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.

3463*
Agricultural Cooperatives. Prerequisite: 3423. 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.

3503*
(S)Natural Resource Economics. Prerequisite: 1114 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, and public issues of taxation, police power and eminent domain.

3603*
Agricultural Finance. Prerequisite: 3423. Farm financial management; preparation and analysis of net worth, cash flow and income statements, including microcomputer applications; financial intermediaries; serving agriculture; procedures for evaluating investments; alternative means of acquiring control of farm resources.

3703
Issues in Agricultural Policy. Prerequisite: 1114. Emerging issues related to agricultural policy in the United States.

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

4101
Agricultural Economics Seminar. Prerequisites: senior standing and agricultural economics or agribusiness major status. Contemporary problems in agricultural economics.

4213*
Quantitative Price Analysis. Prerequisites: 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.

4333*
Commodity Futures Markets. Prerequisites: 3213 and 3333. The nature of commodity futures markets and the mechanics of trading. Fundamentals and technical aspects of commodity prices. Basis and basis trading. Hedging and hedging strategies. Regulating commodity trading. Tax aspects. Appreciation of principles via computer game.

4343*
(I)International Agricultural Markets, Trade and Development. Prerequisite: 3333. International trade of agricultural products with emphasis on theory of trade and monetary flows, national trade policies and world market structures for agricultural products. Impacts of trade on the domestic agricultural sector and the role of trade in agricultural economics.

4403*
Advanced Farm and Ranch Management. Prerequisites: 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.

4413*
Agricultural Law. Prerequisite: 1114. Survey of law with emphasis on agricultural problems and applications. Contract law, tort law, property law, real estate transactions, oil and gas leases, business organization, estate planning and credit.

4423*
Advanced Agribusiness Management. Prerequisites: 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.

4503*
Environmental Economics and Resource Development. Prerequisite: 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.

4513*
Farm Appraisal. Lab 2. Prerequisite: 3423. Estimating the market value of agricultural real estate using the three approaches to value. Determining the feasibility and profitability of land purchases.

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

4723*
(S)Rural Economic Development. Prerequisite: 1114. Concepts and theories of regional and community economics, including input-output, economic base, simulation, budget location, and routing. Oklahoma applications.

4803
International Agricultural Economics Tour. Prerequisite: 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.

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

5000*
Thesis or Report in Agricultural Economics. 1-6 credits, maximum 6. For students working for a M.S. degree in agricultural economics. Independent research and thesis under the direction and supervision of a major professor.

5010*
Professional Experience in Agricultural Economics. 1-6 credits, maximum 6. Prerequisites: approval of internship committee and adviser. Supervised professional experience with approved public and private employers in agricultural economics including banks, production credit associations, federal land banks, soil conservation service, and other agricultural related firms. Credit will not substitute for required courses. Designed for Master of Agriculture program.

5101*
Research Methodology. Prerequisites: selection of a thesis adviser and a thesis topic. Using the scientific method to solve problems in agricultural economics. Written ten-page thesis proposal.

5103*
Mathematical Economics. Prerequisites: differential calculus and ECON 3113. Mathematical tools necessary for formulation and application of economic theory and economic models.

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

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

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

5303*
Agricultural Market Policy and Organization. Marketing firm decisions; structure, conduct and performance of agricultural industries; interregional trade theory; and government policies that influence decisions.

5403*
Production Economics. Prerequisite: 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.

5503*
Economics of Natural and Environmental Resource Policy. Prerequisites: 4503 or ECON 3313 and MATH 2103. Economics of long term resource use with particular emphasis on agricultural and forestry problems. Methods for estimation of nonmarket prices. Cost benefit analysis of long term natural resource use and environmental policy. Elementary computer simulation of long term resource use and environmental policy.

5603*
Advanced Agricultural Finance. Prerequisite: 3603. Financial structure of agriculture, firm financial planning and management, financial intermediation in agriculture and agricultural finance in developing countries.

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

5713*
Rural Regional Analysis. Prerequisite: 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.

5723*
Rural Development Planning. Economics of market based planning for developing and developed countries; methods of incentive planning with emphasis on agricultural and rural project analysis; methods of agricultural and rural sector incentive planning with emphasis on general equilibrium results.

5733*
International Agricultural Policy and Development. Review and evaluation of agricultural trade and development policies emphasizing developing countries. Objectives, constraints and instruments of national food and agricultural trade policy in an interdependent world. Efficiency, stability, distribution, equity and market structure in commodity trade.

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

6000*
Research Problems. 1-15 credits, maximum 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.

6102*
Teaching Practicum in Agricultural Economics. Lab 4. Prerequisites: 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.

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

6113*
Systems Analysis for Agriculture. Prerequisites: 5103, STAT 4043, knowledge of BASIC or FORTRAN. Methodology of systems modeling developed. Problem definition, design of abstract models and the simulation of dynamic agricultural systems with time delays, storage, feedback and stochastic variation. Theory and application of modeling with differential equations and optimal control procedures.

6213*
Advanced Econometrics. Prerequisites: 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, ARIMA models, and multivariate time series modeling. Extensive use of SAS and SHAZAM statistical software packages.

6300*
Agricultural Marketing Seminar. 1-6 credits,maximum 6. Prerequisite: consent of instructor. Current developments in theory, techniques for evaluating marketing behavior, market legislation and market development.

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

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

6403*
Advanced Production Economics. Prerequisite: 5403. Micro dynamic production economic problems under risky conditions; recent developments in agricultural risk management, measuring utility, stochastic efficiency and decision theory; potential application of inventory, replacement, simulation, game theoretic, Bayesian and nonlinear programming models in production economics research.

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

Agricultural Education (AGED)

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.

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.

3101
Laboratory and Clinical Experiences in Agricultural Education. Preprofessional clinical experiences in agricultural education teaching and related careers. Requirement for admission to teacher education, student teaching and internships. Graded on a pass-fail basis.

3103
Foundations and Philosophies of Teaching Agricultural Education. Lab 2. Prerequisite: 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.

3203*
Planning the Community Program in Agricultural Education. Lab 2. Prerequisite: 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.

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.

3333
Contemporary Issues in Leadership. Prerequisites: 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.

3403
Agricultural Agencies and Information Transfer. Prerequisites: junior standing or consent of adviser. Enabling legislation having an impact on federal and state agricultural agencies; corporate agricultural groups, cooperatives, federal, state and private agricultural research entities/organizations and farm organizations. Scope of U.S. and Oklahoma agriculture. Systems providing technical information, financing, markets and distribution of agricultural and food products. Theory involving the dynamics of change, diffusion of innovations and mediums of communication.

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

4103*
Methods and Skills of Teaching and Management in Agricultural Education. Lab 2. Prerequisites: 3203, junior standing in the College of Agriculture, full admission to the University Teacher Education program and concurrent enrollment in 4200. 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.

4113
Laboratory Instruction in Agricultural Education. Prerequisites: 3103, 3203; concurrent enrollment in 4103 and 4200. 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.

4200
Student Teaching in Agricultural Education. 10 credits. Lab 30. Prerequisites: 3203, junior standing in the College of Agriculture, full admission to the University Teacher Education program and concurrent enrollment in 4103. Full-time directed experience in an approved agricultural education department. Applications of methods and skills in agricultural education as related to selecting, adapting, utilizing, evaluating curriculum materials and experiences to meet educational goals and facilitate learning for individual students. Roles, responsibilities, interactions, of school personnel and parents. Study of professional education groups and organization and operation of school systems. Graded on a pass-fail basis.

4203*
Professional Development in Agriculture. Prerequisite: 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.

4300
Agricultural Education Internship. 3-6 credits, maximum 6. Prerequisites: professional course sequence and consent of adviser/internship coordinator. Supervised full-time internships in approved county extension offices, agribusinesses or government agencies, for students preparing career paths in agricultural education. Not intended for teacher certification. Maximum credit requires a 12-week internship in addition to a report and final seminar.

4303*
Facilitating Leadership Education Programs. Prerequisites: 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.

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.

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

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

5100*
Organizing Curriculum and Programs of Agricultural Education. 1-3 credits, maximum 6. Studies of student and community agricultural needs as bases for localizing, personalizing and utilizing a basic core curriculum and other components essential to effective local agricultural education programs.

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.

5202*
Grantseeking. Prerequisite: graduate standing or consent of instructor. Students become proficient in writing proposals to obtain external funding from private and government agencies. Skills such as conceptualizing projects that are worth funding, identifying sources of funders, developing a working narrative that follows the RFP guidelines, developing boilerplate information, conducting a review of literature to demonstrate a need for the project, developing timelines, and budgets.

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.

5353*
Leadership in Agriculture. Prerequisite: 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.

5500*
Directing Programs of Supervised Experience. 1-3 credits, maximum 6. Prerequisite: 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.

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.

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.

5900*
Graduate Internship in Agriculture. 1-6 credits, maximum 6. Prerequisite: 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.

5983*
Research Methods in Agricultural Education. Prerequisite: graduate standing. Research methods presented in support of decision making in a scientifically literate world. Literature, logic and research methodologies for quantitative and qualitative paradigms. Studies in the social sciences. Preparation of a proposal for their thesis, dissertation, or creative component.

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

6000*
Research in Agricultural Education. 1-16 credits, maximum 16. Prerequisite: 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.

6100*
Developments in Agriculture and Extension Education. 1-3 credits, maximum 6. Developing trends in agricultural and extension education. Pending and anticipated organizational and structural changes and changing emphases in goals and objectives. Functional relationships with other agencies.

6103*
History and Philosophical Foundations of Agricultural and Extension Education. Prerequisite: 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.

6120*
Teaching Agriculture in Higher Education. 1-3 credits, maximum 6. The teaching-learning matrix functioning in both undergraduate and advanced study in the field of agricul- ture. Discriminate review and assessment of recently developed instructional methods and trends.

6200*
County Extension Program Development. 1-3 credits, maximum 6. A systematic study and use of methods of developing county extension programs, giving attention to sources of essential basic information, determination of problems and needs of people, functions of lay people and the various groups of extension workers. Uses of committees, step-by-step procedures, coordinated county and state plans and characteristics of effective programs.

6223*
Program Evaluation in Agriculture and Extension. Prerequisite: 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.

6250*
Seminar in Advanced Qualitative Research Methods. 1-2 credits, maximum 2. Prerequisite: AGED 5983 or other graduate level social science research methods. Advanced qualitative research methods and analysis techniques presented in a Socratic context. Active engagement in qualitative research project to benefit from and contribute to this forum.

Agriculture (AG)

1011
Orientation. Required of all freshman 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.

2003
(N)Agriculture and the Environment. A study of agricultural ecosystems for the non-agriculture major. Discussion of contemporary issues related to agriculture and the environment including conservation of natural resources, water quality, use of fertilizer and chemicals, intensive animal production, animal well-being, land utilization, and use of genetically engineered plants and animals.

2112
Microcomputer Techniques in Agriculture. Lab 2. Operation and capabilities of microcomputers in agricultural applications. Simple programming, data analysis, graphical display, spread sheets, word processing.

3010
Internships in Agriculture. 1-3 credits, maximum 12. Supervised internships with business, industry or governmental agencies including cooperating veterinarians. Graded on pass-fail basis.

3080
International Experience. 1-18 credits, maximum 36. Prerequisite: consent of the associate dean of the college. Participation in a formal or informal educational experience outside of the USA.

3090
(I)Study Abroad. 1-18 credits, maximum 36. Prerequisites: consent of the Study Abroad office and associate dean of the college. Participation in an OSU reciprocal exchange program.

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

American Studies (AMST)

2103
(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.

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

3253
(H)Globalization and American Culture, the world looks at America. 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.

3313
(H)Science, Technology and American Cultures. American science and technology as systems of cultural representation, as communities of cultural practices, as mutually determined by other forms of cultural representation such as religion, social thought, art, architecture, literature, and music.

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.

3433
(H)Television Studies. Lab .5. In-depth examination of U.S. television including critical analysis of the development of the medium, its narrative and visual conventions, genres, political economy, and social effects, such as race, class, gender, sexuality and nation, and especially as compared to other mass media. Same course as ENGL 3433.

3713
(H)History of American Children's Culture. Interdisciplinary study of the history of culture for and by children. Children's literature, toys, folklore, music, clothing, movies, games, sports, tv shows, computer games, clubs and organizations.

3723
(H)Cultural History of American Sports and Everyday Life. Representations of sport in art, music, literature, and folklore as a window into the social history of American ideals and values; sport and community formation; cultural dimensions of sport performance. Sports rituals; athlete heroes, issues of race, class and gender; football; basketball; baseball; boxing; stock car racing.

3813
(H)Business in American Culture and Society. Interdisciplinary study of business as relates to the larger U.S. culture and society, in economic theory and ideas, in popular cultural representations of business, and the social effects of business on individuals including issues of race, class, gender and ethnicity.

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

4433
(H)Hollywood Genre Film. Study of one or more Hollywood film genres (romantic comedy, film noir, the musical, the western, the war film) to develop attention to film form and the evolution of generic conventions with the objective of understanding the American social, historical, and aesthetic contexts of specific genres.

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.

4973
Senior Seminar in American Studies. Writing of senior thesis based on original research and its analysis and evaluation or completion of independent project based on practical community experience.

Animal Science (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.

1133
Fundamentals of Food Science. Food industry from producer to consumer and the current U.S. and world food situations.

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.

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

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.

2253
Meat Animal and Carcass Evaluation. Lab 2. Prerequisite: 1124. Evaluation of carcasses and wholesale cuts of beef, pork and lamb. Factors influencing grades, yields and values in cattle, swine and sheep.

3021
Sheep Production. Lab 2. Prerequisites: 1124 and 2123. Modern production and management practices for sheep operations. No credit for animal science students with credit in 4542.

3031
Swine Production. Lab 2. Prerequisites: 1124 and 2123. Modern production and management practices for swine operations. No credit for animal science students with credit in 4643.

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.

3101
Undergraduate Seminar. Prerequisites: 60 credit hours and animal science major status. An in-depth consideration of the various areas of specialization in the field of animal science and their associated career opportunities and obligations.

3113
Quality Control. Lab 2. Prerequisites: introductory microbiology and organic chemistry. Application of the principles of quality control in food processing operations to maintain the desired level of quality.

3154
Food Microbiology. Lab 4. Prerequisites: 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 MICRO 3154.

3182
Meat Grading and Selection. Lab 4. Prerequisite: 2253. Classifying and grading carcasses and wholesale cuts of beef, pork and lamb; factors influencing quality and value.

3210
Animal and Product Evaluation. 1-2 credits, maximum 4. Prerequisite: consent of instructor. Advanced instruction in evaluating slaughter and breeding animals, and grading and evaluating meat, poultry and dairy products.

3242
Advanced Live Animal Evaluation. Lab 4. Prerequisite: 2112. Visual and objective appraisal of beef cattle, sheep, swine and horses.

3333*
Meat Science. Lab 3. Prerequisites: 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.

3373
Food Chemistry. Lab 2. Prerequisite: 3543 or organic chemistry. Basic composition, structure and properties of foods and the chemical changes or interactions that occur during processing and handling.

3422
Horse Management and Production. Nutrition, feeding, reproduction and physical conditioning of horses. Current management concepts as they apply to the health and well being of horses.

3423*
(N) Animal Genetics. Prerequisite: 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.

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

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

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.

3543
(N) Principles of Animal Nutrition. Prerequisite: 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.

3603
Processing Dairy Foods. Lab 2. Prerequisite: 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.

3612*
Rangeland and Pasture Utilization. Lab 2. Prerequisite: AGRON 3213 or 3913. Integration of livestock production with rangeland and pasture management practices.

3653*
Applied Animal Nutrition. Lab 2. Prerequisite: 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.

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.

3763*
Analysis of Food Products. Lab 2. Prerequisite: organic chemistry. Application of quantitative chemical and physical methods of analysis to the examination of foods.

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

4023
Poultry Science. Lab 2. Prerequisites: 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 poultrymen in the commercial production of table and hatching eggs, broilers, turkeys and other poultry meat.

4333*
Processed Meat. Lab 3. Prerequisite: 3033 or 3333. Meat and meat product composition. Techniques in the molding and forming of meat; sausage formulation; curing; quality control; and cost analysis.

4423
Horse Science. Lab 2. Prerequisites: 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.

4543*
Dairy Cattle Science. Lab 2. Prerequisites: 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.

4553*
Sheep Science. Lab 2. Prerequisites: 3433, 3443 and 3653. Breeding, feeding, management and marketing of commercial and purebred sheep.

4613*
Cow-Calf and Purebred Beef Cattle Management. Lab 2. Prerequisites: 3433, 3443, and 3653. Application of scientific knowledge, management principles and research advances to modern commercial cow-calf and purebred beef cattle production.

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

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

4712
Livestock Sales Management. Lab 2. Prerequisite: 3433. Advertising of purebred livestock; performance data and breeding values in the merchandising of purebred livestock; photography and ad copy layout; conduct of an actual livestock auction, including animal selection, advertising, catalog and animal preparation, clerking, receipt of payments, sales budgets and transfer of registration papers.

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

4843
Applications of Biotechnology in Animal Science. Lab 3. Prerequisites: 3423 and BIOCH 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.

4863
Capstone for Animal Agriculture. Lab 2. Prerequisite: senior standing. Examination of the role of animal agriculture in society, the importance of research and current issues. Oral and written reports.

4900
Special Problems. 1-6 credits, maximum 6. Prerequisite: consent of instructor. A detailed study of an assigned problem by a student wishing additional information on a special topic.

4910*
Animal or Food Industry Internship. 3-12 credits, maximum 12. Prerequisite: 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.

4973
Rangeland Resources Planning. Lab 3. Prerequisites: 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 AGRON 4973.

5000*
Research and Thesis. 1-6 credits, maximum 6. Independent research planned, conducted and reported in consultation with a major professor.

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

5110*
Seminar. 1 credit, maximum 3. A critical review and study of the literature; written and oral reports and discussion on select subjects.

5113*
Basic Reproductive Physiology. Prerequisite: ZOOL 3204. Female and male reproductive processes, the influences of environmental factors upon these processes and the application of reproductive physiology to animal production.

5120*
Special Topics in Food Science. 1-4 credits, maximum 8. Prerequisites: graduate standing and consent of instructor. Advanced topics and new developments in food science especially with reference to foods of animal origin.

5213*
Advances in Meat Science. Prerequisites: BIOCH 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.

5303*
Advanced Animal Breeding. Prerequisites: 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.

5733*
Advanced Ruminant Nutrition. Lab 2. Prerequisite: 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.

5743*
Rumenology. Prerequisite: 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.

5753*
Animal Nutrition Techniques and Laboratory Methods. Lab 2. Prerequisite: 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.

5763*
Advanced Nonruminant Nutrition. Prerequisite: 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.

5772*
Protein Nutrition. Prerequisite: BIOC 5753. Nutritional, biochemical and clinical aspects of protein metabolism as it relates to nutritional status.

5782*
Vitamin and Mineral Nutrition. Prerequisite: 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.

6000*
Research and Thesis. 1-10 credits, maximum 30. Prerequisite: M.S. degree. Open only to students continuing beyond the level of the M.S. degree. Independent research, planned, conducted and reported in consultation with and under the direction of a major professor.

6003*
Population Genetics. Prerequisites: 5303 or equivalent and STAT 4023. Population concept of genetics with emphasis on qualitatively inherited traits and statistical techniques utilized in population genetics. Gene and genotypic frequencies, estimation of genetic parameters within a population and the forces which can alter the magnitude of these genetic parameters and inbreeding.

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

6110*
Seminar. 1 credit, maximum 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.

Anthropology (ANTH)

2353
General Anthropology. Anthropology, emphasizing the study of human physical evolution (physical anthropology) and cultural evolution (archaeology).

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

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.

3823
(S)North American Indian Cultures. Pre-contact and traditional subsistence patterns, social organization and ideology with emphasis on specific groups in each culture area.

3990
Fieldwork in Anthropology. 1-8 credits, maximum 8. Prerequisite: 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.

4123*
Archaeology of North America. 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.

4223
(S)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.

4633*
(S)Racial and Cultural Minorities. Ethnic and racial groups in contemporary pluralistic society, including a cultural-historical perspective on their origins, social relations, value systems and goals.

4823*
Contemporary Native Americans. Cultural adaptations of North American Indians within both contemporary 'traditional' communities and urban settings. Federal programs and current problems as they relate to the adaptational processes.

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

4990*
Special Topics in Anthropology. 1-3 credits, maximum 6. Prerequisite: consent of instructor. Directed readings or research on significant topics in anthropology.

Applied Behavioral Studies in Education (ABSE)

6610*
Doctoral Internship in School Psychology. 3-6 credits, maximum 6. Prerequisites: ad-mission to school psychology doctoral program, completion of all course work, completed readiness for internship form, and approved by school psychology faculty. Supervised experience of doctoral school psychologists for final preparation to enter the profession of school psychology.

Architecture (ARCH)

1112
Introduction to Architecture. Lab 2. An introduction to the School of Architecture and OSU resources and how to use them. Introduction to the professions of architecture and architectural engineering and the issues facing these professions in the next century. Introduction to the educational processes and objectives required for becoming a professional architect or architectural engineer.

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.

2003
(H,I)Architecture and Society. Design, planning and building considered in their social and aesthetic contexts.

2100
Architectural Studies. 2-4 credits, maximum 4. Lab 6-12. Beginning studies in graphics and design in architecture.

2116
Architectural Design Studio II. Lab 16. Prerequisite: 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.

2216
Architectural Design Studio III. Lab 16. Prerequisite: grade of "C" or better in 1216 and 2116. 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. Problems in architectural design.

2263
Building Systems. Prerequisites: grade of "C" or better in 1216 and 2116. Architectural, structural and environmental control systems.

3073
(H)History and Theory of Greek and Roman Architecture. Prerequisite: 2003. History and theory of the ancient greek and roman periods of architecture.

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

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

3116
Architectural Design Studio IV. Lab 16. Prerequisites: grade of "C" or better in 2216 and admission to third year. Problems in architectural design.

3126
Structures: Steel, Timber and Concrete. Lab 4. Prerequisite: grade of "C" or better in ENSC 2143. Analysis and design of steel, timber and concrete structures used in architecture.

3134
Environmental Control: Thermal Systems and Life Safety. Lab 2. Prerequisite: MATH 1715 or MATH 1513. A survey of the fundamentals of thermal comfort, energy concerns and mechanical systems for buildings as well as the basic principles of life safety.

3143
Structures: Analysis I. Prerequisite: grade of "C" or better in ENSC 2143. Structural theory for applications in architecture.

3223
Structures: Timbers. Lab 2. Prerequisite: grade of "C" or better in 3323. Analysis and design of timber structures used in architecture.

3224
Structures: Steel II. Lab 2. Prerequisites: grades of "C" or better in 3126 and 3143. Design and analysis of multi-story steel frames, trusses, arches and other architectural structure components.

3253
Computer Applications in Architecture. Prerequisite: "C" or better in 3116. Introduction to 2-D and 3-D computer CAD topics and their application in the design process.

3263
Materials in Architecture. Prerequisites: 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.

3323
Structures: Steel I. Lab 2. Prerequisite: grade of "C" or better in 2113. Analysis and design of steel structures used in architecture.

3433*
Environmental Control: Acoustics and Lighting. Prerequisite: MATH 1513 or 1715. A survey of architectural acoustics, electrical and lighting systems for buildings.

3454
Computer Applications in Architectural Engineering. Prerequisite: grade of "C" or better in 3143. Computer applications in architectural engineering introducing AUTOCAD; computer programming; and the use of commercial analytical software.

4053*
Computer Applications in Architecture. Lab 3. Prerequisite: 3253 or 3454. State-of-the-art applications of computers to the practice of architecture and architectural engineering.

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

4083
(H)History and Theory of English and Early American Architecture. Prerequisite: 2003. English renaissance architecture from 1483 to 1837 and its importance to developments in early American architecture.

4100
Special Topics in Architecture. 1-6 credits, maximum 12. Prerequisites: 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.

4116
Architectural Design Studio V. Lab 6. Prerequisites: grades of "C" or better in 3116 and 3253. Problems in architectural design.

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

4143*
Structures: Foundations for Buildings. Lab 2. Prerequisite: grade of "C" or better in 3126. Interaction of frames and supports for structures used in architecture. Subsurface conditions and design of foundation systems and retaining walls for buildings.

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

4193*
Marketing Professional Services. Prerequisite: 3116. Business development aspects of design firm management, including: marketing plan development; marketing organization; strategies and tools; selling techniques and contract negotiating.

4216
Architectural Design Studio VI. Lab 16. Prerequisites: grades of "C" or better in 3126, 3134, 3433, 4116. Enrollment in appropriate architectural seminar required. Problems in architectural design.

4225*
Structures: Concrete II. Lab 4. Prerequisites: grades of "C" or better in 3126, 3454, and 4143. Design and analysis of multi-story reinforced concrete frames and prestressed and post-stressed concrete structural components used in architecture applications.

4233
Sustainability Issues in Architecture. Prerequisite: grade of "C" or better in 3134. Sustainability topics and their application to architecture.

4263
Architecture Seminar. Prerequisite: concurrent enrollment in 4226 or 5226. Topics in architecture and architectural engineering.

4273
History and Theory of Islamic Architecture. Prerequisite: 2003. Architecture of the Islamic World.

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

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

4443*
Structures: Analysis II. Lab 2. Prerequisites: grades of "C" or better in 3454, and MATH 3263. Mathematical formulation of architectural structural behavior. Matrix applications, finite element, finite differences, stability considerations and three-dimensional structural modeling.

5023*
Masonry Design and Analysis. Prerequisite: 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.

5083*
History and Theory of Japanese Architecture. Prerequisite: 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.

5100*
Special Topics in Architecture. 1-6 credits, maximum 12. Prerequisites: 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.

5116*
Architectural Design Studio VII. Lab 6. Prerequisite: grade of "C" or better in 4216. Problems in architectural design.

5143*
Structures: Special Loadings. Lab 2. Prerequisites: grade of "C" or better in MATH 3263, ARCH 4443, and ENGSC 2123. 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.

5173*
History and Theory of Architecture: Medieval. Prerequisite: 2003. Architecture of Western Europe from the Dark Ages to the beginning of the Renaissance including Romanesque and Gothic.

5193*
Management of Architectural Practice. Prerequisite: 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.

5217*
Architectural Design Studio VIII. Lab 16. Prerequisite: grade of "C" or better in 5116 or consent of instructor. Problems in architectural design.

5226*
Architectural Engineering Comprehensive Design Studio. Lab 6. Prerequisites: grade of "C" or better in 3116, 3224, 3454, 4143, 4225, 4443. Problems in architectural and architectural engineering design.

5293*
Architectural Project Management. Prerequisite: fifth-year standing in architecture or consent of instructor. Principles of management as applied to architectural and architectural engineering projects.

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

6000*
Special Problems. 1-15 credits, maximum 15. Lab 3-18. Prerequisite: 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.

6073*
History and Theory of Non-Western Architecture. Prerequisite: graduate standing or consent of instructor. Architecture in the non-Western and pre-Columbian world.

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

6100*
Special Topics. 3-6 credits, maximum 15. Subjects selected by the graduate faculty in architecture to cover state-of-the-art advances.

6113*
Creative Component Research. Prerequisite: admission to graduate program. Data gathering, analysis and program formulation related to creative component.

6117*
Graduate Design Studio I. Lab 20. Prerequisite: admission to graduate program. Problems in architectural design.

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

6206*
Creative Component in Architectural Engineering. Lab 18. 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.

6207*
Creative Component in Architecture. Lab 20. Prerequisite: 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.

6244*
Structures: Analysis III. Prerequisite: grade of "C" or better in 4443. Analysis techniques for architectural structures including stability, space frames, computer applications, guyed towers and project research.

6283*
Architecture Seminar II. Seminar for graduate students only. Architectural criticism.

6343*
Structures: Steel III. Prerequisite: grade of "C" or better in 4144. Plastic analysis and design of structural steel frames utilizing load and resistance factor design.

6543*
Structures: Concrete III. Prerequisite: grade of "C" or better in 5244. Design of prestressed concrete structures, including pre- and post-tensioning.

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.

1113
Drawing II. Lab 6. Prerequisite: 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.

1203
Color and Design. Lab 6. Introduction to visual problem-solving. Organization of the two-dimensional plane; line, shape, value, texture, and color theory dealing with its visual and psychological aspects.

1603
(H)Introduction to Art. Introductory survey of art history from ancient times to the present. No credit for those with prior credit in 2603 or 2613.

2113
Life Drawing. Lab 6. Prerequisite: 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.

2203
Three-dimensional Design. Lab 6. Prerequisite: 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.

2213
Color Theory. Lab 6. Prerequisite: 1103. Intensive, structured investigation into the nature and properties of color. Hue, value, chroma, and additive color mixing theory as well as the expressive qualities, symbolic potential, and psychological impact of pigment color.

2403
Illustration I. Lab 6. Prerequisite: 1113 and 2.5 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.

2413
Typography I. Lab 6. Prerequisites: 1113 and 2.5 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.

2423
Graphic Design I. Lab 6. Prerequisite: 1113 and 2.5 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.

2603
(H)Art History Survey I. The arts, artists and their cultures from prehistoric times through the Early Renaissance. No credit for those with prior credit in 1603.

2613
(H)Art History Survey II. The arts, artists and their cultures from the Early Renaissance to the present. No credit for those with prior credit in 1603.

2623
Research Methods for Art History. Prerequisite: 1603. An introduction to research methodology and writing art history. Required of art history majors.

3110
Life Drawing Studio. 3 credits, maximum 9. Lab 6. Prerequisite: 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.

3123
Oil Painting. Lab 6. Prerequisites: 1113, 2203, 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.

3133
Watercolor Painting. Lab 6. Prerequisites: 1103, 2203, or consent of instructor. The development of skills in watercolor painting stressing form and content, visual perception and individual expression. Structured assignments in color mixing, wet-on-dry techniques, wet-into-wet techniques, brush handling, paper supports and surface manipulation.

3323
Sculpture I. Lab 6. Prerequisites: 1113, 2203. Studies in clay and plaster. Subtractive and additive processes. Emphasis on sculptural ideas, methods and materials.

3333
Sculpture II. Lab 6. Prerequisite: 3323. Nonferrous metal casting. Basic welding techniques using oxy-acetylene, electric arc and T.I.G. methods. Emphasis on concepts, form, methods, and materials.

3343
Jewelry and Metals. Lab 6. Prerequisites: 1113, 2203, 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.

3403
Illustration II. Lab 6. Prerequisites: 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.

3413
Typography II. Lab 6. Prerequisites: 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.

3423
Graphic Design II. Lab 6. Prerequisites: 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.

3443
Computer Graphics I. Lab 6. Prerequisites: 2403, 2413 and 2423 and portfolio review. Use of computer software to capture, create and alter electronic images for use in graphic design and illustration applications with an emphasis on concept and thematic development.

3503
Ceramics. Lab 6. Prerequisites: 1113, 2203 or consent of instructor. Methods of clay preparation, hand building, wheel forming methods, methods of decoration and glazing, firing and kiln construction. Involvement with ceramic materials and processes.

3600
Writing Methods in Art History. Prerequisite: concurrent enrollment in upper-division art history course. Supervised research and writing experience to be taken in conjunction with another upper division art history course.

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.

3613
(H) History of Medieval Art. Architecture, sculpture, painting and mosaic in the Christian world, c. 400-1400. Early Christian and Byzantine periods in Southern Europe and concurrent developments in the North, including Carolingian, Romanesque and Gothic.

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).

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).

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.

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.

3663
(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.

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.

3693
(H,I)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.

3700
Printmaking: Relief. 3 credits, maximum 9. Lab 6. Prerequisites: 1113 or consent of instructor. Understanding and control of carving, processing and creating prints from wood, linoleum and plastic. Development of images utilizing both traditional and contemporary approaches to relief printmaking.

3720
Printmaking: Intaglio. 3 credits, maximum 9. Lab 6. Prerequisites: 1113 or consent of instructor. Understanding and control of intaglio techniques; preparation, processing, and editioning of images from metal plates. Development of concepts and images through traditional and contemporary approaches to the intaglio process.

3730
Printmaking: Lithography. 3 credits, maximum 9. Lab 6. Prerequisites: 1113 or consent of instructor. Understanding and control of the procedures of drawing, processing and printing editions from stones and metal plates. Development of concepts and images through the medium of lithography.

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

4120
Oil Painting Studio. 3 credits, maximum 9. Lab 6. Prerequisite: 3123. Oil painting with emphasis on personal development of visual ideas and technique.

4130
Watercolor Studio. 3 credits, maximum 6. Lab 6. Prerequisite: 3133. Structured assignments with exploration of individual concepts, ideas and imagery to reinforce growth of technical skills and personal painting style in watercolor.

4330
Sculpture Studio. 3 credits, maximum 9. Lab 6. Prerequisite: 3333. 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.

4340
Jewelry and Metals Studio. 3 credits, maximum 9. Lab 6. Prerequisite: 3343 or consent of instructor. Metalworking processes including casting, rubber modeling, and advanced stone setting. Consideration of non-metal media. Emphasis on development of materials and ideas through conceptual problems.

4420
Graphic Design Studio. 3 credits, maximum 9. Lab 6. Prerequisite: 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.

4430
Illustration Studio. 3 credits, maximum 9. Lab 6. Prerequisites: 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.

4450
Computer Graphics Studio. 3 credits, maximum 9. Lab 6. Prerequisites: 3403 or 3423, 3443 or consent of instructor. Use of computer software to create three-dimensional objects in an artificial three-dimensional space leading to storyboard design, animation scripts and the production of animation sequences to video.

4493
Portfolio Capstone. Lab 6. Prerequisites: 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.

4500
Ceramics Studio. 3 credits, maximum 9. Lab 6. Prerequisite: 3503. Continued explorations of ceramic arts: glazes, clay bodies, methods of forming, decorating and firing. Continued emphasis on the relation between visual unity and individual expressive concepts as these apply to both utilitarian and conceptual forms.

4603
(H)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.

4613
Art Since 1945. Prerequisite: 3683. Art and art theory from 1945 to the present. Major trends of abstract expressionism, pop art, minimalism, photorealism and conceptual art. Theories and intellectual bases of each movement as well as major critical responses.

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.

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

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.

4673
(H)History of Japanese Art. The arts of Japan from the beginning to the modern period in their historical and cultural setting. Cross-cultural contacts with China and the West. Architecture, sculpture, painting, landscape architecture, prints and decorative arts.

4800
Special Studies in Art. 1-3 credits, maximum 9. Prerequisites: junior standing and consent of instructor. Courses in media exploration, special subjects and current issues. Offered on campus or through extension workshops.

4810
Museum Internship. 1-3 credits, maximum 6. An on-site museum experience including exhibition selection and preparation, collection cataloging and research, and museum administration.

4820
Graphic Design Internship. 1-6 credits, maximum 6. Prerequisites: 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.

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

4900*
Directed Study in Art. 1-3 credits, maximum 9. Lab 1-6. Prerequisites: junior standing and written permission of department head. Self-designed special topics in studio art or graphic design. By contract only.

4910*
Directed Study in Art History. 1-3 credits, maximum 9. Lab 1-6. Prerequisites: junior standing and written consent of department head. Self-designed special topics in art history. By contract only.

4933
Art in Context. Prerequisites: senior standing. Capstone course studying the role of visual arts in their historical, social and cultural context and in comparison to other disciplines of creative or performing arts, humanities and science.

4993
Senior Honors Project. Prerequisites: 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.

5900*
Graduate Studies in Art. 1-6 credits, maximum 12. Prerequisite: B.A., B.F.A., or 15 upper-division hours in a discipline; consent of instructor. Projects in art with emphasis on portfolio preparation.

5910*
Graduate Studies in Art History. 1-6 credits, maximum 12. Prerequisite: B.A., B.F.A., or 15 upper-division hours in art history; consent of instructor. Advanced research in art history.

Arts and Sciences (A&S)

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

1221
Honors Freshman Orientation. Prerequisite: 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.

2000
Special Topics. 1-3 credits, maximum 6. Selected interdisciplinary topics presented in lecture or seminar format.

3003
Arts and Sciences Honors Supervised Research. Prerequisites: Honors Program participation, consent of instructor and A&S Honors program director. Introduction to research or other creative activity in student's major field through participation in professor's research or creative activities.

3080
International Experience. 1-18 credits, maximum 36. Prerequisite: consent of the associate dean of the college. Participation in a formal or informal educational experience outside of the USA.

3090
(I)Study Abroad. 1-18 credits, maximum 36. Prerequisites: consent of the Study Abroad office and associate dean of the college. Participation in an OSU reciprocal exchange program.

3603
Colloquium in Area Studies. Interdisciplinary studies in one area: African, Asian, Latin American, Russian and East European, Native American, Ancient and Medieval, or Women's studies. Individual undergraduate research projects.

3710
Arts and Sciences Internship. 1-3 credits, maximum 6. Prerequisite: 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.

4000
Special Topics. 1-3 credits, maximum 6. Selected interdisciplinary topics presented in lecture or seminar format.

4013
Liberal Studies Senior Project. Prerequisite: consent of instructor. Research report or other creative activity undertaken to satisfy capstone requirement for liberal studies degree.

4111
Job Search Strategies for Arts and Sciences Majors. Prerequisite: junior standing. Identification of individual goals and transferable skills, exploration of career options, job market research and development of employment search tools.

5710*
Developmental Workshop in Selected Academic Fields. 1-3 credits, maximum 9. Arts and Sciences discipline-based material. Study groups, lectures and seminars.

6000*
Research for Ed.D. Dissertation. 1-15 credits, maximum 15. Prerequisite: candidacy for Ed.D. degree. Ed.D dissertation.

Astronomy (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.

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.

4010
Observatory Research. 1-2 credits, maximum 8. Prerequisites: 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)

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.

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. Graded on a pass-fail basis.

1403
Advanced Theory of Flight. Prerequisites: 1113 and passed FAA Private Pilot Examination. Advanced navigation, aircraft performance and meteorology, and introduction to crew resource management.

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.

2122
Commercial Flight Laboratory I. Lab 4. Prerequisite: 1222. First of three flight laboratories required for FAA commercial flight certificate with instrument rating. Flight instruction conducted under FAR Part 141. Special fee required.

2132
Commercial Flight Laboratory II. Lab 4. Prerequisite: 2122. Dual instrument flight instruction to meet requirements for FAA instrument rating. Flight instruction conducted under FAR Part 141. Special fee required.

2142
Commercial Flight Laboratory III. Lab 4. Prerequisite: 2132. Final flight lab to meet requirements for the FAA commercial pilot certificate. Flight instruction conducted under FAR Part 141. Special fee required.

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

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

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.

3231
Theory of Multi-engine Flight. Prerequisite: 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.

3243
Human Factors in Aviation. Prerequisite: PSYC 1113. The study of people interacting with the aviation environment. Individual and group performance, equipment design, physical environment, and procedure development.

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

3341
Multi-engine Flight Laboratory. Lab 2. Prerequisites: Private Pilot Certificate and FAA Third-class Medical Certificate. Dual flight instruction to meet requirements for the FAA multi-engine rating. Flight instruction conducted under FAR Part 141. Special fee required.

3433
Aviation 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.

3443
Aviation Legal and Regulatory Issues. Prerequisite: LSB 3213. 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.

3453
Aviation Security. Analysis of the legal and regulatory responses to changing threats to aviation security. Review of technological solutions for airports and aircraft.

3513
Aviation Management Principles. Prerequisite: 50 credit hours. Managing the major elements of the aviation industry including aircraft manufacturing and air transportation system.

3523
Airport Planning and Management. Prerequisite: 50 credit hours. Overview of the major functions of airport management including master planning. Study of the socio-economic effects of airports on the communities they serve.

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

3543
Aviation Organizational Communications. Prerequisites: ENGL 1113 and 1213, SPCH 2713. Aviation communication to aid aviation students in proper use of written and verbal skills needed in various aviation leadership roles.

3563
Aviation Marketing. Prerequisite: 50 credit hours. Marketing aviation products for the major elements of the aviation industry.

3573
Aviation Finance. Prerequisite: 50 credit hours. Financing the major elements of the aviation industry including general aviation, aircraft manufacturing and airports.

3663
Air Carrier Industry. Prerequisite: 50 credit hours. 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.

4100*
Specialized Studies in Aviation. 1-3 credits, maximum 6. Prerequisite: 55 credit hours. Independent studies, seminars, and training within selected areas of aviation.

4113*
Aviation Safety. Prerequisite: 55 credit hours. Overview of flight safety including studies in human factors, weather, aircraft crashworthiness, accident investigation, and aviation safety programs. Students will be introduced to elements of aviation safety in ground and flight operations.

4133
Principles of Flight Instruction. Prerequisites: 2142, 2313. Development of flight training lesson plans and syllabi. Application of learning theory and teaching fundamentals to flight maneuvers and performance evaluation. Preparation for the FAA Fundamentals of Instructing and Flight Instructor-Airplane Written Examinations.

4200*
Internship in Aviation. 1-12 credits, maximum 12. Prerequisite: 55 credit hours. Individually supervised internship in aviation career areas. Directed field experience related to the participant's area of concentration.

4232
Flight Instructor: Airplane Flight Laboratory. Lab 4. Prerequisites: 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.

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

4331
Flight Instructor: Instrument Flight Laboratory. Lab 2. Prerequisite: 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.

4333*
Advanced Aircraft Performance. Prerequisite: 50 hours. A study of advanced aircraft performance including appropriate physical laws, atmospheric properties and power plant technology.

4353*
Cockpit Automation. Prerequisites: 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.

4643*
Aviation Navigation Global Positioning Systems. Prerequisite: 50 credit hours. Overview of the theory and operation of the GPS in the private and public sector.

4653
(I)International Aviation Issues. Prerequisite: 50 hours. The fundamental knowledge, comprehension and the abilities to apply, analyze, synthesize and evaluate international aviation issues.

4663
Aviation Leadership. Examination of leadership theories and practices applicable to the aviation environment and the types of leadership skills required for 21st Century aviation organizational leaders.

4703*
Crew Resource Management. Prerequisites: 2142, 3243. Decision making and communication to improve effective crew management. Ten hours in a dual flight control multi-engine simulator. Special fee required.

4771
Flight Instructor: Multi-engine Flight Laboratory. Lab 2. Prerequisite: 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.

4943*
Basic Aircraft Accident Investigation. Prerequisite: 50 credit hours. A study of statutes, regulations and regulatory agency requirements that influence aircraft accident investigation.

4953*
Corporate and General Aviation Management. Prerequisites: 2142 and 3341. 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.

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.

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

5000*
Master's Report or Thesis. 1-3 credits, maximum 3. Master's degree enrollment for a total of two credit hours if writing a report or three hours if writing a thesis.

5020*
Seminar in Aerospace Education. 1-3 credits, maximum 6. Prerequisite: consent of instructor. Individual research problems in aerospace education.

5053*
Guided Reading and Research. Prerequisite: consent of instructor. Guidance in reading and research required for the M.S. in aviation and space program.

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

5113*
Aviation Safety Program Development. Prerequisite: 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.

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

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

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

5702*
Simulation in Aviation. Prerequisite: 3341. Preparation for the practical skills required for a career as a professional pilot. Skill areas comparable to those required for the FAA Airline Transport Pilot rating.

5711*
Airline Transport Pilot. Prerequisite: 3341. Designed for the professional pilot. Completion of the course assists in preparation for the FAA Airline Transport Pilot written examination.

5720*
Current Issues in Aerospace Education. 1-3 credits, maximum 6. Prerequisite: consent of instructor. Current issues in aerospace education.

5813*
Earth Observations: Land. Prerequisite: GEOG 4333. A study of systems orbiting earth that collect data on the land.

5823*
Space Science: Sun, Inner Planets and Asteroid Belt. A study of the sun, inner planets and asteroid belt.

5843*
Space Science: The Outer Planets and Probes. Evolution of the outer planets, space probe exploration, orbital mechanics and missions.

5850*
Directed Readings in Aerospace Education. 1-3 credits, maximum 6. Prerequisite: consent of instructor. Directed studies in aerospace education.

5853*
Earth Observations: Air. Prerequisite: GEOG 3033. A study of systems orbiting earth that collect data on the atmosphere.

5910*
Practicum in Aerospace Education. 1-3 credits, maximum 6. Prerequisite: consent of instructor. Directed observation and supervised clinical experiences in aerospace education.

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

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

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

6303*
Aviation and Space Safety Data Analysis. Practical application and research of aviation and space safety data bases.

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.

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

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

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

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

6773*
Applied Aviation and Space Research. Prerequisites: 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.

6883*
Doctoral Internship in Aviation and Space. Prerequisites: consent and approval of student's advisory committee. Directed field experiences in aerospace education for doctoral students.

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

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

Biochemistry (BIOC)

2344
Chemistry and Applications of Biomolecules. Lab 3. Prerequisite: 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 preprofessional students or students planning graduate study in biological sciences.

3653*
Survey of Biochemistry. Prerequisite: 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.

3723
Biochemical Laboratory. Lab 6. Prerequisite: 3653 or concurrent enrollment. Qualitative and quantitative examination of biochemical and molecular biology materials and reactions. Hands-on experience with contemporary aspects of biochemical and molecular biology techniques. Designed for biochemistry majors and others desiring an extensive biochemical laboratory experience.

4113*
Biochemistry. Prerequisites: 3653 and BIOL 3024 (or ANSI 3423 or PLNT 3554). An extension and expansion of 3653 emphasizing applications of biochemistry, molecular biology and genetic engineering to studies on protein structure and function, regulation of cell function, metabolism and disease processes.

4224*
Physical Chemistry for Biologists. Prerequisites: 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.

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

5000*
Research. 1-6 credits, maximum 6. For M.S. thesis.

5753*
Biochemical Principles. Prerequisite: 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.

5824*
Biochemical Laboratory Methods. Lab 6. Prerequisites: 4113 or 5753, or concurrent enrollment in either, and CHEM 2113 and 2122, or 3324. 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.

5853*
Metabolism. Prerequisite: 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.

5930*
Advanced Biochemical Techniques. 1-4 credits, maximum 10. Prerequisites: 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.

6000*
Research. 1-15 credits, maximum 60. For Ph.D dissertation.

6110*
Seminar. 1-2 credits, maximum 2 for Ph.D. or 1 for M.S. candidates.

6740*
Physical Biochemistry. 1-2 credits, maximum 2. Prerequisites: 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.

6763*
Nucleic Acids and Protein Synthesis. Prerequisite: 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.

6773*
Protein Structure and Enzyme Function. Prerequisite: 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.

6783*
Biomembranes and Bioenergetics. Prerequisite: 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.

6792*
Plant Biochemistry. Prerequisite: 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.

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

Biological Science (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 nonscience and science majors.

3024*
General Genetics. Prerequisite: BOT 1404, or ZOOL 1604, or equivalent. Inheritance in plants, animals and microorganisms; molecular and classical aspects.

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

3223
(N)Survey of Human Diseases. Prerequisite: 1114 or equivalent. Types of diseases, such as metabolic, genetic, infectious. Biological processes involved in disease. Impact of disease on human activity and of human activity on disease patterns. For the nonbiology major.

3232
(N)Human Reproduction. Prerequisite: 1114. Human reproduction is dealt with in terms of anatomy, physiology, embryology, genetics and evolution. Birth control, and teratogenic substances as well as pregnancy and childbirth. For the nonbiology major.

3243
(N)Biological Rhythms in Humans and Other Organisms. Prerequisite: 1114 or equivalent. Biological rhythms in humans and other organisms. Fundamental concepts and questions related to biological timing, its properties, mechanism and adaptive value. The implications of rhythms in human behavior and medicine.

3253
(N)Environment and Society. Prerequisite: 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 nonbiology major.

3263
(N)Plants and People. Prerequisite: 1114 or consent of instructor. 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 nonbiology major.

3273
Medical Botany Therapeutic, Psychoactive, and Toxic Effects of Plants on Humans. Plants as a source of medicines, psychoactive compounds, and poisons. Exploration in the context of modern western medicine as well as traditional systems of medicine and complementary alternative medicine.

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

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

Biomedical Sciences (BIOM)

5000*
Research and Thesis. 1-6 credits, maximum 6. Lab 1-6. Prerequisite: consent of major adviser. Research in biomedical sciences for M.S. degree.

5013*
Medical Biostatistics. Prerequisite: graduate standing. Fundamentals of biostatistics including parametric and non-parametric statistical methods with applications to biomedical research, clinical epidemiology and clinical medicine.

5020*
Biomedical Sciences Seminar. 1-4 credits, maximum 4. Prerequisite: graduate standing. Literature and research problems in biomedical sciences.

5117*
Gross and Developmental Anatomy. Lab 3. Prerequisite: graduate standing in the biomedical sciences program. General and specific concepts of regional morphology through didactic presentations and laboratory dissections. Emphasis on the range of normal for the various organ systems and their interrelationships. Application of anatomical knowledge in clinical situations.

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

5134*
Neuroanatomy. Lab 2. Prerequisite: graduate standing in the biomedical sciences program. The study of structure and integrative function of the central nervous system. Lectures and laboratory demonstrations emphasizing the role of the brain and spinal cord in sensory perception and motor responses. Neuroanatomy presentations enhancing the students' understanding of the normal anatomy of the central nervous system.

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.

5316*
Medical Microbiology and Immunology. Lab 2. Prerequisite: 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.

5415*
General Pathology I. Prerequisites: 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.

5425*
General Pathology II. Prerequisite: graduate standing. Continuation of General Pathology I.

5513*
Pharmacology I. Prerequisite: 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.

5523*
Pharmacology II. Prerequisite: 5513. Continuation of Pharmacology I.

5616*
Medical Physiology. Prerequisite: 5215. The integration of structure and function of the human body with a functional analysis of the organ systems. Comprehension of the physiologic principles and control mechanisms that maintain homeostasis. Discussion of all systems of the body, and analysis of various interrelationships. The fundamental dynamic view of physiology upon which subsequent clinical learning is dependent. Problem-solving techniques utilized to develop and examine student understanding.

6000*
Research and Dissertation. 1-15 credits, maximum 45. Lab 1-15. Prerequisite: consent of major adviser. Research in biomedical sciences for Ph.D. degree.

6010*
Topics in Biomedical Sciences. 1-3 credits, maximum 3. Prerequisite: consent of instructor. Tutorials in areas of biomedical sciences not addressed in other courses.

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

6113*
Human Embryology. Lab 2. Prerequisite: 5117 or consent of instructor. Formation of the fetus from conception through development of the organs and organ systems with discussions of congenital malformations.

6124*
Advanced Histology. Lab 4. Prerequisite: 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.

6133*
Biology of Transplantation. Prerequisites: basic course in immunology; graduate standing; consent of instructor. The biology of organ and cell transplantation, including study of immune aspects, technical aspects, organ donation and preservation, transplant tolerance, genetic manipulation of graft tissues, use of fetal/stem cells in transplantation, and biomedical ethics related to transplantation.

6143*
Biomedical Electron Microscopy. Lab 4. Prerequisite: graduate standing. The theory and application of transmission and scanning electron microscopy in a biomedical setting.

6153*
Islet Cell Biology and Diabetes. Prerequisite: graduate standing; consent of instructor. An overview of the current knowledge in the field of islet cell biology and the clinical aspects of diabetes.

6163*
Cellular and Molecular Neurobiology. Prerequisites: 5215, 5616. Current aspects of cellular and molecular neurobiology, including cell biology of neurons and glia, communication between neurons and the molecular and cellular aspects of brain development and plasticity.

6175*
Molecular and Cellular Biology. Prerequisite: 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.

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

6214*
Advanced Topics in Medical Biochemistry. Prerequisite: 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.

6223*
Medical Genetics. Prerequisite: 5215. Developments in genetic principles including biochemical, molecular cytological, clinical, diagnostic, prevention and inheritance of genetic disorders in humans.

6233*
Enzyme Analysis. Lab 2. Prerequisite: 6214. Characterisitcs, separation, detection, assays, kinetics, mechamisms of catalysis, inhibition or inactivation, and clinical applications of enzyme analysis.

6243*
Human Nutrition. Lab 2. Prerequisite: 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.

6253*
Biochemistry of Hormone Action. Prerequisite: 6233. Biochemical mechanisms behind peptide and steroid hormone action.

6263*
Techniques in Molecular Biology. Lab 4. Prerequisites: 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.

6313*
Diagnostic Parasitology. Lab 2. Prerequisite: 5316. Animal parasites of humans with a focus on the laboratory identification of the medically important protozoan and helminthic diseases.

6323*
Diagnostic Virology. Lab 4. Prerequisites: 5215, 5316. Viruses causing disease in humans with emphasis on the laboratory diagnosis, prevention, and treatment of viral diseases.

6333*
Immunology. Prerequisites: 5215, 5316. The experimental basis of immunology and immunopathology.

6343*
Microbial Physiology. Lab 2. Prerequisites: 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.

6353*
Molecular Virology. Lab 2. Prerequisites: 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.

6413*
Graduate General Pathology and Laboratory Medicine. Lab 2. Prerequisite: graduate standing. An introduction to the structural and functional abnormalities at the tissue level that manifest as disease states in organ systems, with emphasis on a patho-physiologic approach to etiology and pathogenesis of disease.

6513*
Neuropharmacology. Prerequisites: 5513, 5523. The pharmacology of agents affecting central nervous system (CNS) function, the interaction of drugs with receptors, and the action of endogenous neuromodulators at CNS sites of action.

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

6533*
Principles of Drug Action. Prerequisites: 5513, 5523. The molecular basis of drug uptake, distribution, physiologic action, and elimination from the body including pharmacogenetics, drug allergy, drug resistance, drug tolerance and physical dependence, and chemical mutagenesis, carcinogenesis, and teratogenesis.

6543*
Neurochemistry. Prerequisites: 5215, 5616. Introduction to the fundamental aspects of neurochemistry using both cellular and molecular approaches.

6553*
Neurochemical Basis of Disease. Prerequisites: 5215, 5616, 6543. Introduction to the cellular and molecular aspects of disease states as they relate to changes in neurochemistry.

6563*
Neuroimmunoendocrinology. Prerequisites: 5513, 5523, 5616. The molecular, structural and cellular bases of the bidirectional communication between the immune and neuroendocrine systems.

6573*
Neurotoxicology. Prerequisites: 6543, graduate standing. Fundamental aspects of neurotoxicology using both cellular and molecular approaches.

6613*
Environmental Physiology. Prerequisite: 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.

6623*
Epithelial Transport and Electrophysiology. Prerequisites: 5215, 5616. Transport processes across biological membranes and various electrophysiological methods related to membrane transport.

6633*
Cell Signaling. Prerequisites: 5215, graduate standing. Fundamental aspects of cell signaling inside cells and between cells.

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

Biosystems and Agricultural Engineering (BAE)

1012
Data Analysis in Biosystems Engineering. Lab 2. Prerequisite: engineering major. Introduction to application of computer-based tools in bio-systems engineering. Introduction to the conduct, analysis and reporting of laboratory experiments.

1022
Experimental Methods in Biosystems Engineering. Lab 2. Prerequisite: 1012 or consent of instructor. An introduction to the basics of instru-mentation, 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.

2012
Introduction to Engineering in Biological Systems. Prerequisites: BIOL 1114, MATH 2144. Introduction to the engineering aspects of various biological systems. Case studies that emphasize the interface between engineering and biology in plant systems, mammalian systems, bioenvironmental systems, and industrial biological processes.

2022
Physical Properties of Biological Materials. Lab 2. Prerequisites: 1022, BIOL 1114, PHYS 2014. Basic engineering fundamentals applied to characterization and determination of physical properties of biological materials. Physical characteristics; water relations; and rheological, thermal, and electromagnetic properties of biological materials, including soils. Principles and techniques for measurement and determination of properties.

3013*
Heat and Mass Transfer in Biological Systems. Prerequisite: ENSC 3233. 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, and generation and depletion of heat and mass in biological systems.

3023*
Instruments and Controls. Lab 2. Prerequisites: 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 agri-cultural systems. Design project required.

3113
Engineering Analysis of Biological Systems. Prerequisites: 2012, ENSC 2213, 3233, MATH 2233. Application of engineering analysis and modeling to biological systems of plants, animals and ecosystems. Bioenergetics, homeostasis, enzyme kinetics, bioregulation, motility, photosynthesis and respiration, microbial processes, and ecosystem dynamics.

3213
Energy and Power in Biosystems Engineering. Lab 2. Prerequisites: 1022, ENSC 2123, 2213, 2613. Analysis and design of energy generation, transmission, and utilization in the production and processing of biological materials.

3313
Natural Resources Engineering. Lab 3. Prerequisites: 2022, ENSC 3233. Principles and practices of engineering analysis and design applied to hydrology, water quality, erosion and sedimentation, air quality, irrigation, and animal waste management.

3413*
Processing Biological Materials. Prerequisites: 2022; ENSC 3233. Principles of size reduction, sorting and grading, dehydration, refrigeration, and air handling. Equipment and systems for materials handling, drying, and storage.

4001
Professional Practice in Biosystems Engineering. Prerequisite: concurrent enrollment in 4012. Topics in the practice of the engineering profession, including technical communication, engineering ethics, safety, environment, career development, and lifelong learning strategies.

4012
Senior Engineering Design Project I. Lab 2. Prerequisites: 3023; senior standing, concurrent enrollment in 4001, admission to professional school, or consent of instructor. 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.

4022
Senior Engineering Design Project II. Lab 2. Prerequisite: 4012. Second of two-semester sequence of senior design courses.

4213*
Precision Agriculture. Lab 2. Prerequisites: 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.

4223*
Machinery for Production and Processing. Prerequisite: 3213. Analysis and design of machines 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.

4283*
Bioprocess Engineering. Prerequisites: 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.

4313*
Hydrology. Prerequisites: 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, application of hydrologic models.

4353*
Mechanical Design II. Prerequisites: ENGSC 2013, ENSC 2122, MAE 3323. Design of power transmission systems, including belts, chains and gears. Selection of electric motors, actuators, encoders, and related electromechanical components. Selection and application of hydraulic and pneumatic components in machine design applications. Design practice in the form of short projects integrating the various segments covered in the course. Same course as MAE 4353.

4400
Special Problems. 1-4 credits, maximum 8. Investigations in specialized areas of agricultural engineering.

4413*
Food Engineering. Prerequisites: 3013, 3413; 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.

5000*
Thesis and Research. 1-6 credits, maximum 6. Prerequisite: consent of major professor.

5030*
Engineering Practice. 1-12 credits, maximum 12. Prerequisite: B.S. degree in agricultural engineering. The identification, analysis and synthesis of an authentic problem in agricultural and biological engineering. Solution of the problem will involve making engineering decisions tempered by real-time restraints, economic realities, and limited data with due consideration for environmental and social implications.

5313*
Watershed Modeling and Water Quality. Lab 6. Prerequisites: 4313 or equivalent, CHEM 1314. A computer modeling course with an emphasis on chemical and physical processes governing nonpoint source pollution (nitrogen, phosphorus, sediment) at the basin scale. In 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.

5324*
Modeling and Design in Stormwater and Sediment Control. Lab 3. Prerequisite: 4313 or equivalent. Analysis and design of stormwater, 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 kinematic, diffusion and dynamic modeling of flow; soil erosion, sediment transport and sediment control; stormwater 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.

5413*
Instrumentation in Biological Process Control System. Prerequisite: 3023 or equivalent. Analysis of transducers for on-line measurement and control of biological processes. Emphasis on selection of measurement techniques and transducers to sense physical properties of biological materials. Application to agricultural and food processing industries.

5423*
Food Rheology. Lab 2. Prerequisite: 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.

5501*
Seminar. Discussion of current literature with special emphasis on research and experimental techniques.

6000*
Research and Thesis. 1-10 credits, maximum 30. Prerequisite: approval by the student's advisory committee. Independent research and doctoral thesis preparation under the cognizance of a graduate faculty member in the student's field of specialization.

6100*
Teaching Practicum in Biosystems Engineering. 1-3 credits, maximum 6. Lab 2-6. Prerequisite: 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. Graded on a pass-fail basis.

6313*
Stochastic Methods in Hydrology. Prerequisites: 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 as CIVE 6843.

6333*
Fluvial Hydraulics. Prerequisite: 3013 or equivalent. Principles of sediment detachment and transport in fluvial systems. Design of stable channels and flow resistance relationships for sediment-laden flows.

6343*
Ground Water Contaminant Transport. Prerequisite: 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.

6520*
Problems in Soil and Water Engineering. 2-6 credits, maximum 6. Prerequisite: consent of instructor. Problems associated with erosion control, drainage, flood protection and irrigation.

6540*
Problems in Farm Power and Machinery. 2-6 credits, maximum 6. Prerequisite: consent of instructor. Literature review and analytical studies of selected farm power and machinery problems. Written report required.

6580*
Problems in Transport Processes. 2-6 credits, maximum 6. Prerequisite: 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.

6610*
Advanced Research and Study. 1-10 credits, maximum 20. Prerequisite: 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)

1404
(N)Plant Biology. Lab 2. Prerequisite: BIOL 1114. Morphology and anatomy of plants. Plant functioning: photosynthesis, water relations, translocation, hormonal regulation, photoperiodism. Survey of the plant divisions, algae and fungi.

3005
(N)Field Botany. Lab 6. Prerequisite: 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 and nomenclature. Four weekend field trips required.

3013*
Biological Microtechnique. Lab 3. Prerequisite: 1404 or ZOOL 1604. Techniques for preparation of biological materials for microscopic examination.

3024*
Plant Diversity. Lab 4. Prerequisite: 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.

3114*
Plant Taxonomy. Lab 4. Prerequisite: 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.

3233*
Plant Anatomy. Lab 3. Prerequisite: 1404. Structure of cells, tissues and organs of plants. Consideration of structure as related to ontogeny, phylogeny and function.

3460
Plant Physiology Laboratory. 1-2 credits, maximum 2. Lab 2-4. Prerequisite: 3463 or concurrent enrollment. Skills in techniques for working with plants, experiments involving nutrition, respiration, photosynthesis, water relations, translocation, hormones, growth and development. Students having credit in CLML 3014 should enroll for one hour; all others enroll for 2 hours credit.

3463*
Plant Physiology. Prerequisite: 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.

4123
(N)Ethnobotany. Prerequisite: one course from 1404 or ZOOL 1604, HORT 1013, 3024, PLNT 1213, or consent of instructor. Uses of plants by past and present cultures for food, fiber and medicinal purposes. The role of plants in traditional rituals and religious practice.

4214
Botanical Limnology. Lab 3. Prerequisite: 1404 or equivalent strongly recommended. Taxonomy, ecology, and physiology of freshwater algae and vascular aquatic plants, with special reference to their role in overall limnological dynamics. Field trips required. No credit for students with credit in 5214.

4374*
Agrostology. Lab 4. Prerequisite: 1404. Grasses and the principles involved in their classification. Field trips required.

4400
Undergraduate Research. 1-3 credits, maximum 9. Prerequisite: consent of instructor. Undergraduate research problems in botany.

4993
Senior Honors Thesis. Prerequisites: 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.

5000*
Research. 1-6 credits, maximum 6. Research for the M.S. degree.

5023*
Community Ecology. Prerequisite: 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.

5104*
Mycology. Lab 4. Prerequisite: 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 PLP 5104.

5110*
Problems in Botany. 1-5 credits, maximum 12. Prerequisite: consent of instructor. Special studies in any area of botany.

5153*
Ecosystem Analysis. Prerequisite: BIOL 3034; CHEM 3015 or equivalents. Theory and principles of ecosystem ecology focusing on metabolism and biogeochemical cycles in terrestrial and aquatic systems. Application of principles to current issues of environmental change and management.

5214*
Botanical Limnology. Lab 3. Prerequisite: 1404 or equivalent strongly recommended. Taxonomy, ecology and physiology of freshwater algae and vascular aquatic plants, with special reference to their role in overall limnological dynamics. Field trips required. No credit for students with credit in 4214.

5423*
Plant Mineral Nutrition. Prerequisite: 3463 or equivalent. Uptake, translocation, metabolism, and biochemical function of mineral nutrients in higher plants.

5533*
Advanced Ecology. Prerequisite: strongly recommended to have taken 5023 or BIOL 3034 or equivalent. Physiological and evolutionary aspects of plant ecology as revealed by recent research. Spring recess field trip required.

5753*
Physiology of Plant Growth and Development. Prerequisite: 3463 or equivalent. Molecular mechanisms of growth and development, subcellular organization and function, plant hormones, photomorphogenesis, germination and dormancy, senescence and abscission, plant rhythms. Application of physiological principles to agriculture.

5813*
Plant Developmental Genetics. Prerequisite: BIOL 3024 or equivalent. Discussion of morphogenesis, embryogenesis, gametogenesis, and the regulation of gene expression during plant development. Emphasis on recent genetic, experimental, and molecular studies of development in higher plants.

5850*
Botany Seminar. 1 credit, maximum 6. Required of senior and graduate majors.

6000*
Research. 1-15 credits, maximum 60. Independent research for the doctoral dissertation.

Business Administration (BADM)

1111
Business Freshman Orientation. Prerequisite: freshman standing only. Required of all first semester freshmen in the College of Business Administration. An orientation to the CBA and OSU; survival skills; and a study of the career opportunities and curriculum in the various business departments.

2010
Special Topics. 1-6 credits, maximum 6. Prerequisite: consent of instructor. Special topics and independent study in business.

3090
(I)Study Abroad. 1-18 credits, maximum 36. Prerequisites: consent of the Study Abroad office and associate dean of the college. Participation in an OSU reciprocal exchange program.

3513*
Strategy and Integration in Organizations. Prerequisites: FIN 3113, MGMT 3123, MKTG 3213. Integration of concepts from the business core courses using tools such as simulation and case analysis. Planning model, policy models, and strategy development.

3713
(I)International Business. Prerequisite: MGMT 3123. Development of international business strategy based on the integration of economic, accounting, financial, management and marketing concepts.

4010
Business Projects. 1-6 credits, maximum 6. Prerequisite: consent of instructor. Special advanced topics, projects and independent study in business.

4050*
Business Colloquium. 3-9 credits, maximum 9. Prerequisites: 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.

4113*
New Venture Creation. Prerequisite: business core courses or consent of instructor. Steps involved in starting a new business. Development of a business plan for a venture of student's choosing. Examination of franchising or acquisition of an existing business as alternative steps to business ownership.

5013*
Research Methods for Business. Prerequisite: 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.

5113*
Entrepreneurship and Venture Management. Prerequisite: admission to MBA program or consent of MBA director. Enterprise creation and problems faced by entrepreneurs in early growth stages of business ventures. An interdisciplinary problem-solving approach with emphasis on "live" case studies and plans for new business ventures. Emphasis is on entrepreneurship rather than problems faced by going concerns.

5200*
Selected Master of Business Administra-tion Topics. 3-6 credits, maximum 6. Prerequisite: admission to the Master of Business Administration program. Selected topics dealing with business decision making and contemporary business issues.

5613*
The External Environment of Business. Prerequisite: admission to MBA program or approval from 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.

5713*
Analysis of the Multinational Firm. Prerequisite: 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.

6000*
Research and Thesis. 1-9 credits, maximum 30. Prerequisite: approval of advisory committee.

6100*
Seminar in Business Administration. 3-6 credits, maximum 6. Prerequisite: consent of instructor. Interdisciplinary in nature; focused on research methodology.

6713*
Theory Building and Scientific Research in Business. Prerequisites: doctoral student status and consent of the instructor. Examination of theory building and research methods from a business perspective. Understanding of theory and methods relevant to research in the business disciplines.

Business Communications (BCOM)

3113
Written Communication. Prerequisite: 50 semester credit hours. Analysis of business communication problems in terms of generally accepted communication principles. Practice in written messages; specifically, special goodwill letters, neutral and good-news, disappointing, persuasive and employment messages.

3223
Organizational Communication. Prerequisite: 50 credit hours. Communication theory and process; common and special problems associated with interpersonal and organizational communication affecting business decisions and operations. Principles and methods of basic and applied research in business and communication; practice in administrative report writing. Analysis of selected business cases.

3333
Business Report Writing. Prerequisite: six 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.

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.

5210*
Business Communication Applications. 1-3 credits, maximum 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)

4053
Critical Issues in Global Business. Prerequisites: 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.

4063
Topics in Contemporary Business. Prerequisites: 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.

4073
Literature in Business. Prerequisites: junior standing, admission to the Honors Program. Foundations of American business through selected literary masterpieces.

4083
Applied Research Processes. Prerequisites: junior standing, admission to the Honors Program. The relevant aspects of the philosophical, historical and ethical issues in scientific inquiry and business research methods. Preparation for completion of senior honors thesis.

4990
Business Honors Thesis. 1-5 credits, maximum 5. Prerequisites: 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.

Business Professions (BSPR)

3523
Office Problems in Keyboarding. Lab 2. Prerequisite: 2313 or equivalent. Problems in office situations requiring application of keyboarding knowledge and skills. Emphasis on quality work at high speeds.

3863
Office Procedures. Prerequisite: 2630. Theory of and applied practice in performing secretarial and managerial operations. Human relations in business as well as decision-making and problem-solving.

4363
Teaching Bookkeeping and Accounting. Prerequisites: ACCT 2203, EPSY 3213, skill in secretarial business subjects, and full admission to Professional Education. Teaching bookkeeping and accounting including development of objectives; organization, assessment and preparation of instructional resources and materials. Administration and interpretation of assessment techniques; design and use of diagnostic and achievement examinations; interaction patterns and instructional modifications.

4473
Teaching Business Education Skill Courses. Prerequisite: full admission to Teacher Education. Instructional methods in the teaching of skill development courses, including classroom interaction patterns, instructional modification, and evaluation techniques.

4653
Data Processing Instructional Methods and Procedures. Prerequisite: MSIS 2103. Instructional methods in the teaching of data-processing courses including the development of an understanding of computer hardware and software concepts and terminology. Problems, methods, and techniques in using and teaching concepts about the computer and computer programming languages. Hands-on programming experience integral part of course. Lab required.

5110*
Problems in Business Professions. 1-3 credits, maximum 6. Current problems in business education, based upon the interests and needs of the students.

5770*
Current Issues in Vocational Business Programs. 1-3 credits, maximum 6. Problems, materials, methods, history and current theory and philosophy of vocational business programs.

Cell and Molecular Biology (CLML)

3014
Cell and Molecular Biology. Lab 3. Prerequisite: BOT 1404 or MICR 2125 or ZOOL 1604 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.

3112
Cytology. Prerequisites: BOT 1404 or ZOOL 1604; CHEM 1314 and 1515. Structures found within living cells, the dynamics of these structures and the functions which they perform.

3254
Immunology. Lab 3. Prerequisite: 2125. Vertebrate host's ability to defend itself against foreign intrusion. Chemistry and biology of the acquired immune response. Same course as MICR 3254.

4001
Professional Transitions in Microbiology and Cell and Molecular Biology. Prerequisites: declared microbiology or cell and molecular biology 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. Same course as MICR 4001.

4012*
Laboratory Techniques in Molecular Genetics. Lab 4. Prerequisites: 3014, concurrent enrollment in 4113, MICR 2125. The art and practice of scientific research, with hands-on experience. Techniques including PCR/DNA sequencing, blots, ELISA, and other genetic and forensic techniques.

4113*
Advanced Cell and Molecular Biology. Prerequisite: 3014. Advanced topics in cell and molecular biology including regulatory mechanisms of gene expression, protein function, cell structure and organization, cell division, and development.

4123*
Virology. Prerequisite: 3014 or one course in biochemistry. Corequisite: 3224. Virus-host interactions including structure-function of animal, plant, and bacterial viruses. Discussion of the molecular biology of virus infection and development. Same course as MICR 4123.

4133*
Molecular and Microbial Genetics. Lab 2. Prerequisites: BIOL 3024, MICR 2125, and one semester of organic chemistry. Corequisite: 3224. 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. Same course as MICR 4133.

4253*
Concepts in Medical Genetics. Prerequisite: BIOL 3024. Application of genetic principles in the study of human diseases including the inheritance, molecular mechanisms, detection, characterization, and discovery of human genes.

4264*
Cell Physiology. Lab 3. Prerequisite: 3014 or BIOC 3653. Cellular activities and fundamental physiological processes.

4273*
Developmental Biology. Corequisite: 3014 or one course in Biochemistry and prerequisite BIOL 3024. The molecular biology and molecular genetics of developmental processes such as cell division, differentiation, migration, cell-cell communication, and gene expression in a wide variety of organisms.

4323*
Bioenergetics. Prerequisite: 3014 or BIOC 3653. Bioenergetic reactions and mechanisms involved in energy production in plants, animals and microbial systems. Same course as MICR 4323.

4990
Special Problems. 2-4 credits, maximum 8. Prerequisite: consent of instructor.Minor investigations in the field of cell and molecular biology.

4993
Senior Honors Project. Prerequisites: 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. Required for graduation with departmental honors in CLML.

5203*
Bioinformatics. Prerequisite: graduate standing or consent of instructor. BASIC programs and public domain software to model and analyze simple biological processes. Models to evaluate more complex biological processes. No prior experience with computers or programming necessary, but recommended.

Chemical Engineering (CHE)

2033
Introduction to Chemical Process Engineering. Prerequisites: CHEM 1515, ENSC 2213. Corequisites: MATH 2233 or 3263. 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.

3013
Rate Operations I. Prerequisite: 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.

3113
Rate Operations II. Prerequisites: 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.

3123*
Chemical Reaction Engineering. Prerequisites: 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.

3333
Introduction to Transport Phenomena. Prerequisite: 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.

3473
Chemical Engineering Thermodynamics. Prerequisite: 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.

4002*
Chemical Engineering Laboratory I. Lab 6. Prerequisites: 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 expermental data and presentation of results.

4112*
Chemical Engineering Laboratory II. Lab 6. Prerequisites: 4002, 3113, 3123, admission to CHE Professional School. A continuation of 4002. Primarily reaction and mass transfer processes.

4124*
Chemical Engineering Design I. Lab 2. Prerequisites: 4002, 3113, 3123, 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.

4224*
Chemical Engineering Design II. Lab 2. Prerequisite: 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.

4283*
Bioprocess Engineering. Prerequisite: admission to CHE Professional School. 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.

4293
Biomedical Engineering. Prerequisites: 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.

4343
Environmental Engineering. Prerequisites: 3333, 3473. 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.

4581*
Chemical Engineering Seminar. Prerequisite: senior standing in the department. Through guest lectures and home assignments, provision of an awareness of aspects of career and personal success that are not normally covered in the technical curriculum.

4843*
Chemical Process Instrumentation and Control. Prerequisites: 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.

4990
Special Problems. 1-5 credits, maximum 5. Lab 3-15. Prerequisite: senior standing. Training in independent work, study of relevant literature and experimental investigation of an assigned problem.

5000*
Master's Thesis. 1-6 credits, maximum 6. Prerequisite: approval of major professor. Methods used in research and thesis writing.

5030*
Professional Practice. 2-6 credits, maximum 8. Prerequisites: 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.

5110*
Special Topics In Chemical Engineering. 2-3 credits, maximum 9. Lab 2-6. Prerequisite: 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.

5123*
Advanced Chemical Reaction Engineering. Prerequisite: 4473. Advanced principles and applications of chemical kinetics in catalysis, heterogeneous systems, non-ideal reactions, polymerization and biological reactions.

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.

5283*
Advanced Bioprocess Engineering. Prerequisite: 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.

5293*
Advanced Biomedical Engineering. Prerequisite: 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.

5413*
Fundamentals of Polymer Engineering. Fundamental principles in the engineering of macromolecules. Various aspects of polymer engineering including definitions and nomenclature, polymer physical chemistry, mass-transfer, rheological and mechanical properties, industrial production and applications.

5423*
Process Heat Transfer. Application of fundamental principles of single- and two-phase fluid dynamics and heat transfer to the design and analysis of process heat transfer equipment.

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.

5703*
Optimization Applications. Prerequisite: graduate standing. A survey of various methods of unconstrained and constrained linear and nonlinear 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 and MAE 5703.

5733*
Neural Networks. Prerequisite: 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 and MAE 5733.

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.

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.

5853*
Advanced Chemical Process Control. Prerequisite: 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.

5873*
Air Pollution Control Engineering. Causes, effects and control of atmosphere pollution. Same course as CIVE 5873.

5990*
Special Problems. 2-4 credits, maximum 9. Prerequisite: consent of instructor. Individual report topics in chemical engineering involving operations, processes, equipment, experiments, literature search, theory, computer use or combinations of these.

6000*
Doctoral Thesis. 2-15 credits, maximum 54. Prerequisite: 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.

6010*
Chemical Engineering Seminar. 1-3 credits, maximum 14. Advanced research and development topics.

6223*
Advanced Chemical Engineering Thermodynamics. Prerequisite: 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.

6440*
Advanced Topics in Chemical Engineering. 3-6 credits, maximum 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.

6543*
Chemical Engineering Kinetics. Prerequisite: 6223. Kinetics of chemical reaction. Reaction rates in homogeneous systems. Design of batch and fluid reactors. Catalysis and the design of gas-solid catalytic reactors.

6703*
Research Methods in Chemical Engineering. Prerequisites: M.S. or Ph.D. 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)

1014
(L,N)Chemistry in Civilization. Lab 2. Symbols, methods and contributions to society of the chemical sciences. Includes polymers, pollution, energy, consumer chemicals, drugs, nuclear science and other topics. No credit for students with credit in 1215, 1314.

1215
(L,N)General Chemistry. Lab 2. Prerequisite: MATH 0123 or high school equivalent. The beginning chemistry course recommended for students in the applied biological sciences. No credit for students with credit in 1014, 1314.

1225
(N)General Chemistry. Lab 2. Prerequisite: 1215 or advanced placement. A continuation of general chemistry, recommended for students in the applied biological sciences. No credit for students with credit in 1515.

1314
(L,N)General Chemistry. Lab 2. Prerequisite: MATH 1513 or concurrent enrollment in 1613, 1715 or a higher level math course. The beginning chemistry course recommended for students in basic biological sciences (including premedical science and pre-veterinary science), physical sciences and engineering. No credit for students with credit in 1014, 1215.

1413
(L,N)Inquiry-based Chemistry. Lab 3. Prerequisite: 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.

1414
(L,N)General Chemistry for Engineers. Prerequisites: one year of high school chemistry or one semester of college chemistry and MATH 1513 or concurrent enrollment in 1613, 1715 or 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. No credit for students in 1314.

1515
(L,N)General Chemistry. Lab 2. Prerequisite: 1314 or advanced placement. A continuation of general chemistry. No credit for students with credit in 1225.

2113
Principles of Analytical Chemistry. Prerequisites: 1515 and MATH 1513 or 1715. Modern theories of solutions, separation techniques and methods of analysis.

2122
Quantitative Analysis Laboratory. Lab 6. Prerequisite: 2113 or concurrent enrollment. Laboratory work related to material covered in CHEM 2113.

2990
Special Problems in Chemistry for Non-majors. 1-2 credits, maximum 2. Prerequisite: 1515 or concurrent enrollment. Independent training in chemistry at the lower-division level.

3015*
The Chemistry of Organic Compounds. Lab 4. Prerequisites: 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 uses of acyclic, cyclic, and aromatic compounds. No credit for students with credit in 3053 or 3112.

3053
Organic Chemistry. Prerequisite: 1414 or 1515 or equivalent. Hydrocarbons and their derivatives, including specific compounds of theoretical, biological or industrial importance. No credit for students with credit in 3015.

3112
Organic Chemistry Laboratory. Lab 6. Prerequisite: 3153 or concurrent enrollment. Laboratory exercises related to theoretical principles covered in CHEM 3053 and 3153. No credit for students with credit in 3015.

3153*
Organic Chemistry. Prerequisite: 3053. A continuation of 3053.

3353
Descriptive Inorganic Chemistry. Prerequisite: 1225 or 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.

3434*
Physical Chemistry I. Prerequisites: 2113, 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.

3532*
Physico-Chemical Measurements. Lab 6. Prerequisites: 2122, 3434. Apparatus, experimental methods and calculations employed in physico-chemical investigations.

3553*
Physical Chemistry II. Prerequisite: 3434. A continuation of 3434. Students who are not chemistry majors may receive graduate credit.

4020*
Modern Methods of Chemical Analysis. 1-5 credits, maximum 5. Lab 2. Prerequisites: 2122, 3434. Theoretical and laboratory study of modern techniques, reagents and instruments employed in analytical chemistry.

4101*
Laboratory and Chemical Safety. Instruction on chemical safety, prudent laboratory practices, and federal, state, and OSU regulations on safety. Graded on a pass-fail basis.

4320*
Chemical and Spectrometric Identification of Organic Compounds. 1-3 credits, maximum 3. Lab 1-2. Prerequisites: 3112 and 3153. Theory and practice in separating mixtures of organic compounds and some theory and practice in identifying organic compounds by spectroscopic methods.

4990*
Special Problems. 1-5 credits, maximum 6. Lab 3-15. Prerequisite: senior standing. Training in independent work, study of relevant literature and experimental investigation of an assigned problem.

5000*
Thesis. 1-6 credits, maximum 6. Investigations, chiefly experimental, with necessary conferences. Familiarizes the student with methods used in research in chemistry.

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 M.S. degree.

5103*
Physical and Chemical Separations. Prerequisite: one year of physical chemistry. Principles of bulk and multi-stage separation methods: chromatography, liquid-liquid extraction and zone melting.

5113*
Equilibrium and Kinetics in Analytical Chemistry. Prerequisite: one year of physical chemistry. Physical and chemical principles of equilibrium and kinetics as applied to analytical problems.

5220*
Modern Topics for Teachers. 1-9 credits, maximum 9. Prerequisite: 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.

5223*
Chemistry of High Polymers. Prerequisites: 3153 and 3434 or equivalent. Preparation and polymerization of organic monomers; properties and uses of resulting high polymers; theories of polymerization; inorganic and natural organic polymers.

5260*
Inorganic Chemistry I. 1-3 credit hours, maximum 3. Prerequisites: 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.

5283*
Solid-state Chemistry. Prerequisite: 5260. Structure, bonding, and properties of cyrstalline and amorphous inorganic solids. Emphasis on the characterization of inorganic solids and phase transitions in inorganic solids.

5323*
Reactions of Organic Compounds. Prerequisite: 3153. Products and mechanisms of reactions of importance in organic synthesis.

5373*
Spectrometric Identification of Organic Compounds. Lab 3. Prerequisite: 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.

5443*
Mechanism and Structure in Organic Chemistry. Prerequisites: 3153 and 3553. Relationship of properties of organic compounds to their structure; mechanisms of organic reactions.

5563*
Chemical Thermodynamics I. Prerequisite: 3553. Statistical and classical thermodynamics applied to chemical systems.

5623*
Quantum Chemistry I. Prerequisite: 3553. Fundamentals of quantum mechanics, including classical mechanics, wave representation of matter, the Schroedinger equation and atomic structure.

5960*
Inorganic Chemistry II. 1-3 credits, maximum 3. Prerequisite: 5260. Chemistry of main group and transition metal organometallic compounds, metal clusters, and catalysis by organometallic polymers, bioinorganic chemistry, and materials chemistry.

6000*
Research. 1-12 credits, maximum 60. Prerequisites: M.S. degree in chemistry or consent of instructor. Independent investigation under the direction and supervision of a major professor.

6010*
Research Seminar. 1 credit, maximum 8. Prerequisite: consent of instructor. Presentations of current research. One credit hour per academic year required for M.S. and Ph.D. candidates.

6011*
Advanced Seminar. Prerequisite: 5011 or M.S. degree. Preparation and oral presentation of critical reviews on chemical subjects. Usually related to the student's research area. Completion of 1 credit hour required for the Ph.D. degree.

6050*
Special Topics in Analytical Chemistry. 1-6 credits, maximum 6. Supervised study of topics and fields not otherwise covered.

6103*
Electroanalytical Chemistry. Prerequisite: 4024. The theory, practice and instrumentation in various areas of modern electroanalytical chemistry.

6113*
Analytical Spectroscopy. Prerequisite: 4024. Survey of selected topics in analytical applications of spectroscopic techniques. Fundamental concepts as well as current trends in research, including instrumentation.

6420*
Special Topics in Organic Chemistry. 1-9 credits, maximum 9. Prerequisite: 3153. Deals with topics not covered in other courses.

6453*
Chemical Kinetics. Prerequisite: 3553. The kinetics of chemical reactions and their theoretical interpretation.

6553*
Molecular Spectroscopy. Prerequisite: 5623. Spectra and structure of molecules.

6650*
Selected Topics in Advanced Physical and Inorganic Chemistry. 1-6 credits, maximum 12. Prerequisite: consent of instructor. Supervised study of selected topics and fields not otherwise covered.

6803*
Photonics I: Advanced Optics. Lab 9. Prerequisite: 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. Ultrashort laser pulses. Same course as ECEN 6803 and PHYS 6803.

6810*
Photonics II: THz Photonics and THz-TDS. Lab 1. 1 credit, maximum 4. Prerequisite: 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 ECEN 6810 and PHYS 6810.

6820*
Photonics II: Spectroscopy II. Lab 1. 1 credit, maximum 4. Prerequisite: 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 and PHYS 6820.

6830*
Photonics II: Spectroscopy III. Lab 1. 1 credit, maximum 4. Prerequisite: 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 ECEN 6830 and PHYS 6830.

6840*
Photonics III: Microscopy I. Lab 1. 1 credit, maximum 4. Prerequisite: 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 and PHYS 6840.

6850*
Photonics III: Microscopy II. Lab 1. 1 credit, maximum 4. Prerequisite: 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 and PHYS 6850.

6860*
Photonics III: Microscopy III and Image Processing. Lab 1. 1 credit, maximum 4. Prerequisite: 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 and PHYS 6860.

6870*
Photonics IV: Synthesis amd Devices I. Lab 1. 1 credit, maximum 4. Prerequisites: 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 and PHYS 6870.

6880*
Photonics IV: Semiconductor Devices, Testing and Characterization. Lab 1. 1 credit, maximum 4. Prerequisite: 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 and PHYS 6880.

6890*
Photonics IV: Semiconductor Synthesis and Devices III. Lab 1. 1 credit, maximum 4. Prerequisite: 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 ECEN 6890 and PHYS 6890.

Civil Engineering (CIVE)

3113
Intermediate Mechanics of Materials. Prerequisite: ENSC 2142. Stress-strain behavior of engineering materials. Transformation of stresses and strains in two dimensions. Shear and moment diagrams for beams. Stresses in beams under combined loads. Deflection of beams. Buckling of columns.

3413
Structural Analysis. Lab 3. Prerequisite: 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.

3513
Structural Steel Design. Lab 3. Prerequisite: 3413. Introduction to the design of structural steel members and connections in accordance with AISC specifications.

3523
Reinforced Concrete Design. Lab 3. Prerequisite: 3413. Introduction to the design of reinforced concrete elements in accordance with the strength design requirements of the ACI Building Code.

3614
Engineering Surveying. Lab 3. Prerequisite: MATH 1613 or MATH 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.

3623
Engineering Materials Laboratory. Lab 3. 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.

3633
Transportation Engineering. Prerequisite: 3614 or consent of instructor. 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.

3713
Geotechnical Engineering. Prerequisite: ENSC 2143. Physical and mechanical properties of soils, including specific gravity, grain size distribution, plasticity, permeability, consolidation, and shear strength. Use of physical and mechanical properties to calculate stresses in a soil mass, lateral earth pressures, bearing capacity, and slope stability. Application of physical and mechanical properties to design of foundations, retaining structures and slopes.

3813
Environmental Engineering Science. Prerequisites: 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.

3833
Applied Hydraulics. Prerequisites: CHEM 1314 or 1515, ENSC 3233, PHYS 2014. 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.

3843
Hydrology I. Prerequisites: CHEM 1515, ENSC 3233, PHYS 2014. Basic principles of surface 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, application of hydrologic models.

3853
Environmental Engineering Laboratory. Lab 3. Prerequisite: 3813. 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.

4010*
Civil Engineering Research. 1-4 credits, maximum 12. Prerequisite: senior standing or consent of instructor. Research and investigation of civil engineering problems.

4042
Senior Seminar. Prerequisite: senior standing or consent of instructor. Topics relevant to the professional practice of civil and environmental engineering. Written communications skills are stressed. Resumes, letters of introduction and job interviews are discussed in detail. Management principles and project management are introduced. The advantages of professional registration and professional and technical society membership are covered. Laws impacting the practice of engineering such as OSHA and ADA are introduced. Other topics such as professional ethics, income taxes and investments are discussed.

4043
Senior Design. Prerequisites: 3513, 3523, 3713, senior standing. 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.

4143*
Environmental Engineering Design. Prerequisites: 3833, 3853, 4833. 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 engineering decisions made. Economic, environmental, social and regulatory aspects of environmental engineering design.

4273*
Construction Engineering and Project Management. Lab 3. Prerequisites: senior standing and consent of instructor. 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.

4711*
Basic Soils Testing Laboratory. Lab 3. Prerequisite: 3713. Laboratory measurement of the physical and mechanical properties of soils; specific gravity, grain size distribution, plasticity, compaction, compressibility, and shear strength.

4823*
Human Impact on the Environment. The activities of humans and how they affect the aqueous, terrestrial and atmospheric environment.

4833*
Unit Operations in Environmental Engineering. Prerequisites: 3813, ENSC 3233. 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.

5000*
Master's Thesis or Report. 1-6 credits, maximum 6. Prerequisite: 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.

5010*
Civil Engineering Seminar. 1-3 credits, maximum 6. Prerequisites: graduate standing and approval of major professor. Review of literature of major fields of civil engineering.

5013*
Aquatic Chemistry. Prerequisites: 5813 or concurrent enrollment, CHEM 1515 or equivalent. Application of chemical principles to environmental problems. Chemical kinetics, chemical equilibrium, acid-base chemistry, and development of pc-pH diagrams and coordination chemistry. Precipitation and dissolution reactions and oxidation-reduction reactions.

5020*
Civil Engineering Research. 1-6 credits, maximum 6. Prerequisites: graduate standing and approval of major professor. Research and investigations other than thesis studies.

5030*
Engineering Practice. 1-6 credits, maximum 9. Prerequisite: 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.

5080*
Engineering Problems. 1-3 credits, maximum 6. Prerequisite: graduate standing. Problems of particular interest to graduate students in the field of applied science.

5103*
Engineering and Construction Materials and Methods. Lab 3. Prerequisite: graduate standing or consent of instructor. Analysis of engineered materials for construction and project operations. Examination and analysis of construction methods for civil engineering projects. Management of engineered materials, development of site operations and analysis of construction methods and materials.

5113*
Project Planning, Scheduling and Control. Lab 2. Prerequisite: graduate standing or consent of instructor. Project planning course in the principles and practice of scheduling and control management. Pre-project planning, development of critical path methods, and project schedules, fundamental cost and schedule analysis, and earned value concepts used in the engineering and construction industry.

5123*
The Legal and Regulatory Environment of Engineering. Prerequisite: junior, senior or graduate standing. 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.

5133*
Construction Contracts and Specifications. Prerequisite: graduate standing or consent of instructor. The nature of contracts. Contract documents. Master format. Principles of specification writing. Contract types. Bonds and insurance. Bidding. Subcontracting. Disputes and disputes resolution.

5143*
Project Engineering and Management. Prerequisite: graduate standing or consent of instructor. 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.

5153*
Contract Administration. Prerequisite: graduate standing or consent of instructor. Methods and techniques of tracking and control of construction projects. Evaluation of current research findings to contract implementation.

5163*
Construction Equipment Management. Prerequisite: graduate standing or consent of instructor. 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.

5173*
Concrete Formwork Design. Prerequisite: graduate standing or consent of instructor. Design of formwork for concrete structures. Analysis of loads, deflections, and stresses of forming systems. Evaluation of economics of formwork designs.

5183*
Construction Estimating. Lab 2. Prerequisite: graduate standing or consent of instructor. 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.

5213*
Environmental Geotechnology. Prerequisites: background in soil mechanics and basic chemistry. A study of the ability of soil to retain pollutants, effect of pollutants on chemical, physical and geotechnical properties of soil. Description of soil remediation technologies.

5233*
Geotechnical Engineering Investigations. Prerequisites: 3713, 4711, and basic geology course. Description of methods of subsurface exploration, sampling, and in situ testing. Discussion includes a review of engineering geophysical methods, equipment and methods for boring and sampling of soil and rock, measurement of ground water conditions, and in situ testing equipment and methods such as cone penetration test, pressure meter test and others.

5243*
Use and Design of Geosynthetics. Prerequisites: 3713, 4711. 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.

5263*
Terrain Analysis. Prerequisites: Basic courses in soil mechanics and geology. Prediction of geotechnical engineering characteristics of geological landforms from remote sensing imagery. Emphasis on photographic stereo interpretation. Training and practice of this media in land-use applications and environmental problems.

5303*
Systems Analysis for Civil Engineers. Prerequisite: senior or graduate standing. 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.

5313*
Highway Traffic Operations. Prerequisite: 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.

5343*
Urban Transportation Planning. Prerequisite: 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.

5363*
Design and Planning of Airports. Prerequisite: 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.

5373*
Design of Traffic Control Systems. Prerequisite: 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.

5383*
Geometric Design of Highways. Prerequisite: 3633. Geometric, functional and aesthetic aspects of roadway design. Alignment, sight distance, at-grade intersections, interchanges and freeway systems. Design tools and techniques.

5403*
Advanced Strength of Materials. Prerequisite: 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.

5413*
Classical Methods of Structural Analysis. Prerequisite: 3413. Advanced analysis of indeterminate frames, trusses and arches by classical, numerical, and energy methods with emphasis on methods for hand computations.

5423*
Matrix Analysis of Structures. Prerequisite: consent of instructor. 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.

5433*
Energy Methods in Applied Mechanics. Prerequisites: 3413, 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.

5443*
Theory of Elastic Stability. Prerequisite: 5403. General theory of elastic stability; buckling of columns; analysis of beam-columns; stability analysis of structural frames, thin-walled beams of open cross-section, and plate structures.

5453*
Engineering Analysis. Prerequisite: senior standing and consent of instructor. Advanced, classical mathematical skills for engineers. Dimensional analysis, general tensor analysis, curvilinear coordinates, partial differential equations, perturbation theory, integral equations, special functions, eigen function analysis, integral transform methods, variational methods.

5463*
Structural Reliability and Engineering Judgment. Prerequisite: 3413, STAT 4033. Basic probability and statistics. Probability concept for failure analysis. System reliability. Bayesian approach. Inspection procedures. Allowable stress design versus load and resistance factor design. Classical theory of structural reliability. Reliability analysis of structures. Case histories of engineering judgment. Engineering ethics.

5503*
Computer-aided Structural Analysis and Design. Prerequisites: 3413; 3513 and 3523 (or concurrent enrollment); senior or graduate standing. 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.

5513*
Advanced Reinforced Concrete Design. Prerequisite: 3523. Advanced topics in reinforced concrete design with emphasis on frames, slabs, and earthquake-resistant structures.

5523*
Advanced Steel Structure Design. Prerequisite: 3513. Advanced topics in steel design such as plastic design, plate girders, composite design, fatigue and fracture, stability, and bracing design.

5533*
Prestressed Concrete. Prerequisite: 3523. Design of simple and continuous prestressed concrete beams. Behavior under overload. Calculation of prestress losses and deflections.

5653*
Asphalt Materials and Mix Design. Lab 1.5. Prerequisite: 3633 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.

5673*
Concrete Materials and Mix Design. Lab 1.5. Prerequisite: 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.

5693*
Pavement Design and Analysis. Prerequisite: 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.

5703*
Soils in Construction. Prerequisites: 3713, 4711 or consent of instructor. Soils types and general behavior during construction; earthwork construction requirements and specific considerations for embankments, pavements, buildings and retaining structures; groundwater control during construction; soil modification and stabilization; and construction considerations for geosynthetics. Basic design considerations, including selection of placement conditions for compaction; proportioning of groundwater control systems; selection of type and amount of soil modifier, and design of geosynthetics to meet specific functions.

5713*
Soil Mechanics. Prerequisites: 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.

5723*
Foundation Engineering. Prerequisites: 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.

5733*
Rock Mechanics in Engineering Design and Construction. Prerequisites: 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.

5743*
Soil-Structure Interaction. Prerequisites: 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.

5753*
Engineering Soil Stabilization. Prerequisites: 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.

5793*
Soil Dynamics. Prerequisite: 3713. Behavior of soils under dynamic loads and its modeling. Liquefaction. Analysis of dynamically-loaded foundations and dynamic soil-structure interaction. Response of soil deposits and embankment dams to earthquakes.

5803*
Essentials of Environmental Engineering. Prerequisite: 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.

5813*
Environmental Laboratory Analysis. Lab 3. Prerequisite: 4833 or concurrent enrollment. 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.

5823*
Environmental Risk Assessment and Management. Prerequisites: an introductory class in statistics and background in engineering, management or science. 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.

5833*
Water Quality Management. Physical, chemical and biological factors in pollution and natural purification of rivers and lakes in relation to point and nonpoint sources of pollution. Development of low flow statistics and pollution loading functions for subsequent modeling projects. Dissolved oxygen and nonpoint source contamination models developed and applied.

5853*
Bioremediation. Prerequisite: 3813 or equivalent science background. Process selection and design of bioremediation systems for renovation of contaminated hazardous and industrial waste sites, soils, sludges. Site analysis emphasizing contaminant and environmental characteristics. Engineering factors to promote successful bioremediation. Design project required.

5863*
Advanced Unit Operations in Environmental Engineering. Prerequisite: 4833. Theory and design of advanced physical-chemical water and wastewater treatment processes applied to municipal, industrial, and hazardous waste situations.

5873*
Air Pollution Control Engineering. Causes, effects and control of atmospheric pollution.

5883*
Residuals and Solid Waste Management. Theory, design and operation of systems for handling, treatment, and disposal of process sludges (water treatment, wastewater treatment, industrial) and solid wastes. Potential material reclamation options.

5913*
Groundwater Hydrology. Prerequisite: 3843. Theory of groundwater movement, storage, exploration and pumping tests. Design of groundwater recovery and recharge systems.

5923*
Water Resources Planning and Management. Application of engineering economics and microeconomic theory to the planning and management of water resources projects including flood control, hydroelectric, water supply, and urban stormwater. Systems analysis approaches, primarily linear and dynamic programming, and their application in water resources.

5933*
Water Treatment. Prerequisite: 4833. Theory, design and operation of water treatment plants. Sizing of various unit processes. Water treatment plant control procedures.

5943*
Unit Operations and Processes Laboratory. Lab 3. Prerequisite: 4833, 5813 or equivalent. Bench and pilot-scale experiments as physical models of water and wastewater treatments. Techniques of data collection and analysis applied to design of physical, chemical and biological processes.

5953*
Biological Waste Treatment. Lab 3. Prerequisite: 4833 or equivalent. Fundamentals of microbial systems applied to waste treatment processes. Standard suspended-growth and fixed biofilm wastewater and sludge suspensions and treatment system design calculations.

5963*
Open Channel Flow. Prerequisite: 3833. Open channel hydraulics, energy and momentum concepts, resistance, channel controls and transitions, flow routing, and sediment transport.

5983*
Groundwater Pollution Control. Theory, design and operation of groundwater pollution control systems. Includes examples from site specific applications as well as regional or national focus.

5993*
Groundwater Pollution Analysis and Transport. Prerequisite: 5913 or equivalent. Transport of contaminants through groundwater systems including basics of advective-dispersive-retardance and decay. Parameter and model selection. Detailed treatment of groundwater contamination. Emphasis on application of geostatistics to groundwater pollution problems. Construction and modeling semivariograms, use in kriging and co-kriging and in stochastic simulation. Conditional simulations, the inverse problem, Monte Carlo simulations and the construction of fault and event trees.

6000*
Ph.D. Research and Thesis. 1-16 credits, maximum 30. Independent research under the direction of a member of the graduate faculty by students working beyond the level of Master of Science degree.

6010*
Seminar. 1-6 credits, maximum 12. Prerequisites: 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.

6403*
Theory of Elasticity. Stress, strain and deformation analysis of two- and three-dimensional elastic continua. Propagation of stress waves through elastic continua.

6413*
Plate and Shell Structures. Prerequisite: 5403. 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.

6713*
Seepage and Groundwater Flow. Prerequisite: 3713. Seepage through earthen dams and around hydraulic structures. Properties of phreatic surfaces. Seepage pressures, piping and boiling. Construction and utilization of flow nets. Groundwater mechanics applications including flow characteristics and changes in flow due to pump and drain systems.

6723*
Advanced Geotechnical Engineering. Prerequisites: 3713 and GEOL 1114 or 3023. Geologic occurrence and engineering significance of ground failure hazards such as slope movements, streambank erosion, subsidence, metastable soils and earthquakes. Emphasis on qualitative identification of ground failure hazards with quantitative assessive and remedial actions.

6843*
Stochastic Methods in Hydrology. Prerequisites: 5843, STAT 4033. Stochastic and statistical hydrologic analyses of surface water and ground water systems. Analyses of urban and rural drainage, and detention systems. Same as BAE 6313.

6853*
Modeling of Water Resources Systems. Prerequisites: 5843 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.

6913*
Advanced Environmental Laboratory Analysis. Lab 3. Prerequisite: 5813. Instrumental analysis of environmental contaminants. Process samples, effluents, residuals, and environmental samples. Use of gas and liquid (ion) chromatography, atomic absorption and other analytical methods.

6923*
Industrial Wastes Engineering. Prerequisite: graduate standing. 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.

6953*
Advanced Biological Waste Treatment. Prerequisite: 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)

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. Linguisitic 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.

2213
Phonetics. The analysis and description of speech at the segmental and suprasegmental levels. Development of students' perceptual and analytic skills in speech sound production. Practice using the International Phonetic Alphabet for broad and narrow transcription. Overview of the speech production mechanism and process.

3123
Audiology and Audiometry. 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.

3213
Survey of 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.

3224
Speech and Language Development. Normal acquisition of phonology, morphology, semantics, syntax and pragmatics in children. Biological, 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.

4010
Clinic Practicum. 1-3 credits, maximum 3. Lab 2-6. Prerequisites: 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.

4022
Clinical Methods and Issues. Prerequisites: 2213, 3213, 3224; 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.

4133*
Aural Rehabilitation for the Acoustically Handicapped. Prerequisite: 3123. 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.

4214
Anatomy and Physiology of the Speech Mechanism. Lab 2. Structure and function of the respiratory, phonatory, articulatory, and neural systems involved in the oral communication processes. Laboratory experiences required.

4222*
Language Analysis. Prerequisites: 3224, and one of: FLL 2443, ENGL 2443, 4003, 4013, 4063, 4093. Applications of content, form and use analysis methods to language samples of individuals with communication disorders. Analyses of word, phrase, sentence and discourse levels. Variations as a function of age, culture, modality (spoken or written), and disorder type.

4253*
Diagnostic Procedures in Communication Disorders. Prerequisite: 3224. Speech and language diagnostic testing and procedures, interpreting diagnostic information and deriving appropriate treatment goals.

4313*
Speech Science. Prerequisite: acceptance into CDIS program. Scientific bases of the acoustic parameters, the perceptual and productive processes of speech, and the interrelationships of those factors during speech communication.

4323*
Language Assessment and Intervention. Prerequisite: 3224. Principles of language assessment, diagnosis, intervention; goal selection and procedural processes for language intervention with infants, toddlers and preschool-age children.

4412
Neural Bases of Speech and Language. Prerequisite: 4214. 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 & language.

4413*
Phonological Assessment and Intervention. Prerequisites: 2213; 3224 or concurrent enrollment. Current theories and research in clinical phonology and applied linguistics related to phonological disorders in children. Normal development and contemporary approaches to assessment and treatment. Lecture, discussion, projects and clinical observation.

4443*
Fluency Disorders. Prerequisite: junior standing or consent of instructor. Recent research into the nature, causes and treatment of fluency disorders. Practical classroom experience in diagnosing and treating fluency disorders.

4980
Independent Study in Communication Sciences and Disorders. 1-3 credits, maximum 3. Prerequisite: junior standing and consent of instructor. Directed readings or research in communication sciences and disorders.

4993
Senior Honors Thesis. Prerequisites: 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.

5000*
Research and Thesis. 1-3 credits, maximum 6. Prerequisite: consent of graduate faculty. Research in speech, language and hearing sciences and disorders.

5013*
Research Methods in Communication Disorders. Research methods with emphasis on methods used most frequently in communication sciences and disorders; experience devising, evaluating, and implementing research.

5113*
Language Disorders in Children. Prerequisites: 3224, 4323. 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.

5123*
Clinical Audiology. Prerequisites: 4133, 4313. Hearing disorders and their etiologies. Clinical application of pure tone and speech audiometric tests and impedance screening. Clinical management of the hearing impaired. Central auditory processing disorders diagnosis and management.

5142*
Clinical Phonology. Prerequisite: 4413. Current issues in linguistic theories related to the assessment and treatment of phonological disorders in children. Critical analysis of current research.

5153*
Neurological Communication Disorders. Prerequisite: 4214. Communication changes occuring with aging and common neurological diseases and trauma. Neurophysiological bases and etiology. Evaluation and treatment of aphasia and right hemisphere disorders.

5160*
Dysphagia. 2-3 credits, maximum 3. Prerequisite: 4214. 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.

5172*
Motor Speech Disorders. Prerequisite: 5153. Nature, evaluation and treatment of neurologically-based motor speech disorders such as dysarthria and apraxia.

5182*
Cognitive Communication Disorders. Prerequisite: 5153. Nature, evaluation and treatment of acquired cognitive communication disorders secondary to traumatic injury or dementia.

5210*
Advanced Practicum. 1-6 credits, maximum 9. Prerequisite: consent of instructor. Practical experience for the advanced student on or off campus.

5232*
Communication Disorders in Infants and Toddlers. Prerequisite: 3224. Family-centered assessment and intervention and prevention issues with infants and toddlers, birth to 3 years of age, who are at risk or have communication disorders. Impact of perinatal, neonatal and postnatal biological and environmental risks on developmental outcome.

5242*
Language Disorders of School-Age Children and Adolescents. Prerequisites: 4323, 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.

5333*
Voice Disorders. Prerequisite: 4313. 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.

5422*
Adaptive Communication Systems. Prerequisite: major in communication science and disorders or consent of instructor. Evaluation and management of communication disorders in individuals requiring specially adapted educational intervention programs. Adaptive communication technologies.

5431*
Craniofacial Anomalies. Prerequisites: 4214, 4313. Recent research in the etiology, assessment and management of communicative disorders in individuals with orofacial anomalies.

5442*
Communication Disorders in Individuals with Developmental Delay. Prerequisites: 3224, 5113. Etiology, assessment and intervention considerations for communication disorders in children and adults with varying degrees of developmental delay.

5710*
Special Topics in Communication Disorders. 1-4 credits, maximum 9. Prerequisite: consent of instructor. Individual and group investigations of problems in communication sciences and disorders.

5720*
Seminar in Communication Disorders. 1-3 credits, maximum 3. Prerequisite: consent of instructor. Topics relevant to the evaluation and treatment of communication disorders presented on a rotating basis.

5730*
Independent Study in Communication Sciences and Disorders. 1-3 credits, maximum 3. Prerequisite: graduate standing and consent of instructor. Directed readings or research in communication sciences and disorders.

5731*
Professional Issues. Prerequisite: graduate standing. Discussion of professional standards, ethics, practice and issues in speech-language pathology.

5741*
Advanced Professional Issues. Prerequisite: 5731. Current legal, ethical, and clinical service provision issues for advanced practicum students in communication sciences and disorders.

5742*
Multicultural Applications in Communication Disorders. Prerequisites: 3224, 4253, or consent of instructor. The study of communication differences and disorders in culturally and linguistically diverse individuals. Clinical applications in assessment and intervention. Case study and program design.

5760*
Portfolio. 1-2 credits, maximum 2. Prerequisite: graduate standing. Nature and preparation of professional portfolio with faculty guidance.

Computer Science (CS)

1003
Computer Literacy. Lab 2. For students with little or no personal computer skills. Use of Internet and productivity software such as word processing, spreadsheets, databases, and presentation software.

1103
(A)Computer Programming. Lab 2. Prerequisite: 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.

1113
(A)Computer Science I. Prerequisite: 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.

2133
Computer Science II. Prerequisite: 1113. Recursive algorithms. Intermediate methods of searching and sorting. Mathematical analysis of space and time complexity, worst case, and average case performance.

2301
FORTRAN 77 Programming. Prerequisite: another programming language. FORTRAN 77 control structures, arrays, subroutines, functions, input/output.

2331
SAS Programming. Prerequisite: 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.

2351
UNIX Programming. Lab 2. Prerequisite: 1113. The UNIX programming system. The programming environment. The UNIX file system and the shell. Use of pipes and filters.

2432
The C Programming Language. Prerequisite: 1113. C programming language types, operators, expressions, control flow, functions, structures, pointers, arrays, UNIX interface.

2570
Special Problems in Computer Science. 1-3 credits, maximum 6. Prerequisites: 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.

3030
Industrial Practice in Computer Science. 1-6 credits, maximum 12. Prerequisites: 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.

3302
ADA Programming. Prerequisite: 2133. ADA-R control structures, data structures, subprograms, types, parallel processing, exception conditions.

3363
Organization of Programming Languages. Prerequisites: 2133, 3443. Programming language constructs. Run time behavior of programs. Language definition structure. Control structures and data flow programming paradigms.

3373
Object-oriented Programming and Visual C++. Prerequisites: 2133, 2432. Elements of the object model. Object-oriented design methods. Message passing and the inheritance hierarchy. Operator overloading. An overview of contemporary object-oriented languages. C++ programming using Visual C++. Practical application of object-oriented techniques.

3423
File Structures. Prerequisite: 2133. Basic physical characteristics of peripheral storage devices. File organization and processing methods for sequential, direct, indexed, tree structured and inverted files. Application of data structure concepts to logical and physical file organization: Performance analysis. Elements of advanced data base systems.

3443
Computer Systems. Prerequisite: 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.

3513
Numerical Methods for Digital Computers. Prerequisites: MATH 2144 and a 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.

3570
Special Problems in Computer Science. 1-3 credits, maximum 6. Prerequisites: 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.

3613
Theoretical Foundations of Computing. Prerequisites: 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.

3653
Discrete Mathematics for Computer Science. Prerequisite: 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.

4003*
Mathematical Logic and Computability. Prerequisite: MATH 3613 or PHIL 3000 or 3003 or consent of instructor. The basic mecatheorems of first order logic: soundness, completeness, compactness, Lowenheim-Skolem theorem, undecidability of first order logic, Godel's incompleteness theorem. Topics include enumerability, diagonalization, formal systems, standard and nonstandard models, Godel numberings, Turing machines, recursive functions, and evidence for Church's theses. Same course as MATH 4003 and PHIL 4003.

4113*
Techniques of Computer Science for Science and Engineering. Prerequisites: one year calculus and senior or graduate standing. For graduate and advanced undergraduate students requiring a one-semester treatment of computer topics. No background in computing topics assumed. Comprehensive treatment of the FORTRAN programming language with emphasis on numerical applications. Number systems, finite arithmetic, iterative processes, program structuring, numerical methods, program libraries are covered.

4143*
Computer Graphics. Prerequisite: MATH 2144. 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.

4154*
Computer Science Migration. Lab 2. Prerequisites: MATH 2144, knowledge of a programming language and senior standing. A survey of computer science for students whose major is not computer science. Programming in high level languages. Algorithm design and analysis. Fundamental data structures.

4273*
Software Engineering. Prerequisites: 2133, 3443 or ECEN 3213, 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.

4283*
Computer Networks. Prerequisites: 2133, 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.

4323*
Design and Implementation of Operating Systems I. Prerequisites: 2133, 3653, 3443 or ECEN 3213. 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.

4343*
Data Structures and Algorithm Analysis I. Prerequisites: 2133, 3653. Storage, structures, data and information structures, list processing, trees and tree processing, graphs and graph processing, searching, sorting.

4443*
Compiler Writing I. Prerequisites: 2133, 3443. Syntax and semantics of procedure-oriented languages and theory of translation techniques used in their compilation. Study of languages for particular application areas, including nonalgebraic languages.

4513*
Numerical Mathematics: Analysis. Prerequisites: MATH 2233, MATH 3013, knowledge of FORTRAN. 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.

4570*
Special Topics in Computing. 1-3 credits, maximum 5. 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.

4793*
Artificial Intelligence I. Prerequisites: 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.

4883
(S)Social Issues in Computing Sciences. Prerequisite: senior standing. Social implications of computer use 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.

4993
Senior Honors Project. Prerequisites: 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.

5000*
Research and Thesis. 1-6 credits, maximum 6. Prerequisite: 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.

5013*
Linear Programming. Prerequisites: MATH 3013 or IEM 4014; FORTRAN. Simplex algorithm to solve deterministic linear optimization models considering maximization and minimization objectives; degeneracy, alternative optima and no feasible solutions. Revised simplex procedures. Duality theory, economic interpretations, dual simplexing and complementary pivoting. Sensitivity analysis and parametric programming. Special cases of linear optimization problems and underlying mathematical foundations. Large-scale models including computational considerations.

5030*
Professional Practice. 1-9 credits, maximum 9. Prerequisites: 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.

5070*
Seminar and Special Problems. 1-6 credits, maximum 6. Prerequisite: consent of instructor. Designed to allow students to study advanced topics not provided in existing courses.

5113*
Computer Organization and Architecture. Prerequisite: 3443. Computer architecture, computer control, microprogrammed control, addressing structures, memory hierarchies, hardware description languages, specific architectures, hardware simulation, emulation.

5253*
Digital Computer Design. Prerequisite: 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.

5273*
Advanced Software Engineering. Prerequisite: 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.

5283*
Computer Network Programming. Prerequisite: 4283. Detailed technical concepts related to computer and telecommunications software development. Client-server programming using various application program interfaces, including STREAMS, the Transport Layer Interface (TLI), and Berkeley Sockets. Application development using TCP/IP protocols.

5313*
Formal Language Theory. Prerequisite: 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.

5323*
Design and Implementation of Operating Systems II. Prerequisite: 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.

5333*
Compiler Writing II. Prerequisite: 4443. Continuation of 4443. Theory and practice of compiler writing techniques. Compiler writing systems. A formal approach to computer languages.

5363*
Advanced Organization of Programming Languages. Prerequisite: 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.

5373*
Object-oriented Programming for Telecommunications. Prerequisites: 4343 and working knowledge of C programming. Object-oriented design methodology. Message passing, inheritance and operator overloading. Contemporary distributed object-oriented programming using C++. Practical applications of object-oriented techniques in telecommunications.

5413*
Data Structures and Algorithm Analysis II. Prerequisite: 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.

5423*
Principles of Database Systems. Prerequisites: 3423, 4343 or equivalents. 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, principles of database systems with the Internet.

5433*
Distributed Database Systems. Prerequisites: 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, SQL server.

5513*
Numerical Analysis I. Prerequisite: 4513 or MATH 4513. Algorithms and error analysis; solution of equations; interpolation and approximation theory.

5653*
Automata and Finite State Machines. Prerequisite: 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.

5663*
Computability and Decidability. Prerequisite: 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.

5793*
Artificial Intelligence II. Prerequisite: 4793. Advance knowledge representation and expert system building, including reasoning under uncertainty. Applications to planning, intelligent agents, natural language processing, robotics, and machine learning. Common lectures with ECEN 5293, IEM 5933 and MAE 5793.

6000*
Research and Dissertation. 2-15 credits, maximum 30. Prerequisites: graduate standing and approval of advisory committee. Independent research under the direction of a member of the graduate faculty. For students working toward a Ph.D. degree.

6023*
Nonlinear and Integer Optimization. Prerequisite: 5033 or equivalent. Theoretical and practical aspects of nonlinear and integer optimization. Development and application of nonlinear optimization techniques for unconstrained and constrained problems; sequential search, gradient, penalty and barrier, and projection methods. Development and application of integer and mixed integer techniques for unconstrained and constrained problems; implicit numeration, branch and bound, and cutting methods. Same course as IEM 6023.

6240*
Advanced Topics in Computer Organization. 2-6 credits, maximum 12. Prerequisites: 5113 and 5253. Structure and organization of advanced computer systems, parallel and pipeline computers, methods of computation, alignment networks, conflict-free memories, bounds on computation time.

6253*
Advanced Topics in Computer Architecture. Prerequisite: 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.

6300*
Advanced Topics in Programming Languages. 2-6 credits, maximum 12. Prerequisite: 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.

6350*
Advanced Topics in Operating Systems. 2-6 credits, maximum 12. Prerequisite: 5323. Design and analysis of operating systems. Concurrent processes, server scheduling, models of auxiliary storage, memory management, virtual systems, performance algorithms. May be repeated with a change in topics.

6400*
Advanced Topics in Information Systems. 2-6 credits, maximum 12. Prerequisites: 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, distributed DBMS reliability.

6500*
Advanced Topics in Numerical Analysis. 2-6 credits, maximum 12. Prerequisites: 5543, 5553. 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.

6600*
Advanced Topics in Analysis of Algorithms. 2-6 credits, maximum 12. Prerequisite: 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.

6623*
Algebraic Structures of Formal Grammars. Prerequisites: 5313, 5653. Context-free languages, Kleene languages, Dyck languages, context-sensitive languages; use of algebraic systems to define languages; linear bounded automata.

6700*
Advanced Topics in Artificial Intelligence. 2-6 credits, maximum 12. Prerequisite: 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.

Construction Management Technology (CMT)

1214
Introduction to Construction. Lab 2. Overview of the construction industry with emphasis on construction materials, methods and systems.

2253
Construction Drawings and CAD. Lab 6. Interpretation and production of construction drawings, architectural and engineering drafting using both drafting machines and computer aided drafting.

2263
Estimating I. Prerequisites: 1214, 2253. Quantity take-off with emphasis on excavation, formwork and concrete, masonry, rough carpentry and miscellaneous specialty items.

2343
Concrete Technology. Lab 3. Prerequisite: 1214. 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.

3273
Scheduling Construction Projects. Prerequisite: 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.

3331
Construction Practicum I. Prerequisite: 1214 or 2253. Supervised field experience in construction; 400 hours minimum documented time required.

3332
Construction Practicum II. Prerequisites: 3331, 2263 and CIVE 3614. 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.

3364
Structures I. Lab 3. Prerequisites: 2343, GENT 3323. Methods of structural analysis applicable to construction; design of timber structures and forms for concrete structures.

3433
Principles of Site Development. Lab 3. Prerequisites: CIVE 3614, GENT 3323. Site layout, vertical and horizontal control, surveying instrument adjustments, site investigations, excavations, site drainage and geotechnical considerations.

3463
Environmental Building Systems. Lab 3. Prerequisite: PHYS 1214. Plumbing, heating, air-conditioning, electrical and lighting systems as applied to residences and commercial buildings.

3554
Structures II. Lab 3. Prerequisite: 3364. Analysis and design of elements in steel and reinforced concrete structures; review of shop drawings for both types of construction.

3663
Concrete Design. Lab 3. Prerequisite: MET 3323. Analysis and design of reinforced and pre-stressed concrete in accordance with the ACI building code.

3734
Soils in Construction Technology. Lab 3. Prerequisite: GENT 3323. Physical characteristics of soils and soil deposits. Classification of soils and construction quality control procedures for soils in earthwork construction. Discussion, practical problems, and laboratory measurement of soil properties including grain-size distribution, plasticity/Atterberg limits, compaction, and field density. Earthwork construction specifications and quality control requirements. Basic requirements for dewatering, excavations, and foundation construction.

4050
Advanced Construction Management Problems. 1-6 credits, maximum 6. Prerequisites: junior standing and consent of instructor. Special problems in construction management.

4263
Estimating II. Prerequisite: 2263. Extensive use of actual contract documents for quantity take-off, pricing and assembling the bid for several projects. Use of computers in estimating.

4273
Computer Estimating. Lab 3. Prerequisite: 4263. Various software programs applied to estimating for building construction. Automated take off (Digitizer) systems.

4283
Business Practices for Construction. Prerequisites: 4563, ACCT 2103. 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.

4293
Construction Manager Concepts. Prerequisites: 3332, 4273, 4283. 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.

4443*
Construction Safety and Loss Control. Prerequisite: senior standing. 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.

4563
Construction Law and Insurance. Prerequisite: 3273. Legal and insurance problems as they pertain to the construction industry.

4783
Seminar. Prerequisites: CIVE 3614. Construction scheduling; construction equipment management; advanced techniques of construction project layout and control.

Counseling Psychology (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.

5000*
Master's Thesis. 1-6 credits, maximum 6. Prerequisite: 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.

5173*
Gerontological Counseling. An examination of mental health treatment modalities and approaches to counseling with older adults. An experiential component is included.

5223*
Psychology of Disability. Psychological and sociological implications of physical disability and illness. Dynamics involved in adjusting to disabling conditions including issues in rehabilitation psychology, counseling, and somatopsychology.

5320*
Seminar in Counseling Psychology. 3-9 credits, maximum 9. Prerequisite: graduate standing. In-depth exploration of contemporary topics in counseling psychology.

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.

5473*
Introduction to Counseling Practice. Prerequisite: 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.

5483*
Community Counseling and Resource Development. Prerequisite: 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.

5493*
Professional and Ethical Issues in Counseling. Prerequisite: 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.

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.

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.

5523*
Individual Appraisal. 3 credits, maximum 6. 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.

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.

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.

5553*
Principles of Counseling. A comprehensive foundation for counseling practice and the application of contemporary theories to fur-ther knowledge of counseling as a communication process.

5563*
Conceptualization and Diagnosis in Counseling. Prerequisites: 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.

5573*
Elementary School Counseling and Development. Cooperation of the school counselor, teachers, principals, and parents emphasized in organizing, developing, implement- ing, and evaluating a counseling and development program in elementary schools.

5583*
Group Process. Lab 2. 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.

5593*
Counseling Practicum. 3-12 credits, maximum 12. Prerequisites: grade of "B" or better in 5473 and 5553; admission to the counseling and student personnel program or consent of instructor. 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.

5683*
Internship in Counseling I. Prerequisites: grade of "B" or better in 5593 and admission to counseling program. Supervised experience working and studying in a counseling agency or setting.

5693*
Internship in Counseling II. Prerequisites: grade of "B" or better in 5683 and admission to counseling program. Supervised experience working and studying in a counseling agency or setting.

5720*
Workshop. 1-9 credits, maximum 9. Professional workshops on various topics. Designed to meet unique or special needs of professionals in various mental health fields.

6000*
Doctoral Dissertation. 1-25 credits, maximum 25. Prerequisite: 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.

6053*
Ethical and Legal Issues in Professional Psychology. Prerequisite: consent of instructor. Ethical and legal standards applied to the professional practice of psychology.

6083*
Principles of Counseling Psychology. Prerequisite: admission to the doctoral program in couseling psychology. Development, theoretical foundations and applications of therapeutic models of counseling and psychology.

6123*
Adult Personality Assessment. Prerequisite: admission to counseling, school, or clinical psychology program. Administration and interpretation of adult personality assessment instruments such as Rorschach, TAT and DAP.

6153*
Personality Theories. Prerequisite: graduate standing. An in-depth analysis of personality theories and personality disorders.

6310*
Advanced Practicum and Supervision. 3-12 credits, maximum 12. Prerequisite: 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.

6313*
Advanced Group Interventions. Lab 1. Prerequisite: 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.

6413*
Counseling Psychology Practicum I. Prerequisite: admission into 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.

6423*
Counseling Psychology Practicum II. Prerequisite: 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.

6433*
Counseling Psychology Practicum III. Prerequisite: 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.

6443*
Counseling Psychology Practicum IV. Prerequisite: 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.

6543*
Clinical Supervision. Prerequisite: 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.

6553*
Advanced Practice in Marital and Family Treatment. Prerequisite: 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. Same as PSYC 6553.

6560*
Advanced Internship in Counseling. 1-3 credits, maximum 6. Prerequisite: admission to the doctoral program in psychology. Designed to facilitate counseling effectiveness and to set the stage for a productive life of professional practice.

6850*
Directed Reading. 1-6 credits, maximum 6. Prerequisite: consent of instructor. Directed reading for students with advanced graduate standing.

Curriculum and Instruction Education (CIED)

0123
Improving College Reading Skills. Lab 1. Individualized instruction and lab experiences for the improvement of college reading and learning skills, including vocabulary, reading rate, comprehension and learning strategies. May be used to fulfill the reading improvement requirement established by State Regents policy. Graded on a satisfactory-unsatisfactory basis.

1230
Reading and Study Skills for College Students. 1-4 credits, maximum 4. Lab 1-4. Instruction and laboratory experience for the improvement of reading rate, vocabulary, comprehension and study skills. Graded on pass-fail basis.

2450
Early Lab and Clinical Experience in Elementary Education I. 1-2 credits, maximum 2. Lab 3-6. Prerequisite: declaration of intention to pursue a program in Teacher Education. The initial preprofessional clinical experience in schools, kindergarten through grade eight. Required for full admission to Teacher Education. Graded on a pass-fail basis.

3005
Foundations of Literacy. Lab 0-2. Prerequisites: ENGL 1113, 1213, 2413. Survey of evaluation, selection and utilization of literature of childhood; introduces cognitive and linquistics foundations of literacy; language conventions needed to compose and comprehend oral and written texts. Work in school setting.

3153
Teaching Mathematics at the Primary Level. Lab 2. Prerequisites: MATH 1513, 1483 or 1493 and MATH 3403 or 3603. Developmental levels in selection and organization of content and procedures for primary mathematics education.

3283
Foundations of Reading Instruction. Current theories of developmental reading instruction at the primary and intermediate grade levels.

3430
Early Lab and Clinical Experience in Elementary Education II. 1-2 credits, maximum 3. Lab 3-6. Prerequisite: 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.

3450
Foreign Language Field Experiences in the Schools, K-12. 1-2 credits, maximum 2. Lab 3-6. Prerequisites: consent of instructor; 2.50 GPA and passing scores on the Oklahoma General Education Test. Seminars, directed observation and participation in foreign language classrooms, K-12. Experiences in addressing the mental, social, physical and cultural differences among children. Graded on a pass-fail basis.

3620
Field Experiences in the Middle School. 1-4 credits, maximum 4. Lab 2-8. Seminars, directed observation, and participation in a particular subject area of the middle school (grades 5-9). Experience in meeting the mental, social, physical and cultural differences among middle school children. Graded on pass-fail basis.

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.

3710
Field Experiences in the Secondary School. 1-3 credits, maximum 3. Lab 2. Prerequisite: 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 school. Develops experience in meeting the mental, social, physical and cultural differences among children. Graded on a pass-fail basis.

3813
Topics of Middle School Mathematics. Prerequisite: consent of instructor. Strategies for teaching the topics of the middle grades and the mathematics basic skill areas of the middle grades (grades 5-9).

4000
Field Studies in Education. 1-4 credits, maximum 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.

4003*
Teaching Fundamental Concepts of Mathematics. Prerequisite: full admission to Teacher 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.

4005
Literacy Assessment and Instruction. Lab 0-2. Prerequisite: 3005 or consent of literacy faculty. 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.

4012
Integration of Literacy across the Curriculum. Prerequisites: 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.

4023
Children's Literature. Survey, evaluation, selection and utilization of materials for children; extensive reading with emphasis on books which meet the needs and interest of children through grade six.

4053*
Teaching Geometry in the Secondary School. Prerequisite: full admission to Teacher 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.

4153
Teaching Mathematics at the Intermediate Level. Lab 1. Prerequisites: 3153 and MATH 3403 and MATH 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.

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.

4233
Reading Diagnosis and Remediation. Lab 1. Prerequisites: full admission to Professional Education. Identification and treatment of reading problems in the classroom including group and individual diagnostic procedures. Practical experiences required.

4253
Language Arts in the Elementary School Curriculum. Prerequisite: full admission to Teacher Education. The purposes, selection and organization of content, teaching and learning procedures, and evaluation of outcomes in elementary school listening, speaking and writing.

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.

4293
Teaching Reading in the Elementary School. Lab 0-8. Application of skills, techniques and materials utilized in the effective teaching of reading in the elementary schools.

4313*
Young Adult Literature. 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. Same course as LBSC 4313.

4323
Social Studies in the Elementary School Curriculum. Prerequisite: full admission to Teacher Education. Purposes, selection and organization of content, teaching and learning procedures and evaluation of outcomes in elementary social studies.

4353
Science in the Elementary School Curriculum. Prerequisite: full admission to Teacher Education. The purposes, selection and organization of content, teaching and learning procedures and evaluation of outcomes in elementary school science.

4363
Design and Management of the Elementary School Classroom. Prerequisite: full admission to Professional Education. Design and management of the physical, social, intellectual, cultural, special needs, and learning materials aspects of the school classroom, kindergarten through grade 8. Purposes, selection, and organization of classroom management systems and teaching approaches.

4450
Internship in Elementary Education. 1-12 credits, maximum 12. Lab 3-36. Prerequisites: 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.

4453
Senior Seminar in Elementary Education. Prerequisites: 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.

4473
Reading for the Secondary Teacher. Prerequisites: full admission to Teacher Education and consent of instructor. Materials and procedures in the teaching of reading in secondary schools for content area teachers.

4560*
Environmental Education. 1-4 credits, maximum 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.

4713
Teaching and Learning in the Secondary School. Prerequisite: full admission to Teacher Education. Purposes, selection and organization of curriculum content, teaching and learning theories and procedures, and evaluation of outcomes for diverse students. Teaching techniques and materials in grades 7-12 subject areas. Available in certification disciplines: art, English/language arts, foreign languages, mathematics, science, social studies.

4720
Internship in the Secondary Schools. 1-12 credits, maximum 12. Lab 3-36. Prerequisites: concurrent enrollment in 4730 or 4724 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.

4724
Planning and Management in the Multicultural Secondary Classroom. Prerequisites: 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.

4730
Planning and Management in the Multicultural Art Classroom K-12. 1-2 credits, maximum 2. Prerequisites: 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.

4734
Planning and Management in the Multicultural Foreign Language Classroom K-12. Prerequisites: 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.

5000*
Master's Report or Thesis. 1-6 credits, maximum 6. Prerequisite: 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.

5033*
Teaching Foreign Languages in the Schools K-12. Curriculum, materials, methods and procedures related to foreign languages (grades K-12).

5043*
Issues in Teaching. Current issues and trends in teaching theory, practice and research with emphasis on teacher reflection.

5050*
Integrated Mathematics and Science Applications. 4 credits, maximum 8. Using a variety of themes, students design, implement, and evaluate inquiry-based experiences that are primarily context based.

5053*
Curriculum Issues. A study of curriculum that includes philosophy, history, decision making, major concepts and terms.

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.

5123*
Curriculum in the Secondary School. Contemporary curricular issues, philosophies and points of view in secondary school education.

5143*
Language Arts in the Curriculum. Content and current issues in the language arts. Materials and methods for teaching the communication skills.

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.

5163*
Middle School Curriculum. Theory of planning and developing learning experiences appropriate to the needs and interests of early adolescents.

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.

5223*
Teaching Science in the Schools. Materials, methods and classroom procedures related to science in grades K-12.

5233*
Teaching Science in the Secondary School. Materials, methods and classroom procedures related to science in the secondary school.

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.

5253*
Intermediate (4-6) Mathematics Education. The study of the theory and research on mathematics curriculum and instruction at the intermediate (4-6) grade levels. Problem solving, fractions, decimals, percent, and applications.

5263*
Remediation in School Mathematics. Lab 2. Identification of learning disabilities in school mathematics. Selection of appropriate remedial measures.

5270*
Practicum in School Mathematics. 1-3 credits, maximum 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.

5273*
Kindergarten-Primary (K-3) Mathematics Education. Theory and research on mathematics learning and teaching from the preschool level through the early elementary years. Study and analysis of children's construction of mathematics knowledge and the implications for teaching. Methods for promoting conceptual understanding and enthusiasm for the further study of mathematics.

5280*
Workshop in Science Education. 1-4 credits, maximum 4. Develops and/or implements elementary and secondary science programs.

5323*
Teaching Social Studies in the Schools. Curriculum, materials, methods and procedures related to social studies.

5350*
The Visual Arts in the Curriculum. 1-3 credits, maximum 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.

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.

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.

5433*
Reading and Writing in the Content Areas. Study of the development and use of reading and writing across the content areas.

5463*
Reading Assessment and Instruction. Prerequisite: 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.

5473*
Reading and Writing Difficulties. Study of research and formal assessment tools related to reading and writing difficulties in children and adults.

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.

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.

5613*
Effective Teaching of Mathematics in the Secondary School. Prerequisite: 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.

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.

5633*
Developmental Reading for College and Adult Learners. Identification of the needs, materials, curricula, and instructional strategies for college and adult readers. The study of illiteracy. Consideration of the development, organization and supervision of programs for such learners.

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.

5663*
Integrating Teaching in the Secondary School. Inservice 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.

5720*
Education Workshop. 1-8 credits, maximum 8. For teachers, principals, superintendents and supervisors who need advanced curriculum and instruction coursework related to K-12 subject areas and pedogogy, 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.

5730*
Seminar in Education. 1-6 credits, maximum 6. Seminar topics may differ depending upon the nature of current interests and topics in American education.

5750*
Seminar in Mathematics Education. 1-6 credits, maximum 6. Lab 0-6. Prerequisite: consent of instructor. Problems, issues and trends in mathematics education.

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.

5850*
Directed Study. 1-6 credits, maximum 6. Lab maximum 6. Prerequisite: consent of instructor. Directed study for master's level students.

6000*
Doctoral Dissertation. 1-25 credits, maximum 25. Required of all candidates for the Doctor of Philosophy degree. Credit is given upon completion of the dissertation.

6030*
Contemporary Issues in Curriculum Studies. 1-6 credits, maximum 6. Examination of selected contemporary topics in curriculum studies.

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.

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.

6080*
Seminar in Science Education. 1-6 credits, maximum 6. Problems, issues and trends in science education. The focus at the pre-service or in-service level.

6113*
Curriculum of the Elementary School. Contemporary trends, philosophies and points of view in elementary school education.

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.

6152*
Current Issues in Art in the School Curriculum. Problems, issues and trends in art education programs of the elementary and secondary schools and their relationship to the total curriculum. For teachers, supervisors and administrators.

6163*
Advanced Research Strategies in Curriculum. Prerequisites: 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.

6433*
Seminar in Literacy. Research of issues in literacy education using knowledge gained through both research and classroom practice.

6513*
Staff Development in Literacy Education. Design and delivery of research related to staff development experiences in literacy.

6684*
Language, Literacy and Culture. Lab 4. 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.

6750*
Research in Mathematics and Science Education. 1-6 credits, maximum 6. The examination of current research in mathematics and science learning and teaching research designs, employed, and the generation of new hypotheses.

6850*
Directed Reading. 1-6 credits, maximum 6. Prerequisite: consent of instructor. Directed reading for students with advanced graduate standing to enhance students' understanding in areas where they wish additional knowledge.

6853*
Improvement of Instruction in Reading. Problems and issues related to reading instruction. The roles of various school personnel in changing curriculum and methods.

6880*
Internship in Education. 1-8 credits, maximum 8. Lab 3-24. Prerequisite: consent of instructor. Directed off-campus experiences designed to relate ideas and concepts to problems encountered in the management of the school program.

6910*
Practicum. 1-6 credits, maximum 6. Prerequisite: 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)

1003
Design Theory and Processes for Apparel and Interiors. Lab 4. Design elements, principles and processes applied to design and merchandising.

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.

1123
Graphic Design for Interiors. Lab 6. Interior design majors only. Drafting and visual communication techniques related to interiors.

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.

2003
Creative Problem Solving in Design and Merchandising. Participatory problem solving in design and merchandising; critique of proposed solutions as a positive process of evaluation.

2203
Intermediate Apparel Assembly. Lab 4. Prerequisite: 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.

2303
Materials and Finishes for Interior Building Systems. Prerequisites: 1003 and 1123. Materials and procedures used in the design and production of interiors and building systems.

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.

2913
Sewn Product Quality Analysis. Lab 2. Prerequisites: 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.

2993
Communication and Presentation Techniques for Apparel and Interior Design. Lab 4. Prerequisites: 1003, ART 1103 and SPCH 2713. Creative communication methods and techniques including a variety of media for two- and three-dimensional presentations in apparel and interior design.

3013
Flat Pattern Design. Lab 4. Prerequisites: 2203 and MATH 1483 or 1513, pass proficiency review. Interpretation of dress design developed through the medium of flat pattern; introduction to pattern drafting.

3023
Computer-aided Flat Pattern Design. Lab 4. Prerequisites: 3013 and pass proficiency review. Advanced apparel design problems using flat pattern and computer-aided design (CAD) techniques.

3102
Fashion Sketching. Lab 4. Prerequisites: 1003 or 3 credit hours of art and completion of 60 credit hours. Principles and techniques of sketching in the fashion field.

3153
Mass Production of Apparel and Related Products. Lab 4. Prerequisites: 2913, 3023. Understanding and applying mass production strategies for apparel and related products. Design for production and production operations including CAD marker making and material utilization, production simulation modeling, and costing.

3203
Functional Clothing Design. Lab 4. Prerequisites: 2573, 3013 and 4 credit hours of chemistry. Problem-solving approach to functional clothing design for specialized market segments (athletic sportswear, occupational clothing, children's wear, clothing for the handicapped) including performance evaluation of selected materials using standard methods of textile testing.

3213
(H)Heritage of Dress. Prerequisite: 3 credit hours of history. Survey of historic modes of dress as they reflect the social, economic and cultural life of a people. Application of design principles to modern dress.

3233
(H)Heritage of Interiors 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.

3243
Design of Interior Components. Lab 2. Prerequisite: pass proficiency review. Studio course exploring the design, materials, construction and production of interior design components. Custom furnishings, interior treatments and modification.

3253
Environmental Design for Interior Spaces. Lab 2. Prerequisite: pass proficiency review. Design factors and human performance criteria for lighting, acoustics and thermal/ atmospheric comfort as they relate to the practice of interior design.

3263
Interior Design Studio I: Residential. Lab 4. Prerequisite: 1003, 1123 and 2993 or consent of instructor. Studio course utilizing the design process in the analysis and planning of residential environments.

3301
Supervised Field Experience. Prerequisite: 3243 or consent of instructor. Field experience in specialized residential, commercial and institutional design with both historic and contemporary elements.

3353
(S)Socio-Economic Aspects of Housing. Family housing needs, present social and economic conditions affecting housing and building processes and the roles of business and government in housing.

3363
Interior Design Studio II: Small Scale Contract. Lab 4. Prerequisites: 3243 and 3263. Studio course utilizing the design process in the analysis and planning of hospitality, retail and other small scale commercial environments with emphasis on materials, lighting, codes and accessibility.

3373
Computer-aided Design for Interiors. Lab 4. Prerequisite: 1123. Computer-aided design and drafting for two-dimensional and three-dimensional interior systems.

3433
Retailing of Apparel, Interiors and Related Products. Prerequisites: 1433, ACCT 2103, ECON 1113. Marketing structures at retail level; job descriptions and responsibilities at management level; financial and control functions.

3533
Decorative Fabrics. Lab 4. Prerequisite: 3 credit hours in art. Historic and contemporary textile designs. Creation of textile designs using personal inspirations, cultural expressions and a variety of techniques.

3553
Profitable Merchandising Analysis. Prerequisites: 3433, ACCT 2103, MATH 1513 or 1483. 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.

3563
Merchandise Acquisition and Allocation. Prerequisites: 3433, 3553. In-depth study of buying and distributing merchandise.

3643
Apparel and Accessories for Special Markets. Prerequisites: 1433, PSYC 1113, SOC 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.

3823
Professional Practices for Interior Design. Prerequisites: 2303, 3243 and 3263. Specific terminology, procedures, relationships and ethics pertaining to the organization and conduct of interior design practice in the United States.

3853
Visual Merchandising and Promotions. Lab 1. Prerequisites: 1003, 1433 and completion of 60 credit hours. Study and application of principles and practices in merchandise presentation and promotions for commercial purposes.

3881
Interior Design Pre-Internship Seminar. Prerequisites: 3243, 3263, SPCH 2713. Preparation for obtaining and completing a directed practical experience in a work situation in the interior design field.

3991
Pre-internship Seminar. Prerequisites: 1003, 2003, 2573, SPCH 2713 (all students), 3433 (merchandising students), 3013 (apparel design and production students), and a 2.5 major GPA. Skills requisite to completion of a directed, practical experience in a work situation within the fashion industry.

3994
Internship. Prerequisite: 3991. Directed practical experience in an approved work situation related to the fashion industry.

4003
(S)Environmental Perspectives on Apparel and Interior Design. Prerequisites: completion of 90 credit hours. Analysis of apparel and interior design, development and use from physical, technological, economic, political, religious, social and aesthetic perspectives.

4011
Post-internship Seminar. Prerequisite: 3994. Study and comparison of student work experiences. Individual student conferences, review of merchant supervisor reactions.

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.

4163
(H,I)Housing in Other Cultures. Housing and interior design and expressions of cultural beliefs, attitudes, family patterns and environmental influences.

4243*
Draping. Lab 4. Prerequisites: 3013 and pass proficiency review. Interpretation of garment design developed through the medium of draping on dress forms.

4263*
Interior Design Studio III: Large Scale Contract. Lab 4. Prerequisites: 3253, 3363 and 3823. Studio course utilizing the design process in the analysis of large scale office planning and institution design including systems and specifications.

4293*
Interior Design Studio IV. Lab 4. Prerequisite: 4263. Studio course developing comprehensive interior design solutions in historic preservation or adaptive reuse and an advanced design project.

4323*
Heritage of Interiors II. Prerequisite: 3233 or consent of instructor. 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.

4373*
Advanced Computer-aided Design for Interiors. Lab 2. Prerequisites: 3373 and pass proficiency review. Advanced computer-aided design and visualization for three-dimensional interior systems.

4403*
Advanced Apparel Design. Lab 4. Prerequisites: 4243 and pass proficiency review. Application of design and pattern-making principles and apparel assembly processes in the development of original designs.

4443*
Facility Management for Contract Interiors. Philosophy and principles of facility management and the practice of coordinating the physical workplace in relation to the workforce and organizational structure of the corporate environment.

4453*
Entrepreneurship and Product Development for Apparel and Interiors. Prerequisites: ECON 1113 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.

4523
Critical Issues in Design, Housing and Merchandising. Prerequisite: senior standing. Capstone course examining critical issues in design, housing and merchandising in the context of central themes from general education.

4810*
Problems in Design, Housing and Merchandising. 1-6 credits, maximum 6. Prerequisite: consent of instructor. Selected areas of study in design, housing and merchandising.

4824
Professional Internship. Prerequisite: 3881. A supervised internship experience that simulates the responsibilities and duties of a practicing professional in interior design.

4850*
Special Unit Course in Design, Housing and Merchandising. 1-6 credits, maximum 6. In-depth study of specific areas of design, housing and merchandising.

4900
Honors Creative Component. 1-3 credits, maximum 3. Prerequisites: College of Human Environmental Sciences Honors Program participation, senior standing. Guided creative component for students completing requirements for College Honors in the College of Human Environmental Sciences. Thesis, creative project or report under the direction of a faculty member in the major area, with second faculty reader and oral examination.

4993*
(I)Textiles, Apparel, Interiors and Related Products in the International Econ-omy. Prerequisites: 2573 (all students), 2913 (apparel students), 2303 (interior students), 3 credits of ECON, and 90 hours. Broad multi-disciplinary study of textiles, apparel, interiors and related products in the international economy.

5000*
Master's Thesis. 1-6 credits, maximum 6. Prerequisites: graduate standing and consent of major professor. Research related directly to design, housing and merchandising for the master's thesis.

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.

5003*
Theoretical Perspectives for Design, Housing and Merchandising. A study of terminologies associated with theory. Exploration of key theories and their application to practice and research in design, housing and merchandising.

5013*
Research Developments in Design, Housing and Merchandising. Prerequisite: 5001. Current methods and needs in research for design, housing and merchandising including the application and integration of research into design, housing and merchandising practice.

5112*
Research Planning and Proposal Writing. Prerequisites: 5001, 5013, STAT 4013 or 5013. Fundamentals of planning and completing qualitative and quantitative research projects, including writing the proposal.

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.

5213*
Product Design, Production and Promotional Strategies for Apparel and Interior Design Industries. Lab 2. Prerequisite: 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.

5233*
Design Evaluation. Prerequisite: consent of instructor. Theoretical perspectives on evaluation of applied design; examination and evaluation of historic and contemporary designers, their philosophies and their work.

5240*
Master's Creative Component. 1-6 credits, maximum 6. Prerequisites: 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.

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.

5343*
Constructed Environment and Human Behavior. Prerequisites: 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.

5353*
Graduate Interior Design Studio. Lab 4. Prerequisite: 4263 or equivalent. Studio course exploring alternative, research-based design solutions for selected interior environments.

5363*
Color Theories and Applications for Apparel and Interiors. Prerequisites: 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.

5360*
Advanced Studies in Design, Housing and Merchandising. 1-6 credits, maximum 6. Investigation into special areas in the fields of design, housing and merchandising.

5383*
Design, Housing and Merchandising in Higher Education. Prerequisite: 9 credit hours in design, housing and merchandising. Development and organization of curricula and teaching methods for design, housing and merchandising.

5440*
Career Internship. 1-6 credits, maximum 6. Prerequisites: 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.

5463*
Design and Merchandising Management. Analysis of project management strategies and techniques unique to apparel and interiors industries as applied to budget, schedule, and personnel with emphasis on leadership, quality assurance, and risk management issues.

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.

5533*
Theory and Design of Functional Apparel. Lab 2. Prerequisites: 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.

5653*
Merchandising Trends, Practices and Theories in Apparel and Interior Industries. Prerequisite: nine credit hours in marketing or merchandising. Current trends in merchandising; theories, concepts and processes related to management level problems.

5663*
International Merchandising Management. Prerequisites: 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.

5810*
Problems in Design, Housing and Merchandising. 1-3 credits, maximum 6. Prerequisites: consent of instructor and department head. Individual and group investigations and discussions of special problems in the various phases of design, housing and merchandising.

5830*
Design, Housing and Merchandising Seminar. 1-6 credits, maximum 6. Prerequisite: consent of instructor. A selected group of current issues in design, housing and merchandising.

6000*
Doctoral Thesis. 1-12 credits, maximum 30. Prerequisite: consent of major professor. Research in design, housing and merchandising for the Ph.D. degree.

6133*
Research Methods in Design, Housing and Merchandising. Prerequisites: 5013 or equivalent, and six credits of graduate statistics. Survey and discussion of research methods, experiences in research design and analysis of data.

6303*
Sociological, Psychological and Economic Aspects of Consumer Behavior. Prerequisite: 5653. 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.

6403*
Merchandising Theory Application and Strategy Implementation. Prerequisite: 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.

6410*
Independent Study in Design, Housing and Merchandising. 1-3 credits, maximum 6. Prerequisite: consent of instructor. Selected areas of design, housing and merchandising for advanced graduate students working toward the doctorate degree.

6810*
Advanced Problems in Design, Housing and Merchandising. 1-6 credits, maximum 6. Prerequisites: 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.

6830*
Design, Housing and Merchandising Seminar. 1-3 credits, maximum 6. Prerequisite: consent of instructor. Problems and recent developments in design, housing and merchandising.

Economics (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. No credit for students with prior credit in 2103 or 2203. No general education credit for students also taking ECON 2103 or AGEC 1114.

2103
(S)Introduction to Microeconomics. Prerequisite: 15 credit hours. 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. No general education credit for students also taking ECON 1113 or AGEC 1114.

2203
Introduction to Macroeconomics. Prerequisite: 2103 or AGEC 1114. 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.

3010
Special Topics in Economics. 1-3 credits, maximum 9. Prerequisites: 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.

3013
Practical Macroeconomics for Business and Finance. Prerequisite: 2203. Examination of the relationship between macroeconomic performance and business planning and investment analysis. Business cycles, economic indicators, and behavior of domestic and global financial markets.

3023
Managerial Economics. Prerequisite: 2203. 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.

3113
(S)Intermediate Microeconomics. Prerequisite: 2203. 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.

3123
(S)Intermediate Macroeconomics. Prerequisite: 2203. 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.

3213
Game Theory and Experimental Economics. Prerequisite: 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.

3313
Money and Banking. Prerequisite: 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.

3423
(S)Public Finance. Prerequisite: 3 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.

3513
(S)Labor Economics and Labor Problems. Prerequisite: 3 credit hours in economics. Economic analysis of contemporary labor market problems and survey of U.S. unionism. The labor force, education and training. discrimination, inflation and unemployment theories of the labor movement, economic impact of unions and public policy toward labor.

3523*
(S)Poverty and Economic Insecurity. Prerequisite: 3 credit hours in economics. Problems, programs and proposals for dealing with poverty and economic insecurity.

3613
(I,S)International Economic Relations. Prerequisite: 3 credit hours in economics. International trade and finance; international economic organizations; the foreign economic policy of the U.S.

3713
(S)Government and Business. Prerequisite: 3 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.

3813*
Development of Economic Thought. Prerequisite: 3 credit hours in economics. The ideas of great economists with emphasis upon economic concepts and systems of thought in relation to social, ethical and political ideas under evolving historical conditions.

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.

3903
(S)Economics of Energy and the Environment. Prerequisite: 2103. Issues related to the development and use of energy resources, and the management of the natural environment.

4000
Economics Honors Seminar. 3-6 credits, maximum 6. Prerequisite: Honors Program participation. Topical seminar in economics for junior and senior students in the Honors Program. Special problem areas of the economy or the economics discipline. Appropriate for Honors students in any major.

4213*
Econometric Methods. Prerequisites: 2203, STAT 3013 or 4013. 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.

4223*
Business and Economic Forecasting. Prerequisites: 2203; STAT 3013 or 4013. 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.

4643*
(I,S)International Economic Development. Prerequisite: 3 credit hours in economics. Problems of underdeveloped economics related to the world economy; obstacles to economic growth and policies for promoting growth.

4713*
(S)Economics of Industries. Prerequisite: 2103. Industrial organization of major U.S. industries. The structure-conduct-performance paradigm is used to evaluate how costs and concentration interact with pricing, marketing and R&D decisions to affect industry profitability, technological progress, and the efficient allocation of resources. Case studies included.

4723*
Economic Analysis of Law. Prerequisite: 3 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.

4823*
(I,S)Comparative Economic Systems. Prerequisite: 2203. Comparative analysis of the economic theory and institutions of capitalism, socialism, and mixed systems.

4913*
(S)Urban and Regional Economics. Prerequisite: 3 credit hours in economics. Urban and regional economics; the spatial aspects of poverty, land use, the urban environment and rural industrial development.

4993
Economics Honors Thesis. Prerequisites: 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.

5000*
Research and Thesis. 1-6 credits, maximum 6. Workshop for the exploration and development of research topics. Research leading to the master's thesis.

5003*
Research Report. Prerequisite: consent of committee chairperson. Supervised research for M.S. report.

5010*
Research and Independent Studies. 1-3 credits, maximum 10. Prerequisite: consent of departmental committee under a workshop arrangement or supervised independent studies.

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.

5033*
Macroeconomic Analysis. Prerequisite: 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 Ph.D. students in economics.

5113*
Managerial Economics. 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 Ph.D. students in economics.

5123*
Microeconomic Theory I. Prerequisites: 3113, MATH 2265 or MATH 2713. Contemporary price and allocation theory with emphasis on comparative statics.

5133*
Macroeconomic Theory I. Prerequisites: 3123, MATH 2265 or MATH 2713. National income, employment and the price level from the point of view of comparative statics.

5223*
Mathematical Economics I. Prerequisites: 3113, MATH 2265 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.

5243*
Econometrics I. Prerequisite: 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.

5313*
Monetary Economics I. Contemporary issues in monetary theory and policy. Demand for money and supply of money theory, interest rate theory and issues in monetary policy.

5413*
Economics of the Public Sector I. Allocation and distribution effects as well as incidence of governmental budget policies.

5433*
Economics of the Public Sector II. Fiscal policy as a means of promoting economic stabilization and growth.

5543*
Labor Market Theory and Analysis. A critical evaluation of the theoretical and empirical literature dealing with labor market processes; wage determination and the impact of unions on relative wages; estimation of aggregate labor supply; resource allocation and labor mobility; the inflation-employment tradeoff and the economics of labor market discrimination.

5613*
International Finance. Open economy macroeconomics 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.

5623*
Economic Development I. 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.

5633*
International Trade. 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.

5643*
Economic Development II. Major problems of development policy. Inflation and mobilization of capital, investment criteria, agriculture, foreign trade, population and manpower, planning and programming methods.

5703*
The Economics of Organization and Competitive Advantage. Prerequisite: 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.

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.

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.

5903*
Regional Economic Analysis and Policy. Selected topics in location theory, regional economic growth and policies toward regional development in the U.S.

5913*
Urban Economics. The urban area as an economic system. Problems of economic policy in urban environment.

6000*
Research and Thesis. 1-12 credits, maximum 30. Prerequisite: approval of advisory committee. Workshop for the exploration and development of research topics. Research leading to the Ph.D. dissertation.

6010*
Seminar in Economic Policy. 1-3 credits, maximum 6. Intensive analysis of selected problems in economic policy. Individual research, seminar reports and group discussion of reports.

6113*
Seminar in Economic Theory. Microeconomics.

6123*
Seminar in Economic Theory. Macroeconomics.

6133*
Microeconomic Theory II. Prerequisite: 5123. Contemporary price and allocation theory with emphasis on general equilibrium analysis. Welfare economics.

6143*
Macroeconomic Theory II. Prerequisite: 5133. National income, employment and the price level from the point of view of dynamics. Growth models.

6223*
Mathematical Economics II. Prerequisite: 5223. A mathematical approach to general equilibrium and welfare economics.

6243*
Econometrics II. Prerequisite: 5243. Advanced econometric theory covering single and simultaneous equations models, seemingly unrelated regressions, limited dependent variable models, causality, and pooled models.

6313*
Monetary Economics II. Intensive analysis of classical monetary theory and individual research on selected problems in monetary economics. The ideas of Patinkin, Wicksell, Fisher and Keynes.

6803*
History of Economic Thought. Economic theories from the 18th century until the present with emphasis on the origin and improvement of analytical tools.

Education (EDUC)

1111
Orientation to Education. Lab 1. Study of the profession of education with emphasis on the skills, qualities and student support services available throughout the campus.

2000
Special Topics in Education. 1-3 credits, maximum 3. Specialized readings in education.

2443
(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.

2510
Innovative Education Studies. 1-3 credits, maximum 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.

3080
International Experience. 1-18 credits, maximum 36. Prerequisite: consent of the associate dean of the college. Participation in a formal or informal educational experience outside of the USA.

3090
(I)Study Abroad. 1-18 credits, maximum 36. Prerequisites: 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.

3110
Honors Directed Study. 1-3 credits, maximum 3. Prerequisite: admission to the College of Education's Honor Program. Individualized directed study approved by a sponsoring professor or Honors coordinator.

4050
Honors Colloquium. 1-9 credits, maximum 9. Prerequisites: 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.

4110
Teacher Education Seminar. 1-6 credits, maximum 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.

4443
Cultural Diversity in Professional Life. Knowledge, awareness and skills regarding cultural diversity in one's profession.

4920
Teacher Education Practicum. 1-9 credits, maximum 9. Prerequisites: admission to Professional Education. Directed observation and supervised laboratory and clinical experiences in appropriate teacher education program areas. Appraisal and learning theory approaches employed.

5110*
Contemporary Educational Issues. 1-6 credits, maximum 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.

5910*
Educational Field Experiences. 1-6 credits, maximum 6. Prerequisite: 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.

5993*
Instructional Effectiveness in Higher Education. Prerequisites: 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)

5000*
Thesis or Report. 1-10 credits, maximum 10. Prerequisite: 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.

5253*
The Principalship. Prerequisite: 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.

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.

5633*
Community Education. Purpose, organization and administration of community education and its various components.

5720*
Education Workshop. 1-4 credits, maximum 8. Analysis of organizational, administrative, and instructional problems by common schools and higher education personnel.

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.

5813*
Leadership and Agency. Furthering understanding about leadership and agency through exploring and examining contemporary and perennial issue from multiple perspectives in diverse educational contexts.

5883*
Field Studies Internship I. Lab 3. Prerequisite: consent of the instructor. Directed internship experiences designed to relate ideas and concepts to problems encountered in education by faculty and administrators.

5893*
Field Studies Internship II. Lab 3. Prerequisite: consent of the instructor. Directed advance internship experiences designed to relate ideas and concepts to problems encountered in educational organizaitons by faculty and administrators.

5953*
Introduction to Educational Leadership. Prerequisite: 5813. Provide educational leaders with opportunities to apply conceptual tools to problems of practice.

5973*
Foundations of Higher Education. Overview of the historical background and philosophical foundations of American higher education.

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.

6000*
Doctoral Dissertation. 1-15 credits, maximum 15. Required of all candidates for the Doctor of Education degree. Credit given upon completion of the thesis.

6003*
Educational Ideas. Decision-making processes used in educational systems and use of modern technologies for curricular enhancement and professional development.

6143*
Resources for the Study of Educational Leadership. Introduction to research traditions, tools and processes that are integral to the study of educational leadership.

6233*
Critical Issues in Higher Education. Issues that have shaped and are shaping higher education in American society.

6243*
Connecting Theory and Practice in Administering Schools. Application of research findings and theoretical concepts to best practice in administering educational organizations.

6263*
Professional Development and Instructional Improvement. Developmental perspectives of human, conceptual and technical skills needed for continuing professional development and instructional improvement through supervisory processes.

6323*
Public 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.

6333*
The Business Function in School Administration. Analysis and critique of practice of budget planning and development, administration and evaluation. Selected topics in school accounting and other business management functions.

6343*
Problem Solving in School Administration. Identifying and analyzing administrative problems, individually and collectively, in school settings.

6353*
The Superintendency. Integration of theory and practice through examination of roles and responsibilities of the superintendent. Leadership, communications and the changing nature of public education.

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.

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.

6433*
Special Topics in School Site Administration. Investigation of in-depth issues encountered in school site administration.

6453*
Special Topics in Education Law. Analysis and critique of selected topics in school law relating to public school administration.

6463*
Higher Education Law. National and state constitutional provisions, laws, and court cases concerning higher education. Considerable legal research required.

6573*
Special Topics in Education Facilities. Analysis and critique of validity of selected established standards and research in education facilities.

6583*
The Impact of College on 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.

6603*
Organizational Theory in Education. Selected organizational typologies, conceptuali-zations and theoretical frameworks as they relate to organizational behavior and behavior of personnel in organizations.

6650*
Problems in Educational Administration. 1-4 credits, maximum 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.

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.

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.

6710*
Special Problems. 1-4 credits, maximum 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.

6713*
Effective Teaching in Colleges 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.

6733*
Planning and Educational Change. Organizational and environmental parameters, sources of change, barriers to change, and strategies for planning and implementing organizational change.

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.

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.

6813*
Development and Implementation of Academic Programs. Development and implementation of academic programs including curriculum for colleges and universities, investigation of teaching-learning relationships, and instructional emphasis.

6823*
Educational Leadership. Leadership and the implications of leadership across contexts, cultures and time.

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.

6843*
The Academic Department. Organization and administration in higher education emphasizing an analysis of the academic department and its leader, the department head.

6850*
Directed Reading. 1-4 credits, maximum 6. Directed reading for students with graduate standing.

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.

6870*
Seminar. 1-4 credits, maximum 10. Topical issues related to administration and/or higher education, including research techniques available to analyze such topics.

6883*
Internship in Education I. Lab 3. Prerequisite: consent of instructor. Directed internship experiences designed to relate ideas and concepts to problems encountered in education by faculty and administrators.

6893*
Internship in Education II. Lab 3. Prerequisite: consent of instructor. Field experiences in a variety of educational work settings.

6910*
Practicum. 1-5 credits, maximum 9. Prerequisite: 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)

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.

3113
Psychological Foundations of Childhood. The child from conception to puberty with focus on educational implications of development in cognitive, affective and psychomotor domains.

3213
Psychology of Adolescence. The adolescent from pubescence to adulthood with focus on educational implications of development in cognitive, affective and psychomotor domain.

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.

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.

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.

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.

5000*
Master's Thesis. 1-6 credits, maximum 6. Prerequisite: 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.

5023*
Introduction to School Psychological Service. Prerequisite: 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.

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.

5103*
Human Development in Psychology. Introduction to basic research and theories of cognitive, emotional and social development. Applications to educational and family settings.

5113*
Child Psychopathology. Prerequisites: 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.

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.

5210*
Introductory Practicum in School Psychometry. 2-6 credits, maximum 6. Prerequisites: 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.

5213*
Advanced Educational Psychology. Learning and its effect upon coping and adjustment. How learning, environmental and personality factors interact to change human behavior.

5320*
Seminar in Educational and School Psychology. 3-9 credits, maximum 9. In-depth exploration of contemporary topics in educational and school psychology.

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.

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.

5463*
Psychology of Learning. Application to education of the principles and theories of the psychology of learning.

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.

5510*
Practicum in School Psychology. 2-6 credits, maximum 6. Prerequisites: 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.

5603*
Developmental Issues in Instruction. Prerequisite: 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.

5620*
Practicum with Exceptional Learners. 1-8 credits, maximum 8. Lab 1-8. Prerequisite: 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.

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.

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.

5720*
Educational and School Psychology Workshop. 1-9 credits, maximum 9. Workshop on various topics related to educational and school psychology.

5753*
Psychoeducational Assessment of Preschoolers. 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.

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.

5783*
Psycho-educational Testing of Exceptional Individuals. Intensive practice in the selection, administration and interpretation of individual tests, appropriate for exceptional individuals.

5793*
Individual Intellectual Assessment of Children and Youth. Prerequisite: 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 nondiscriminatory assessment.

5803*
Advanced Intellectual Assessment, Contemporary Theories and Assessment of Intelligence and Cognitive Abilities. Prerequisites: 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.

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 specialities.

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.

5933*
Altered States of Consciousness in Human Development. Theory and research concerning the role of altered states of consciousness in human development. Practical techniques for facilitating healthy human development which might be of use to counselors, teachers, and other human services workers. Techniques include guided imagery, progressive relaxation and, especially, meditation.

5962*
Developing Support Resources for Gifted and Talented Programs. Development, management, and evaluation of volunteer programs in intra- and extra-class settings. Program types include parent-aid, volunteer-aid, mentors, tutors, group sponsors. Developing community interest, finding external resources, external funding and resource information sources.

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.

6000*
Doctoral Dissertation. 1-25 credits, maximum 25. Prerequisite: 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.

6030*
Doctoral Seminar in School Psychology. 3-6 credits, maximum 6. Prerequisite: 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.

6033*
Introduction to Psychotherapy with Children and Adolescents. 3 credits. Prerequisite: 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.

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.

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.

6110*
Seminar in School Psychology. 1-3 credits, maximum 6. An assessment of psychological techniques applied to problems encountered in the internship.

6113*
Child Personality Assessment. Prerequisite: admission to school psychology or counseling psychology program, or consent of instructor. The personal and social assessment of children using objective and projective techniques.

6133*
History and Systems of Psychology. History and systems of psychology related to contemporary applied psychology.

6143*
Introduction to Developmental Psychopharmacology. Prerequisites: 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.

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.

6210*
Internship in School Psychology. 3-6 credits, maximum 12. Prerequisites: 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 nondoctoral 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.

6310*
Doctoral Practicum in School Psychology. 1-6 credits, maximum 6. Prerequisites: 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.

6323*
Psychological Consultation. Prerequisite: 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.

6333*
Instructional Assessment and Consultation. Prerequisite: 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.

6343*
Behavioral Assessment and Consultation. Prerequisites: 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.

6460*
Internship in Educational Psychology. 1-9 credits, maximum 9. Prerequisite: 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.

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.

6610*
Doctoral Internship in School Psychology. 3-6 credits, maximum 18. Prerequisites: 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.

6613*
Instructional Systems Design. A practically-oriented coverage of analyzing, defining, sequencing and validating instructional systems. Develop-ing educational objectives, course development, matching instruction to individual differences and evaluation of systems. Techniques of developing and validating instructional components.

6850*
Directed Readings in Educational and School Psychology. 1-6 credits, maximum 6. Prerequisite: consent of instructor. Directed reading for students with advanced graduate standing in educational and school psychology.

6880*
Internship in Education. 1-8 credits, maximum 8. Lab 3-24. Prerequisites: 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)

3123
Applications of Educational Technologies. Lab 2. 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.

4113*
Multi-media Program Production. Prerequisite: 3122. Design and production of synchronized automatic sound slide programs coordinated with subject matter content. Includes photographic techniques, audio recording and sound-mixing methods, graphics, and synchronizing techniques. Individual projects required.

5000*
Master's Report or Thesis. Prerequisite: 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.

5103*
Advanced Computing Applications in Education. Lab 0-2. Includes educational applications involving authoring systems, data-base management, hardware interfacing, and non-instructional uses within the school environment. Impact of current issues on instructional computing.

5113*
Videotape Television for Instruction. Educational design and production of videotape using single camera, small studio production and other technology. Individual and team projects.

5153*
Computer-Based Instruction Development. Lab 0-2. Prerequisite: 4113. 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.

5720*
Education Workshop. 1-8 credits, maximum 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.

5753*
Educational Technology Strategies. Lab 1. Principles of designing instructional units and courses incorporating integrated advanced technologies within the framework of the current educational environment. Contemporary education issues. Advanced educational technologies: importation, information amassment, accessibility, linkage to curricula, support, planning, and teacher empowerment. Assumes concept of teacher as designer/conductor vs. teacher as consumer.

5773*
Administration and Supervision of Audiovisual Materials. Building, planning, selecting and purchasing equipment and materials, surveying existing materials, and planning and financing adequate programs. For administrators or teachers who are responsible for audio-visual programs.

5850*
Directed Study. 1-3 credits, maximum 3. Prerequisite: consent of instructor. Directed study for master's level students.

6000*
Doctoral Dissertation. 1-15 credits, maximum 15. Required of all candidates to the Doctor of Education degree. Credit is given upon completion of the thesis.

6850*
Directed Reading. 1-6 credits, maximum 6. Prerequisite: consent of instuctor. Directed reading for students with advanced graduate standing to enhance students' understanding in areas where they wish additional knowledge.

6880*
Internship in Education. Prerequisite: consent of instructor. Directed off campus experiences designed to relate ideas and concepts to problems encountered in the management of the school program.

6910*
Practicum. 1-6 credits, maximum 6. Prerequisite: 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)

2011
Experimental Methods I. Lab 3. Prerequisites: PHYS 2114; corequisite: 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 nonmajors.

3021
Experimental Methods II. Lab 3. Prerequisites: 2011, ENSC 2613; corequisite: ECEN 3713. Second laboratory in electrical measurements and instrumentation techniques and devices. Frequency response using gain/phase meter and spectrum analyzer. Identification of unknown two-port networks, steady state operation of linear networks. Reinforces ECEN 3713 and continues with the design of networks.

3031
Experimental Methods III. Lab 3. Prerequisites: 3021, 3713; corequisite: 3313. Third laboratory in electrical measurements and instrumentation techniques and devices. Use of transistor curve tracers. Transistor operating points. Behavior of BJT amplifiers. MOSFET circuits and behavior. Operational amplifiers and feedback circuits. Reinforces ECEN 3313, continuing the design experience in the context of electronics.

3113
Energy Conversion. Lab 2. Prerequisites: 3021, 3613. Physical principles of electromagnetic and electromechanical energy conversion devices and their application to conventional transformers and rotating machines. Network and phasor models; steady-state performance.

3213
Microcomputer Principles and Applications. Lab 2. Prerequisite: junior standing or above. Introductory microcomputers. Digital logic elements and number systems, memory components and organization. Microprocessor and microcomputer system architecture, assembly language programming, software development, interfacing techniques.

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.

3313
Electronic Devices and Applications. Prerequisites: 2011, 3713. 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.

3513
Signal Analysis. Prerequisites: 3413 and 3713. Deterministic signals. Fourier series and Fourier transforms. Impulse response, convolution and correlation. Sampling theorem. Analog modulation techniques.

3613
Electromagnetic Fields. Prerequisites: ENSC 2613, 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.

3623
Computational Electromagnetics. Lab 2. Prerequisite: 3613. Investigations of electromagnetics with computer simulation. Electro and magnetostatics, electromagnetic wave phenomina, radiation sources, calculation techniques for electromagnetics and photonics.

3713
Network Analysis. Prerequisites: ENSC 2613, MATH 2233. Laplace transform, transfer functions, magnetically coupled circuits and two-port networks.

3723
Systems I. Prerequisites: ENSC 2122, 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. Same course as MAE 3723.

3813
Engineering Optics. Lab 6. Prerequisites: PHYS 2114, MATH 2155, MATH 3013. Review of classical optics and optical systems. Ray matrices. Introduction to lasers and optical beams. Birefringence. Polarization-sensitive optical devices. Electro-optic and acousto-optic modulators. Resonators on an introductory level.

3913
Solid State Electronic Devices. Prerequisites: ENSC 3313, 3613, PHYS 3313. 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.

4010*
Technical Problems and Engineering Design. 1-12 credits, maximum 12. Prerequisite: 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.

4013
Senior Design Laboratory I. Lab 2. Prerequisites: 3013, 3313, 3413, and 3213 or 3233. 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.

4023
Senior Design Laboratory II. Lab 2. Prerequisite: 4013. 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.

4133*
Power Electronics. Prerequisite: 3113. 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.

4153*
Power System Analysis and Design. Prerequisite: 3113. 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.

4213*
Computer-based System Design. Lab 2. Prerequisites: 3213 and CS 2113. 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.

4243*
Computer Architecture. Prerequisites: 3213 and 3233. 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.

4273*
Software Engineering. Prerequisites: 3213, 3653 or CS 2133, 3442. 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 CS 4273.

4283*
Computer Networks. Prerequisites: 3213 or CS 3443; 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 CS 4283.

4303*
Digital Electronics Circuit Design. Lab 2. Prerequisite: 3233, 3313. 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.

4313*
Linear Electronics Circuit Design. Prerequisite: 3313. 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.

4353*
Communication Electronics. Prerequisite: 3313. Design of tuned voltage and power amplifiers, oscillators and mixers, modulation and detection, and parametric amplifiers.

4413*
Automatic Control Systems. Prerequisite: 3723 or MAE 3723. 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.

4503*
Random Signals and Noise. Prerequisites: 3413, 3513 and 3713. 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.

4523*
Communication Theory. Prerequisite: 3513. Noise in modulation systems. Digital data transmission. Design of optimal receivers. Introduction to information theory.

4533*
Data Communications. Prerequisite: 4503. 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.

4613*
Microwave Engineering. Prerequisite: 3613. 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.

4703*
Active Filter Design. Lab 2. Prerequisites: 3413 and 3713. Introduction to passive filters; operational amplifiers as network elements; filter specifications; design of active filters. Laboratory design projects and computer simulations.

4763*
Introduction to Digital Signal Processing. Prerequisites: 3513, 3713 and 3723. 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.

4773*
Real Time Digital Signal Processing. Prerequisite: 4763 or equivalent. 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.

4813*
Optical Electronics. Lab 6. Prerequisite: 3613. Extension of electronics principles into the optical domain. Ray matrices of passive devices. Properties and propagation of Gaussian beams. Design of optical resonators and oscillators. Lasers. Propagation through fiber optics. Detection problems. Integrated optical circuits.

5000*
Thesis or Report. 1-6 credits, maximum 6. Prerequisite: approval of major professor. A student studying for the master's degree will enroll in this course for a maximum of six credit hours.

5030*
Professional Practice. 1-8 credits, maximum 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.

5060*
Special Topics. 1-6 credits, maximum 30. Prerequisite: consent of instructor. Engineering topics not normally included in existing courses. Repeat credit may be earned with different course subtitles assigned.

5070*
Directed studies. 1-6 credits, maximum 6. Prerequisite: consent of instructor. Investigation outside of the classroom of topics not normally covered in lecture courses.

5113*
Power System 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.

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.

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.

5193*
Power Economics and Regulation. Prerequisites: 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. Cogenerators and independent power producers.

5223*
Digital Systems Testing. Prerequisite: 3233. Testing of combinational and sequential circuits. Test generation techniques. Design of reliable and testable circuits and systems. Testing for LSI and VLSI.

5253*
Digital Computer Design. Prerequisite: 3233. 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.

5263*
VLSI Digital Systems Design. Prerequisite: 4303; recommended: 5253. 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.

5273*
Advanced Software Engineering. Prerequisite: 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 enginering and software repositories. Same course as CS 5273.

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.

5293*
Artificial Intelligence and Expert Systems. Prerequisite: graduate standing in electrical engineering. Fundamental concepts: search-oriented problem solving, knowledge representation, logical inference, building. An expert system, artificial intelligence languages, specialized machine architectures. Applications to planning, natural language processing, and robotics. Development of an expert system or research report required. Common lectures with CS 5793, IEM 5933 and MAE 5793.

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.

5333*
Semiconductor Devices. Prerequisites: 3313 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.

5353*
Advanced Power Electronics. Prerequisite: 4133. Characteristics of high power semiconductor devices and the application of such devices to power conditioning, inversion, and wave shaping at high power levels.

5363*
CMOS Analog Integrated Circuit Design. Prerequisite: 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.

5373*
RF Microwave Circuit Design. Prerequisites: 3313, 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.

5413*
Optimal Control. Prerequisite: 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.

5423*
Control of Hybrid Systems. Prerequisites: 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.

5433*
Robotics Kinematics, Dynamics and Control. Prerequisite: 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.

5463*
Nonlinear System Analysis and Control. Prerequisite: 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.

5473*
Digital Control Systems. Prerequisite: 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.

5483*
Digital Data Acquisition and Control. Prerequisite: undergraduate course in programming. Use of microcomputers operating in real-time applied to engineering systems for data acquisition and control, use of analog to digital, digital to analog, and digital input/output, synchronous and asynchronous programming. Competence in the engineering use of microcomputers through lectures and laboratory applications. Same course as MAE 5483.

5493*
Software Design for Real-time Distributed Systems. Prerequisite: 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.

5513*
Stochastic Systems. Prerequisites: 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 nonstationary random processes. Response of linear systems to stochastic processes. State-space formulation and covariance analysis. Same course as MAE 5513.

5523*
Estimation Theory. Prerequisite: 5513 or MAE 5513. Optimal estimation theory including linear and nonlinear estimation of discrete and continuous random functions. Wiener and Kalman filter theory included. Same course as MAE 5523.

5533*
Modern Communication Theory. Prerequisite: 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.

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.

5553*
Telecommunications Systems. Prerequisite: graduate standing or consent of instructor. Ways and means that voice, data and video traffic is moved long distances. Data networks (Ethernet and Token Ring Local Area Networks; FDDI and SMDS Metropolitan Area Networks; Internet, Frame Relay, and ATM Wide Area Networks); the telephone system (POTs, network synchronization and switching, ISDN, SONET, cellular telephone); and video (NTSC, switching and timing, compressed video standards such as MPEG and Px64, HDTV).

5613*
Electromagnetic Theory. Prerequisite: 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.

5623*
Antenna Theory. Prerequisite: 3613. Fundamental antenna parameters, including directivity, efficiency, radiation resistance, and pattern. Analysis of dipole, loop, aperture, broadband, and traveling wave antennas. Array theory. Introduction to numerical techniques used in modern antenna design.

5633*
Radar Theory. Prerequisites: 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.

5643*
Antennas and Propagation for Wireless Communications. Prerequisites: 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.

5703*
Optimization Applications. Prerequisite: graduate standing. A survey of various methods of unconstrained and constrained linear and nonlinear 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 and MAE 5703.

5713*
Linear Systems. Prerequisite: 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.

5733*
Neural Networks. Prerequisite: 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 and MAE 5733.

5753*
Digital Processing of Speech Signals. Prerequisite: 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.

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.

5773*
Intelligent Systems. Prerequisite: 5733 or MAE 5773. 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.

5793*
Digital Image Processing. Prerequisite: 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.

5833*
Fiber-Optic Communication Systems. Prerequisite: 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.

5843*
Microelectronic Fabrication. Lab 1. Prerequisite: 3313. Contamination control and cleanroom, 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.

5853*
Ultrafast Optoelectronics. Prerequisite: graduate standing or consent of instructor. Combining ultrafast 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.

6000*
Research. 1-16 credits, maximum 36. Prerequisite: consent of major professor. Independent research for students continuing graduate study beyond the level of the M.S. degree.

6050*
Preliminary Ph.D. Research and Proposal. 3 credits, maximum 3. Prerequisite: consent of adviser. Independent research and report of an advanced electrical engineering problem. Work performed serves as foundation of the oral Ph.D. preliminary exam.

6060*
Advanced Special Topics. 1-6 credits, maximum 30. Prerequisite: consent of instructor. Advanced engineering topics not normally included in existing courses. Repeat credit may be earned with different course subtitles assigned.

6070*
Advanced Directed Studies. 1-6 credits, maximum 12. Prerequisites: admission into Ph.D. program and consent of instructor. Investigation outside of the classroom of topics not normally covered in lecture courses.

6123*
Special Topics in Power Systems. Prerequisite: 5113. Selected relevant current topics related to power system operation and planning.

6253*
Advanced Topics in Computer Architecture. Prerequisite: 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.

6263*
Advanced VLSI Design and Applications. Prerequisites: 5223 and 5263. System timing. Designing testable integrated circuits. Specialized parallel processing architectures. Application examples.

6363*
Analog VLSI for Signal Processing. Lab 2. Prerequisite: 4273. Continuation of 5363. Advanced theory and practice of analog VLSI design methodology. Very large scale design and implementation of signal processing solutions, including oversampled A/Ds, neural networks and filters.

6423*
System Identification. Prerequisite: 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.

6453*
Adaptive Control. Prerequisite: 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.

6463*
Advances in Nonlinear Control. Prerequisite: 5463 or MAE 5463. Introduction to vector fields and Lie algebra; controllability and observability of nonlinear systems; local decompositions; input-output and state-space representation of nonlinear systems; feedback linearization; controlled invariance and distribution; control of Hamiltonian systems. Same course as MAE 6463.

6483*
Robust Multivariable Control Systems. Prerequisite: 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.

6523*
Information Theory. Prerequisite: 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 waveforms for noise immunity. Information transfer in learning systems.

6803*
Photonics I: Advanced Optics. Lab 9. Prerequisite: 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 and PHYS 6803.

6810*
Photonics II: THz Photonics and THz-TDS. 1 credit, maximum 4. Lab 3. Prerequisite: 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 and PHYS 6810.

6820*
Photonics II: Spectroscopy II. 1 credit, maximum 4. Lab 3. Prerequisite: 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 and PHYS 6820.

6823*
Advanced Optical Techniques. Prerequisite: 5813 or 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.

6830*
Photonics II: Spectroscopy III. 1 credit, maximum 4. Lab 3. Prerequisite: 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 and PHYS 6830.

6840*
Photonics III: Microscopy I. 1 credit, maximum 4. Lab 3. Prerequisite: 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 and PHYS 6840.

6850*
Photonics III: Microscopy II. 1 credit, maximum 4. Lab 3. Prerequisite: 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 and PHYS 6850.

6860*
Photonics III: Microscopy III and Image Processing. 1 credit, maximum 4. Lab 3. Prerequisite: 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 and PHYS 6860.

6870*
Photonics IV: Synthesis and Devices I. 1 credit, maximum 4. Lab 3. Prerequisites: 6803 and 6841. 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 and PHYS 6870.

6880*
Photonics IV: Semiconductor Devices, Testing and Characterization. 1 credit, maximum 4. Lab 3. Prerequisite: 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 and PHYS 6880.

6890*
Photonics IV: Semiconductor Synthesis and Devices III. 1 credit, maximum 4. Lab 3. Prerequisite: 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 and PHYS 6890.

Electrical Engineering Technology (EET)

1003
Introduction to Microcomputer Programming. Lab 2. Co-requisite: MATH 1513. Programming a microcomputer in BASIC. Algorithms to solve defined problems. Numerical limitations of small machines.

1104
Fundamentals of Electricity. Lab 3. Prerequisites: 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.

1244
Circuit Analysis I. Lab 4. Prerequisites: 1104, co-requisite MATH 1613. Analysis of AC electric circuits. The use of network theorems and phasors, coupled circuits, resonance, filters, and power.

2303
Technical Programming. Lab 3. Prerequisites: 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.

2544
Pulse and Digital Techniques. Lab 3. Prerequisites: 1244 and 1225. Electronic circuits used in digital control and computation. Pulse generation, Boolean algebra and logic circuits.

2635
Solid State Devices and Circuits. Lab 1. Prerequisites: 1244, MATH 1613. Diodes, transistors, LSI linear devices; their operation and applications in electronic circuits.

3005
Electronics Analysis I. Prerequisites: 1104, 1244, 2544, 2635, MATH 1513, 1613, or evaluated equivalent, and corequisite MATH 2123. Extensive use of mathematics in analyzing discrete, linear device, linear systems and nonlinear 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.

3104
Elements of Electricity and Electronics. Lab 1. Prerequisite: MATH 1513. Essentials of electricity, controls, and electronics for non-majors. No credit for ECT majors.

3113
Circuit Analysis II. Prerequisite: 3123; co-requisite: GENT 3123. Application of elementary switching functions and LaPlace transforms to electronic circuit analysis. Circuit analysis in the S-plane, transfer functions. Application of circuit analysis software.

3124
Project Design and Fabrication. Lab 1. Prerequisites: 1244, 2544, 2635. Methods of designing, analyzing and fabricating electronic circuits using standard software packages. Heat transfer characteristics and problem solutions are included.

3254
Microprocessors I. Lab 1. Prerequisites: 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.

3264
Microprocessors II. Lab 1. Prerequisites: 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.

3354
Advanced Circuits I. Lab 1. Prerequisites: 1244, 2635, MATH 2133, GENT 3123; Corequisite: 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.

3363
Data Acquisition. Lab 3. Prerequisites: 2544, 2634. 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.

3524
Advanced Logic Circuits. Lab 1. Prerequisites: 2544, 2635, 3254. Computer-based design, simulation and implementation of digital/mixed-signal systems using programmable logic, field programmable gate arrays, ASICs and system-on-chip technology.

3533
Introduction to Telecommunications. Lab 1. Prerequisites: 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.

4050
Advanced Electronic Problems. 1-4 credits, maximum 4. Prerequisites: junior standing and consent of head of department. Special problems in the electronic area.

4153
Data Communications. Lab 3. Prerequisites: 3263, 3363, 3354 and 3733. Data communications including point-to-point, LANs, WANs, and switched networks. Topologies, protocols, routing, error detection and correction, text compression, modulation techniques, OSI, TCP/IP, Internet, and ISDN. Laboratory focus on design, assembly, test, demonstration, oral and written presentation of the design project. Capstone course for the computer option.

4314
Elements of Control. Lab 3. Prerequisites: 3113, 3123, 3363, 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.

4363
Digital Signal Processing. Prerequisites: 3123, 3354, 3363. Introduction to Digital Signal Process. Theoretical development of Fourier transforms, IIR and FIR filters. Significant Design and programming projects.

4514
Advanced Telecommunication Topics. Lab 1. Prerequisite: 3533. Study of data transmission techniques between digital electronic devices.

4654
Microwave Techniques. Lab 1. Prerequisites: 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.

4833
Senior Project. Lab 1. Prerequisite: 20 credit hours of upper-division electronics courses or consent of instructor. For the student's last semester. A synthesis of all pertinent skills and knowledge developed in the curriculum. Students work as product design group developing a useful or marketable electronics product or device through design, assembly, test, and demonstration phases. Graded written and oral presentations.

Engineering (ENGR)

1111
Introduction to Engineering. Lab 1. Study skills, orientation and enrollment in engineering. Computer-based productivity tools. Engineering ethics and careers.

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.

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.

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.

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.

1412
Introductory Engineering Computer Programming. Programming to solve problems typical of practice in engineering. Techniques and methods.

2030
Co-op Industrial Practice I. 1-6 credits, maximum 12. Prerequisites: sophomore standing and permission of Co-op coordinator. Pre-engineering industrial practice. Written reports as specified by advisor. Application of credit to meet degree requirements varies with level and department.

2100
Orientation Projects. Lab 2-6. 1-3 credits, maximum 3. Prerequisite: pre-engineering standing. Enrollment in independent study or small groups. Projects to assist students with special needs to adjust to engineering curriculum.

3030
Co-op Industrial Practice II. 1-6 credits, maximum 12. Prerequisites: 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.

3061
Domestic Scholars Experience. Prerequisite: consent of the coordinator of CEAT Student Services. Participation in the domestic scholars experience.

3080
International Experience. 1-18 credits, maximum 36. Prerequisite: consent of the associate dean of the college. Participation in a formal or informal educational experience outside of the USA.

3090
(I)Study Abroad. 1-18 credits, maximum 36. Prerequisites: consent of the Study Abroad office and associate dean of the college. Participation in an OSU reciprocal exchange program.

4030
Co-op Industrial Practice III. 1-6 credits, maximum 12. Prerequisites: 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.

4060*
Topics in Technology and Society. 1-3 credits, maximum 6. Problems of society relating to technology and added problems stemming from their solution. Minimal reliance on mathematics; for engineering and nonengineer-ing students.

4103
Impact of Law on Engineering Practice. Prerequisites: 30 credit hours. 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 products liability on the design, research and oversight of technologies. No credit if prior credit in LSB 3213.

4113*
Intellectual Property for Technical Professionals. Prerequisite: 4103 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.

4133*
Environmental Regulation for Technical Professionals. 4103 or consent of instructor. Environmental laws and regulations are omnipresent in the practice of engineering, science and architecture. Survey and the environmental laws and regulations affecting the practice of these professions.

Engineering Science (ENSC)

2113
(A)Statics. Prerequisites: 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.

2123
Elementary Dynamics. Prerequisite: 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.

2143
Strength of Materials. Prerequisite: 2113. Bending moments, deformation and displacement in elastic and plastic deformable bodies. Axial, torsional and shear loads. Budkling stress transformations and combined loads.

2213
Thermodynamics. Prerequisites: CHEM 1314, 1414 or 1515, MATH 2144, PHYS 2014. Properties of substances and principles governing changes in form of energy. First and second laws.

2613
Introduction to Electrical Science. Prerequisites: 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.

3233
Fluid Mechanics. Prerequisites: 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.

3313
Materials Science. Prerequisite: 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)

5110*
Seminar. 1-6 credits, maximum 6. Prerequisites: admission to the master's program or consent of instructor. Guided study in a topic area selected to enhance a student's program.

5111*
Introduction to Strategy, Technology, and Integration. Prerequisite: admission to the M.S. in ETM program or consent of instructor. The first credit hour of a three-credit hour creative component requirement. The "big picture" of engineering and technology management, emphasizing the importance of strategy, technology, and integration, where timing of products and services are keys to market success.

5121*
Capstone to Strategy, Technology and Integration I. Prerequisite: admission to the M.S. in ETM program or consent of instructor. The first part of the capstone and the second credit hour of the creative component requirement. Proposal for a project to be completed for the ETM 5131 course. Substantive use of ETM course material, and a notable and relevant contribution to the student's organization. Participation in formal critique and discussion of other proposals.

5131*
Capstone to Strategy, Technology and Integration II. Prerequisite: admission to the M.S. in ETM program or consent of instructor. The second part of the capstone and the third and final credit hour of the creative component requirement. Presentation of student's project. Substantive use of ETM course material, and a notable and relevant contribution to the student's organization. Participation in formal critique and discussion of other projects.

5211*
Enterprise Integration. Prerequisite: admission to the M.S. 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.

5221*
Application and Execution of Engineering Teaming. Prerequisite: admission to the M.S. in ETM program or consent of instructor. Management and group issues inherent in the application and implementation of high performing work teams. The team's roles in improving organizational performance, along with the best practice procedures and techniques that increase team effectiveness.

5231*
Benchmarking. Prerequisite: admission to the M.S. 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.

5241*
Strategic Project Management. Prerequisite: admission to the M.S. 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.

5251*
Problem Solving and Decision Making. Prerequisite: admission to the M.S. in ETM program or consent of instructor. Patterns utilized by successful managers for decision making. Organizational skills, investigation through questioning and logic, decision making among alternatives, and ensuring the success of decision. Analyzing problems and decisions, appraising situations, managing problems of human performance, and implementing processes.

5261*
Process Discipline. Prerequisite: admission to the M.S. in ETM program or consent of instructor. A combination of theory and practice for understanding processes involved in any production.

5271*
Technology Forecasting and Assessment. Prerequisite: admission to the M.S. 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.

5281*
Comprehensive Planning. Prerequisite: admission to the M.S. in ETM 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.

5291*
Failure Mode and Effects Analysis in Design. Prerequisite: admission to the M.S. 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.

5311*
Value Engineering. Prerequisite: 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.

5341*
Leadership Strategies for Technical Professionals. Prerequisite: 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.

5351*
Planning Technical Projects. Prerequisite: 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.

5361*
Managing Virtual Project Teams. Prerequisites: 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 workspaces. 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.

5371*
Ethics for Practicing Engineers. Prerequisite: 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.

5381*
Design and Implementing Change in Technical Management. Prerequisite: admission to the MSETM program or consent of instructor. Major issues, principles, and processes associated with successfully implementing change in technical workgroups and organizations. Case study examples of successful and not-so-successful implementation efforts highlight and demonstrate fundamental principles. Strategy and techniques to increase the probability of effective implementation and use.

5391*
New Product Introduction and Commercialization. Prerequisite: 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.

5411*
Engineering Economic Analysis. Prerequisite: 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.

5421*
Technology Organization and Structure. Prerequisite: admission to the MSETM program or consent of instructor. The structure and processes by which an engineering or technology organization applies and integrates functional expertise to achieve business objectives. The interplay between business strategy and structure, the utilization of technical personnel and resources, and comparison of various organizational design and management structures.

5431*
Managing Technical Functions. Prerequisite: admission to the MSETM program or consent of instructor. Issues, concepts, theories, and insights of technical management. Unique characteristics of managing engineering and technical functions, the management process in technical settings, and individual- and group-level performance measurement and improvement.

5471*
Introduction to System Safety. Prerequisite: 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.

Engineering Technology

(See specific technology programs listed alphabetically)

English (ENGL)

0003
Composition for International Graduate Students. Lab 2. Review of complex sentence structure and organizational patterns, with an emphasis on documented research paper writing and oral presentation. Graded on a satisfactory-unsatisfactory basis.

0123
Basic Composition. Intensive instruction in grammar and error avoidance (especially the differences between spoken and written English), paragraph structure, and essay writing. May be used for skills remediation or to satisfy high school curricular deficiency in English. Graded on a satisfactory-unsatisfactory basis.

1010
Studies in English Composition. 1-2 credits, maximum 2. Special study in composition to allow transfer students to fulfill general education requirements as established by Regent's policy.

1113
Composition I. The fundamentals of expository writing with emphasis on structure, development and style.

1123
International Freshman Composition I. Lab 2. 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.

1213
Composition II. Prerequisite: 1113 or 1123 or 1313. Expository composition with emphasis on technique and style through intensive and extensive readings.

1223
International Freshman Composition II. Prerequisite: 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.

1313
Critical Analysis and Writing I. Prerequisites: English ACT score of 27 and 3.50 overall high school or transfer GPA; or, consent of course director. Expository writing forms, including summary, critique, and synthesis. Writing assignments based on readings from across the curriculum. May be substituted for 1113.

1413
Critical Analysis and Writing II. Prerequisites: 1313, an "A'' in 1113, or consent of course director. Critical thinking, research, and writing skills necessary for success in courses across the curriculum. May be substituted for 1213.

1923
(H)Masterpieces of Literature. Readings in the great works of the most important writers of Britain and America, such as Shakespeare, Dickens, Twain, Faulkner, and others.

2243
(H,I)Language, Text and Culture. Investigation of how human language relates to culture.

2333
Introduction to Technical Writing. Prerequisite: 1113. Does not meet any part of the six-hour composition requirement for the bachelor's degree. Technical literature and publications in the student's area of specialization. Emphasis on clarity, simplicity and careful organization.

2413
(H)Introduction to Literature. Fiction, drama/film and poetry. Written critical exercises and discussion.

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.

2453
(H)Introduction to Film. The principles of film form as they affect the art of watching and thinking about motion pictures.

2513
(H)Introduction to Creative Writing. Literary composition with emphasis on techniques and style through readings and writings in fiction, poetry and drama.

2543
Survey of British Literature I. The beginnings through the Neo-Classic Period.

2653
Survey of British Literature II. The Romantic Period to the present.

2773
Survey of American Literature I. The Puritans through the Romantic Period.

2883
Survey of American Literature II. The Romantic Period to the present.

3030
Fiction Writing. 3 credits, maximum 6. Prerequisite: 2513. Directed readings and practice in writing fiction with special attention to techniques.

3040
Poetry Writing. 3 credits, maximum 6. Prerequisite: 2513. Directed readings and practice in writing poetry with special attention to techniques.

3050
Screenwriting. 3 credits, maximum 6. Prerequisite: 2513. Readings and practice in writing scripts with special attention to form.

3123
(H)Classical Mythology. Classical Greek and Roman myths and their cultural context. Selections from Homer, Hesiod, Vergil, Ovid.

3163
(H)World Literature I. Selected literary masterpieces exemplifying ideals and values in Western cultures.

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.

3183
(H)Native American Literature. Origins and development of a literary tradition in its historical and cultural context.

3193
(H)African-American Literature. Origins and development of a literary tradition in its historical and cultural context.

3200
Special Problems in Language and Literature. 1-3 credits, maximum 3. Prerequisite: 9 credit hours of English. Specialized readings and independent study.

3203
Advanced Composition and Rhetoric. Prerequisite: 9 hours of English. Theories of regulative grammar and rhetoric as applied to the writing process.

3240
Criticism. 3 credits, maximum 6. Study and application of principal critical theories in literature, film or technical writing.

3323
Technical Writing. Prerequisites: 1113, 1213, and junior standing. Applied writing in areas of specialization. Intensive practice in professional writing modes, styles, research techniques and editing for specialized audiences and/or publications. This course may be substituted for 1213 with an "A'' or "B'' in 1113 and consent of the student's college.

3333
(H)Short Story. Origins, development, theory and craft of the short story.

3353
(H)Film as Literature. Analysis, aesthetics, and theory of the adaptation of plays, novels, and short stories for the screen.

3363
(H)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).

3410
(H)Popular Fiction. 3 credits, maximum 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.

3433
(H)Television Studies. Lab .5. In-depth examination of U.S. television including critical analysis of the development of the medium: its narrative and visual conventions, genres, political economy, and social effects, such as race, class, gender, sexuality and nation, and especially as compared to other mass media. Same course as AMST 3433.

3453
(H)History of American Film. Lab 1.5. Introduction to the history of the American cinema, the principal eras in American film history, key directors, and the main genres. Basic approaches to film history.

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.

3603
(H)British Literature to 1600. Close study of various works in the context of cultural, political, and artistic developments throughout Europe, such as the Arthurian legend, the grail myth, the troubadors.

3633
(H)British Literature 1600-1800. Thematic and historical concerns of the seventeenth and eighteenth centuries.

3643
(H)British Literature 1800-1900. A variety of topics focusing on literary and cultural developments in the nineteenth century, i.e. scary novels, women writers, sensationalist literature.

3653
(H)British Literature Post 1900. Various topics in the literature and culture of England and Ireland, i.e. the city, survival, Irish Renaissance.

3703
(H)American Literature to 1800. Historical development. Major writers and their works.

3713
(H)American Literature 1800-1900. Historical development. Major writers and their works.

3723
(H)American Literature Post 1900. Historical development. Major writers and their works.

3813
(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.

3923
(H)Shakespeare I: Comedies and Romances. Recurring themes in Shakespeare's comedies, and their revision in later romances. 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.

3933
(H)Shakespeare II: Histories and Tragedies. Recurring themes and their variations in Shakespeare's histories and tragedies. Nature of these genres in the period and Shakepeare's innovations. The structure and language. Occasional examination of historical documents and contexts, modern performances, and critical essays.

4003*
History of the English Language. The growth of the English language.

4013*
English Grammar. The traditional terminology and concepts of English grammar leading or evolving into the several current systems of description.

4063*
Descriptive Linguistics. The methodology of linguistic analysis.

4083*
Applied Linguistics. The study of topics in psycholinguistics, including language and the brain, animal communication and language acquisition.

4093*
Language in America. Historical development of American English. Regional, social and cultural language differences.

4223*
Introduction to Old English. The basics of pronounciation, vocabulary, and grammar, enabling students to read short works in prose and poetry.

4233*
Old English Poetry: Beowulf. Prerequisite: 4223. A close reading of the poem, taking into account the original Old English manuscript and recent translations.

4263
(H)Aesthetics of Film. The form, meaning and value of American and international motion pictures.

4303
(H)British Drama 1500-1660. Medieval and Renaissance drama by Shakespeare's contemporaries.

4313
(H)British Drama 1660-1800. Restoration and Heroic Drama, and cultural controversies related to the theater.

4323
(H)British Drama Post 1800. Genre development. Major writers and their works.

4333
(H)American Drama. Genre development. Major writers and their works.

4403
(H)American Poetry to 1900. Genre development. Major writers and their works.

4413
(H)American Poetry Post 1900. Genre development. Major writers and their works.

4433
(H)British Poetry Post 1900. Genre development. Major writers and their works.

4450
Culture and the Moving Image. 3 credits, maximum 9. The study of the moving image in a social or cultural context, including genre, auteurs and auteurism, film and feminism, television and other media.

4453
(H)Contemporary Literature. Genre development. Major writers in the novel, poetry, or drama and their works.

4460
Creative Nonfiction. Theory and practice of creative nonfiction in English, including autobiography, memoir, travel writing, literary journalism, correspondence, and the essay.

4520*
Problems in English. 1-3 credits, maximum 6. Prerequisite: 12 credit hours of English. Specialized readings and independent studies.

4523*
Technical Writing Internship. Prerequisite: 6 credit hours of English including 3323. Practice in writing resumes, proposals, abstracts and articles. Concentrated review of mechanics, proofreading, editing and interviewing techniques. Second eight weeks will include internship experience.

4533*
Advanced Technical Writing. Prerequisite: 6 credit hours of English including 3323. Specialized writing projects growing out of areas of specialization with emphasis on practical and marketable skills.

4543*
Technical Editing. Prerequisite: 9 credit hours of English. Scientific and technical editing skills; emphasis on editing project.

4553*
Document Design. Prerequisite: six credit hours of English, including 3323. Design theories and practice for hard copy, computer screens and visuals. Students will learn about design standards, page layout, instructional design, desktop publishing, typography, reading theory, and current research in visual design.

4563
(H)Scientific and Technical Literature. Prerequisite: 6 credit hours of English. Scientific and technical style.

4630*
Advanced Fiction Writing. 3 credits, maximum 6. Prerequisite: 3030. Intensive practice in fiction writing.

4640*
Advanced Poetry Writing. 3 credits, maximum 6. Prerequisite: 3040. Intensive practice in poetry writing.

4650*
Advanced Screenwriting. 3 credits, maximum 6. Discussion of professional screenplays and critiquing peers' work; completion of exercises on structure, visualization, and characterization; and writing a fictional screenplay.

4703
(H)Chaucer. Selections from *The Canterbury Tales,* showing the variety of Medieval life.

4713
(H)Milton. The more notable minor poems, prose selections and the major poems-*Paradise Lost, Paradise Regained* and *Samson Agonistes*-studied critically in context of the 17th century.

4723
(H)Shakespeare. Major plays and selected criticism.

4730*
Single Author or Work. 3 credits, maximum 6. Study of a single author or a work, chosen at the instructor's discretion.

4773
(H)Literature by Women. The collection of literature written by women in England and America, classical and modern figures.

4803
(H)British Romantic Poetry. Works of the major writers who revolutionized literature and the idea of the poet.

4813
(H)British Victorian Poetry. Studies of poets who wrote between 1832 and 1901.

4823
(H)British Novel 1700-1800. Emergence and development of the novel as a literary form in the eighteenth century. Authors include Austen, Burney, Defoe, Fielding, Richardson, Sterne.

4833
(H)British Novel 1800-1900. Representative authors in cultural and historical contexts such as class and gender, or the Irish novel.

4843
(H)British Novel Post 1900. Genre development. Major writers and their works.

4853
(H)American Novel to 1900. Genre development. Major writers and their works.

4863
(H)American Novel Post 1900. Genre development. Major writers and their works.

4901*
Tutor Training. Lab 3. Training to become effective writing tutors and teachers through face-to-face conferences with writing students, weekly seminar presentations, and discussions of current writing center theory and practice.

4933
(H)Regional Literature. Literature of a nation such as Ireland or Canada, or of a region such as the American Southwest. Topic varies by semester.

4993
Senior Honors Thesis. Prerequisites: 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.

5000*
Thesis. 1-6 credits, maximum 6. M.A. thesis.

5013*
Introduction to Graduate Studies. Principles and procedures in scholarly research.

5043*
Traditions in Literary Criticism and Theory. A survey of the major documents in literary theory and criticism from Plato to 1965.

5063*
Seminar in Shakespeare. Intensive study of a limited number of plays. Assignment of problems to individual students.

5093*
Seminar in Milton. Poetry, major prose, and criticism.

5120*
Studies in Teaching English as a Second Language. 1-3 credits, maximum 6. Selected topics in teaching English as a second language; e.g. cross-cultural communication, materials preparation, bilingual education.

5123*
Social and Psychological Aspects of Language. An introduction to language acquisition, processing, and production, and their interaction with social contexts.

5130*
Studies in English Grammar. 3 credits, maximum 6. Selected study of current topics in grammatical theory as it applies to the teaching of English.

5140*
Seminar in Linguistics. 3 credits, maximum 6. Selective study of current topics in linguistics.

5143*
Seminar in Descriptive Linguisitics. An introduction to phonology, morphology, syntax and semantics.

5163*
Middle English Literature. Major works in Middle English.

5210*
Seminar or Directed Study. 1-6 credits, maximum 9. Specialized readings or independent studies.

5213*
Teaching Freshman Composition. Materials and methods of instruction in freshman composition.

5223*
Teaching Technical and Business Writing. Materials and methods of instruction in teaching technical and business writing.

5243*
Teaching English as a Second Language. Theories of second language acquisition. Materials and methods of instruction.

5293*
Interdisciplinary Uses of English. Interdisciplinary study with emphasis on multiple uses of English: for example, literature, writing for scholarly publication, new media, and American studies.

5313*
Internship, Teaching English as a Second Language. Supervised teaching of beginning through advanced English as a second language courses.

5333*
Seminar in TESL: Testing. Standardized testing for teaching English as a second language.

5353*
Studies in the History of Rhetoric. An exploration of selected topics and texts in the history of Western rhetoric from Plato to the present.

5410*
Seminar in British Literature of the 16th Century. 3 credits, maximum 6. Selected writers and their works, themes and literary developments of the 16th century.

5420*
Seminar in British Literature of the 17th Century. 3 credits, maximum 6. Selected writers and their works, themes and literary developments of the 17th century.

5440*
Seminar in British Literature of the 18th Century. 3 credits, maximum 6. Selected writers and their works, themes and literary developments of the 18th century.

5460*
Seminar in British Literature of the 19th Century. 3 credits, maximum 6. Selected writers and their works, themes and literary developments of the 19th century.

5463*
Seminar in Film Studies. The exploration of key aesthetic issues of analysis and evaluation as they pertain to film criticism.

5480*
Seminar in Modern Literature. 3 credits, maximum 6. Selected writers and their works, themes and literary developments of modern literature.

5503*
Technical Documentation Production. Practical considerations to managing professional publications—paper-based, web-based or any of many electronic forms.

5513*
Introduction to Technical Communications. Development of critical cognitive skills of analysis, synthesis, and interpretation from the perspective of "consumer of research".

5520*
Internship in Technical Writing. 1-6 credits, maximum 6. Practice in writing appropriate documents such as proposals, manuals (software, hardware, reference, training), articles, functional specifications in job-simulation situations. Review of academic materials as appropriate.

5523*
New Genres in Technical Writing. Theoretical and practical considerations in specialized writing projects that include manuals, proposals and visual aids used to communicate technical information delivered in an online medium or as a combination of online and print documents.

5553*
Information Design for Professional Publication. Study of information design theories to design and integrate textual and visual informatin using appropriate tools.

5563*
History of Scientific Rhetoric. Structural, stylistic and rhetorical analysis of selected scientific and technical works.

5573*
Theories of Communication. Survey of a broad range of theories of communication and application of those theories to technical communication.

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, including risk communication, environmental impact statements, scientific papers and research reports, EPA communications, and other forms of environmental writing directed toward the general public. Major writing project tailored to individual research interests and career goals with the aim of producing a publishable document.

5593*
Technical Style and Editing. An intensive study of writing style and editing. Study of style from the sentence level (including diction and grammatical arrangement) up to the levels of genres of technical communication. Writing assignments on style for different audiences.

5630*
Seminar in Early American Literature. 3 credits, maximum 6. Selected writers and their works, themes and literary developments of the 17th and 18th centuries.

5660*
Seminar in American Literature of the 19th Century. 3 credits, maximum 6. Selected writers and their works, themes and literary developments of the 19th century.

5680*
Seminar in Contemporary Literature. 3 credits, maximum 6. Selected writers and their works, themes and literary developments in contemporary literature.

5730*
Seminar in Fiction Writing. 3 credits, maximum 6. Writing fiction at the professional level.

5740*
Seminar in Poetry Writing. 3 credits, maximum 6. Writing poetry at the professional level.

5750*
Seminar in Scriptwriting. 3 credits, maximum 6. Scriptwriting at the professional level.

5990*
Special Problems. 1-3 credits, maximum 6. Investigation into a designated area of English leading to material for creative component option (M.A.). Graded on a pass-fail basis.

6000*
Dissertation. 1-9 credits, maximum 20. Ph.D. dissertation.

6130*
Studies in Fiction Writing. 3 credits, maximum 6. Prerequisite: 5730. Individual projects in fiction.

6140*
Studies in Poetry Writing. 3 credits, maximum 6. Prerequisite: 5740. Individual projects in poetry.

6150*
Studies in Scriptwriting. 3 credits, maximum 6. Prerequisite: 5750. Individual projects in scriptwriting.

6210*
Seminar or Directed Study. 1-6 credits, maximum 9. Specialized readings or independent studies.

6220*
Seminar in Genre. 3 credits, maximum 9. The development, traditions, concerns or characteristics of genre in selected texts. Major genres and subgenres considered.

6240*
Studies in Literature. Advanced topics in literature and literary research.

6250*
Seminar in Race, Region or Gender. 3 credits, maximum 9. A study of the complex relations between race, region or gender and the texts that represent them.

6253*
Seminar in Film and Society. Social conduct and value systems as they affect the role of media in culture.

6260*
Studies in Literary Criticism. 3 credits, maximum 9. Selected work in literary criticism, for example ancient and neo-classical, 19th century, 20th century.

6350*
Topics in Rhetorical Theory. 3 credits, maximum 6. Study of advanced topics in rhetorical theory and research. May focus on an important thinker, or a specific theme, or some combination of thinkers and themes.

6410*
Topics in Linguistics. 3 credits, maximum 9. Prerequisite: 5143. Study of advanced topics in linguistic theory and research.

6420*
Topics in Second Language Acquisition. 3 credits, maximum 9. Prerequisite: 5243. Study of topics in second language theory and research.

6500*
Studies in Technical Writing. 1-3 credits, maximum 9. Selected topics in technical writing.

Entomology (ENTO)

2003
(N)Insects and Society. A course for non-majors that emphasizes the impact of insects on society. Influence of arthropods in beliefs, culture and fears and the view of insects in folklore and mythology from ancient times to present. Focus on the use of insects as model systems in biological research. Exposure to the use of insects in teaching, music, art, literature and the cinema.

2023
Introduction to the Science of Entomology. Lab 2. Basic structure, function and classification of insects and closely related animals. Coverage of insects in ecosystems and development of control programs that reduce reliance on chemical pesticides.

3003
Livestock Entomology. Lab 2. Economic importance, biology and control of pests affecting domestic animals.

3021
Postharvest Insect Pests. Lab 2. Prerequisite: 2023 (or concurrent enrollment) or 3003. The biology and management of insect pests of bulk-stored grains, flour, feed, dried fruits and nuts, and those of quarantine significance for export of fresh fruits and vegetables within food processing plants, warehouses, wholesale and retail distribution systems.

3043
Insect Physiology. Prerequisites: 2023; one course in organic chemistry, nine credit hours of biology. Functions of the organ systems of insects. Lecture-demonstrations of selected insect physiology techniques. Same course as 5043.

3331
Insect Pests of Agronomic Crops. Lab 2. Prerequisite: 2023 or concurrent enrollment. Sampling and decision-making processes for evaluation and control of insect pest populations in agronomic crops. Coverage of identification of pests and beneficials and damage symptoms resulting from insect feeding in crops.

3421
Horticultural Insects. Prerequisite: 2023 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.

3461
Insects in Forest Ecosystems. Lab 2. Prerequisite: concurrent enrollment in 2023. Identification and seasonal life history of insect pests and beneficial insects on shade trees in urban settings, in commercial forests, and in forest products.

3644
Insect Morphology. Lab 4. Prerequisite: 2023. Insect development and comparative morphology. Same course as 5644.

3663
Turfgrass Integrated Pest Management. Lab 2. Prerequisite: 2023, PLP 3344. 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.

4223*
Ecological Methodology. Lab 2. Prerequisite: 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.

4464*
Systematic Entomology. Lab 4. Prerequisite: 2023 or equivalent. Classification and comparative biologies of insects.

4800
Undergraduate Traineeship. 1-5 credits, maximum 5. Prerequisite: consent of instructor. Participation in research or extension pest management programs of departmental faculty.

4854*
Medical and Veterinary Entomology. Lab 4. Prerequisite: 3553. Biology and control of insects affecting public health.

4922*
Applications of Biotechnology in Arthropod and Pathogen Control. Prerequisites: introductory biology and chemistry or equivalent. Applications of biotechnology in controlling arthropod pests of plants and animals and plant pathogens. Introduction to underlying technology, products being deployed, their effectiveness and associated problems or concerns resulting from their use. Same course as PLP 4922.

5000*
Master's Research and Thesis. 1-6 credits, maximum 6. Research in entomology.

5003*
Insect Biochemistry. Prerequisite: 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.

5020*
Special Problems. 1-8 credits, maximum 8. Prerequisite: graduate standing. Selected studies in the area of entomology, acarology or araneology.

5043*
Insect Physiology. Prerequisites: one course in organic chemistry and nine credit hours of biology. Functions of the organ systems of insects. Lecture-demonstrations of selected insect physiology techniques. Same course as 3043.

5330*
Advanced Systematic Entomology. 1-5 credits, maximum 5. Prerequisite: 5464. Special problems in advanced systematic entomology.

5332*
Principles of Proposal Writing and Review. Prerequisite: consent of instructor. Mechanics of proposal development and the peer review system. Effective use of scientific literature, and the development of hypotheses, objectives, and experimental design and methods through intensive writing and discussion.

5513*
Biological Control. Lab 2. Prerequisite: 2023 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.

5523*
Integrated Management of Insect Pests and Pathogens. Lab 2. Prerequisites: 2023 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 5523.

5550*
Advanced Agronomic Entomology. 1-5 credits, maximum 5. Prerequisite: 4523. Special problems in advanced agronomic entomology.

5613*
Host Plant Resistance. Lab 2. Prerequisites: 2023 and PLP 3344 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.

5644*
Insect Morphology. Lab 4. Prerequisite: 2023. Insect development and comparative morphology. Same course as 3644.

5710*
Advanced Medical and Veterinary Entomology. 1-5 credits, maximum 5. Prerequisite: 4854. Special problems in methods of disease transmission, animal parasite control and the relationships existing between parasite and host.

5733*
Natural Chemical Mediators in Ecology. Prerequisites: BIOL 1114, CHEM 3015 or equivalent. 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 semichemicals.

5753*
Insecticide Toxicology. Prerequisite: organic chemistry or 15 credit hours biology. Properties and mode of action of the major insecticidal materials. Assessment of their impact on the environment.

5833*
Insect Molecular Biology. Prerequisites: 2023 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.

5850*
Epidemiology of Arthropod-borne Diseases. 1-4 credits, maximum 4. Lab to be arranged. Prerequisite: 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.

5870*
Scientific Presentations. 1 credit, maximum 5. Prerequisite: consent of instructor. Preparation and delivery of scientific presentations including 50-minute seminars, 10-minute talks, and posters. Same course as PLP 5870.

5992*
Career Skills and Professionalism for Scientists. Prerequisite: 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.

6000*
Doctoral Research and Dissertation. 1-9 credits, maximum 36. Prerequisite: M.S. in entomology or consent of major professor. Independent investigation under the direction and supervision of a major professor.

6100*
Advanced Insect Physiology. 1-5 credits, maximum 5. Prerequisite: 4043. Special problems in advanced insect physiology.

Environmental Science (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.

4010
Internships in Environmental Science. 1-6, maximum 6. Prerequisite: junior standing in environmental science or consent of instructor. Supervised internships with business, industry, or governmental agencies in environmental assessment and remediation.

4500
Environmental Science Problems. 1-6 credits, maximum 6. Prerequisites: 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.

4573
Ethical Issues in Agriculture and the Environment. Application of ethical concepts and economics theory to real-world agricultural and environmental issues. Recognition of the moral, ethical, and economic dimensions of value that aid in understanding and resolving the controversial aspects of these private and public issues.

4813
Environmental Science Applications and Problem Solving. Lab 2. Prerequisites: AGEC 3503, BISC 3034, FOR 4813, GEOL 3073, POLS 4363, senior standing, or consent of instructor. Integrated problem solving applied to environmental issues using physical, biological, economic, quantitative, policy and administrative principles. Primarily for environmental science majors.

5000*
Research for Thesis or Report. 1-6 credits, maximum 6. Prerequisites: approval of advisory committee and departmental steering committee. Research leading to master's thesis or report.

5103*
Environmental Science and Ecology. The basics of ecological principles. Ecosystem components and structure, biogeochemical cycles, energy flow, properties of populations, population interactions, predation and community ecological basics. May be offered in a shortened format.

5110*
Advanced Topics in Environmental Science. Prerequisite: consent of instructor. Individual library, laboratory and field projects on facets of environmental science.

5200*
Special Topics in Environmental Science. 1-4 credits, maximum 10. Prerequisite: 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.

5300*
Seminar in Environmental Science. 1-3 credits, maximum 3. Prerequisite: 3000 or 4000 level ecology course. Selected environmental problems, individual research, seminar reports and group discussion of reports.

5400*
Environmental Problem Analysis. 3 credits, maximum 6. Prerequisite: 5300. Multidisciplinary team investigation of environmental problems. Problem formulation, review of applicable theory from different disciplines, data collection from field, library and laboratory, mathematical modeling and application of appropriate techniques of analysis to selected environmental problems and environmental impact assessments.

5500*
Environmental Management Problem Analysis. 1-3, maximum 6. Prerequisites: must have either: 5200 or POLS 5633; and either POLS 5643 or CIVE 5823. Finding sustainable solutions to complex environmental, safety and health problems using an integrated team approach. Problem formulation and analysis integrated from different disciplines using technical, legal, economic and sociopolitical approaches. May be substituted for ENVR 5100 on plan-of-study. Required for environmental management specialization.

5600*
Environmental Management Internship and Report. 1-6 credits, maximum 12. Prerequisites: 5500 and consent of director. Internships on environmental problem solving project(s) and submission and approval of a formal report. Course must be completed within three consecutive semesters from date of initial enrollment.

5703*
Chemical Aspects of Environmental Science I. Prerequisites: 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.

5713*
Chemical Aspects of Environmental Science II. Prerequisite: 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.

6000*
Research for Dissertation. 1-12 credits, maximum 24. Prerequisite: approval of advisory committee. Research leading to the Ph.D. dissertation.

6201*
Seminar in Environmental Problems. Multidisciplinary investigations of a current environmental problem that may be either global or local in nature.

6500*
Advanced Environmental Management Practicum. 1-3 credits, maximum 6. Prerequisites: 12 hours of core courses. For doctoral students specializing in environmental management issues. Using a team approach for working with safety, health, economic, policy and administrative principles.

6600*
Advanced Environmental Management Internship. 6 credits. Prerequisites: 6500 and consent of director. A minimum of 480 contact hours within an approved internship placement. Report at end of internship. Course must be concluded within three consecutive semesters from initial enrollment.

Finance (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.

3113
Finance. Prerequisites: ACCT 2003, ECON 2203, STAT 2023. Operational and strategic financial problems including allocation of funds, asset management, financial information systems, financial structure, policy determination and analysis of the financial environment.

3613
General Insurance. Introduction to the theory and general principles of insurance. A broad analysis of the elements and operation of property, casualty, health and life insurance.

3623
Property and Casualty Insurance. Prerequisite: 3613. Emphasis on loss and the insurance contract from fire, marine, property damage, automobile and other liability and loss adjustment. Rate formulation, social implications, government regulations and government regulation of the insurance industry.

3633
Life and Group Insurance. Prerequisite: 3613. Principles of insurance applied to life and human values. Group plans in industry, with coverage emphasizing the managerial point of view.

3713
Real Estate Investment and Finance. Prerequisite: 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.

4063
Applied Financial Studies. Prerequisite: completed six hours beyond 3113 or consent of the instructor. Structured internship or field project with supporting academic study.

4113*
Financial Markets and Institutions. Prerequisites: 3113, ECON 3313. Money and capital markets, flow-of-funds, commercial banks and other financial intermediaries.

4213*
(I)International Financial Management. Prerequisite: 3113. Financial problems of multinational corporations. Designed to develop a sound conceptual understanding of the environmental factors that affect decisions of financial managers; to extend the current developments in the theory of financial management to incorporate variables peculiar to international operations; and to formulate financial strategies under different business systems and ideologies.

4223
Investments. Prerequisite: 3113. Various approaches to selecting and timing investment opportunities, e.g., common stocks, bonds, commodities and options. Modern concepts of portfolio theory.

4333*
Financial Management. Prerequisite: 3113. 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.

4443*
Banking Strategies and Policies. Prerequisites: 3113 and ECON 3313. Theories and practices of bank asset management; banking markets and competition.

4453*
Bank Decision Simulation and Analysis. Prerequisite: 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.

4550*
Selected Topics in Finance. 1-6 hours credit, maximum 6. Prerequisite: 3113. Advanced topics in finance. Topics are updated each semester.

4613*
Risk Management. Prerequisites: 3113, 4223. Introduction to relevant analytical tools necessary for the effective management of risk.

4763*
Financial Futures and Options Markets. Prerequisite: 3113. 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.

4813*
Portfolio Management. Prerequisite: 4223 with a grade of "C" or better. 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.

4913*
Advanced Risk Management. 3 credits. Prerequisites: 4223, 4613 with a grade of "C" or better, 4763. Applications of risk management concepts and skills for the development of programs to manage risk exposures.

5000*
Research and Thesis. 1-6 credits, maximum 6. Prerequisite: good standing in Master of Science in quantitative financial economics program. Consent of program coordinator. Research and thesis for master's students.

5010*
Finance Projects and Independent Studies. 1-6 credits, maximum 6. Prerequisites: good standing in a graduate program, consent of project adviser, consent of department head. Graduate projects and independent study in finance.

5013*
Business Finance. Prerequisite: graduate standing. 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.

5053*
Theory and Practice of Financial Management. Prerequisites: 5013 or equivalent and prior or concurrent enrollment in ACCT 5103 or equivalent. Concepts and theories applicable to the financial administration of a firm. Cases, problems and readings to illustrate various financial problems and techniques of solution.

5213*
International Business Finance. Prerequisite: 5053. Theories and financial management practices unique to business firms which operate in, or are influenced by, an increasingly global economy.

5223*
Investment Theory and Strategy. Prerequisite: 5053. Selected investment topics and advanced portfolio management techniques.

5243*
Financial Markets. Prerequisite: 5053. An analysis of the structure of financial markets, the determination and behavior of interest rates, the functioning of and the flow of funds.

5550*
Special Topics in Finance. 1-6 credits, maximum 9. Prerequisite: 5053. Theoretical and applied aspects of specialized financial areas. Evaluation of models, current trends and problems.

5613*
Corporate Financial Strategy. Prerequisite: 5053. 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.

5763*
Derivative Securities and the Management of Financial Price Risk. Prerequisite: 5053. 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.

5773*
Financial Engineering. Prerequisite: MATH 4513. Techniques for the design, development and implementation of innovative financial instruments and processes to the formulation of creative solutions of problems in finance.

5883*
Quantitative Financial Applications. Prerequisites: 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.

6053*
Financial Theory and Corporate Policy. Prerequisite: consent of Ph.D. director. Theoretical and empirical underpinnings of modern corporate finance.

6513*
Theory of Finance. Prerequisite: 5053. Development of theoretical structure of financial decisions beginning with case of certainty and moving to uncertainty models. Fundamental decisions of investment, financing, and production within the context of economic theory of choice and capital market equilibrium.

6660*
Seminar in Finance. 3-6 credits, maximum 12. Prerequisite: consent of instructor. Advanced research with emphasis on theoretical problems and solutions. Selected topics covered.

Fire Protection and Safety Technology (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.

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.

2023
Introduction to Occupational Safety Techniques. Lab 3. Occupational facilities, equipment and operations and their inherent hazards. Directed toward worker, machine and environmental control.

2050
Studies in Loss Control. 1-4 credits, maximum 6. Prerequisites: 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.

2153
Fire Protection Management. Applied human relations, technical knowledge and skills for achieving optimum effectiveness from a fire protection organization.

2243
Design and Analysis of Sprinkler Systems. Lab 3. Prerequisites: 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.

2344
Elements of Industrial Hygiene. Lab 3. Prerequisite: CHEM 1225. Toxic or irritating substances, physical, biological, ergonomic and other occupational stress factors causing employee illness or discomfort. Environmental pollution sources and controls.

2483
Fire Protection Hydraulics and Water Supply Analysis. Lab 3. Prerequisites: 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.

2650
Technical Problems and Projects. 1-4 credits, maximum 4. Special problems or projects assigned by advisers with the approval of the department head. A comprehensive written report or equivalent creative effort.

3013
Industrial Safety Organization. Survey course. 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.

3113
Advanced Extinguishing Systems Design and Analysis. Prerequisites: 2483, 2243. Automatic fixed fire-extinguishing systems and water supply systems. Emphasis upon computer assistance through use of existing design programs.

3143
Structural Designs for Fire and Life Safety. Lab 3. Prerequisites: 1213, 1373, 2243. Building construction standards and codes to assure maximum life and property safety from fires, explosions and natural disaster. Egress design specifications, occupancy and construction classifications and fire protection requirements for building construction and materials.

3233
Radiological Safety. Lab 2. Ionizing radiation problems; detection and measurement, shielding and exposure limiting, radiation health aspects, storage, handling and disposal.

3373
Fire Dynamics. Lab 3. Prerequisites: CHEM 1225, CHEM 1515 and MATH 2123 or MATH 2145. Fundamental thermodynamics of combustion, fire chemistry and fire behavior. The physical evidence left by fire for investigation. Use of computer models to study fire behavior.

3383
Building Electrical Systems. Prerequisite: 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.

3713
Hydraulic Design of Automatic Sprinkler Systems. Prerequisites: 1373, 2483, MATH 1513. Hydraulic calculation technique for the design and analysis of automatic sprinkler fire extinguishing systems.

3723
Industrial Fire Pump Installations. Prerequisites: 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.

3733
Sprinkler System Design for High Piled and Rack Storage. Prerequisites: 2243, MATH 1513. Specific design techniques for sprinkler system protection of commodities stored in solid piles or racks over 12 feet in height.

4050
Special Problems in Loss Control. 1-4 credits, maximum 6. Prerequisite: consent of department head. Special technical problems in fire protection and safety.

4133
Industrial Hygiene Instrumentation. Lab 3. Prerequisites: 2344, CHEM 1225, PHYS 1114. Description, operation and application of quantitative instruments in general use in industrial hygiene.

4153
Issues in Local Government and Fire Services. Prerequisites: 2153, MGMT 3013. Issues relating to the proper operation of a fire department and the fire department's role within the structure of local government.

4333
System Safety Analysis. Lab 3. Prerequisites: 2344, 3013, 3143 and STAT 2013 or 4013 or 4033. Fire and safety techniques to anticipate, recognize and control hazards. Fault Tree, HazOp, FMEA and other process safety techniques.

4403
Hazardous Materials Incident Management. Lab 3. Prerequisites: 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.

4684
Industrial Loss Prevention. Lab 3. Prerequisites: 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.

4993
Advanced Fire and Safety Problems. Prerequisites: 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.

Foreign Languages and Literatures (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.

1000
Special Studies in Foreign Languages and Literatures. 1-10 credits, maximum 10. Special studies in areas not regularly offered; basic level.

2000
Special Study in Foreign Languages and Literatures: Intermediate. 1-5 credits, maximum 10. Prerequisite: 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.

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.

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.

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.

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.

3500
Specialized Study in a Modern Foreign Language. 1-20 credits, maximum 20. Lab 1-5. Prerequisite: consent of instructor. Instruction and/or tutorial work in a modern foreign language other than those offered in a major program.

4000
Specialized Studies in Foreign Languages and Literatures. 1-9 credits, maximum 9. Lab 1-9. Prerequisite: junior standing or consent of instructor. Individual guided study, tutorial or seminar on specially selected topics in a foreign language or literature.

4993
Senior Honors Thesis. Prerequisites: 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.

5210*
Graduate Studies in Foreign Languages. 1-6 credits, maximum 20. Prerequisite: 15 upper-division hours in the language. Graduate studies in foreign languages.

Forensic Sciences (FRNS)

5000*
Research and Thesis. 1-6 credits, maximum 6. Lab 1-6. Prerequisite: consent of major adviser. Research in forensic sciences for M.S. degree.

5013*
Survey of Forensic Sciences. Prerequisite: 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.

5023*
Questioned Document Examination. Lab 2. Prerequisite: 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.)

5033*
Theory and Practice of Forensic Handwriting Examination. Prerequisite: 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.

5043*
Technical Aspects of Forensic Document Examination. Prerequisite: 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).

5073*
Quality Assurance in Forensic Science. Prerequisite: 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.

5081*
Scientific Method and Investigation. Prerequisite: admission to the program. Introduction to structure and essence of the scientific method and how investigations are conducted. Manner in which ethics impacts the scientist, especially in the use of humans and animals as subjects of scientific research.

5223*
Genetics for the Forensic Scientist. Lab 2. Prerequisite: admission to the program. Optional introductory course to develop an understanding of the concepts of genetic marker analysis especially DNA typing, that form the core of the Identity Testing Section of FRNS 5513. Fulfills genetics course requirement for classification of technologists working in crime laboratories as "DNA analysts" as defined by the DNA Advisory Board of the FBI. (Three courses, biochemistry, genetics, molecular biology, in addition to the baccalaureate degree, are required to a technologist to be designated as an analyst capable of performing independent casework analysis in the crime lab certified by the American Society of Crime Lab Directors).

5233*
Molecular Biology for the Forensic Scientist. Lab 2. Prerequisite: admission to the program. Optional preparatory course for FRNS 5513. Development of a solid foundation of knowledge in molecular biology for undetstanding the concepts of genetic marker analysis, especially DNA typing, that form the core of the Identity Testing Section FRNS 5513. Fulfills molecuar biology requirement needed for classification of technologists working in crime laboratories as "DNA analysts" as defined by the DNA Advisory Board of the FBI. Three courses, biochemistry, genetics, molecular biology, in addition to the baccalaureate degree, are required for a technologist to be designated as an analyst capable of performing independent casework analysis in a crime lab certified by the American Society of Crime Lab Directors.

5313*
Forensic Engineering and Technology. Lab 2. Prerequisites: 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.

5413*
Forensic Pathology and Medicine. Prerequisite: 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.

5513*
Forensic Bioscience. Prerequisites: 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.

5613*
Criminalistics and Evidence Analysis. Lab 2. Prerequisite: 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.

5653*
Scientific Evidence. Prerequisite: 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.

5713*
Forensic Psychology. Lab 2. Prerequisite: 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.

5913*
Forensic Accounting and Fraud Investigation. Prerequisite: 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.)

6010*
Forensic Specialization. 1-3 credits, maximum 15. Prerequisite: 5013. Preparation for advanced research study in a specialty area of forensics. The study of existing research and methodologies directly related to the individual discipline via computer, literature review, classroom and laboratory experience, and applied training. Courses from OSU-COM and Stillwater campuses may be used to satisfy requirements for this course with the consent of the program director.

6043*
Forensic Management and Organizational Development. Prerequisite: 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.

Forestry (FOR)

1114
Elements of Forestry. Lab 3. Survey of forestry as an art, science and profession including forestry and natural resource management theory, forest resource distribution and ownership, history of forest resource policy development, administration and management of forest resources, forest protection, wildlife interactions, forest recreation, forest ecosystem process, land and tree measurements, mapping, current issues, and career opportunities. One required two-day field trip.

1214
Introduction to Wood Properties and Products. Lab 2. Basic understanding of 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.

2003
Forest Mensuration I. Lab 3. Prerequisites: 1114; 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.

2113
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.

2134
Dendrology. Lab 4. Identification, taxonomy and distribution of forest trees and shrubs of the United States; their environmental requirements and utilization.

3102
Forest Mensuration II. Lab 5. Prerequisite: 2003. Two-week segment of seven-week summer field camp. Field study focusing on land, tree and stand-level mensuragion and the use and care of measurement equipment. Special emphasis on the statistical and physical design of forest inventory methods.

3103
Natural Resources Use, Values and Assessment. Lab 8. Three-week segment of seven-week summer field camp. Integrated management of forests and timberlands and associated wildland natural resources including wildlife, water, soil, recreation, range, wilderness and minerals to sustain a broad array of uses and values. Visits to private and public natural resource lands and projects integrated with methods of measuring resource attributes and assessing management potential and effects. The ecology, policies, and social and ethical issues that affect management at the landscape level.

3112
Silvics and Silvicultural Practices. Lab 5. Prerequisites: 2134; BOT 1404. Two-week segment of seven-week summer field camp. Field study of climatic, edaphic, biotic and topographic components of forest ecosystems and their relationship to the distribution, growth and productivity of trees and forest stands. Examination of silvicultural tools and methods for managing timber stand regeneration, composition and growth.

3113
Wood Properties. Lab 2. Prerequisite: 1214. 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.

3213
Forest Ecology. Lab 3. Prerequisite: BOT 1404. Study of the forest ecosystem, its structure, function, physical environment, biotic components, change over time and management implications.

3223
Silviculture. Lab 2. Prerequisite: 3213. Principles and techniques of natural and artificial regeneration, intermediate cultural treatments, and silvicultural systems applicable in various forest cover types. Two-day field trip may be required.

3643
(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 forestry majors.

3663
Forest Biometrics. Lab 2. Prerequisites: 3102; MATH 2103. The application of statistical methods to forestry problems including stand volume estimation, growth measurement, and volume table construction. Introduction to the use and significance of forest yield tables in forest management. Applications of microcomputing to analysis of forestry data.

3883
Aerial Photogrammetry and Information Systems. Lab 3. Prerequisite: MATH 1483, 1493 or 1513. Principles and techniques of aerial photogrammetry, remote sensing, aerial photo interpretation, and geographic information systems. Applications to management of natural resources utilizing photogrammetric instrumentation and geographic information system software. Same course as RLEM 3883.

3993
Forest Economics and Finance. Prerequisites: 3223 or concurrent enrollment; 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 nonmarket goods.

4113*
Mechanical Processes of Wood Products. Prerequisite: 3113. Lumber, veneer, plywood manufacturing and lumber grading rules. Wood as a raw material to produce pulp and paper. Dry and wet type fiber board, particleboard and structural wood composites manufacture and their physical and mechanical properties. Quality control tests of wood products. Two one-day field trips required.

4223*
Timber Management. Prerequisites: 3223, 3993. Regulation of forest growing stock to meet management objectives. Land and timber appraisals. Organization of the forest enterprise to meet financial objectives of management.

4333*
Forest Resource Management: Planning and Decision Making. Lab 3. Prerequisites: 4223, any computer science course, senior standing or consent of instructor. Integrated problem solving, to apply biological, quantitative, economic, political, and administrative principles in solving forest resource management problems.

4443*
Forest Administration and Policy. Prerequisite: senior standing. Forest policy and legislation; personnel matters, organization, supervision and financing of federal, state and private forest enterprises.

4493*
(I)International Forestry and Natural Resources. Prerequisite: consent of instructor. Forestry and natural resource management, policy, use, and historical development with an international focus, including an examination of the role of culture, politics and economics in the linkage between people and natural resources. Ten-14 day international travel component.

4500*
Forest Problems. 1-3 credits, maximum 3. Prerequisites: upper-division standing, GPA of 2.50 or better and consent of instructor. Selected problems in forestry.

4553*
Forest Recreation. An analysis of planning, management, administration and use of forests and related wildlands for recreation, including an overview of public agency and private sector recreation resources, programs, and policy; social foundations of recreation; measurement and evaluation of recreation resource settings, activities, experiences, and use-impact; resource operations and interpretive services; and wilderness management.

4563*
Forest Ecophysiology. Prerequisite: BOT 1404. The growth and response of trees and forests to einvironmental, cultural and genetic factors. Application of physiological principles in predicting the effects of cultural practices on tree growth.

4601*
Contemporary Issues in Forestry and Natural Resources. Prerequisite: senior standing. Exploration and discussion of current issues related to the values, use, and management of forests, natural resources, and the natural environment.

4773*
Forest Genetics and Tree Improvement. Prerequisite: 3213, BIOL 3034, or consent of instructor. A review of mechanisms and principles of inheritance, study of natural variation in forest populations, variation patterns, types and uses of variation, and application of this knowledge to forest tree improvement methods and programs as part of forest and nursery management systems.

4811*
Water Quality Laboratory. Lab 3. Prerequisite: 4813, previous or concurrent. Techniques to monitor surface water for nonpoint 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.

4813*
Hydrology and Water Quality. Lab 2. Prerequisite: senior standing. A study of the effects of land management on nonpoint source pollution of surface waters. Basic watershed hydrology and the role of hydrologic processes and watershed characteristics in controlling the quantity and quality of water from watersheds. Forest, range and agricultural land uses. Discussion of methods of nonpoint source pollution control.

5000*
Research and Thesis. 1-6 credits, maximum 6. Open to students working for a Master of Science degree in forest resources.

5003*
Productivity of Forest Stands. Lab 2. Prerequisite: 3223. Integrated study of the ecological, and genetic factors controlling the productivity of forest stands. Analysis of natural, economic and social factors influencing silvicultural treatment of forest stands. Tree and stand response to silvicultural manipulation.

5010*
Graduate Seminar. 1 credit, maximum 2. Presentation of current and new concepts in forest land management and research techniques for their investigation. Required for the Master of Science degree.

5030*
Advanced Forestry Problems. 1-3 credits, maximum 9. Individual problems in advanced forestry subject-matter appropriate to students with capability at the master's level.

5033*
Quantitative Forest Management and Biometrics. Prerequisites: 3663 or equivalent; STAT 5013 concurrently or equivalent. Quantitative description of forest populations and modeling of the dynamics of forest growth, quantitative timber management including applications of linear programming and related techniques for management of forest populations.

5113*
Timber Manufacturing. Mechanical wood processing of logs to lumber and panel products. Relationship between workpiece properties, ties and product quality coupled with equipment, mill design and processing efficiency of solid wood and composites manufacturing.

5623*
Advanced Plant Biotechnology Methods. Lab 4. Prerequisites: BIOC 3653, BIOL 3024 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 plant biotechnology, including genome analysis, gene transfer, identification and isolation of genes and their products, and regulation of gene expression in plants.

6000*
Research and Thesis. 1-9 credits, maximum 30. Prerequisites: admission to program and consent of major professor. Research and preparation of thesis required of candidates for the Ph.D. in crop science, environmental science, plant science or associated Ph.D. programs.

French (FREN)

1115
Elementary French I. Lab 1 1/2. Main elements of grammar and pronunciation, with work on the four basic skills of listening comprehension, speaking, reading and writing.

1225
Elementary French II. Lab 1 1/2. Prerequisite: 1115 or equivalent. Continuation of 1115.

2112
(I)Intermediate Reading and Conversation I. Lab 1. Prerequisite: 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.

2113
(I)Intermediate French I. Lab 1. Prerequisite: 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.

2232
(I)Intermediate Reading and Conversation II. Lab 1. Prerequisite: 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.

2233
(I)Intermediate French II. Lab 1. Prerequisite: 2113 or equivalent competence. (May have been gained in high school.) Continuation of 2113. May be taken concurrently with other 2000-level French courses.

3073
(I)French Conversation. Prerequisite: 2232 and 2233 or equivalent. Colloquial speech, with discussion of French newspapers and magazines. Practice in brief public address in French.

3203
(I)Advanced Written Expression. Prerequisite: 20 hours of French or equivalent. Practice in composition and stylistics, designed to bring students up to a high level of proficiency in writing.

3213
(I)Advanced Grammar. Conceptual framework and presentation of the finer points of French grammar.

3343
(I)Business French. Prerequisite: 2232 and 2233 or equivalent. Applied French for students in commercial and technical fields. Overview and strategies of business and economic climate in France.

3463
(I)Advanced Diction and Phonetics. Lab 1. Prerequisite: 2232 and 2233 or equivalent. Required course for teacher certification. French speech sounds and intonation patterns, with practice to improve the student's pronunciation.

3853
(H,I)Introduction to Analysis of French Literature. Prerequisite: 2232 and 2233 or equivalent. Close reading of shorter texts in a variety of literary genres, with presentation of French versification and literary terminology.

4153
(H)History of French Literature I. Prerequisite: 20 credit hours of French or equivalent. Historical survey of French literature before 1700, with reading of representative texts.

4163
(H)History of French Literature II. Prerequisite: 20 credit hours of French or equivalent. Historical survey of French literature of the eighteenth century, with reading of representative texts.

4173
(H,I)History of French Literature III. Prerequisite: 20 credit hours of French or equivalent. Historical survey of French literature of the nineteenth century, with reading of representative texts.

4183
(H,I)History of French Literature IV. Prerequisite: 20 credit hours of French or equivalent. Historical survey of French literature of the twentieth century, with reading of representative texts.

4333
Background of Modern French Civilization. Prerequisite: 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.

4550
(I)Directed Studies in French. 1-3 credits, maximum 9. Lab 1-2. Prerequisite: 20 credit hours of French or equivalent. Individual or group study of French language or literature.

4573
(H,I)Modern French Theater. Prerequisite: 20 credit hours of French or equivalent. Analysis of French plays from the 19th and 20th centuries.

5110*
Advanced Studies in French. 1-3 credits, maximum 9. Prerequisite: 15 credit hours of upper-division French. Discussion or research in specialized topics.

General Engineering (GENG)

4010
Senior Design Project. 2-4 credits, maximum 4. Prerequisite: senior standing in general engineering. Capstone design project through independent application of engineering principles and concepts from the disciplines covered in earlier course work.

5110*
Seminar. 1-6 credits, maximum 6. Prerequisite: approval of major professor. Independent or guided study in a topic area selected to enhance a student's program.

6000*
Research and Thesis. 1-30 credits, maximum 30. Prerequisites: consent of graduate committee and approval of student's advisory committee. Independent research under the supervision of a member of the graduate faculty for students pursuing work beyond the master's level.

General Technology (GENT)

1153
Engineering Graphics. Lab 6. Sketching, manual drafting and CAD generation of engineering drawings to ANSI standards. Interpretation of 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.

1223
Manufacturing Processes. Basic methods and processes of fabrication with emphasis on manufacturing operations, metrology and conventional machining.

2323
Statics. Prerequisites: MATH 1613, 2123 and PHYSC 1114. Forces acting on bodies at rest; forces, moments of force, distributed forces, reactions, free-body diagrams, friction, internal forces and moments of inertia. Applications.

2650
Technical Projects. 1-4 credits, maximum 4. Prerequisite: 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.

3123
Applied Analysis for Technology. Prerequisite: MATH 2133 or equivalent. Applications of elements of matrix algebra, ordinary differential equations, and infinite series to problems in engineering technology.

3323
Strength of Materials. Prerequisites: GENT 2323 and MATH 2123. Stress and strain and their relation to loads. Axial, torsional and bending loads, beam deflection, columns and combined stresses. Applications emphasized.

3433
Basic Thermodynamics. Prerequisite: MATH 2123. Basic scientific principles of energy and the behavior of substances as related to engines and systems. Gas laws, vapors and engine cycles.

4433
Heat Transfer. Prerequisites: MATH 2133. Conduction, convection, radiation, condensation and boiling heat transfer. Heat exchangers. Prediction of heat transfer rates. Retardation and enhancement of heat transfer.

Genetics (GENE)

5102*
Molecular Genetics. Prerequisites: BIOC 3653 or 3014 and one course in genetics or consent of instructor. An introduction to molecular genetics on the graduate level.

Geography (GEOG)

1113
(I,S)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.

1114
(L,N)Physical Geography. Distribution and analysis of natural features of the earth. Landforms, soils, minerals, water, climates, flora and fauna. Emphasis on human-environment relations where appropriate.

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.

2343
Introduction to Geographic Information Systems. Lab 2. Survey of a variety of resource management and socioeconomic applications using geographic information systems (GIS) technology.

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.

3033
(N)Meteorology. A non-quantitative introduction to weather. Physical elements that cause and influence weather. Interpretation of weather maps and satellite imagery.

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 and RUSS 3053.

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.

3123
(S)Urban Geography. Locational aspects of urbanization; functions of and relations among cities and between cities and rural areas; internal structure of urban areas.

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.

3153
(S)Conservation of Natural Resources. Problems and corrective methods of conservation of land, water, forests, wildlife, minerals and people.

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.

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.

3243
(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.

3333
Spatial Analysis. Prerequisite: STAT 2013. The utility and application of modeling and statistics to spatial problem solving. The role of quantitative methods in geographic research.

3703
(S)Geography of Oklahoma. Geographic interpretation of physical, economic, historical and scenic features.

3713
(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, US-Canada relations and global relations.

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.

3733
(I,S)Geography of Russia and its Neighbors. A regional analysis encompassing cultural, economic and physical features.

3743
(I,S)Geography of Latin America. Areal distribution and analysis of physical, cultural and economic features of Latin America.

3753
(I,S)Geography of Asia. Systematic interpretation of significant spatial patterns of man and natural environment. (Exclusive of the USSR.)

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.

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.

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.

3910
Applied Geographical Topics. 1-3 credits, maximum 6. Specialized physical, human, regional, or technical issues and trends in geography.

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.

4053*
(N)Geography of Biotic Resources. Prerequisites: 1114 or BOT 1404, ZOOL 1604. Distribution of plants and animals and processes causing distribution. Human impact on biotic resources considered along with policy and management practices.

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.

4113*
Cultural Ecology. Prerequisite: junior or senior standing or consent of instructor. A study in human-environment interaction addressing the processes and patterns of human coping behavior from prehistoric to contemporary periods. Framework for understanding the transformation of cultural and natural landscapes by systematically exploring how culture works to socially and technologically adapt to environmental opportunities and limitations in arctic, alpine, grassland, arid, and tropical environments.

4123*
Geographic Aspects of Urban Planning. Prerequisite: 3123. Spatial aspects of urban planning: development of planning theory, various planning tools, and specific problem areas such as urban renewal and urban transportation.

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.

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.

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.

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.

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.

4243
(I,S)Geography of the World's Indigenous Peoples. 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 communties, and their efforts to establish geo-political autonomy.

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.

4323*
Computer Cartography. Lab 2. 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.

4333*
Remote Sensing. Lab 2. Prerequisite: junior standing. Use of several types of sensors and imagery in solving problems. LANDSAT imagery use. Uses and limitations of data extraction techniques, manual and computer-assisted. Applications to a variety of specific problems.

4343*
Geographic Information Systems: Resource Management. Lab 2. Prerequisite: 2343. Theory and principles of geographic information systems (GIS) applied to resource management problems using both raster and vector data structures. GIS and remote sensing integration.

4353*
Geographic Information Systems: Socioeconomic Applications. Lab 2. Prerequisite: 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.

4413
History and Philosophy of Geography. Historical research questions and techniques, the structure of contemporary geography and its relations to other fields of study, and future prospects of geography.

4510
Senior Project. 1-3 credits, maximum 3. Lab 1-3. Prerequisites: senior standing and consent of instructor. Individually designed projects involving laboratory work, field work, library research, or a combination of these.

4910*
Topics in Geography. 1-6 credits, maximum 6. Prerequisite: consent of instructor. Specialized physical, social and methodological topics in geography.

4930*
Readings in Geography. 1-3 credits, maximum 6. Prerequisite: consent of instructor. Directed readings on selected topics, regions or methods in geography.

4940
Undergraduate Cooperative Education Internship. 1-3 credits, maximum 3. Prerequisites: consent of departmental adviser and consent of instructor. Practical experience in applying geographical concepts to societal problems. Students work with both agency representatives and faculty members.

4993
Senior Honors Thesis. Prerequisites: 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.

5000*
Thesis. 1-6 credits, maximum 6. Prerequisite: consent of adviser or major professor. Open only to students working on the master's degree in geography.

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.

5113*
Landscape Ecology. Prerequisite: 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.

5123*
International Resource Management. Prerequisite: graduate standing. Spatial perspectives on the assessment and management of natural resources. The role of resources in world trade, security and international environmental concerns.

5140*
Cultural and Historical Geography Seminar. 1-3 credits, maximum 9. Prerequisite: consent of instructor. Development and critical analysis of research and theory in cultural and historical geography.

5150*
Geography of Sport, Recreation and Leisure Seminar. 1-3 credits, maximum 9. Prerequisite: consent of instructor. Spatial perspectives of topics selected in sport, recreation and leisure geography.

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 GEOG 4163.

5243*
Geography of the World's Indigenous Peoples. Prerequisites: 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 geo-political autonomy.

5303*
Geographical Analysis I. Prerequisite: one course in statistics. Application of models and statistics to geographic problem solving.

5343*
Advanced Geographic Information Systems: Resource Management Applications. Lab 2. Prerequisite: 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 an group discussion sessions.

5353*
Advanced Geographic Information Systems: Socioeconomic Applications. Lab 2. Prerequisite: 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.

5403*
Current Geographic Research. Prerequisite: graduate standing in geography. Review of recent literature in light of current human and physical geography research themes.

5413*
History and Philosophy of Geography. Prerequisite: graduate standing in geography. Identification and evaluation of major themes in geographical research and teaching.

5450*
Seminar in Geography. 1-3 credits, maximum 7. Prerequisite: graduate standing in geography or consent of instructor. Specialized topics in geography.

5510*
Research Problems in Geography. 1-3 credits, maximum 6. Prerequisite: consent of instructor.

5940*
Graduate Cooperative Education Internship. 1-6 credits, maximum 6. Prerequisites: consent of departmental adviser and consent of instructor. Practical experience in applying geographical concepts to societal problems. Emphasis on programs in planning and geographic education.

6000*
Doctoral Dissertation Research. 1-12 credits, maximum 30. Prerequisites: admission to candidacy and consent of major professor.

6013*
Seminar in Quaternary Paleoecology. Prerequisite: 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.

6110*
Seminar in Cultural Ecology. 3 credits, maximum 6. Prerequisite: graduate standing in geography or consent of instructor. History, trajectory, and possibilities of human-environment interaction, including cultural adjustment to, and of the environment along with the human and environmental conditions that encourage the management and mismanagement of resources.

6120*
Seminar in Urban Geography. 3 credits, maximum 6. Prerequisite: 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.

6130
Seminar in Political Geography. 3 credits, maximum 6. Prerequisite: 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.

6180*
Seminar in Transportation Geography. 3 credits, maximum 6. Prerequisite: 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.

6210*
Seminar in Historical Geography. 3 credits, maximum 6. Prerequisite: graduate standing. Current epistemological issues and archival methodologies in historical geography.

6303*
Geographic Analysis II. Prerequisite: 5303. Advanced methods of spatial analysis including spatial autocorrelation, geographically weighted regression, and related spatial analysis methods.

6313*
Advanced Geodata Collection. Prerequisite: graduate standing in geography or consent of instructor. Advanced field methods course emphasizing spatial and attribute capture of natural resource and socioeconomic data. Student projects and use of geographic information systems (GIS) for analysis and presentation.

6330*
Special Studies in GIS Image Analysis. 1-3 credits, maximum 6. Prerequisites: 4333, and 5343 or 5353. Independent study course addressing unique applications of geographic information systems (GIS) or remote sensing technologies. Scoping and implementation for public or private sectors. Specific issues and problems pertaining to data capture, preprocessing and analysis.

Geology (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.

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 precollege science and math is recommended. Field trip required.

1224
(L,N)Prehistoric Life and Development of the Continents. Lab 2. Earth formation and the development of continents and oceans through time including the origin and evolution of life. Field trips required.

1613
(L,N)Inquiry-based Earth Science. Lab 3. Prerequisites: CHEM 1413 and PHYS 1313 recommended. Natural earth systems and their influence on the human environment. Essential aspects of astronomy, meterology, hydrology and geology. Taught using inquiry methods. Intended for prospective elementary teachers as a model that can be adapted for use in the classroom. Field trip required.

2030
Geologic Field Investigation. 1-3 credits, maximum 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.

2254
Practical Mineralogy. Lab 2. Prerequisite: 1014 or 1114. 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.

2364
Elementary Petrology. Lab 3. Prerequisite: 2254. Origin, occurrence and classification of rocks; hand-specimen identification. Field trips required.

3004
Earth Science for Teachers. Lab 3. Prerequisite: 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.

3014
Structural Geology. Lab 3. Prerequisites: 1224, PHYS 1114 or consent of instructor. Behavior of earth materials during various deformational processes and analysis of the resulting structural features such as folds, faults and fractures. Field trips required.

3034*
Principles of Stratigraphy and Sedimentology. Lab 3. Prerequisite: 1224. Principles of stratigraphy and their applications. Laboratory emphasizes realistic practical problems undertaken in the field and in the laboratory. Field trips required. Nonmajors may receive graduate credit.

3043
(N)Scenic Geologic Regions. Prerequisite: 1014 or equivalent recommended. The geologic characteristics of national parks and scenic regions in North America and throughout the world.

3073*
Geomorphology. Lab 2. Prerequisite: 1114 or consent of instructor. 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.

3103
(N)Paleontology. Lab 3. Prerequisite: 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.

3353*
Methods in Mineralogy. Lab 2. Prerequisite: 2254. Identification of rock-forming minerals using the petrographic microscope, X-ray diffraction and other modern methods of mineral identification.

3503
Environmental Geology. Prerequisite: 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.

3546*
Field Geology. Lab 12. Prerequisites: 2364, 3014, 3034, 3073. Six weeks of field methods in geology. Required of all geology majors. Transportation and room and board fees required.

4023*
Petroleum Geology. Prerequisites: 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.

4213*
Plate Tectonics. Prerequisite: 1114. Principles and major concepts of plate tectonics, the unifying theory of earth sciences. Geology and plate tectonics evolution of the major mountain chains of North America; Ouachitas, Appalachians, and Cordillerans. Field trip required.

4403*
Geochemistry. Prerequisite: general chemistry. Application of chemical principles to geological processes. Processes affecting the composition of surface and ground waters.

4453*
Hydrogeology.The water cycle and groundwater systems as well as general problems related to ground-water occurrence, quantity, quality and pollution. Field trip required.

4463*
Physical Hydrogeology. Lab 2. Prerequisite: 4453 recommended but not required. 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.

4563*
Sedimentology. Lab 3. Prerequisites: 3546, senior standing. Sediments, sedimentary processes and sedimentary environments, geometry and internal features of sediments. Field trips required.

4663*
(I)Global Geologic Resources. Distribution and analysis of global mineral, energy and water resources. Economic, environmental, social and political impact of selected resources on local to global scales.

4990*
Special Problems in Earth Science. 1-8 credits, maximum 8. Prerequisites: 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.

4993
Senior Honors Thesis. Prerequisites: 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.

5000*
Thesis. 1-6 credits, maximum 6. Prerequisite: approval of graduate committee. Work toward master's thesis in geology.

5050*
Problems in Economic Geology. 1-3 credits, maximum 6. Prerequisite: consent of instructor. Individually-designed problems in economic geology. Field trips may be required.

5073*
Fluvial Geomorphology. Prerequisite: 3073 or consent of instructor. Landforms and processes related to the action of running water in stream channels and on hillslopes. Field trips required.

5100*
Problems in Hydrogeology. 1-4 credits, maximum 8. Prerequisite: 4453. Advanced problems in hydrogeology with emphasis on quantitative methods. Field trips may be required.

5150*
Problems in Engineering Geophysics. 1-3 credits, maximum 3. Prerequisite: consent of instructor. Advanced problems in engineering geophysics with emphasis on problem solving. Field trips may be required.

5183*
Advanced Paleontology. Lab 3. Prerequisite: 3103 or equivalent. In depth study of selected fossil groups with emphasis on marine micropaleontology. Student projects on assigned fossil groups with presentation of results both orally and in writing. Field trips required.

5203*
Structural Styles in Oil and Gas Exploration. Lab 2. Prerequisite: 3014. 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. Field trips required.

5223*
Advanced Methods in Structural Geology. Lab 3. Prerequisite: 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.

5233*
Trace Elements in Hydrogeology. Lab 2. Prerequisite: CHEM 1515. Examination of the behavior of various trace elements in the aqueous environment. Availability and mobility of selected trace elements, the characterization of geochemical environments, pe-pH stability fields, adsorption and other parameters that affect element mobility. Introduction to thermodynamic water-equilibrium computer programs.

5243*
Research Methods and Techniques in Sedimentology and Stratigraphy. Methods and techniques for solving practical scientific problems in sedimentary rocks and stratigraphy. Scientific method, definition of a research problem, sampling. Techniques for characterizing sedimentary rocks focused on rock mineralogy/texture, porosity/permeability and associations/stacking patterns of stratigraphic sequences.

5253*
Characterization of Clastic Rocks. Lab 3. Prerequisites: 2254, 2364. 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.

5263*
Electron Microprobe Analysis. Lab 2. Prerequisites: CHEM 1515, PHYS 2414, or GEOL 2254. Practical course for operators of the electron microprobe. Basic principles of X-ray microanalysis and hands-on training using the electron microprobe.

5283*
Subsurface Geologic Methods. Lab 3. Prerequisites: 3014, 3034. Use of subsurface geologic information from cores and well logs to prepare maps and identify oil and gas prospects. Field trips required.

5303*
Applied Geophysics. Lab 3. Prerequisite: PHYS 1214. Principles of exploration geophysics with emphasis on the petroleum and mineral industries. Field trips required.

5353*
Advanced Well Log Analysis. Lab 3. Prerequisite: 3034. 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.

5363*
Sedimentary Petrography of Nonclastic Rocks. Lab 3. Prerequisite: 2364. Systematic classification of nonclastic marine and nonmarine sedimentary rocks. Recognition of evidence of depositional environments and diagenesis, using petrographic methods. Field trips required.

5383*
Sequence Stratigraphy. Lab 2. Prerequisites: 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.

5443*
Environmental Geophysics. Lab 2. Geological aspects of problems associated with environmental engineering, ground-water pollution and regional and urban planning. Problem assessment and field methods. Two required field projects include geophysical surveys using resistivity and seismic refraction methods. Field trip required.

5453*
Advanced Hydrogeology. Lab 3. Prerequisites: 4453, CS 2113 or equivalent, MATH 2144, MATH 2153 and 2163 or equivalent. Advanced quantitative techniques used to address groundwater management and pollution. Advanced field and laboratory techniques as well as management and chemical transport models applied to actual field problems and case studies. Field trips required.

5503*
Advanced Environmental Geology. Prerequisite: 3503 or consent of instructor. Utilization of geologic principles to resolve environmental issues in land use, land management and development. Methods of acquiring, compiling, and applying geologic information for site assessment and environmental impact. Application of these methods to an interdisciplinary project. Field trips required.

5523*
Organic Geochemistry. Lab 3. Prerequisite: introductory chemistry. Introduction to some environmental aspects of organic geochemistry. Soils and sediments as pollutant receptors, sources of pollutants and selected aspects of environmental health.

5553*
Environmental Geochemistry. Lab 3. Prerequisite: introductory chemistry. Origin and evolution of natural water quality. Distribution and mobility of elements in the secondary environment. Computational methods for the interpretation of water analyses.

5603*
Basin Analysis. Lab 1. Prerequisites: 3546, 5203, 5223, 5253, 5363. Team-taught course. Interpretations of the evolution of selected sedimentary basins. Emphasis on facies analysis, petrography, diagenesis, and structural evolution. Field trips required.

5710*
Advanced Studies in Geology. 1-4 credits, maximum 8. Prerequisite: consent of instructor. Individual library, laboratory and/or field projects on facets of geology not covered by existing courses. Field trips may be required.

5773*
Planetary Geology. Lab 2. Prerequisites: GEOL 1114; upper-division standing in the natural sciences; ASTR 1014 recommended. Geophysics and tectonics of planetary interiors; geomorphology and sedimentology of planetary surfaces; geochemistry and mineralogy of planetary materials; geologic factors that could affect life on other planets; interpretation of geologic data from planetary exploration. Field trips required.

German (GRMN)

1115
Elementary German I. Lab 1 1/2. Main elements of grammar and pronunciation, with work on the four basic skills of listening comprehension, speaking, reading and writing.

1225
Elementary German II. Lab 1 1/2. Prerequisite: 1115 or equivalent. Continuation of 1115.

2112
(I)Intermediate Conversation and Composition I. Lab 1. Prerequisite: 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.

2113
(I)First Readings in German. Prerequisite: 1225 or equivalent competence. (May have been gained in high school.) Selections from German newspapers and other contemporary material. May be taken concurrently with other 2000-level German courses.

2222
(I)Intermediate Conversation and Composition II. Lab 1. Prerequisite: 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.

2223
(I)Introduction to German Literature. Prerequisite: 1225 or equivalent competence. (May have been gained in high school.) Reading and analysis of prose, drama and poetry; literary appreciation. May be taken concurrently with other 2000-level German courses.

3013
(I)German for Reading Requirements I. Reading in the humanities and the sciences. Translation from German to English.

3023
(I)German for Reading Requirements II. Prerequisite: 3013 or equivalent. Intermediate and advanced reading in the humanities and sciences. Translation from German to English.

3333
(H,I)Modern Germany. Prerequisites: 20 credit hours of German or equivalent. The major cultural, social and political forces that have shaped the Germany of today.

3343
(I)Business German. Lab 1. Prerequisite: 2222 and 2223 or equivalent. Introduction to business practices and economic environment in Germany. Study of specialized vocabulary.

3463
(I)Advanced Diction and Phonetics. Lab 1. Prerequisite: 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.

3803
(I)Advanced Conversation. Lab 1. Prerequisite: 2222 and 2223 or equivalent. Colloquial speech forms and sentence structure. Practice in brief public address in German.

3813
(I)Advanced Grammar and Composition. Lab 1. Prerequisite: 2222 and 2223 or equivalent. Practice in original composition in German. Problematic points of German grammar and stylistics.

3902
(I)Orientation to Internship Abroad. Prerequisite: 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.

3903
(I)Internship Abroad. Lab TBA. Prerequisite: 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.

4153
(H)Survey of German Literature I. Prerequisite: 20 credit hours of German or equivalent. German literature from the beginning to 1785.

4163
(H,I)Survey of German Literature II. Prerequisite: 20 credit hours of German or equivalent. German literature from 1785 to the present.

4333
Backgrounds of Modern German Civilization. Prerequisite: 20 credit hours of German or equivalent. Historical, cultural, political and literary trends in the formation of German civilization. Capstone course.

4513
(H,I)The Age of Goethe. Prerequisite: 20 credit hours of German or equivalent. Principal figures of German Classicism and Romanticism.

4523
(**H,I)19th Century German Literature**. Prose, lyric and drama from Romanticism to Naturalism.

4543
(H,I)20th Century German Literature. Prerequisite: 20 credit hours of German or equivalent. Main currents in German literature from Naturalism until present day.

4550
(I)Studies in German. 1-3 credits, maximum 9. Prerequisite: 20 credit hours of German or equivalent competence. Reading and discussion of vital subjects in German.

Graduate (GRAD)

5880*
Graduate Traveling Scholar. 1-24 credits, maximum 24. Prerequisite: graduate degree candidate. Credit will vary depending on the program of each traveling scholar. Enrollment of graduate traveling scholars in academic or research courses.

5883*
Orientation to Gerontology. Prerequisite: graduate standing. Interdisciplinary introduction to the field of gerontology with particular focus on biological, psychological and sociological theories of aging.

5990*
Graduate Research and Teaching Practicum. 1-6 credits, maximum 12. Prerequisite: graduate standing. Graduate-level instructional program in research and teaching techniques and procedures. Graded on pass-fail basis.

6010*
Research or Intern Practicum. 1-9 credits, maximum 12. Prerequisite: 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.

Greek (GREK)

1113
Elementary Classical Greek I. Grammar and vocabulary of ancient Greek.

1223
Elementary Classical Greek II. Prerequisite: 1113 or equivalent. A continuation of 1113. Grammar and readings of classical Greek authors.

2113
Elementary Classical Greek III. Prerequisite: 1223 or equivalent. A continuation of 1223. Grammar and readings of classical Greek authors.

2213
Intermediate Readings. Prerequisite: 2113 or equivalent. An introduction to a variety of classical authors to increase reading facility and grammatical comprehension.

3330
Advanced Readings. 1-6 credits, maximum 9. Prerequisite: 2213. Prose authors, epic poetry, drama, Koine Greek and religious texts.

Health and Human Performance (HHP)

1713
Introduction to Athletic Training. Lab 1. 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.

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.

1812
Pedagogy of Outdoor Activities. Prerequisite: HHP and LEIS majors and minors only. Introduction of selected motor skills, activities, methods and theories within outdoor activities. Analysis of skills concepts, terms, safety issues, teaching strategies and developmental appropriateness.

1822
Pedagogy of Rhythm and Movement. Prerequisites: 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.

1832
Pedagogy of Sports Skills. Prerequisite: HHP and LEIS majors and minors only. Introduction of selected motor skills, activities, methods and theories of individual, dual and team sports. Analysis of skills, concepts, terms, safety issues, teaching strategies, and developmental appropriateness.

1842
Pedagogy of Fitness and Wellness. Prerequisite: HHP and LEIS majors and minors only. Introduction of concepts, technologies and teaching methods for strength training, aerobic conditioning, fitness assessment and stress management. Analysis of skills, concepts, terms, computer applications, safety issues, teaching strategies, and developmental appropriateness.

2052
Sports Officiating. Current rules and techniques. Students who perform satisfactorily may apply for official ratings.

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.

2222
Introduction to Health Aspects of Gerontology. An introductory course of the physical and physiological aspects of aging combined with common pathology and intervention.

2451
Athletic Training Practicum. Lab 1. Prerequisite: full admission into athletic training program. Directed observation in supervised introductory laboratory and clinical experiences in athletic training.

2461
Athletic Training Practicum II. Lab 1. Prerequisite: successful completion of 2451. Directed observation in supervised introductory laboratory and clinical experiences in athletic training.

2602
First Aid. Lab 2. A competency- and performance-based first aid course.

2603
Total Wellness. Overview of individual, interpersonal, and socio-cultural issues that have an impact on health. Behavioral decision making, social relations, cultural diversity and environmental sensitivity.

2653
Applied Anatomy. 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.

2663
Prevention and Care of Athletic Injuries. Prerequisite: 2653. Introduction to the appropriate prevention of athletic injury and the administration of medical care. Didactic theory and practical experience regarding many aspects of athletic training. Preparation for future healthcare professionals to identify and care for injury occurring within athletics.

2712
Psychomotor Development. Prerequisite: HHP and LEIS majors and minors only. Fundamental aspects of motor development for infants, children, youth and adults.

2733
Procedures in Athletic Training. Lab 1. Prerequisite: 1713. Introduction to the psychomotor skills required in the profession of athletic training. Procedures relative to athletic injuries and development of essential skills and competencies needed to perform selected athletic training procedures. Theory-based course with required lab experience.

2844
Assessment of Lower-extremity Athletic Injuries. Lab 1. Prerequisites: 2653, 2663. Advanced knowledge and skills related to the recognition, assessment and appropriate medical referral of athletic injuries to the spine and lower extremities.

2854
Assessment of Upper-extremity Athletic Injuries. Lab 1. Prerequisites: 2653, 2663, 2844. Advanced knowledge and skills related to the recognition, assessment and appropriate medical referral of athletic injuries to the spine and upper extremities.

3010
Health and Human Performance Workshop. 1-3 credits, maximum 6. Concentrated study of selected areas of health and human performance, including problems in instruction and administration not usually addressed in the undergraduate curriculum.

3114
Physiology of Exercise. Lab 2. Prerequisite: 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.

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.

3233
General Medical Concepts. Lab 1. Prerequisites: 2653, 2663, and ZOOL 3204. Introduction to specific pathologies, medical conditions, and possible avenues for treatment of non-orthopedic conditions. Course based in medical theory and practical outcomes, using the most current research and experiences on the topics.

3430
Early Laboratory and Clinical Experiences in Physical Education. 1-2 credits, maximum 4. Prerequisites: 1753 and declaration of intention to pursue a program in Teacher Education. The initial preprofessional clinical experience for schools, kindergarten through grade twelve with primary duties including instruction in physical education. Required for full admission to Teacher Education. Graded on a pass-fail basis.

3451
Athletic Training Practicum III. Lab 1. Prerequisite: successful completion of 2461. Directed observation in supervised intermediate laboratory and clinical experiences in athletic training.

3461
Athletic Training Practicum IV. Lab 1. Prerequisite: successful completion of 3451. Directed observation in supervised intermediate laboratory and clinical experiences in athletic training.

3613
Community Health. A survey of issues impacting the health of populations from a community health perspective.

3623
School Health Programs. Prerequisite: 2603. The identity and relationships of school health instruction, services and environments.

3663
Biomechanics. Prerequisite: 2653. 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.

3673
Pathology and Pharmacology in Sports Medicine. Prerequisite: 2663. Principles of cellular inflammation, immunopathology, tissue growth and circulation. Examination of physiological drug activity in the body, drug disposition and pharmacokinetics in sports medicine.

3713
Principles of Epidemiology. Prerequisites: 2213, 2603. Survey of epidemiological principles as they relate to the planning of both community and consumer-focused health promotion and disease prevention programs.

3753
Methods in Teaching Elementary Physical Education. Prerequisites: 1753, 2712, 3430 and any two of 1812, 1822, 1832, 1842. 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.

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.

3773
Methods in Teaching Secondary Physical Education. Lab 2. Prerequisites: 1753, 3430 and any two of 1812, 1822, 1832, 1842. Instructional styles, implementation of behavioral goals and objectives through unit and lesson preparation, teaching methods, and classroom management.

3904
Therapeutic Modalities for Athletic Injuries. Lab 1. Prerequisites: 2653, 2663. Discussion and application of common electronic and physiologic devices used in the treatment of acute and chronic athletic injuries to the musculoskeletal systems.

3924*
Rehabilitation of Athletic Injuries. Lab 1. Prerequisite: 2653, 2663, 3903. Scientific methods used in therapeutic exercise and rehabilitation of injured athletes. Investigation of mechanisms of injury, anatomical structures involved and methodological approach in designing rehabilitative programs.

4010
Directed Study. 1-3 credits, maximum 6. Prerequisite: 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.

4033*
Alcohol and Drug Education. Prerequisites: 2603, junior standing or consent of instructor. Examination of pathological and socio-behavioral aspects of drug use, misuse and abuse across an array of populations and social contexts.

4433*
Program Design in Health Promotion. Prerequisites: 2603, 3613. A survey of program design principles including theoretical foundations, planning, marketing, delivering and evaluating.

4451
Athletic Training Practicum V. Lab 1. Prerequisites: successful completion of 3461. Directed observation in supervised advanced laboratory and clinical experiences in athletic training.

4461
Athletic Training Practicum VI. Lab 1. Prerequisites: successful completion of 4451. Directed observation in supervised advanced laboratory and clinical experiences in athletic training.

4480
Internship in Health and Human Performance. 1-12 credits, maximum 12. Prerequisites: last semester senior standing with cumulative GPA of 2.50. Supervised experience in school (physical education and health), community, worksite or athletic training settings in order to qualify or prepare for appropriate teaching and professional certification. Graded on a pass-fail basis.

4503*
Applied Health Behavior. Prerequisite: senior standing or consent of instructor. Health assessment and intervention strategies with focus on diet, weight management, stress, substance abuse, consumer health and other current health issues.

4533
Psychosocial Issues in Health Promotion. Prerequisites: 2213, 2603. Survey of psychosocial issues as they relate to the practice of health promotion.

4643
Methods in School and Community Health Education. Prerequisites: 3623; full admission to Teacher Education. Conceptual approach to health education through a variety of teaching methodologies.

4702
Pre-internship Seminar. Prerequisite: junior standing. Capstone course for the health promotion program. Preparation for the health internship experience.

4723
Measurement and Evaluation in Health and Physical Education. Prerequisite: full admission to teacher education. Evaluation techniques commonly used by physical educators and health professionals to measure knowledge, attitudes, sport skill proficiency, and physical fitness.

4733
Administration and Program Design in Physical Education and Athletics. Prerequisites: 3753, 3773 or concurrent enrollment; full admission to teacher education. Design and management of physical education (K-12) and athletic programs.

4773
Principles of Exercise Testing and Prescription. Prerequisite: 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.

4783*
Health Issues in Gerontology. Prerequisite: 2603, or consent of instructor. An in-depth study of physiological aspects, special health concerns, chronic illnesses and services as applied to gerontology.

4793*
Adapted Physical Education. Prerequisites: 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.

4933
Administration and Organization of Athletic Training Programs. Prerequisites: 3653, 4902, 4922. The administration and organization of athletic training programs including planning and implementation, certification procedures, code of professional practice, safety standards, and resource management.

4983*
Current Issues in Athletic Training. Prerequisites: 3663 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.

4993*
Health and Human Sexuality. Prerequisite: 2603 or consent of instructor. The study of human sexuality as it relates to the health and well-being of individuals in the community, worksite, college and school setting.

5000*
Master's Thesis. 1-6 credits, maximum 6. Independent research required of candidates for master's degree. Credit awarded upon completion of thesis.

5010*
Seminar. 1-2 credits, maximum 4. Selected topics from the profession not covered in other courses. Presentation and critique of research proposals and results.

5020*
Health and Human Performance Workshop. 1-3 credits, maximum 6. Workshop in selected areas of health and human performance.

5030*
Field Problems in Health and Human Performance. 1-3 credits, maximum 6. Individual investigations of issues in the areas of health and human performance.

5053*
Research Design in Leisure, Health and Human Performance. Prerequisite: 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.

5073*
Psychological Aspects of Sport. Psychological foundations of sport emphasizing performance enhancement by athletes through psychological training techniques.

5143*
Health Promotion Program Implementation and Evaluation. Prerequisite: 4433 or consent of instructor. An intensive overview of principles of health promotion program planning, implementation, and evaluation, with special emphasis on application.

5523*
Current Readings in Health. Contemporary research, literature, projections and views as applied to total health and well-being.

5593*
Human Electrocardiographic Interpretation. Prerequisites: 3114 and 4773 or consent of instructor. Knowledge concerning the collection and interpretation of the electrocardiogram (EKG) and its relationship to heart anatomy, physiology and electrophysiology.

5613*
Cardiac Rehabilitation. Prerequisites: 2653 and 3114 or equivalent. Factors involved in cardiovascular disease. History, implementation and administration of cardiac rehabilitation programs.

5733*
Motor Learning. Research in psychology and physical education relevant to the understanding of the nature and basis of motor skill learning.

5823*
Advanced Applied Anatomy. Prerequisite: 2653. Structure and movement of the human body with emphasis on the relationship of physical activity to musculoskeletal and neurological factors.

5843*
Quantitative Biomechanics and Kinesiology. Prerequisite: 5823. Analytical approach to the study of human motion as applied to kinesiological description and kinematic and kinetic evaluation.

5853*
Stress Testing and Exercise Prescription I. Lab 2. Prerequisite: 3114. Theory and practice in resting and exercise EKG, stress test protocols and exercise prescription.

5863*
Stress Testing and Exercise Prescription II. Prerequisite: 5853. Theoretical aspects of evaluating functional capacity through stress testing with the development of exercise prescription for special populations with physiological limitations imposed by age, disease, heredity and environment.

5873*
Human Bioenergetics. Prerequisite: 3114. Human energy production, utilization and storage in response to exercise.

5883*
Program Development for Adapted Physical Education. Strategies for designing and implementing adapted physical education programs in public schools. Inclusion of students with disabilities into the regular physical education program.

5894*
Biochemistry of Exercise Lab Methods. Lab 2. Prerequisite: 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.

6000*
Doctoral Dissertation. 1-25 credits, maximum 25. Required of all candidates for the Doctor of Philosophy degree. Credit is given upon completion of the dissertation.

6010*
Independent Study in Health and Human Performance. 1-3 credits, maximum 6. Prerequisite: consent of instructor. Supervised readings, research or independent study of trends and issues related to the areas of health and human performance.

6013*
Professional Issues in Health and Human Performance. Introduction of doctoral students to the major areas of higher education relevant to professional preparation in health and human performance curricula. Issues of higher education, roles of the educator, curriculum development, implementation and management, instructional strategies and accreditation.

6020*
Research Colloquium. 1-3 credits, maximum 3. Exploration and presentation of selected topics and research in health and human performance.

6023*
Special Topics in Health and Human Performance. Prerequisite: admission to the Graduate College. Special topics related to health and human performance. Investigation, discussion and analysis of contemporary topics.

6043*
Ethical Issues in Health, Leisure and Human Performance. Prerequisite: admission to the Graduate College. A survey of ethical issues with specific emphasis on health, leisure and human performance.

6053*
Advanced Research in Health and Human Performance. Prerequisite: graduate elementary statistical methods course. Indepth study of selected surveys and experimental research in HHP, including questionnaire development, survey methodology and analysis of data.

6063*
Statistical Computing and Proposal Writing. 1-3 credits, maximum 3. Prerequisite: consent of instructor. Instruction in the use of SPSS using a personal computer. Preparation of research proposals.

6723*
Curriculum Development in Health, Leisure and Human Performance. Prerequisite: 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)

1010
Studies in American History. 1-2 credits, maximum 2. Special study in American history to allow transfer students to fulfill general education requirements as established by Regents' policy.

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 credit for students with prior credit in HIST 1483 or 1493.

1483
American History to 1865. From European background through the Civil War. Satisfies, with POLS 1113, State Regents requirement of six credit hours of American history and American government before graduation. No credit for students with credit in HIST 1103.

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. Satisfies, with POLS 1113, State Regents requirement of six credit hours of American history and American government before graduation. No credit for students with credit in HIST 1103.

1613
(H)Western Civilization to 1500. Lab 1. History of western civilization from ancient world to Reformation. Laboratory discussion sessions on interpretation of primary sources in translation.

1623
(H)Western Civilization After 1500. Lab 1. History of western civilization from Reformation to present. Laboratory discussion sessions on interpretation of primary sources in translation.

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.

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.

2333
(H)American Thought and Culture: Survey. Survey of American religious, philosophical, artistic, and scientific ideas and their impact on culture and values.

2343
(H)Religion in America. Survey of the history of religion in America and its impact on social reform, politics, and intellectual life.

3013
(H)Ancient Near East. The Ancient world from the beginnings of recorded history through the Egyptian, Mesopotamian, Hebrew and Persian civilizations, in addition to the minor civilizations of the area.

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.

3033
(H)Ancient Rome. Political, social, economic and cultural history of the Roman Republic and Empire.

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 and RUSS 3053.

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.

3153
(H)Russia to 1861. Political, institutional, societal and economic development of Russia from the Kievan period to the Great Reforms.

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.

3173
(H)Eastern Europe, 1000-1800. Formation of the eastern European nations and the influence of Rome, Byzantium, the Ottoman Empire, Russia, Austria and Prussia on them.

3203
(H)Early Middle Ages, 325-1000. Economic, social, cultural and religious developments in Byzantium, Islam, and the Germanic West, which succeeded imperial Rome.

3233
(H)Medieval Europe, 1000-1450. High and Late Middle Ages in the West with emphasis on political, social, economic and intellectual development.

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.

3253
(H)Absolutism and Enlightenment, 1648-1789. Political, economic, social, intellectual and religious transformation of Europe between the Peace of Westphalia and the French Revolution.

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.

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.

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.''

3333
(I,S)History of the Second World War. Problems leading to World War II with their international implications and consideration of the war years.

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.

3353
(H)Mediterranean World, 1200-1600. 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.

3373
(S)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.

3383
(S)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.

3403
(H)East Asia to 1800. Traditional Chinese civilization and its impact on Japan, Korea and Southeast Asia.

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.

3423
(H,I)Modern Japan. Modernization process in Japan since 1868.

3433
(H,I)Modern China. Response of China to the West since 1840, with stress on economic, social and intellectual currents.

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.

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.

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.

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.

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.

3533
(H)Historical Archaeology. Problems and methods of historical archaeology through a review of fieldwork done in the United States and Near East.

3543
(H)Islamic Institutions. Prerequisite: 3503 is strongly recommended. Development of Islamic institutions from their origins in the seventh century until the present.

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.

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.

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.

3633
(S)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.

3643
(S)The Jacksonian Era, 1828-1850. Development of a modern political system and an entrepreneurial economy; social reform; territorial expansion; and sectionalism.

3653
(S)Civil War and Reconstruction, 1850-1877. Causes, decisive events, personalities and consequences of the disruption and reunion of the United States.

3663
(S)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.

3673
(S)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.

3683
(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.

3753
(S)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.

3763
(S)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.

3773
(S)Old South. Social, political and industrial conditions in the South before the Civil War.

3783
(S)New South. Recent history and major current social and economic problems of the southern regions of the United States.

3793
(S)Indians in America. American Indian from Columbus to the present, emphasizing tribal reaction to European and United States cultural contract and government policy.

3913
(S)History of Medicine. Historical growth of medicine and its relationship to the society in which it develops. Scientific problems, cultural, religious, and medicine.

3963
(H)Ideas and Ideologies in Modern Europe. Prerequisite: 1623. Intellectual and ideological developments in modern Europe, including political, social, and cultural foundations and impact on modern Europe.

3980
Studies in History. 1-3 credits, maximum 9. Presented for general audiences. Not intended for history majors.

3983
Historians and the Study of History. Prerequisites: history major or consent of instructor. An exploration of how the craft and theory of history has evolved over the centuries. Special emphasis on the controversies over purposes, methods, and meanings, especially in the 20th century.

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.

4253
(S)American Foreign Relations to 1917. American experience in foreign relations from colonial times to World War I.

4273
(H)American Foreign Relations Since 1917. America's emergence as the decisive factor in the world balance of power.

4353
(S)American Military History. Civil-military relations, the military implications of American foreign policy, and the impact of technological advances on warfare since colonial times.

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.

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.

4503
(S)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.

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.

4523
(S)American Environmental History. Examination of the changing ways society (from Native American to post-industrial) has defined, interpreted, valued, and used nature.

4533
(S)Blacks in America. Achievements of blacks in America and their participation in the development of the United States.

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.

4553
(H)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.

4563
(H)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.

4573
(H)Women in Western Civilization. Women in the development of Western Civilization from the earliest times to the present.

4583
History of Technology. The development of technology in western civilization. The relationship between science and technology and the effect of technology on society.

4903
Senior Seminar. Prerequisites: 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.

4980*
Topics in History. 1-3 credits, maximum 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.

4990
Undergraduate Internship. 1-6 credits, maximum 6. Prerequisite: consent of instructor. History related internship experience designed to introduce majors to career possibilities.

4993
Senior Honors Thesis. Prerequisites: 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.

5000*
Thesis. 1-6 credits, maximum 6.

5021*
Teaching History at the College Level. Survey of objectives and methods in the teaching of history at the college level.

5023*
Historical Methods. Methods of historical research and the writing of history.

5030*
Applied History Internship. 3-6 credits, maximum 6. Prerequisite: consent of graduate committee. Supervised practical experience in applied history.

5120*
Reading Seminar in American History. 3 credits, maximum 15. Historiographical and bibliographical study of special areas of American history.

5140*
Reading Seminar in European and World History. 3 credits, maximum 15. Historiographical and bibliographical study of special areas of European and World history.

5220*
Research Seminar in American History. 3 credits, maximum 15. Research in selected problems in American history.

5240*
Research Seminar in European and World History. 3 credits, maximum 15. Research in selected problems in European and World history.

6000*
Doctoral Dissertation. 1-19 credits, maximum 30. Prerequisite: admission to candidacy. Advanced research in history.

6023*
Historiography. Major writers of history, historical schools and patterns of developments in historical interpretation from the earliest times to present.

6120*
Special Studies in History. 1-3 credits, maximum 36. The meaning and operation of the historical processes and develop capabilities for clarity of statement, investigation, and creative, critical attitude. Areas studied vary from semester to semester.

Honors College (HONR)

1000
Introductory Honors Topics. 1-3 credits, maximum 6. Prerequisite: 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.

1013
(H)The Ancient World. Prerequisite: 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. Teamtaught by faculty from appropriate disciplines in a lecture and discussion format. For the Honors student. No credit for students with prior credit in HONR 2113.

1023
(H)The Middle Ages and Renaissance. Prerequisite: 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 credit for students with prior credit in HONR 2113.

1033
(H)The Early Modern World. Prerequisite: 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 credit for students with prior credit in HONR 2223.

1043
(H)The Twentieth Century. Prerequisite: Honors Program participation. Interdisciplinary study of art, history, philosophy and literature from the late 19th century to the present. Teamtaught by faculty from appropriate disciplines in a lecture and discussion format. For the Honors student. No credit for students with prior credit in HONR 2223.

1093
(A)Patterns and Symmetry in Mathematics. Prerequisite: 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.

2013
(S)Honors Law and Legal Institutions. Prerequisite: 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.

2063
(H)Ethical Issues Across Cultural Perspectives. Prerequisite: 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.

2514
(L,N)Honors Scientific Inquiry. Lab 2. Prerequisite: Honors Program participation. A teamtaught 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.

3000
Advanced Honors Topics. 1-3 credits, maximum 6. Prerequisites: 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.

3013
(H,I)Holocaust Studies Seminar. Prerequisites: 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.

4993*
Honors Creative Component. Prerequisites: 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)

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.

1013
(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.

2010
Internship in Horticulture. 1-6 credits, maximum 6. Prerequisites: 24 credit hours and consent of adviser. Supervised work experience with approved public and private employers in horticulture and related fields. Credit will not substitute for required courses. Graded on a pass-fail basis.

2112
Indoor Plants and Interior Plantscaping. Lab 2. Identification, cultural requirements and use of ornamental foliage and flowering plants for indoor gardens.

2212
Herbaceous Ornamental Plants. Lab 2. Identification, cultural requirements and landscape value of ornamental flowering herbaceous plants. Discussions of design and installation of herbaceous beds and borders.

2313
Landscape Plant Materials I. Lab 2. Prerequisite: BIOL 1114 or 1403. Identification, adaptation, tolerance and use of deciduous trees, shrubs, vines and ground covers in the landscape.

2413
Landscape Plant Materials II. Lab 2. Prerequisites: 2313. Identification, adaptation, tolerance and use of evergreen trees, shrubs, vines and ground covers in the landscape.

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.

3014
Business and Practice of Arboriculture. Lab 2. Prerequisites: 2313 and 2413 or FOR 2134, and SOIL 2124. Theory and practice of selecting, planting and maintaining trees, shrubs and vines. Basics of the landscape management business, including estimates for labor, equipment and plant materials; bidding; costs and record keeping; and employee safety.

3084
Plant Propagation. Lab 2. Prerequisites: 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.

3113
Greenhouse Management. Lab 3. Prerequisites: 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.

3153
Turf Management. Prerequisites: 1013, SOIL 2124 and 2 hours plant science. Selection, establishment and maintenance of grass species and other plant materials for special use areas.

3213
Fruit and Nut Production. Prerequisite: 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.

3433*
Commercial Vegetable Production. Prerequisites: 1013, SOIL 2124 and BIOL 1403. Commercial production and marketing of vegetable crops.

3544*
Nursery Production. Lab 2. Prerequisites: 2313, 2413, and SOIL 2124. The propagation, production, management and marketing of commercial nursery stock.

3553
Advanced Floral Design and Marketing. Lab 2. Prerequisite: 2652. Preparation, arrangement, care and marketing of floral products in the retail shop, advanced designing, pricing, wholesale purchasing and retail selling.

4313*
Commercial Flower Production and Marketing. Lab 3. Prerequisite: 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.

4453*
Turfgrass Physiology and Ecology. Lab 2. Prerequisites: 3153, BIOL 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.

4713*
Public Garden Management. Lab 4. Prerequisite: 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.

4773
Applied Landscape Planning. Lab 3. Prerequisite: 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.

4990*
Horticultural Problems. 1-6 credits, maximum 6. Prerequisite: consent of instructor. Problems related to pomology, olericulture, nursery production, landscape design, or the culture, sales and arrangement of flowers.

5000*
Research and Thesis. 1-6 credits, maximum 6. Research on thesis problems required of master's degree candidates.

5020*
Graduate Seminar. Prerequisite: graduate standing. Proposal and results seminars for graduate programs.

5110*
Advanced Horticultural Problems. 1-12 credits, maximum 20. Selected research problems in horticulture, floriculture, landscape design; nursery production, olericulture, and pomology.

5123*
Advances in Horticultural Science. The latest advances in horticultural science and technology affecting the vegetable, fruit and nut, turfgrass, nursery, and floriculture commodity areas. Areas of production systems, postharvest preservation, plant responses to the environment, and sound environmental practices.

5133*
Temperature Stress Physiology. Prerequisite: 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.

5233*
Experimental Horticulture. Methods of conducting research with horticultural crops including organization and plans, field plot techniques and analysis of data.

5412*
Mineral Nutrition in Horticultural Crops. Prerequisites: BOT 3463, SOIL 4234. Fertilizer use and plant response in horticultural crops.

5422*
Flowering and Fruiting in Horticultural Crops. Prerequisite: BOT 3463. Environmental, chemical and cultural factors affecting the flowering and fruiting of horticultural crops.

5433*
Postharvest Physiology. Prerequisites: BOT 3463 and 3460. Physiological causes for postharvest 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.

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.

6000*
Research and Thesis. 1-12 credits, maximum 20 for crop science; maximum 24 for environmental science; maximum 30 for plant science. Research on thesis problems required of candidates for the Ph.D. in crop science.

Hotel and Restaurant Administration (HRAD)

1103
(I)Introduction to Hotels, Restaurants, and Tourism Around The World. Study of hotels, restaurants, tourism and the hospitality industry around the world. The scope of the industry, development and history of the hospitality industry on an international basis, ethical issues, and career opportunities.

1114
Introduction to Professional Food Preparation and Sanitation. Lab 3. Techniques and theories of food preparation and sanitation including use and selection of equipment, quality controls, presentation, and nutrient relationships based on food preparation systems. The theory and practice of food safety and sanitation.

2125
Service Management in Hospitality Operations. Lab 4. Analysis and development of service management skills for the hospitality industry, including leadership behavior, motivation; communication training, staffing and professionalism with an emphasis on fine dining.

2283
Hospitality Industry Financial Analysis. Prerequisite: ACCT 2103. Financial analysis theory and practice in the hospitality industry including planning and control of revenue and expenses and analysis financial reports, concepts, examples, and case studies specific to the hospitality industry.

2533
Hospitality Information Technology. Overview of computer system components, file structure, operating systems, word processing, spreadsheets, and databases utilized in the hospitality industry. The interaction between technology, oral, and written communication at all levels of hospitality organizations.

2770
Hospitality Industry Speakers Colloquium. 1-3 credits, maximum 3. Seminars presented by distinguished hospitality industry professionals. Current issues and implications for the future of the hospitality and service industries.

2771
Hospitality Speakers Series. Seminars presented by distinguished hospitality industry professionals. Current issues and implications for the future of the hospitality and service industries. Same course as 3771 and 4771.

2850
Special Topics in Hotel and Restaurant Administration. 1-3 credits, maximum 6. Study of specific issues or topics in hotel and restaurant administration.

3193
Hospitality Training Program Development. 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.

3213
Hospitality Management and Organizations. Function and methods of management as related to the hospitality industry including management principles and analysis and decision making skills as applied to hospitality management system organizations, interpersonal relationships, and production systems.

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.

3330
On-campus Internship. 1-3 credits, maximum 6. Prerequisites: HRAD 2125, 3213 or consent of instructor. Supervised experience in an approved on campus work situation related to a future career in the hospitality industry. Human resource, customer service, management or supervisory experience in multiple aspects of the department.

3363
Lodging Front Office Systems. Lab 2. Prerequisites: 3213, ACCT 2103. The organization, duties and administration of a hotel front office. The various jobs in the lodging front office, and procedures for registering, accounting for, and checking out guests. Additional focus on the organization duties, and administration of a hotel reservations, night audit, and uniformed services departments.

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.

3443
Hospitality Industry Internship. 1-3 credits, maximum 9. Prerequisites: 2125, 3213, 3363, or 3943 or consent of instructor. Supervised experience in an approved work situation related to a future career in the hospitality industry. Management and supervisory experience in multiple aspects of a hospitality organization.

3473
Mechanical Equipment and Facility Management. 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.

3553
Purchasing in the Hospitality and Food Service Industries. Procurement of food, supplies, and services utilized in the hospitality and food service industries. Food and nonfood materials management of the purchasing process and communication. Specification writing, menu analysis, and costing.

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.

3623
Hospitality Industry Revenue and Cost Controls. Prerequisites: 2283, ACCT 2103. Strategies for the identification and management of revenue and cost controls in the hospitality industry. The different characteristics of hospitality revenues and costs and their relationship to products and services.

3771
Hospitality Speakers Series. Seminars presented by distinguished hospitality industry professionals. Current issues and implications for the future of the hospitality and service industries. Same course as 2771 and 4771.

3783
Hospitality Industry Human Resources Management. 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.

3943
Lodging Property Management. Prerequisites: 3213, 3363. 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.

4090*
International Hospitality Studies. 1-18 credits, maximum 18. Prerequisite: consent of school director. 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.

4103*
Hospitality Law and Ethics. 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.

4120*
Special Events Management. 1-3 credits, maximum 6. Study of special event planning, implementation, and evaluation. The interaction between the staff, the customer, guests, contrac- tors, and others necessary to implement a successful special event. Catering through hotels, restaurants or private companies.

4121*
Special Events Management. Study of special event planning, implementation, and evaluation. The interaction between the staff, the customer, guests, contractors, and others necessary to implement a successful special event. Catering through hotels, restaurants or private companies.

4163*
Hospitality Marketing. Strategies for marketing and decision-making in the hospitality industry. Customer identification, consumer behavior, competition, and product, promotion, placement, and pricing strategy.

4213*
Hospitality Sales and Catering. Prerequisites: 2125, 3213, and 3363. 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.

4221*
Special Events Management. Prerequisite: 4121. Study of special event planning, implementation, and evaluation. The interaction between staff, customer, guests, contractors, and others necessary to implement a successful special event. Catering through hotels, restaurants or private companies.

4293*
Hospitality Small Business Development. 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.

4321*
Special Events Management. Prerequisites: 4121, 4221. Study of special event planning, implementation, and evaluation. The interaction between the staff, the customer, guests, contractors, and others necessary to implement a successful special event. Catering through hotels, restaurants or private companies.

4333*
Hospitality and Tourism Financing. Prerequisites: 2283, ACCT 2103. 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.

4365*
Food Production Management. Lab 5. Prerequisites: 2125, 3213, 3553, and a course in accounting, or consent of instructor. Organizing, purchasing, costing, recipe development, preparation, and service of food. Emphasis on the management of the process, budgeting, marketing, and food safety.

4383
Hospitality Education. An examination of the foundation, organization and operation of hospitality education; especially focused on vocational, secondary, community college, and university settings.

4413*
Hospitality Information Systems. Prerequisites: 2125, 2533 and 3363. 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.

4421*
Special Events Management. Prerequisites: 4121, 4221, 4321. 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. Catering through hotels, restaurants or private companies.

4443*
Advanced Hospitality Management Internship. Prerequisites: 2125, 3213, 3363 or 3943 and 3443 or concurrent enrollment in 3443 with consent of instructor. Management experience in multiple aspect of a hospitality 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.

4523*
Integrated Capstone Seminar. Prerequisite: senior or graduate standing. 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.

4553*
Specifications and Advanced Purchasing. Prerequisites: 2283, 3213 and 3553. Development of specifications for food, supplies, and services used in the hospitality and service industries. The product mix and its integration with the services in hospitality operation. The developing e-commerce and other technological advances in purchasing and distribution.

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.

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, college 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.

4593*
Manufacturing and Distribution of Goods and Services in the Hospitality Industry. Prerequisite: 4553. Examination of product and service distribution channels. The characteristics and management of the sequence necessary to bring goods and services from manufacture to market. Additional focus on the marketing concepts associated with the distribution process.

4633*
Labor Relations In The Hospitality Industry. Prerequisites: 3213 and 3783. Examination of the concepts related to labor relations in the hospitality and service industries. Emphasis on collective bargaining and applicable law. Training and development programs for the hospitality and service labor force.

4663*
Hotel Food and Beverage Operations. 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.

4723
International Beverage Education. Prerequisite: 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.

4770*
Hospitality Industry Speakers Colloquium. 1-3 credits, maximum 3. Seminars presented by distinguished hospitality industry professionals. Current issues and implications for the future of the hospitality and service industries.

4771*
Hospitality Industry Speakers Colloquium. Seminars presented by distinguished hospitality industry professionals. Current issues and implications for the future of the hospitality and service industries. Same course as 2771 and 3771.

4783*
Critical Issues In the Hospitality and Tourism Industry. Prerequisite: senior or graduate standing. 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.

4850*
Special Unit Course in Hotel and Restaurant Administration. 1-6 credits, maximum 6. Prerequisite: consent of instructor. Special unit of study related to specific problems in the hospitality industry.

4883*
Multi-Level Organizational Behavior. Prerequisite: senior or graduate standing. Study of the structure and management of multi-level and multi-national organizations in the hospitality industry. Organizational behavior, policy and procedure, multi-unit management, and decision making in complex organizations in domestic and multi-national hospitality organizations.

4900
Honors Creative Component. 1-3 credits, maximum 3. Prerequisite: College of Human Environmental Sciences Honors Program participation, senior standing. Guided creative component for students completing requirements for College Honors in College of Human Environmental Sciences. Thesis, creative project or report under the direction of a faculty member in the major area, with second faculty reader and oral examination.

4983*
Conference and Meeting Planning. Prerequisite: junior standing. Planning and implementing conferences, teleconferences, conventions, special events, seminars and symposia. Designing, promoting, managing and evaluating educational events, contract management.

5000*
Master's Thesis. 1-6 credits, maximum 6. Prerequisites: graduate standing and consent of adviser. Individual research interests in hospitality administration fulfilling the requirements for the M.S. degree.

5030*
Master's Creative Component and Independent Study. 1-3 credits, maximum 3. Prerequisites: graduate standing and consent of instructor. Individual research and study having relevance to the hospitality field and a positive impact on the hospitality industry.

5111*
Hospitality Graduate Studies and Research. Systematic introduction to the competencies of graduate education and research in hospitality and tourism education and administration.

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.

5243*
Retailing and Franchising in the Hospitality Industry. Entrepreneruial 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.

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.

5413*
Employee Development Issues in the Hospitality Industry. Recent theories and research in human resource management, employee development, and labor issues affecting the hospitality and tourism industry in maintaining a productive workforce.

5423*
Hospitality Customer Development Strategies. Prerequisite: undergraduate marketing course. The concepts and strategies of hospitality and tourism marketing and customer development.

5513*
Contemporary Issues in Hospitality and Tourism. Analysis of major and current issues confronting the hospitality and tourism industry.

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.

5813*
Research Methods in Hospitality and Tourism Administration. Prerequisites: 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.

5850*
Special Topics in the Hospitality Industry. 1-3 credits, maximum 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.

5870*
Problems in the Hospitality Industry. 1-3 credits, maximum 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.

6000*
Doctoral Thesis. 1-12 credits, maximum 30. Prerequisite: consent of major professor. Research in hospitality administration for the Ph.D. degree.

6113*
Hospitality and Tourism Education. Theoretical and practical components of hospitality and tourism education with emphasis on universities, community colleges, and vocational schools.

6213*
Advanced Hospitality Purchasing. Development of supply chain management systems for hospitality businesses. Management of hospitality procurement operations.

6313*
Tourism Policy and Planning. Examination of current international and national tourism policies, planning and development perspectives and the economic impact.

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.

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.

6680*
Seminar in Food Service Management. 1-3 credits, maximum 9. Examination of research, practice, and future trends in food service management issues from a strategic perspective.

6780*
Seminar in Lodging Management. 1-3 credits, maximum 9. Examination of lodging management issues from a strategic perspective. Latest developments in research, practice, and future trends in the lodging industry.

6880*
Seminar in Travel and Tourism Management. 1-3 credits, maximum 9. Study of the latest developments in travel and tourism research and management.

Human Development and Family Science (HDFS)

1112
Introduction to Human Development and Family Science. Explores the philosophy of human development and family sciences grounded in a model of policy, education, and practice.

2113
(S)Lifespan Human Development. Study of human development within diverse family systems. Taught from a life span perspective.

2114
(S)Lifespan Human Development: Honors. Prerequisite: honors students only. Honors course critically examining the study of human development within diverse family systems. Taught from a lifespan perspective.

2211
Early Field Experience in Primary Education. Lab 3. Prerequisites: 1112 and 2113. The initial preprofessional clinical experience in schools, grades 1 through 3. Required for full admission to Professional Education.

2213
Human Sexuality and the Family. Sexual development emphasizing personal adjustment and interaction with family and culture.

2223
Foundations in Early Childhood. Lab 3. Prerequisites: 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.

2233
Development of Creative Expression, Play and Motor Skills in Early Childhood. Prerequisite: 2113 and one child development course. 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.

2243
Infant-Toddler Programming. Lab 3. Prerequisites: 2113, 3413. Program planning, implementation and evaluation of developmentally appropriate programs for infants and toddlers. Directed observation and participation in infant and toddler programs.

2850
Special Unit Courses in HDFS. 1-6 credits, maximum 6. Various units taught by specialists in Human Development and Family Science.

3013
(S)Early Adulthood. Study of the unique characteristics of development during early adulthood. Theories of adult development with emphasis on application to program development and providing services for adults.

3113
Non-normative Development. Prerequisite: 2113. The intersection of biological and environmental influences on atypical development across the life span in multiple contexts in early development. Assumes a basic knowledge of the cultural diversity in normative human development and the research methods employed in human development. Directed observation in non-normative settings.

3123
(S)Parenting. Prerequisites: 2113 or other lifespan 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.

3213
Literacy Development in Early Childhood Education. Prerequisites: concurrent enrollment in 3224 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.

3224
Integrated Curriculum in Early Childhood. Prerequisites: concurrent enrollment in 3213, and full admission to Professional Education. Application of theories of cognitive development to developmentally appropriate curriculum in mathematics, social studies, physical and natural sciences.

3233
Guidance and Discipline in Programs for Young Children. Prerequisites: concurrent enrollment in 3243 and 3246, and full admission to Professional Education. Child-centered approach to the guidance and discipline of young children. Relevant theories, influential research and developmentally appropriate guidance techniques that facilitate the development of pro-social, cooperative and helping behaviors.

3243
Preparation for Field Experience in Pre-kindergarten-Kindergarten Education. Prerequisites: concurrent enrollment in 3233 and 3246, and full admission to Professional Education. Program planning, implementation and evaluation of developmentally appropriate programs for pre-kindergarten-kindergarten settings.

3246
Internship in Early Childhood Education in Pre-kindergarten-Kindergarten. Prerequisites: concurrent enrollment in 3233 and 3243, full admission to Professional Education. Supervised teaching experience in pre-school settings through kindergarten. Graded on a pass-fail basis.

3413
Infant and Child Development. Prerequisite: 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.

3423
(S)Adolescent Development in Family Contexts. Prerequisite: 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.

3433
(S)Relationship Development and Marriage. Theory and research on the formation and development of interpersonal relationships from dating through courtship and marriage.

3443
(S)Family Dynamics. Prerequisite: 2113. Applying family theories and current research to the examination of dynamics of diverse families across the life course and within the social context.

3453
Management of Human Service Programs. Prerequisites: 1112, 2113, 3433, 3443. Designing and managing human service programs: planning, needs assessment, program hypothesis, developing human resources, budget management, monitoring and evaluation. Emphasis on accountability.

3513
(S)Introduction to Research Methods. Prerequisite: STAT 2013 or equivalent. Examination of fundamentals of scientific method as applied to research in human development and family sciences. Research design, sampling, and measurement. Analytical, evaluative, and interpretive skills needed to understand the professional research literature. Introduction to how computers are used in research.

3523
Professional Skills in Human Services. Prerequisites: 1112, 2113, 3433, 3513. Development of professional skills for the human services. Intakes, interviewing, reporting, program marketing, case management, advocacy, facilitating change, community collaboration, and using data bases.

3533
Observation and Assessment. Prerequisite: 2113. Examination of individual and family interaction through observation and assessment techniques in multiple contexts.

3613
Professional Services for Children and Families. Study of current major issues and selected services for children and families.

4000
Senior Thesis. 1-6 credits, maximum 6. Prerequisites: 4743, STAT 2013, senior standing, consent of instructor. Supervised research for the bachelor's degree.

4223
Field Experience Preparation in Primary. Prerequisites: 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.

4226
Internship in Early Childhood Education in Primary. Prerequisites: concurrent enrollment in 4223 and 4333, and full admission to Professional Education. Supervised teaching experience in grades 1-3. Graded on a pass-fail basis.

4333
Early Childhood Capstone. Prerequisites: concurrent enrollment in 4223 and 4226, 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.

4413
(S)Adulthood and Aging. 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.

4423*
Family Risk and Resilience. Prerequisite: 3443. Examination of selected theoretical approaches; areas of family risk; protective factors; individual and family qualities relating to resilience; and prevention and intervention strategies.

4433*
Family Life Education. Prerequisites: 2113, 3123, 3433, senior standing. Philosophy and principles of family life education. Planning, implementing, and evaluating family life programs in community and education settings. Field experience.

4473
Policy, Law and Advocacy. Prerequisites: 1112 and 2113. The study of local, state, and federal legislation, regulations, social policies, and advocacy that affect children and families. Domestic relations, child welfare, health, education, social services, employment, and housing.

4526
Internship in Child and Family Science. Prerequisites: 1112, 3523, 3533, and consent of adviser and consent of instructor. Supervised field experience applying HDFS knowledge and skill base. Must complete application for internship.

4533
Critical Issues in Human Development and Family Science. Prerequisite: senior standing. An examination of the place of family relations and child development in the context of broader themes. An exploration of the students' specialization and its implications for an educated life.

4543*
(S)Adulthood: Later Years. Analysis of the aging process. Interrelation between physical, psychological and social development in later years. Special emphasis on multigenerational family issues and relationships.

4663
Theories and Issues in Child Development. Prerequisites: 2113; six additional hours in HDFS, or consent of instructor. Current research and issues related to child development; theories and philosophical bases underlying development.

4673
(S)Theories and Issues in Family Relationships. Prerequisite: 3753. Introduction to family theories. Current research and issues related to family dynamics, relationships, and crises within the context of the family system.

4750
Special Problems in HDFS. 1-6 credits, maximum 6. Prerequisite: consent of instructor. Various units of work related to specific issues in family relations and child development.

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.

4850
Special Unit Courses in Family Relations, Child Development and Early Childhood Education. 1-6 credits, maximum 6. Various units taught by specialists in the field.

4900
Honors Creative Component. 1-3 credits, maximum 3. Prerequisite: College of Human Environmental Sciences Honors Program participation, senior standing. Guided creative component for students completing requirements for College Honors in College of Human Environmental Sciences. Thesis, creative project or report under the direction of a faculty member in the major area, with second faculty reader and oral examination.

5000*
Master's Thesis. 1-6 credits, maximum 6. Research in FRCD for M.S. degree.

5110*
Directed Study in HDFS. 1-9 credits, maximum 9. Prerequisites: 5223 or 5523 and consent of instructor. Directed individual study in human development and family sciences.

5112*
Computer Applications in HDFS Research. Creating variable codebooks, coding data for input and inputing data for computer analysis using the SPPS-X package. No computer experience necessary.

5133*
Research Methods in Human Development and Family Science. 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 in individual and relationship competence in diverse contexts. Development of a research proposal.

5143*
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. Application of scholarship on parenting to parent education and child guidance.

5190*
Teaching Practicum. 1-3 credits, maximum 3. Prerequisites: six hours of graduate course work and consent of instructor. Teaching human development and family sciences; content and techniques.

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.

5213*
Child Behavior and Development. Prerequisite: consent of instructor. Current issues in child development beyond infancy explored within the context of recent research. Contrasting theoretical and methodological approaches critically evaluated.

5223*
Theories of Child Behavior and Development. Prerequisite: 6 credit hours at graduate level in child development or related areas. Major theories and supportive research that contribute to the understanding of child behavior and development.

5243*
Infant Behavior and Development. Prerequisite: 5223 or consent of instructor. Survey of research and theory pertaining to infant development, including behavioral genetics, perception, cognition and learning, social and emotional development, and assessment.

5273*
Assessment of Infant and Child Development. Prerequisite: consent of instructor. Study and application of formal evaluative methods for the investigation of infant and child development. Supervised practice in administration, scoring, and interpretation of individual tests of cognitive ability, adaptive behavior, language development, and psychomotor development.

5290*
Practicum. 1-6 credits, maximum 6. Prerequisite: consent of instructor. Supervised experience in various settings relevant to human development and family sciences.

5333*
Early Childhood Education: Curriculum. Implications of child development theory and research for planning educational programs and learning experiences appropriate for young children.

5343*
Assessment Within Early Childhood Programs. Prerequisite: consent of instructor. Examination of standardized and alternative assessment strategies for documenting children's learning and development within early childhood educational contexts. Exploration and critical review of strategies for evaluating early childhood classrooms.

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.

5363*
Early Childhood Models and Practice. Curriculum development and program models for children through third grade emphasizing individual differences, equipment and materials, physical facilities and space, teacher roles, and philosophical objectives.

5373*
Early Childhood Administration, Policy Analysis and Advocacy. Examination of the administration of programs for young children as well as policy evaluation and advocacy. Legal, social and economic conditions as they affect the welfare of individuals and families.

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.

5413*
Adult Development and Aging. The biological, psychological and social factors associated with aging. Web-based instruction.

5423*
Research Perspectives in Gerontology. Current research knowledge related to gerontology and the aging process. Critical study of classic and current research.

5470*
Developments and Innovations in Family Relations, Child Development and Early Childhood. 1-9 credits, maximum 9. 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.

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.

5523*
Family Theory. Theoretical frameworks and processes in family science. Overview of the interface between theory, research, and application in family science.

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.

5553*
Marital and Premarital Enrichment Education. Analysis of educational models and processes that relate to enriching couple relationships. Approaches to facilitating premarital and marital enrichment, emphasizing program development, implementation and evaluation.

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.

5583*
Human Sexuality. Multiple aspects of human sexuality including physiological and psychosexual development and response, sexual relationships, and sexual dysfunction.

5602*
Pre-practicum in Marriage and Family Therapy: Counseling Skills. Pre-clinical experience for students in the marriage and family therapy (MFT) specialization, emphasizing counseling skills and structured observations.

5612*
Pre-practicum in Marriage and Family Therapy: Group Processes. Prerequisites: 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.

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.

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.

5633*
Couples Treatment in Marriage and Family Therapy. Prerequisite: graduate standing or consent of instructor. Focus on assessment of couples and the systemic interventions available to address common couple issues. Premarriage, divorce and remarriage, sexuality, domestic violence, infidelity, and gender.

5643*
Child and Adolescent Treatment in Marriage and Family Therapy. Prerequisite: 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.

5653*
Systemic Approaches to Psychopathology and Psychopharmacology. Prerequisite: 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.

5663*
Professionalism and Ethics in Marriage and Family Therapy. Prerequisites: 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.

5690*
Marriage and Family Therapy Practicum. 1-3 credits, maximum 18. Prerequisite: admission to marriage and family therapy specialization. Supervised clinical experience for students in the marriage and family therapy specialization.

5743*
Management of Family and Community Service Programs. Functions of management applied to programs and services for children and families. Program planning, personnel decisions, resource development, marketing, community engagement, employee development, and evaluation.

5750*
Seminar in Child Development and Family Relationships. 1-8 credits, maximum 8. Current research in child development and family relationships. Critical study of classic and current research.

5933*
Evaluation Design. Fundamental principles of evaluation, emphasis on instrumentation.

6000*
Doctoral Thesis. 1-12 credits, maximum 30. Prerequisite: consent of instructor. Research in human environmental sciences for the Ph.D. degree under supervision of a graduate faculty member.

6110*
Directed Study in FRCD. 1-9 credits, maximum 9. Prerequisites: 5523 or 5223 and consent of instructor. Doctoral level directed individual study in human development and family sciences.

6133*
Advanced Research Methods in Family Relations and Child Development. Prerequisites: one course in research methods and one in statistics. Research design and analysis of data appropriate to the areas of family relations and child development.

6190*
Research Internship. 1-6 credits, maximum 6. Prerequisite: consent of instructor. Special research studies under the supervision of a graduate faculty member.

6223*
Analysis and Application of Child Development Theory. Prerequisite: 5223. Critical analysis of selected child development theories using primary source material with demonstration of application to development, research and practice.

6243*
Theory and Research in Early Cognitive Development. Prerequisites: 5213, 5223 or consent of instructor. Critical examination of the concepts and principles derived from cognitive development theory with special emphasis on research and methodological literature.

6250*
Seminar in Child Development. 1-6 credits, maximum 6. Prerequisite: 5223 or equivalent. Selected topics in child development with special attention given to recent research literature and current theory.

6253*
Theory and Research in Early Social Development. Prerequisites: 5213, 5223 or consent of instructor. Research and theory pertaining to social and emotional development, including attachment, social interaction, friendships and temperament.

6363*
Theories and Research in Early Communication Development. Prerequisites: 5213, 5223 or consent of instructor. Recent theories and research in language communication development, including receptive and active language and the relationship of language to early social and cognitive development.

6373*
Theory and Research in Developmental Disabilities. Prerequisites: 5213, 5223 or consent of instructor. Recent theories and research related to developmental disabilities, including both physical and mental handicapping conditions and their impact on human development.

6523*
Analysis and Application of Family Theory. Prerequisite: 5523. Family theory process, including logic, theory construction, and relating conceptual orientations to current research areas.

6580*
Seminar in Family Sciences. 1-6 credits, maximum 6. Prerequisite: 5513 or consent of instructor. Current research and theory in the family area; selected topics.

6613*
Contemporary Issues in Marriage and Family Therapy. Prerequisite: 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.

6843*
Economic and Social Foundations of Family Economics. Prerequisites: graduate standing, consent of instructor. The lives, times and ideas of great economic and social thinkers and how their influence on the economic and social development of our society affects the economics of family living.

Human Environmental Sciences (HES)

1111
Exploration in Human Environmental Sciences. A survey of the majors and career opportunities in the various human environmental sciences departments. The transition from high school to university life, awareness of campus and college resources, and enhancement of study skills and attitudes that contribute to academic success. Required of all first semester freshmen in the College of Human Environmental Sciences. Graded on a pass-fail basis.

2111
Career Exploration in Human Environmental Sciences. Acquisition of career information critical to introduce students to the world of work. Career searches, processes for interviewing and acquiring careers.

3002
Leadership and Collaboration in the Workplace. Prerequisites: junior standing in a major in the College of Human Environmental 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.

3080
International Experience. 1-18 credits, maximum 36. Prerequisite: consent of associate dean. Participation in a formal or informal educational experience outside of the USA.

3090
(I)Study Abroad. 1-18 credits, maximum 36. Prerequisites: consent of the Office of the Study Abroad and associate dean of the College of Human Environmental Sciences. Participation in an OSU reciprocal exchange program.

3111
Directions in Human Environmental Sciences. An exploration of the career opportunities and curriculum in the various human environmental sciences departments. Transition to university life at OSU, awareness of campus and CHES resources; and enhancement of skills and attitudes that contribute to academic success. Required of all first semester transfer students in the College of Human Environmental Sciences (CHES). Graded on a pass-fail basis.

4000
Honors Seminar in Human Environmental Sciences. 1-6 credits, maximum 6. Prerequisites: 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.

5240*
Master's Creative Component. 1-6 credits, maximum 6. Prerequisite: consent of associate dean. An in-depth application of theoretical models and philosophies related to area of specialization.

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.

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.

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.

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.

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.

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.

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.

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.

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.

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.

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.

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.

5803*
Case Studies in Family Financial Planning. Prerequisites: 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.

6180*
Research Seminar. 1-3 credits, maximum 3. Prerequisite: graduate course in research methods or consent of instructor. Research in human environmental sciences with emphasis on problems involving a multidisciplinary approach. Methodological analysis of research. Development and evaluation of research focused on current problems.

6993*
Graduate Seminar in Human Environmental Sciences. 1-3 credits, maximum 3. Prerequisite: consent of instructor. Analysis of philosophy, critical issues, current developments and interrelationships among elements in human environmental sciences.

Human Resources and Adult Education (HRAE)

4010*
Occupational and Adult Education Workshop. 1-3 credits, maximum 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.

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.

5000*
Thesis or Report. 2-10 credits, maximum 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.

5010*
Seminar. 1-3 credits, maximum 6. Graduate student seminars focusing on current and critical issues and common problems relevant to occupational and adult education.

5123*
Program Evaluation in Human Resource Development and Adult Education. The practice of evaluation in organizational training, adult education and organizational development.

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.

5213*
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.

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.

5233*
Needs Analysis. Techniques of conducting organizational analyses of human performance problems, including surveys, interviews, records analysis, group interaction, and task analysis.

5243*
Advanced Project in Needs Analysis. Prerequisite: 5233. The conduct of an analysis of human performance problems in an organizational, agency, institutional or community setting, including need or problem identification, investigation, clarification and resolution, and the development of a formal report and a presentation to management.

5253*
Instructional Strategies for Adults. Prerequisite: graduate standing. 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.

5340*
Special Problems. 1-6 credits, maximum 6. Directed independent study of special topics involving assigned readings, library research, field work or a combination of these.

5433*
Instructional Design for Training. Design and development of training to address performance problems in organizations, business and industry. Indepth study of a systematic approach to training for performance.

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.

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.

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.

5720*
Workshop. 1-3 credits, maximum 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.

5730*
Special Topics in Human Resource Development. 1-3 credits, maximum 6. The practice, theory and research related to a current topic in human resource development.

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.

5880*
Internship. 3-6 credits, maximum 6. Supervised experience working in business, industry, human service, or education settings.

5912*
Organization and Administration of Adult Basic Education Programs. Organizing and administering adult basic education for occupational programs.

6000*
Doctoral Dissertation. 2-10 credits, maximum 15. Required of all candidates for the Doctor of Education degree in adult education and human resource development.

6103*
Foundations of Lifelong Learning. The definitions, historical and philosophical development, and the scope and function of lifelong learning.

6110*
Graduate Readings in Adult Education and Human Resource Development. 1-6 credits, maximum 6. Prerequisite: consent of supervising professor. Supervised readings of significant literature not included in regularly scheduled courses.

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.

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.

6223*
Current Research in Adult Education. Analysis of the major research trends in the field of adult education. Recent research studies in the field.

6233*
Critical Issues in Adult Education. Exploration of current issues of concern to adult educators from diverse settings.

6330*
Special Topics in Adult Education. 1-3 credits, maximum 9. Prerequisites: 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.

6340*
Independent Study in Human Resources and Adult Education. 1-3 credits, maximum 9. Directed independent study for doctoral students involved in a research-based project.

6533*
Organization Development. Seminar examining the field of organization development. Emergence of the field, diagnosis, performance, change management, the client, and the consultation.

6633*
Advanced Human Resource Development. Prerequisite: 5533. Scholarly critique of organizations as adaptive systems and the role human resource development plays in organization, process and individual performance.

6871*
Doctoral Seminar: Level 1. Orientation to doctoral program in HRAE. May be taken prior to program application; required of all applicants.

6880*
Internship in Human Resources and Adult Education. 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.

6881*
Doctoral Seminar: Level 2. Preparation of the required tentative proposal for dissertation and the comprehensive doctoral examination. Required for HRAE doctoral candidates.

Industrial Engineering and Management (IEM)

2903
Introduction to Industrial and Systems Engineering. Lab 1. Prerequisites: ENGR 1111; MATH 2144. Industrial engineering concepts and techniques in production control, quality control, layout, methods engineering, material handling, mathematical programming, and engineering economy. Laboratory sessions provide additional learning experiences with these topics and with computer software used in industrial engineering analyses.

3303
Industrial Processes I. Lab 3. Prerequisites: ENGR 1322 and ENSC 3313. Manufacturing processes used to transform raw materials including metals and non-metals into finished goods. Near-shape processing and basic metal cutting theory, process selection, and planning. Field trips to manufacturing plants.

3313
Industrial Processes II. Lab 3. Prerequisite: 3303. Manufacturing processes in joining, finishing, metrology, nontraditional machining, tool design, electronics manufacturing assembly and numerical control. Field trips to manufacturing plants.

3503
Engineering Economic Analysis. Prerequisite: MATH 2153. Development and use of time value of money interest formulas. 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-lived 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.

3513
Economic Decision Analysis. Prerequisite: 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.

3523
Engineering Cost Information and Control Systems. Prerequisite: MATH 2144. Basic cost measurement and control concepts. How to measure and interpret cost data and define its use in planning, control and estimating. Role of accounting in cost control.

3703
Engineering Computation and Interactive Modeling. Prerequisites: ENGR 1412, MATH 2144. Using the computer for engineering problem solving through analysis, design and pseudocode. Applications using computer languages, spreadsheets, statistical packages and equation solvers.

3813
Work Performance: Analysis and Design. Lab 3. Productivity improvement through job design. Productivity planning, measuring and improvement. Major emphasis on measuring, evaluating and redesigning work processes.

4010*
Industrial Engineering Projects. 1-3 credits, maximum 6. Prerequisite: consent of school head. Special undergraduate projects and independent study in industrial engineering.

4014*
Operations Research. Prerequisites: 3703, MATH 3263, STAT 4033. Fundamental methods, models, and computational techniques of operations research. Linear programming including transportation and assignment models. Network models, dynamic programming, decision theory, and queueing theory.

4020
Undergraduate Engineering Practicum. 1-3 credits, maximum 4. Prerequisites: 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.

4103*
Industrial Quality Control. Prerequisite: STAT 4033. Principles and practice of industrial control. Modern quality philosophy, including a process improvement strategy incorporating charter, documentation of knowledge and improve- ment cycle. Theory and use of statistical process control (SPC) tools for problem solving and continuous improvement. Variables and attributes control charts for both discrete and continuous flow/batch processes. Process capability and performance analysis including strengths and weaknesses of Cpk and Ppk indices. Introduction to acceptance sampling, including ANSI/ASQC Z1.4 standards.

4113*
Industrial Experimentation. Prerequisite: 4103. Analytical methods for the purpose of continuous process improvement using the Deming approach. Experimentation driven by the Taguchi loss function, Taguchi arrays, linear graphs, triangular tables, and Taguchi's concepts of parameter and tolerance design. Extensive use of factorial and fractional factorial designs for measurement and attributes data. Analysis of variance and graphical interpretation of significant factors and interactions. Wide variety of industrial applications.

4203*
Facility Location and Layout and Material Handling Systems. Prerequisites: 3813, 4014 and senior standing. Design principles and analytical procedures for locating and developing an overall functional relationship plan and the methods for materials receipt, storage and movement for either an industrial or service oriented industry. Product-quantity analysis and material flow, and information routing warehouse design, various layout methodologies, and their measures of merit. Introduction to material handling methods and technologies including automated systems. Case studies and field trips are required.

4323*
Manufacturing Systems Design. Prerequisites: 3313, 3503. Principles and procedures related to the design, implementation, documentation, and control of manufacturing systems. Consideration of transfer lines, numerical control, flexible automation, robotics, and manufacturing support activities such as cost, quality, and materials control. Introduction to basic computer-aided design and computer-aided manufacturing (CAD/CAM).

4413*
Industrial Organization Management. Issues, concepts, theories and insights of management with a focus on productivity. Application of management, emphasizing effective performance.

4613*
Production Control. Prerequisite: 4014. Concepts of planning and control of production environments. Design of operation planning and control systems. Techniques used in demand forecasting, operations planning, inventory control, scheduling, and progress control. A production simulator is used to provide a realistic application experience.

4713*
System Simulation. Prerequisites: 4014, STAT 4033. Simulation of discrete-event systems. Problem formulation, translation to a computer model, use of a model for problem solution. Simulation concepts and theory including random variable selection and generation, model validation and statistical analysis of results. Use of simulation languages and related software tools.

4723*
Information Systems for Management Decisions and Control. Prerequisite: 3703. Systems engineering methodology applied to the design of information systems for management of all types of organizations. Data base management systems. Distributed and centralized systems. Different phases of system design and implementation.

4823*
Industrial Ergonomics. Lab 3. Prerequisite: 3813. Characteristics of humans, equipment, and work environment examined using a systems approach. Job designs that concurrently emphasize multiple goals of productivity, safety and employee satisfaction, investigation of psychological, social, safety, reward, training and ergonomic parameters that affect work life of both employee and supervisor.

4913
Senior Design Projects. Lab 6. Prerequisite: limited to students in the final semester of their professional program. 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. (Open only to students in industrial engineering and management.)

4923*
Energy and Water Management. Prerequisites: 3503, ENSC 2213, 2613. Design, implementation and management of energy and water management programs. Energy and water conservation, choice of energy sources, safety and security of fuel storage, contingency planning and use of standby fuels, and choice of rate schedules. Improvement of profits through optimal energy and water utilization. Outside speakers when appropriate.

4931
Industrial Engineering and Management Seminar. Prerequisite: 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.

5000*
Research and Thesis. 1-6 credits, maximum 6. Prerequisite: approval of major adviser. Research and thesis for master's students.

5003*
Statistics and Research Methods. Prerequisite: STAT 4033. 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.

5010*
Industrial Engineering Projects. 1-6 credits, maximum 6. Prerequisites: consent of school head and approval of major adviser. Special graduate projects and independent study in industrial engineering.

5013*
Linear Modeling. Prerequisite: 4014 or equivalent. Model formulation and modeling of linear optimization problems using linear programming and network optimization techniques. Product mix, blending, staffing and covering, and multi-period planning models. Formulation of network problems as linear programming models, including maximum flow, minimum cost, and capacited flow networks.

5020*
Graduate Engineering Practicum. 1-3 credits, 3 maximum. Prerequisites: 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.

5023*
Optimization Applications. Prerequisite: graduate standing. A survey of various methods of unconstrained and constrained linear and nonlinear 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 and MAE 5703.

5030*
Engineering Practice. 1-9 credits, maximum 12. Prerequisite: 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.

5033*
Linear Optimization. Prerequisite: 4014 or equivalent. Algorithms for linear optimization, including linear programming and network optimization. Simplex algorithm to solve deterministic linear optimization models considering maximization and minimization objectives. Degen- eracy, alternative optima and no feasible solutions. Revised simplex procedures. Duality theory, economic interpretations, dual sim-plexing and complementary pivoting. Sensitivity analysis and parametric programming. Interior point methods. Minimum cost, maximum flow, Dijkstra and other network optimization algorithms.

5043*
Nonlinear Optimization. Prerequisite: 5033 or equivalent. Theoretical and practical aspects of nonlinear optimization, integer optimization, and dynamic programming. Development and application of nonlinear optimization techniques for unconstrained and constrained problems; sequential search, gradient, penalty and barrier, and projection methods. Development and application of integer and mixed integer techniques for unconstrained and constrained problems; branch and bound, and cutting methods.

5103*
Breakthrough Quality. Prerequisites: 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.

5113*
Strategic Quality Leadership. Prerequisites: 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.

5123*
Service Quality. Prerequisites: 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.

5133*
Stochastic Processes. Prerequisites: 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 and MATH 5133.

5143*
Reliability and Maintainability. Prerequisites: 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.

5153*
Process Design and Integration. Prerequisite: 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.

5203*
Advanced Facility Location and Layout and Material Handling Systems. Prerequisites: 3503, 4014, 4203. A continuation and expansion of topics covered in 4203 with an emphasis upon model development for predicting and evaluating the effectiveness of production and/or service systems. Advanced analytical and computer techniques.

5303*
Computer Integrated Manufacturing Systems Design for Higher Volume Products. Prerequisites: 4613, 3313 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.

5313*
Computer Integrated Manufacturing Systems Design for Lower Volume Products. Prerequisites: 3313, 4613, 4723 or equivalents. Principles and procedures for design, implementation, documentation, and control of manufacturing systems focusing on lower volume, higher product variety production systems. Product life cycle concepts, concurrent engineering, and computer-aided design and manufacturing practices for systems characterized by frequent product, product mix or product volume changes. Product and production system design and analysis for flexible automation. Operational philosophies and applicable systems engineering concepts, especially those providing system flexibility and those regarding the critical role of information availability and exchange in rapidly changing environments.

5350*
Industrial Engineering Problems. 1-6 credits, maximum 6. Prerequisite: approval of major adviser. A detailed investigation into one area of industrial engineering with a required written report.

5363*
Management of Cellular Manufacturing Systems. Prerequisites: graduate standing and consent of instructor. Issues related to cellular manufacturing systems, including group technology, production control, cell formation and design, office cells, industrial relations, performance measurement, justification and implementation.

5413*
Managing the Engineering and Technical Function. Prerequisite: 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.

5503*
Financial and Advanced Capital Investment Analysis. Prerequisites: 3503, 4014, STAT 4033. 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.

5603*
Project Management. Prerequisite: 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.

5613*
Integrated Manufacturing Control Systems. Prerequisite: 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.

5623*
Project Planning and Control Technologies. Prerequisites: graduate standing and consent of instructor. Project planning and control technologies including time and cost resources required to accomplish projects related to manufacturing, service, and software development enterprises. Project planning and control software: purpose, methods of use, progress reporting, deviation correction, and implementation issues.

5633*
Advanced Production Control. Prerequisites: 4014, 4613, corequisite: 5003. 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 aggregrate 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.

5703*
Discrete System Simulation. Prerequisite: 4713. 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.

5713*
Statistical Topics in Simulation Modeling. Prerequisite: 4713 or 5703. Statistical analysis in simulation modeling of discrete-event systems. Modeling of input processes, random variate generation and analysis of simulation output. Methods applied to any discrete-event simulation.

5723*
Data, Process and Object Modeling. Prerequisites: 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).

5743*
Information Systems and Technology. Prerequisite: 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 manufactur- ing and service organizations. Management issues involved in the use of information technology in organizations.

5753*
Manufacturing Enterprise Modeling. Prerequisites: 5723 or equivalent. Generic Enterprise Reference Architecture (GERAM). Review of data, process, and object modeling techniques. Overview of enterprise modeling tools, methods, and architectures including the CIMOSA method and architecture, IDEF modeling tools, SAP's event-driven process chain (EPC) model, Baan's Dynamic Enterprise Modeling (DEM) approach, and integrated enterprise modeling (IEM) using the object-oriented (OO) approach. Role and scope of methods and tools in enterprise analysis, design and improvement. Emerging modeling frameworks and techniques for next-generation enterprises.

5763*
Supply Chain Strategy. Prerequisites: 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.

5773*
Supply Chain Modeling. Prerequisites: 4713 or 5703; 5013 or 5033 or 5763; 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.

5803*
Human Factors. Lab 3. Prerequisites: 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.

5813*
Performance Measurement Systems. Prerequisites: 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.

5823*
Performance Management and Improvement. Prerequisites: 3813 and 4413 or equivalents. Philosophies and approaches for managing and improving organizational-, group-, and individual-level performance. Historical roots, theoretical foundations, implementation and use, and demonstrated efficacy of these approaches in production and service contexts. Planning, leadership, employee involvement and teams, culture, technology, training, and measurement and reward.

5913*
Decision-making Models for Multi-objective Analysis. Prerequisite: 4014. Quantitative and qualitative aspects of multiple-criteria decision making. Dynamics of the decision process are examined and the multi-objective nature of most managerial decision problems is illustrated. General concepts and solution methodologies of the multi-objective problem. Multi-objective linear programming, goal programming, and compromise programming. Attribute importance, risk measurement, and utility measurement.

5923*
Advanced Energy and Water Management. Prerequisite: 4923. Continuation of material covered in 4923 with an emphasis on modern management techniques. Cogeneration, energy management control systems, private purchases of gas, energy accounting. Significant case study or term paper required.

5943*
Hazardous Material and Waste. Prerequisites: 3503 or equivalent, CHEM 1515. Management of hazardous materials and waste by the generator to reduce operating costs and protect employees. Emphasis on hazard communication program, reducing volume and toxicity, and management activities.

5990*
Special Topics in Industrial Engineering and Management. 1-6 credits, maximum 6. Prerequisite: 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.

6000*
Research and Thesis. 1-15 credits, maximum 30. Prerequisites: approval of major adviser and advisory committee. Independent research for Ph.D. dissertation requirement under direction of a member of the Graduate Faculty.

6110*
Special Problems in Industrial Engineering. 1-6 credits, maximum 12. Prerequisites: 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.

6123*
Queueing Systems: Theory and Manufacturing Applications. Prerequisites: 5003, STAT 4033, 5133 or consent of instructor. Review of probability, stochastic processes, and Markov chains. Single-server and multi-server exponential queueing models. Queueing models with Poisson arrivals and general service times. Product form queueing 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 nonproduct form networks. Applications of queueing models in the performance analysis of transfer lines, automatic assembly systems, and flexible manufacturing systems.

6990*
Advanced Topics in Industrial Engineering and Management. 1-6 credits, maximum 6. Prerequisite: 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.

International Studies (INTL)

5000*
Thesis. 1-6 credits, maximum 6. Prerequisites: graduate standing and consent of adviser. For students studying for a master's degree in international studies under the thesis option.

5010*
Contemporary Issues in International Studies. 1-6 credits, maximum 6. Prerequisite: graduate standing. Study of contemporary international issues including news reports, speeches from foreign dignitaries, political leaders and experts in selected international fields.

5110*
International Studies Practicum. 1-6 credits, maximum 6. Prerequisites: graduate standing and consent of adviser. For students studying for a master's degree in international studies under the creative component option.

5213*
International Relations, Affairs and Policy. Prerequisite: graduate standing. Research on the mechanics and theories of interaction between economic and political phenomena. Same course as POLS 5213.

5223*
Culture, History and World Systems. Prerequisite: graduate standing. Study of the impact and influence of culture and history on the development of contemporary world systems with future projections.

5233*
Global Competitive Environment. Prerequisite: graduate standing. 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 MBA 5233.

Japanese (JAPN)

1115
Elementary Japanese I. Pronunciation, conversation, grammar and reading.

1225
Elementary Japanese II. Prerequisite: 1115 or equivalent. Reading, the writing system, culture, grammar, conversation.

2113
(I)Intermediate Japanese I. Prerequisite: 1225 or equivalent proficiency. Oral and written practice of modern Japanese. A continuation of 1225.

2223
(I)Intermediate Japanese II. Prerequisite: 2113 or equivalent proficiency. A continuation of 2113.

3012
(I)Advanced Japanese Conversation I. Designed to increase facility and naturalness of delivery in dialogue. Development of general oral and aural proficiency.

3112
(I)Advanced Japanese Conversation II. Designed to increase facility and naturalness of delivery in dialogue. Development of general oral and aural proficiency.

3133
(I)Readings in Japanese I. Development of the student's competence in reading a wide variety of materials by contemporary Japanese writers. Designed to be taken concurrently with 3223.

3333
(I)Readings in Japanese II. Prerequisite: 3133. A continuation of 3133.

Journalism and Broadcasting (JB)

1143
(S)Media and Society. An overview of the characteristics of newspapers, magazines, photojournalism, radio, television, film, advertising, public relations and interactive media, emphasizing the media's impact and role in American society.

2003
Mass Media Style and Structure. Lab 2. Prerequisites: CS 1003, ENGL 1113 and ENGL 1213 with grade of "C" or better. Elementary writing and editing techniques in print, broadcasting and other media.

2013
Principles of Advertising. Process of advertising examined from the perspectives of art, business and communication. Introductory course for majors and non-majors that surveys advertising and how it fits into society. Applications of integrated marketing communication, consumer behavior, segmentation and target marketing, advertising research, creative and media strategy, international advertising and local advertising.

2183
Principles of Public Relations. An introduction to the history, development and current practice of public relations as a process in building relationships between organizations and publics.

3013
Advertising Media and Markets. Prerequisites: 2003 with "C" or better, 2013 with "C" or better, minimum grade of 70 on Language Exam. Introduction to the strategic use of media. Major principles of media planning and buying, audience measurement, media re-search, new media technology, and market segmentation. Television, radio, magazine, newspaper, outdoor and the Internet.

3153
Fundamentals of Audio and Video Production. Lab 2. Prerequisites: 2003 with "C" or better, minimum grade of 70 on Language Exam. Theory and practice of basic audio and video production techniques leading to later applications in radio, television and multimedia production.

3173
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.

3263
Reporting. Lab 2. Prerequisites: 2003 with "C" or better, minimum grade of 70 on Language Exam. Reporting and writing through enterprise techniques for news coverage.

3283
Public Relations Communications Methods. Prerequisites: 2003 with "C" or better, 2183 with "C" or better, minimum grade of 70 on Language Exam. An analysis and ap-plication course focused on the communications methods and techniques used in the practice of public relations.

3293
Visual Communication. Prerequisites: 2003 with "C" or better, minimum grade of 70 on Language Exam. Use of photographs, charts, graphs and other visual representations in the mass media; the language of pictures; theories of nonverbal communication visual aids in education and other information systems.

3313
News Editing I. Lab 2. Prerequisites: 3263 with grade "C" or better, minimum grade of 70 on Language Exam. Copy editing, design and headline writing for newspapers and magazines.

3383
Public Relations Management and Strategies. Prerequisites: 2003 with grade "C" or better, 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.

3400
Advertising Internship. 1-3 credits, maximum 3. Prerequisites: 2003 with grade of "C" or better; 2013 with grade of "C" or better; minimum grade of 70 on Language Exam; consent of instructor. Internship practice for qualified advertising students who wish creative communications experience beyond that available in the classroom.

3500
News Editorial Internship. 1-3 credits, maximum 3. Prerequisites: 3263 with grade of "C" or better; minimum grade of 70 on Language Exam; consent of instructor. Internship practice for qualified news editorial students who wish creative communications experience beyond that available in the classroom.

3553
Broadcast News Writing I. Lab 3. Prerequisites: 3153 with "C" or better, 3263 with "C" or better, minimum grade of 70 on Language Exam. Broadcast news writing and reporting techniques with emphasis on radio coverage. Familiarization with news values, news services, broadcast equipment. Lab work in news reporting and writing.

3600
Public Relations Internship. 1-3 credits, maximum 3. Prerequisites: 3283 with grade of "C" or better; minimum grade of 70 on Language Exam; consent of instructor. Internship practice for qualified public relations students who wish creative communications experience beyond that available in the classroom.

3603
Advertising Copywriting. Lab 2. Prerequisites: 2003 with "C" or better, 2013 with "C" or better, minimum grade of 70 on Language Exam. An examination of the language of advertising. In-depth skills development in commercial writing for print, broadcast, and direct mail.

3623
Internet Communications. Lab 2. Prerequisite: 2003 with "C" or better, 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.

3753
Graphic Communication. Lab 3. Creative and practical aspects of typography, layout and design, and production of printed communication.

3800
Broadcast Operations. 1 credit, maximum 2. Lab 2. Prerequisites: 3153 with "C" or better, minimum grade of 70 on Language Exam. Preparation and participation in the operation and coordination of student managed radio and television facilities.

3803
Advertising Layout and Design. Prerequisites: 2003 with grade of "C" or better; 2013 with grade of "C" or better; minimum grade of 70 on Language Exam. A comprehensive look at the design of print advertising, magazine, outdoor, direct mail, and others. Lab component offers hands-on instruction and skills development.

3823
Photography I. Lab 3. Taking and processing photographs: cameras, lenses, films, printing, and developing; essentials of good pictorial composition. For students who want an elementary understanding of photography, or to prepare for advanced work in photography or photojournalism.

3843
Sports and the Media. Prerequisites: 3263 with grade "C" or better, minimum grade of 70 on Language Exam. Reporting skills to cover the sports beat and an understanding of the history of sports journalism and sports and culture in America. Reporting, feature writing and column writing in sports for print journalism.

3873
Audio Production. Lab 2. Prerequisites: 3153 with "C" or better, minimum grade of 70 on Language Exam. Theory and practice of communication using electronic media. Students prepare and present materials in a broadcasting situation.

3900
Broadcast Internship. 1-2 credits, maximum 2. Prerequisites: 3153 with "C" or better, minimum grade of 70 on Language Exam, and consent of instructor. Preparation and participation in all phases of radio-television and cable through active internship program.

3913
Video Production. Lab 3. Prerequisite: 3153 with "C" or better, minimum grade of 70 on Language Exam. Television production techniques, including camera, audio, lighting, staging, producing, graphics and on-camera performance.

3943
Photojournalism. Lab 2. Prerequisites: 2003 with "C" or better, minimum grade of 70 on Language Exam. Theory and practice in the digital techniques of photojournalism. Intermediate concepts of lighting, composition, action and story telling via digital photography. A basic understanding of photography and photo developing necessary. Must have access to 35mm single reflex or digital camera.

4033
Communication Technology. Prerequisites: 2003 with "C" or better, minimum grade of 70 on Language Exam. Overview of satellite delivery of print media, radio, television and cable program services, data services, computer technology; public relations and advertising uses of the new technologies.

4123
Public Relations Crisis Communications. Prerequisites: 2003 with grade of "C" or better; 3283 with grade of "C" or better; minimum grade of 70 on Language Exam. The nature of organizational crises and the techniques for preparing crisis communications plans for various types of organizations.

4163
Mass Communication Law. Prerequisite: 2003 with grade of "C" or better, minimum grade of 70 on Language Exam. Statutes and case decisions in print and broadcast law, including government regulation of broadcasting by the FCC and media relations with other regulatory agencies. Meets with MC 5163. No credit for students with credit in MC 5163.

4223
Media Sales and Marketing. Prerequisite: 2003 with grade of "C" or better, minimum grade of 70 on Language Exam. Sales development, pricing, promotion and other aspects of broadcast sales and sales management.

4243
Programs and Audiences. Prerequisite: 2003 with grade "C" or better, minimum grade of 70 on 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.

4253
(I)International Mass Communications. 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. Meets with MC 5253. No credit for students with credit in MC 5253.

4263
Broadcast Management. Prerequisites: 2003 with grade "C" or better, minimum grade of 70 on Language Exam. Functions, structure and organization of the broadcasting industry; special problems in broadcast station management, including personnel, sales, programming and government regulations.

4313
Public Affairs Reporting. Lab 2. Prerequisites: 3263 with grade "C" or better, minimum of 70 on Language Exam. Coverage of social problems, people and events in fields of government, business, science, sports and entertainment.

4360
Special Problems in Journalism and Broadcasting. 1-3 credits, maximum 6. Prerequisites: junior standing, a minimum of 3.00 GPA, or consent of instructor. Independent study and project development to fit the student's major or minor specialization.

4393
Computer-assisted Journalism. Prerequisites: 3263 with grade "C" or better, minimum grade of 70 on Language Exam, STAT 2013. Access by news media and communication specialists to electronic sources of information primarily through the Internet. A skills course in understanding and applying ways to obtain and share information through computer access.

4413
Advanced Reporting and Writing. Prerequisites: 4313 with grade "C" or better, minimum grade of 70 on Language Exam. Enhancement of writing style and reporting techniques; evaluation of sources and polling practices, and investigative coverage of newsmakers and events.

4423
News Editing II. Lab 2. Prerequisites: 3313 with grade "C" or better, minimum grade of 70 on Language Exam. Advanced copy editing; ethics and legal considerations from an editor's viewpoint; design techniques for newspapers and magazines including picture editing, introduction to type, makeup and design practices, and special pages.

4433
Feature Writing for Newspapers and Magazines. Prerequisites: 15 credit hours of English or journalism. Newspaper features and special articles for general circulation magazines, business and trade journals; sources, materials, markets and other factors pertinent to nonfiction writing.

4493
Advanced Public Relations Media. Lab 2. Prerequisites: 3263 with grade "C" or better, 3283 with grade "C" or better, minimum grade of 70 on Language Exam. An advanced application course in planning, researching, writing, editing and designing of materials used in public relations communications.

4520
Specialized Public Relations Applications. 3 credits, maximum 6. Prerequisites: 3283 with grade "C" or better, minimum grade of 70 on Language Exam. Professional public relations at an advanced level. Public relations study of non-profit, corporate, agency, international and other specialized applications. Course content varies by semester. Meets with MC 5520. No credit for students with credit in MC 5520.

4553
Broadcast News Writing II. Lab 3. Prerequisites: 3553 with grade "C" or better, minimum grade of 70 on Language Exam. Advanced broadcast news writing with emphasis on techniques of feature and in-depth reporting for radio, television and cable television. Students work up to two full-time days per semester producing OSU cable news show and serve as writers and anchors.

4573
Broadcast Documentary. Lab 3. Prerequisites: 3553 with grade "C" or better, 3913 with grade "C" or better, minimum grade of 70 on Language Exam. Student-written and produced broadcast and cablecast mini-documentaries; analysis of selected programs.

4603
Integrated Marketing Communications. Prerequisites: 2003 with grade "C" or better; 2013 with grade "C" or better or 2183 with grade "C" or better or MKTG 3213 with grade "C" or better; minimum grade of 70 on 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. Meets with MC 5603. No credit for students with credit in MC 5603.

4623
Advertising Campaigns. Prerequisites: 3603 with grade of "C" or better; 3803 with grade of "C" or better; minimum grade of 70 on Language Exam. Planning, preparation and presentation of comprehensive advertising and marketing campaigns for national or local clients. Student teams produce all aspects of the campaign, from conception to presentation. Satisfies capstone requirement for advertising majors.

4653
Electronic Media Advertising. Lab 2. Prerequisites: 3603 with grade of "C" or better, minimum grade of 70 on Language Exam. A concentrated examination of how advertising is prepared for electronic media, including developing media technologies. Radio, television, web-based streaming and Internet and their unique contribution to advertising.

4662
Professional Portfolio. Lab 2. Prerequisites: 2003 with grade of "C" or better, minimum grade of 70 on Language Exam. The advanced design skills necessary to compete in the creative sector of the advertising, graphic or other industry. Advanced theories of design in the construction of professional creative materials, and the elements of effective persuasive communication.

4773
Censorship. Prerequisites: 2003 with grade of "C" or better, minimum grade of 70 on 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. Meets with MC 5773. No credit for students with credit in MC 5773.

4843
Public Relations Research and Campaigns. Prerequisites: 3283 with grade "C" or better, minimum grade of 70 on Language Exam. Capstone course requiring public relations students to prepare a public relations campaign involving the public relations process; research, planning, communications and evaluation.

4863
Media Management. Prerequisites: 2003 with grade "C" or better, minimum grade of 70 on Language Exam. Basic issues, theoretical concepts and operational procedures associated with managing newspapers, magazines, advertising, public relations, broadcast and cable companies and firms specializing in computer-mediated communications. Meets with MC 5863. No credit for students with credit in MC 5863.

4953
Advanced Production Practices. Lab 3. Prerequisites: 3913 with grade "C" or better or 4553 with grade "C" or better, minimum grade of 70 on Language Exam. Advanced professional television production. Student produced and directed television programs, including "specials," for distribution on cable or other professional media.

4980
Advertising Competitions. 3 credits, maximum 6. Prerequisite: 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.

4993
Senior Honors Thesis. Prerequisites: 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 journalism and broadcasting.

Landscape Architecture (LA)

1013
Introduction to Landscape Architecture and Landscape Contracting. An overview of the field of landscape architecture and landscape contracting with emphasis on the role of the landscape architect/landscape contractor and the need for design and management of outdoor space and structures and the environment.

2213
Landscape Architecture Graphics I. Lab 6. Recommended: 3 hours credit in freehand drawing or drafting. Drafting and illustration techniques for developing and presenting landscape concepts and designs in black and white media. Computer graphics applications including illustration, typesetting, scanning and visualization techniques.

2223
Landscape Architecture Graphics II. Lab 3. Prerequisite: 2213. The application of multimedia color presentation and delineation techniques to more complex plans, drawings and programs.

2323
Computer-aided Design. Lab 2. Prerequisite: 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.

3010
Internship in Landscape Architecture and Landscape Contracting. 1-6 credits, maximum 6. Prerequisites: 45 credit hours, consent of internship chairperson. Supervised work experience with approved public and private employers in landscape architecture, landscape contracting or related fields. May not be substituted for other required courses.

3112
Landscape Architecture Seminar I. Prerequisite: 1013. Professional analysis of various aspects of the landscape architecture profession and designed works with guest speakers and in-state or regional field trips to completed works. Required of fourth year students.

3314
Landscape Architectural Design I. Lab 8. Prerequisites: 1013, 2223 and 2323. Introduction to the principles of design, problem solving, site analysis, and the correlation of aesthetic concerns with functional solutions in small-scale landscape architecture design problems and computer-aided design applications.

3324
Landscape Architectural Design II. Lab 8. Prerequisite: 3314. The design of small to medium scale areas with an emphasis on design process, site analysis and computer-aided design applications.

3673
(H)History and Theory of Landscape Architecture. History and historic styles and approaches to landscape architectural design. Past and present landscape design theory.

3682
Professional Practice and Office Procedure. Ethics, office practice and procedure. Contract documents and specifications relating to landscape architecture.

3884
Landscape Architectural Construction I. Lab 4. Prerequisites: 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.

3894
Landscape Architectural Construction II. Lab 4. Prerequisites: 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.

4034*
Landscape Planting Design. Lab 4. Prerequisites: 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.

4112
Landscape Architecture Seminar II. Prerequisite: 4514. Topics in landscape architecture and related fields, career exploration and job placement. Out-of-state field trips to completed landscape architecture projects. Required of fifth year students.

4414*
Landscape Architectural Design III. Lab 8. Prerequisites: 3324, 3884. Medium scale site development projects with an emphasis on landforms, structures and computer-aided design applications. Portfolio must be reviewed and approved in Design II for admittance to the professional phase of the program.

4424*
Landscape Architectural Design IV. Lab 8. Prerequisites: 4414, 4894. Medium-scale complex landscape architectural design projects with emphasis on arrangement and design of landscape elements as they relate to functional and aesthetic qualities. Integration of landscape construction detailing, drawings as part of design presentation, and computer-aided design applications.

4433*
Land Use and Community Planning. Lab 3. Prerequisite: 3313. 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.

4514*
Landscape Architectural Design V. Lab 8. Prerequisites: 4424, 4894. The design of large-scale sites with an emphasis on mixed use developments and computer-aided design applications.

4524*
Landscape Architectural Design VI. Lab 10. Prerequisite: 4514. A capstone course with a large scale development project in urban design, recreation or resource planning with computer-aided design applications, summarizing previous planning, design and construction course work.

4534
Landscape Architecture Vertical Design Studio. Lab 8. Prerequisite: 2223. Individual studio projects geared to design, course level. Offered on demand. Can be substituted for one landscape architecture design course (LA 3314, 3324, 4414, 4424, 4514, or 4524).

4573*
Recreation Planning. Lab 6. Prerequisite: consent of instructor. Theory and methods for small and large scale area planning with emphasis on natural and cultural resources.

4583*
Landscape Environmental Planning. Lab 6. Prerequisite: 3324. Development of landscape architectural projects in the context of conservation, preservation, urban, regional planning and other developmental design problems encountered by the landscape architect.

4680
Landscape Architecture Assembly. 1 credit, maximum 4. Presentations by faculty members and guest speakers dealing with various aspects of landscape architecture or related fields.

4894*
Landscape Architectural Construction III. Lab 4. Prerequisites: 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.

4990*
Landscape Architecture Special Problems. 1-6 credits, maximum 12. Prerequisite: consent of appropriate faculty member. Landscape architectural related problems.

5110*
Advanced Special Problems. 1-12 credits, maximum 20. Prerequisite: consent of appropriate faculty member. Specific landscape architectural problems.

Latin (LATN)

1113
Elementary Latin I. The rudiments of beginning Latin: grammar, vocabulary and elementary readings.

1223
Elementary Latin II. Prerequisite: 1113 or equivalent proficiency. Continuation of 1113. Grammar, vocabulary and readings.

2113
Elementary Latin III. Prerequisite: 1223 or equivalent. A continuation of 1223. Grammar and readings of Latin authors.

2213
Intermediate Readings. Prerequisite: 2113 or equivalent proficiency. Readings from Virgil's *Aeneid*.

3330
Advanced Readings in Latin. 1-6 credits, maximum 9. Prerequisite: 2213. Prose authors, poetry, and medieval Latin.

Legal Studies in Business (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.

3010
Special Topics in Legal Studies in Business. 1-3 credits, maximum 6. Prerequisites: 3213, prior consent of instructor. Analysis of a contemporary topic in business law. Changing social issues and trends in legal studies in business.

3213
Legal and Regulatory Environment of Business. Prerequisite: 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 activitiy, the nature of government regulation, fundamental principles of tort and contract law.

3323
Law of Commercial Transactions and Debtor-Creditor Relationships. Prerequisite: 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.

3423
Employment Law. Prerequisite: 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.

4413*
Law of Business Organizations. Prerequisite: 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.

4523*
Law of Real Property. Prerequisite: 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.

4633*
(I)Legal Aspects of International Business Transactions. Prerequisite: 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, antitrust aspects of international business, and jurisdictional problems in resolving disputes.

5163*
Legal Environment of Business. Prerequisite: graduate standing. 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.

Leisure (LEIS)

1212
Beginning Swimming. Lab 2. Theory and practice of swimming strokes; techniques and basic water safety skills.

1232
Beginning Golf. Lab 2. Theory and practice of basic skills, rules, terminology and etiquette.

1242
Beginning Tennis and Racketball. Lab 2. Theory and practice of tennis and racketball; basic skills, rules, terminology, and game strategy for singles and doubles play. No credit for students with credit in 1252.

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.

1322
Bowling. Lab 2. Theory and practice of approaches, deliveries, releases and mechanical principles involved in aiming and follow through.

1342
Physical Fitness. Lab 2. Theory and practice of aerobic and weight training activities with learning experiences designed to promote physical fitness.

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.

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.

2112
Rock Climbing. Lab 2. Theory and practice in the basics of technical rock climbing, bouldering and spelunking.

2122
Backpacking and Hiking. Lab 2. Theory and practice of outdoor skills and leadership techniques for executing and evaluating a wilderness activity.

2212
Intermediate Golf. Lab 2. Prerequisite: 1232. Development of swing principles, analysis of errors in direction and distance, trouble shots, handicapping, tournament play and rules.

2222
Intermediate Tennis. Lab 2. Prerequisite: 1252. Theory and practice of advanced serves and strokes; strategy for singles and doubles play; rules and competitive tennis.

2322
Recreational Dance. Lab 2. Theory and practice of traditional social dances and a variety of "free style" dance forms.

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.

2433
Introduction to Therapeutic Recreation. Theory and application of therapeutic recreation with emphasis on types of illnesses and disabilities, delivery systems, programming and services.

2462
Laboratory in Leisure Services. Lecture, discussion and experiential learning of recreation and leisure activity. Adapted activities, small and large group games, sports, arts and crafts, music, drama and cultural events. Fee required.

2473
Foundation of Leisure Service Leadership. Lab 2. Introduction to the principles and practical applications of group leadership techniques, problem solving, supervision and evaluation of personnel.

3010
Leisure Services Workshop. 1-3 credits, maximum 6. Intensive training program on a specialized topic in leisure services.

3212
Lifeguard Training. Lab 2. Prerequisites: 2372. Theory and practice of water safety and rescue skills essential for lifeguards. May obtain American Red Cross Lifeguard Training Certification.

3333
Outdoor Pursuits. Lab 1. Field based course to understand origins and components of involvement in outdoor pursuits. Numerous skills applied to various outdoor settings.

3430
Practicum in Leisure Services. 1-3 credits, maximum 3. Prerequisites: 2413. Supervised practical experience with leadership responsibilities for planning, conducting and evaluating activities and programs. Graded on a pass-fail basis.

3453
Advanced Practices in Leisure Services Leadership. Prerequiste: 2423. Advanced techniques in principles and practices of group leadership; problem solving; supervision and evaluation of personnel.

3463
Program Design in Leisure Services. Emphasis on organization, supervision, promotion and evaluation of programs.

3473
Evaluation of Leisure Services. Prerequisite: 2413, 3463 or consent of instructor. Methods, techniques and application of the evaluation process related to a wide variety of leisure service functions: clientele, programs, personnel, facilities and organization.

3483
Principles and Clinical Practices in Therapeutic Recreation. Lab. Prerequisite: 2433 or consent of instructor. Clinical intervention techniques and strategies, including treatment techniques, leisure education and role of recreation in the treatment process.

3491
Pre-internship in Leisure Services. Preparation for internship in therapeutic recreation and leisure services management.

4010
Directed Studies in Leisure. 1-3 credits, maximum 6. Prerequisites: consent of instructor and program head. Supervised readings, research or study of trends and issues related to leisure studies.

4213
Water Safety Instructorship. Lab 1. 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).

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.

4463*
Areas and Facilities in Leisure Services. Prerequisites: 3463 or consent of instructor. Planning, design and development of areas and facilities in leisure service delivery systems.

4473*
Outdoor Recreation. Theory and practical application of outdoor recreation concepts with emphasis on philosophies, principles, policies, economics, trends and problems.

4480
Internship in Leisure Services. 1-12 credits, maximum 12. Prerequisite: last semester senior year with cumulative GPA of 2.50. Supervised field work experience in leisure services management or therapeutic recreation. Graded on a pass-fail basis.

4482
Senior Seminar in Leisure Services. Prerequisite: LEIS major. Culmination of course work in leisure studies. Examination of current issues, professional practices and personal philosophy of leisure.

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.

4513*
Leisure Education. Prerequisite: 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.

4523*
Program Design in Therapeutic Recreation. Lab. Prerequisite: 3483 or consent of instructor. Systematic approach to the development, design and evaluation of therapeutic recreation programs.

4563*
Entrepreneurial Leisure Services. Prerequisite: 3463 or consent of instructor. Introduction to the scope, characteristics and management aspects of the commercial recreation industry from an entrepreneurial perspective.

4573*
Leadership in Experiential Education. An investigation of leadership styles and management models with an application to adventure based education.

4580*
Technical Management in the Wilderness. 1-6 credits, maximum 6. Developing technical competencies in back country navigation, emergency medical care and evaluation, winter Nordic mountaineering, technical rock climbing, hazard analysis and expedition planning.

4903*
Grantwriting and Fund-raising in Non-profit Agencies. Methods, techniques and direct experience in acquiring funds and in-kind resources necessary for the operation of philanthropic agencies.

4913*
Managing Non-profit Agencies. Management skills necessary for the development and ongoing operation of a non-profit agency.

4933*
Advanced Methods in Therapeutic Recreation. Prerequisites: 3483 and consent of instructor. Theoretical and practical examination of contemporary implementation procedures used in therapeutic recreation practice.

5000*
Master's Thesis. 1-6 credits, maximum 6. Prerequisite: consent of major professor. Research in leisure studies for master's degree.

5020*
Workshop in Leisure Studies. 1-6 credits, maximum 6. Prerequisite: consent of instructor. Advanced instruction on specialized topic area in leisure studies.

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.

5030*
Field Problems in Leisure Studies. 1-6 credits, maximum 6. Prerequisite: consent of instructor. Applied research within the practice of leisure studies.

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.

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.

5433*
Current Issues in Leisure Services. Prerequisite: admission to the leisure studies program. Current issues related to the leisure services profession. Investigation, discussion and analysis of contemporary issues.

5443*
History and Philosophy of Leisure. Contributions of recreation and leisure and its effect on humans throughout history. Additional philosophical foundations in relation to current times.

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.

5463*
Issues in Therapeutic Recreation. Prerequisite: LEIS 2433 or professional experience in therapeutic recreation. Current issues in therapeutic recreation with emphasis on accreditation, certification, licensure, quality assurance and ethics.

5473*
Leisure and Aging. Prerequisite: 2433 or consent of instructor. Overview of the leisure needs and services for older adults, with emphasis upon the delivery system and leisure interventions.

5483*
Therapeutic Recreation for Persons with Physical Disabilities. Prerequisite: 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.

5493*
Therapeutic Recreation in Mental Health and Mental Retardation. Prerequisite: 3483 or consent of instructor. Role of therapeutic recreation in mental health with emphasis upon client prognosis and methodologies of treatment programs.

6000*
Doctoral Dissertation. 1-25 credits, maximum 25. Required of all candidates for the Doctor of Philosophy degree. Credit is given upon completion of the dissertation.

6010*
Independent Study in Leisure Studies. 1-6 credits, maximum 6. Prerequisite: consent of instructor. Supervised readings, research or study of trends and issues related to leisure studies.

6013*
Professional Issues in Leisure Studies. Prerequisite: 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.

6020*
Leisure Research Colloquium. 1-3 credits, maximum 6. Prerequisite: doctoral standing. Exploration and presentation of selected topics and research in leisure studies.

6023
Special Topics in Leisure Studies. Prerequisite: admission to the Graduate College. Special topics related to recreation, parks and leisure studies. Investigation, discussion and analysis of contemporary topics.

6453*
Leisure Behavior. The advanced study of leisure and human behavior. Research related to the understanding of how and why humans engage in leisure.

6763*
Management in Health, Leisure, and Human Performance Settings. Prerequisite: 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)

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.

4313*
Young Adult Literature. 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. Same course as CIED 4313.

5013*
Library Media Center in the Schools. Effective utilization of the centralized school media center for the teaching-learning process.

5113*
Selection of Print and Non-print Materials. Selection, evaluation and use of print and non-print materials including reference materials.

5413*
Cataloging and Classification. Basic principles of cataloging, with practice based on functional application of current codes and manuals recognized by the profession.

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.

5823*
Administration of Library Media Programs. Selecting and purchasing equipment and materials for the school library media program, evaluating existing materials; for teachers who are responsible for school library media programs.

Management (MGMT)

3013
Fundamentals of Management. Survey of management principles and techniques. Variety of issues at individual, team and organizational levels. Challenges faced by today's managers. For nonbusiness majors. Does not apply to a College of Business Administration major's degree program.

3123
Managing Behavior and Organizations. Managing behavior and organizations with an emphasis on understanding performance. Performance expectations and determinants at the individual, team and organizational levels. For College of Business Administration majors only. Nonbusiness majors see MGMT 3013.

3133
Management Performance Development. Prerequisite: 3123. The study of personal, interpersonal and group factors relating to managerial performance. An integration of the theory and practice of management.

3313
Human Resource Management. Prerequisite: 3123. Policies and practices used in personnel management. Focuses upon the functions of a human resource management department.

3943
Sports Management. Prerequisite: 3123. An understanding of the basic management skills necessary in the operation of sport organizations. The social, behavioral and managerial foundations of sport management, public relations, finance, economics, and budgeting in the sport industry, and managing a sports facility.

4013
Current Topics in Management and Leadership. Prerequisite: 3123. Examination of selected topics representing the most current management and leadership theories and practices.

4123*
Labor Management Relations. Prerequisite: 3123. Labor relations and collective bargaining. Negotiation and administration of labor agreements and employee relations in nonunion organizations. Modes of impasse resolution.

4133*
Compensation Administration. Prerequisites: 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.

4213*
Managing Diversity in the Workplace. Diversity in the workplace as a business issue that affects performance. Companies' adaptation and alignment with the population they serve or represent. The development of a cohesive work team made up of individuals who differ in gender, age, race and national origin.

4313*
Organization Theory and Development. Prerequisite: 3123. The design of formal organizations with an emphasis on topics related to organizational and managerial effectiveness. Focus on what is known about managerial and organizational effectiveness and how this knowledge may be applied.

4413
Change Management. Prerequisite: 4313 or equivalent. 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.

4533*
Leadership Dynamics. Prerequisite: MGMT 3123 or equivalent. Leadership applications in business management. Contemporary business challenges require managerial leadership of the highest order. Students will be exposed to the latest developments in leadership theory and research. A cornerstone of the course will be the emerging construct of transformational leadership. The course emphasizes readings, class discussions, experiential exercises, and group projects to facilitate learning.

4613
International Management. Prerequisite: 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.

4650
Leadership Issues. Prerequisite: 3123. Examination of leadership issues. Specific topics vary from semester to semester.

4693*
International Human Resource Management. Prerequisites: 3123 required, 3313 preferred and LSB 3423 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.

4713*
Negotiation Essentials. Prerequisite: 3123. Fundamentals of effective negotiation and dispute resolution practices. Current theory, strategies and tactics. More effective negotiations and how to secure "win-win" solutions.

4813*
Staffing Organizations. Prerequisite: 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.

4850
Applied Leadership Studies. 1 to 6 credits, maximum 6. Prerequisite: 3123. Structured internship of field project with supporting academic study.

5113*
Management and Organization Theory. Prerequisite: admission to MBA program or consent of MBA director. Contemporary theories of organization. Structure and dynamics of organizational goals and environments.

5123*
Contemporary Management Topics. Prerequisite: admission to MBA program or consent of MBA director. Examination of selected topics representing the most current management theories and practices.

5213*
Seminar in Organizational Behavior. Prerequisite: 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.

5223*
Seminar in Human Resource Management. Prerequisite: 5113 or consent of instructor. 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.

5313*
Project Management. Prerequisite: admission to MBA 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.

5323*
Teams in Organizations. Prerequisites: 5113, admission to the MBA program, or consent of the 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.

5333*
Managing the Electronic Commerce Enterprise. Prerequisites: 5113 and admission to the MBA, MSTM, or MS in MIS/AIS program or consent of instructor. Organizational issues faced by nascent internal electronic commerce enterprises and traditional "brick & mortar" organizations as they navigate their worlds as internet pureplays or evolve into "click & mortar" organizations. Strategic alliances, experimental organizational forms, and organization of human resource systems.

5413*
Fundamentals of Entrepreneurship for Science and Technology. Prerequisite: graduate standing. For nonbusiness majors with fundamental knowledge of entrepreneurship. Course allows such majors to pursue advanced business courses in technology commercialization or entrepreneurship.

5453*
Technology Commercialization. Prerequisites: admission to the MBA program or consent of the MBA director. The steps involved in evaluating and commercializing new technologies. The necessary steps in moving from prototype to product.

5513*
Advanced Strategic Management and Business Policy. Prerequisite: MBA core courses. A terminal integrating course with emphasis on formulating and implementing basic policy decisions for business. An analytic approach to strategic decisions pursued through readings, cases and participation in a complex computer game.

5533*
Leadership Challenges. Prerequisites: 5113, admission to the MBA program or consent of the MBA director. Contemporary leadership practices. Leadership as a behavior, not as a position. The challenges of leadership, regardless of position.

5553*
Management of Technology and Innovation. Prerequisite: MBA core courses or consent of instructor. 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.

5563*
Crisis in Organizations. Prerequisites: 5113, admission to the 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.

5613*
Business Opportunity Identification and Analysis. Prerequisites: admittance to the MBA program or consent of the MBA director. The techniques required for locating business opportunities, assessing their feasibility, and evaluating their potential returns.

5653*
Business Development and Venture Capital. Prerequisites: 5613, admittance to MBA program or consent of MBA director. Venture capital investing and the business development process investments. Essentials of the venture capital industry and corporate venturing.

5713*
Negotiation and Third-Party Dispute Resolution. Prerequisites: admission to MBA program or consent of MBA director. The fundamentals of effective negotiation and dispute resolution practices. Current theory, strategies and tactics.

5743*
International Negotiations. Prerequisites: admission to the MBA program or consent of the MBA director. Improvement of negotiation skills and learn how cultural and national issues affect negotiations.

6313*
Advanced Organizational Behavior. Prerequisites: doctoral 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.

6323*
Advanced Strategic Management. Prerequisites: doctoral student standing and consent of instructor. Research concerning the content of organizational strategy and the process through which it is formulated and implemented.

6333*
Meso Organization Studies. Prerequisites: 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.

6343*
Contemporary Research in Management. Prerequisites: doctoral student standing and consent of instructor. Specialized contemporary topics in management for doctoral students.

6353*
Advanced Methods in Management Research. Prerequisites: doctoral student status 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.

6553*
Structural Equation Modeling Applications in Business. Prerequisites: 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)

2103
Business Computer Concepts and Applications. Prerequisite: MATH 1513. Concepts for the design, operation, and use of computer information systems in organizations, including fundamentals of key information technologies, approaches to computer-supported problem-solving, and use of personal computing applications. Practical computer-based training in fundamental productivity software and Internet tools.

2203
Computer Programming for Business. Prerequisites: 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.

3103
Database Systems Design, Manipulation, and Management for End Users. Prerequisites: 2103 or equivalent. 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 or MSCS majors.

3203
Advanced Computer Programming for Business. Prerequisite: 2203. Advanced programming features are examined with an emphasis on the development of computer programs for business application. File processing including magnetic tape sequential files, disk-indexed sequential files, and virtual storage applications are an integral part of the course. Subjects and techniques such as TSO, segmentation, debugging tools and procedures, and pertinent JCL are also studied and applied.

3223
Production and Operations Management. Prerequisites: 2103 and STAT 2023 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.

3233
Management Science Methods. Prerequisites: 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.

3243
Managerial Decision Theory. Prerequisites: 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.

3303
Systems Analysis and Design. Prerequisite: 2203. 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 project management.

3363
Advanced Management Information Systems Programming. Prerequisite: 2203 or equivalent. Programming tools with applications in industry. Advanced programming procedures, processes and algorithms.

3373
File and Data Management for Business. Prerequisite: 2203. A survey of business data storage methodologies and approaches and of file management methodologies for business enterprises.

4010
Applied Management Science and Information System Studies. Prerequisites: consent of department head; MIS and MSCS majors only. Structured internship, field study or independent project with supporting academic study.

4013
Database Systems Design, Management, and Administration. Prerequisites: MSIS 3303 and MSIS 3363. Theoretical aspects and business of data models and databases. Data security, maintaining database integrity, and database administration in a shared, networked or distributed environment. Related database concepts including object-oriented databases and web database development. Analysis, design, and implementation of a database system using advanced DBMS tools and high-level languages to retrieve, manipulate data. Required for MIS or MSCS majors.

4113
Enterprise Systems and Collaborative Commerce. Prerequisite: 4013. 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.

4133
Information Technologies for Electronic Commerce. Prerequisite: 4013. 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.

4263
Knowledge Management Tools and Techniques. Prerequisite: 3303. Applied knowledge management tools and techniques for organizational decision support. Knowledge-based systems, case-based reasoning systems, and data mining techniques such as inductive learning and neural networks.

4363*
Advanced Topics in Systems Development. Prerequisites: senior standing and consent of instructor. Current and emerging advanced topics in information systems development. Development of web-based information systems and groupware systems, advanced object-oriented systems development methodologies, and other related emerging topics.

4373*
Advanced Topics in Management Information Systems. Prerequisites: 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.

4443*
Computer-based Simulation Systems. Prerequisites: 2203 and 3233 or 3243. Discrete-event systems simulation. Modeling of systems to be simulated such as inventory, financial management, data communications, information system problems, or other queing situations. Collection and numerical analysis of associated data, understanding of simulation as a useful tool in management science and information systems.

4523*
Data Communication Systems. Prerequisite: senior standing. 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.

4533
Advanced Data Communications. Prerequisite: 4523. An applied and indepth study of voice, video and data networks and technologies. Actual implementation knowledge and experience, using current technologies and equipment.

5033*
Information Systems Project Management. Prerequisite: consent of MIS/AIS 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.

5123*
Enterprise Resource Planning. Prerequisites: graduate standing and ACCT 5103, ACCT 5113, MSIS 5643, or consent of director of MIS/AIS. Resource planning for today's 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. Same course as ACCT 5123.

5133*
Advanced Information Technologies for Electronic Commerce. Prerequisites: admission to MBA, MSTM, or MS in MIS/AIS program or consent of instructor. Information technologies that enable electronic commerce, including data base and web technologies and infrastructure, web software, transaction security, business web models, and applications.

5223*
Object-oriented Programming Applications for Business. Prerequisites: 5643, graduate standing and computer programming proficiency, or consent of director of MIS/AIS. Object-oriented programming concepts and applications for business in a global environment. Implementation through an appropriate object-oriented programming language.

5303*
Quantitative Methods in Business. Prerequisites: admission to the MBA program or consent of MBA director; demonstrated calculus proficiency. Application of quantitative techniques to business problems. Linear programming, transportation and assignment models, goal programming, integer programming, and networks.

5313*
Production Operations Management. Prerequisites: 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.

5413*
Advanced Management Science. Prerequisite: admission to MBA program or consent of MBA director. Advanced management science methods, with computer applications. Mathematical programming, simulation, forecasting, queuing, Markov processes.

5543*
Advanced File and Data Management for Business. Prerequisites:5223, or consent of director of M.S. in MIS/AIS program. A design perspective of business data storage methodologies, structures and approaches; and of file management techniques for business enterprises.

5600*
Special Projects in Business Information Systems. 1-6 credits, maximum 6. Prerequisite: consent of the director of the M.S. in MIS/AIS program. Study of advanced topics not covered directly in other classes or directed study under the supervision of a faculty member.

5603*
Introduction to Object-oriented Programming for Business. Prerequisite: admission to the MS/AIS program or consent of director of MS in MIS/AIS. Introduction to elementary object-oriented computer programming for business including fundamental constructs, construction and integration of objects, and the use of development tools and methodologies for successful development of business applications.

5613*
Advanced Production and Operations Management. Prerequisites: 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.

5623*
Advanced Applications in Management Information Systems. Prerequisite: 5643 or consent of director of MIS/AIS program. Design and use of management information systems in businesses and other organizations. Model building, information resource management and decision support systems.

5633*
Decision Support and Expert Systems. Prerequisite: BADM 5003 or equivalent. Technical and managerial issues involved in the evaluation, acquisition and implementation of advanced technologies, such as decision support systems, expert systems, artificial intelligence, executive information systems, neural networks and others.

5643*
Advanced Data Base Management. Prerequisites: admission to the MBA, MSTM or MS in MIS/AIS programs or consent of director. Advanced theoretical and practical foundations. Brief review of classical issues surrounding design, analysis, and implementation of data bases, both from a micro and a mainframe perspective. Current and emerging issues in the data base field. Analysis, design, and implementation of distributed data bases, the object orientated data model paradigm, the use and management of automated design and support tools (e.g., CASE) from a data base perspective, and data security.

5653*
Advanced Systems Development. Prerequisites: 4363 and 5643 or equivalent, programming proficiency in C or C++; or consent of director of M.S. in MIS/AIS program. Theory and applications for business systems development from an enterprise-wide perspective.

5900*
Practicum in Management Information Systems. 1-3 credits, maximum 3. Prerequisites: consent of director of and admission to the M.S. in MIS/AIS program. Application of MIS-related methods and skills in a business environment. Integration of knowledge through real-world problem solving situations in organizational contexts.

6200*
Advanced Topics in Management Information Systems. 3-12 credits, maximum 12. Prerequisites: doctoral student status and consent of instructor. Special advanced topics in management information systems for doctoral students.

6300*
Contemporary Topics in MSIS Research. 1-6 credits, maximum 6. Prerequisite: 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.

6333*
Overview of MSIS Research. Prerequisite: 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.

6343*
Advanced Methods in MSIS Research. Prerequisite: 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.

Marketing (MKTG)

3213
Marketing. Marketing strategy and decision-making. Consumer behavior, marketing institutions, competition and the law.

3323
Consumer and Market Behavior. Prerequisite: 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.

3433
Promotional Strategy. Prerequisite: 3213. Promotional policies and techniques and their application to selling problems of the firm.

3473
Professional Selling. Prerequisite: 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.

3513
Sales Management. Prerequisite: 3213. Sales planning and control, organization of the sales department, developing territories, motivating salespersons and control over sales operations.

3613
Retailing Management. Prerequisite: 3213. Applied marketing knowledge, with attention given to those concepts and methods which provide the necessary foundation for a retailing manager.

3713
Sports Marketing. Prerequisite: 3213. Applied marketing knowledge with attention given to those concepts and methods used in sports marketing.

4113*
Marketing Decision Analysis. Prerequisite: 3213. Decision making in a variety of marketing applications to include model building, analysis of courses of action, and development of online information systems. Applications with microcomputers to focus on decision areas such as sales forecasting, media selection, sales force allocation and site location.

4223
Supply Chain Management. Prerequisites: 3213 and MGMT 3223. An economic and operational analysis of the physical flow of goods and materials. A system interpretation of marketing channels.

4333*
Marketing Research. Prerequisite: 3213; 3223; STAT 2023. Basic research concepts and methods. Qualitative and quantitative tools of the market researcher.

4443*
Social Issues in the Marketing Environment. Prerequisite: 3213. Social and legislative considerations as they relate to the marketplace.

4550
Problems in Marketing. 1-9 credits, maximum 9. Prerequisite: 3213. Problems in marketing. Specific topics vary from semester to semester.

4553*
(I)International Marketing. Prerequisite: 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.

4683
Managerial Strategies in Marketing. Prerequisites: ACCT 2103 and 2203, ECON 2103 and 2203, FIN 3113, LSB 3213, MGMT 3123, and MSIS 2103. Analysis of the marketing management decision process; market opportunity analysis, strategy development, planning and integration with corporate strategy.

4773*
Services Marketing. Prerequisite: 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.

4850
Applied Marketing Studies. 1-6 credits, maximum 6. Prerequisites: 12 credit hours of marketing and consent of instructor. Structured internship or field project with supporting academic study.

4973
New Product Development. Prerequisites: 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.

4983
Data Base Marketing. Prerequisites: 3213, 4333, MSIS 2103 or consent of instructor. An information-driven process to develop, test, implement, measure, and adopot customized marketing programs and strategies. Mechanisms to manage data (data base technology), techniques for converting data to information (interpretation and summarization), and tools to use data for decision making (statistical as well as artificial neural-based models to make forecasts and do "what if" analyses).

4993
Electronic Commerce Marketing. Prerequisites: 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.

5133*
Marketing Management. Prerequisite: admission to MBA program. 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.

5213*
Services Marketing. Prerequisite: 5133. Services and services marketing with emphasis on services research and services management.

5220*
Seminar in Marketing. 3 credits, maximum 9. Prerequisite: 5133. Selected topics in marketing. Industrial marketing, product management, strategic marketing planning, international marketing, and services marketing.

5313*
Marketing Research Methodology. Prerequisite: 5133. Research methodology applied to marketing problems. Measurement, survey research, experimentation, and statistical analysis of data.

5513*
Seminar in Sales and Relationship Management. Prerequisite: 5133. Analysis of issues related to sales force management and managing the overall customer relationship initiative of a firm. Identifying types of decisions made by managers involved in leading these processes. Integration of selling and customer relationship strategies with a firm's business-level and marketing strategies as a central theme.

5553*
International Marketing Strategy. Prerequisite: 5133. An analysis of marketing in the global environment. Environmental effects on international marketing management and corporate strategy decisions.

5613*
Seminar in Consumer Behavior. Prerequisite: 5133 or consent of instructor. Psychological, sociological, and anthropological theories related to consumer decision processes. Special emphasis on current empirical research in consumer behavior.

5713*
Seminar in Promotional Strategy. Prerequisite: 5133. Promotional problems encountered by a firm and approaches to their solution.

5813*
Seminar in Supply Chain Management. Prerequisite: 5133. Development structure and interrelationships among members of marketing channels involving customer service, physical distribution decisions, and operating policies.

5963*
Data Mining and Customer Relationship Management Applications. Prerequisites: consent of MBA, MIS/AIS or MSTM, 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.

5973*
New Product Development. Prerequisites: 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.

5983*
Data Base Marketing. Prerequisite: 5133 or consent of the instructor. An information-driven process managed by database technology that enables marketers to develop, test, implement, measure, and adopt customized marketing programs and strategies.

5993*
Digital Business Strategy. Prerequisite: 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.

6100*
Advanced Seminar in Marketing. 1-3 credits, maximum 6. Prerequisite: consent of instructor and doctoral student standing. Specialized topics in marketing for doctoral students.

6323*
Seminar in Advanced Consumer Behavior. Prerequisite: 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.

6413*
Advanced Marketing Research. Prerequisite: 5313. Introduction to the latest empirical marketing research techniques. Data collection and analysis techniques such as conjoint analysis, multidimensional scaling, path analysis, and structural equations modeling (via LISREL).

6513*
Seminar in Marketing Theory. Prerequisite: 5133 or consent of instructor. Development of an evaluation of marketing theory.

6683*
Seminar in Marketing Strategy. Prerequisite: 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.

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)

5000*
Thesis. 1-6 credits, maximum 6. For mass communication graduate students who are candidates for the master's degree.

5010*
Capstone Project or Creative Component. 1-3 credits, maximum 3. Capstone research project or creative activity for a mass communication graduate stuent electing to not write a thesis to complete a master's degree.

5020*
Advanced Practicum or Internship in Mass Communication. 1-3 credits, maximum 3. Prerequisites: 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.

5030*
Independent Study in Mass Communication. 1-3 credits, maximum 3. Prerequisite: consent of instructor. Independent study, directed readings or project development in mass communications to fit the student's academic and professional interests.

5113*
Methods of Research in Mass Communication. Principles and techniques of research; research planning, design and measurement in mass communication.

5163*
Mass Communication Law. Prerequisites: 2003 and graduate standing. Statutes and case decisions in print and broadcast law, including government regulation of broadcasting by the FCC and media relations with other regulatory agencies. Meets with JB 4163. No credit for students with credit in JB 4163.

5223*
Mass Communication Research Analysis and Interpretation. Prerequisite: 5113. Single- and multi-variate analysis, interpretation and reporting of mass communication research data. Use of computers in research analysis.

5253*
International Mass Communications. Prerequisite: graduate standing. 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. Meets with JB 4253. No credit for students with credit in JB 4253.

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.

5520*
Specialized Public Relations Applications. 3 credits, maximum 6. Prerequisites: JB 3283 and graduate standing. Professional public relations at an advanced level. Non-profit, corporate, agency, international and other specialized applications. Course content varies by semester. Meets with JB 4520. No credit for students with credit in JB 4520.

5603*
Integrated Marketing Communications. Prerequisites: JB 2003; JB 2013 or JB 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 examination of strategies for combining and integrating them into an effective campaign. Theories, models and tools to make better promotional communication decisions. Meets with JB 4603. No credit for students with credit in JB 4603.

5651*
Introduction to Graduate Study in Mass Communications. Prerequisite: 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 M.S. candidates, and prerequisite to M.S. candidates enrolling in mass communication seminars.

5733*
Responsibility in Mass Communication. Interaction between mass media and society, with emphasis upon the communicator's ethics and responsibilities.

5770*
Seminar in Communication Media. 1-3 credits, maximum 9. Prerequisite: graduate standing. International communication, media history, legal research, new technology, women and the media, television and children, industrial television, and communication research.

5773*
Censorship. Prerequisite: graduate standing. A critical examination of historical and contemporary occurrences of censorship from legal, philosophical, political, religious and sociological perspectives. 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. Meets with JB 4773. No credit for students with credit in JB 4773.

5863*
Media Management. Prerequisites: 2003 and graduate standing. Basic issues, theoretical concepts and operational procedures associated with managing newspapers, magazines, advertising public relations, broadcast and cable companies and firms specializing in computer-mediated communication. Meets with JB 4863. No credit for students with credit in JB 4863.

5883*
Advanced Media Management. Prerequisite: 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.

Master of Business Administration (MBA)

5010*
Independent Study. 3-6 credits, maximum 6. Prerequisite: 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.

5100*
Professional Development. 1 credit, maximum 6. Prerequisite: 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.

5192*
Managing Operations and Decision Processes. Prerequisite: 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.

5211*
Business Ethics and Social Responsibility. Prerequisite: admission to MBA program or consent of MBA director. Introduction to ethical theory and its relationship to business practices. Meaning and implementation of socially responsible business actions. Provides mid-level managers with an understanding of ethical perspectives adopted by others. Development of tools needed to make ethical decisions.

5221*
Public Environment of Business. Prerequisite: admission to MBA program or consent of MBA director. Survey of the external forces that influence and shape the organizational environment. Strategies for forecasting, responding to, and influencing these forces.

5233*
Global Competitive Environment. Prerequisite: admission to the MBA program or consent of the 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 IS 5233.

5240*
Managerial Communication Skills. 1-2 credits, maximum 2. Prerequisite: admission to MBA program or consent of MBA director. Identification and analysis of interactive corporate communications: oral, written and interpersonal. Application of communication theories to business situations with the goal of behavior and skill development.

5251*
Leadership Strategies. Prerequisite: admission to MBA program or consent of MBA director. Leadership strategies, principles, styles, and dynamics.

5261*
Legal Issues in Business. Prerequisite: 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.

5300*
Current Business Topics. 1-6 credits, maximum 9. Prerequisite: admission to the MBA program or consent of the director. Examination of selected topics representing the most current academic and business concepts.

5303*
Corporate and Business Strategy. Prerequisite: admission to MBA program or consent of the director. 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.

5310*
Integrative Decision Making II: Crossing Organizational Boundaries. 2-6 credits, maximum 6. Prerequisites: 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.

5400*
Business Practicum. 1-3 credits, maximum 3. Prerequisites: 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.

5500*
Interdisciplinary Inquiry in Business Administration. 1-3 credits, maximum 9. Prerequisite: consent of MBA director. Investigation of various business problems using an interdisciplinary approach. Courses team taught to ensure problems viewed from varying functional perspectives.

5990*
MBA Applied Business Report. 3-6 credits, maximum 6. Prerequisite: admission to MBA program or consent of MBA director. Independent investigation of a business problem under the direction of a supervising professor.

Mathematics (MATH)

0123
Intermediate Algebra. Prerequisite: one year of high school algebra or equivalent. Review of fundamental operations of algebra, rational expressions, exponents and radicals, linear and quadratic equations, inequalities, introduction to analytic geometry. Does not count for college credit. Graded on a satisfactory-unsatisfactory basis.

1483
(A)Mathematical Functions and Their Uses. Prerequisite: 0123 or placement into 1513. 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.

1493
(A)Applications of Modern Mathematics. Prerequisite: 0123 or placement into 1513. Introduction to contemporary applications of discrete mathematics. Topics from management science, statistics, coding and information theory, social choice and decision making, geometry and growth.

1513
(A)College Algebra. Prerequisite: two years of high school algebra or 0123. Quadratic equations, functions and graphs, inequalities, systems of equations, exponential and logarithmic functions, theory of equations, sequences, permutations and combinations. No credit for those with prior credit in 1715 or any mathematics course for which 1513 is a prerequisite.

1613
(A)Trigonometry. Prerequisites: 1513 or equivalent, or concurrent enrollment. Trigonometric functions, logarithms, solution of triangles and applications to physical sciences. No credit for those with prior credit in 1715 or any course for which 1613 is a prerequisite.

1715
(A)College Algebra and Trigonometry. Prerequisites: one unit of high school plane geometry, and 0123 or high school equivalent. An integrated course in college algebra and trigonometry. Combined credit for 1513, 1613, and 1715 limited to six hours. No credit for those with prior credit in any course for which 1613 is a prerequisite. Satisfies the six hour general education Analytical and Quantitative Thought area requirement.

2103
(A)Elementary Calculus. Prerequisite: 1513. An introduction to differential and integral calculus. For students of business and social sciences.

2123
(A)Calculus for Technology Programs I. Prerequisites: 1715 or 1513 and 1613. First semester of a terminal sequence in calculus for students in the School of Technology. Functions and graphs, differentiation and integration with applications.

2133
(A)Calculus for Technology Programs II. Prerequisite: 2123. 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.

2144
(A)Calculus I. Prerequisites: 1715, or 1513 and 1613. An introduction to derivatives, integrals and their applications.

2153
(A)Calculus II. Prerequisite: 2144. A continuation of 2144 including series and their applications, elementary geometry of three dimensions and introductory calculus of vector functions.

2163
Calculus III. Prerequisite: 2153. A continuation of 2153 including differential and integral calculus of functions of several variables and an introduction to vector analysis.

2233
Differential Equations. Prerequisite: 2153. Methods of solution of ordinary differential equations with applications. First order equations, linear equations of higher order, series solutions, and Laplace transforms.

2653
Discrete Mathematics I. Prerequisite: 1513 or 1715. Logic, set theory proof techniques, probability and combinatorics, relations and functions, matrix algebra graphs, Boolean algebra and lattices.

2910
Special Studies. 1-3 credits, maximum 6. Prerequisite: consent of instructor. Special subjects in mathematics.

3013*
Linear Algebra. Prerequisite: 2153. Algebra and geometry of finite-dimensional linear spaces, linear transformations, algebra of matrices, eigenvalues and eigenvectors.

3263*
Linear Algebra and Differential Equations. Prerequisite: 2153. An integrated treatment of linear algebra and differential equations. No credit for those with credit in 2233 or 3013.

3403*
(A)Geometric Structures. Prerequisite: 1483, 1493 or 1513. Fundamentals of plane geometry, geometric motion (translation, rotations, reflections), polyhedra, applications to measurements.

3603*
(A)Mathematical Structures. Prerequisite: 1483, 1493 or 1513. Foundations of numbers (set theory, numeration, and the real number system), number theory, algebraic systems, functions and applications, and probability.

3613*
Introduction to Modern Algebra. Prerequisite: 3013. Introduction to set theory and logic; elementary properties of rings, integral domains, fields and groups.

3653
Discrete Mathematics II. Prerequisite: 2653 or 3613. Algebraic structures, coding theory, finite state machines, machine decomposition, computability, formal language theory.

4003*
Mathematical Logic and Computability. Prerequisites: 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 CS 4003 and PHIL 4003.

4013*
Calculus of Several Variables. Prerequisites: 2163 and 3013. Differential and integral calculus of functions of several variables, vector analysis, Stokes' Theorem, Green's Theorem and applications.

4023*
Introduction to Modern Analysis. Prerequisite: 2163, recommended 3613. 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.

4033*
History of Mathematics. Prerequisite: 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.

4143*
Advanced Calculus I. Prerequisites: 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.

4153*
Advanced Calculus II. Prerequisite: 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.

4233*
Intermediate Differential Equations. Prerequisites: 2233, 3013. Systems of differential equations, series, solutions, special functions, elementary partial differential equations, Sturm-Liouville problems, stability and applications.

4283*
Complex Variables. Prerequisite: 4013. Analytic functions, power series, residues and poles, conformal mapping, and applications.

4403*
Geometry. Prerequisite: 3013, recommended 3613. An axiomatic development of Euclidean and non-Euclidean geometries.

4513*
Numerical Mathematics: Analysis. Prerequisites: 2233, 3013, knowledge of FORTRAN 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.

4553*
Linear and Nonlinear Programming. Prerequisites: 2163, 3013. Linear programming, simplex methods, duality, sensitivity analysis, integer programming and nonlinear programming.

4583*
Introduction to Mathematical Modeling. Prerequisite: 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.

4613*
Modern Algebra I. Prerequisite: 3613. An introduction to the theory of groups and vector spaces.

4663*
Combinatorial Mathematics. Prerequisite: 3013. Counting techniques, generating functions, difference equations and recurrence relations, introduction to graph and network theory.

4713*
Number Theory. Prerequisite: 3613. Divisibility of integers, congruences, quadratic residues, distribution of primes, continued fractions and the theory of ideals.

4813*
Groups and Representations. Prerequisites: 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.

4900
Undergraduate Research. 1-4 credits, maximum 4. Prerequisite: consent of instructor. Directed readings and research in mathematics.

4910*
Special Studies. 1-3 credits, maximum 9. Prerequisite: consent of instructor. Special subjects in mathematics.

4950
Problem Solving Seminar. 1 credit, maximum 3. Prerequisites: 2233, 3013. The general process of problem solving. Selected problem-solving techniques. Applications to challenging problems from all areas of mathematics.

4993
Senior Honors Thesis. Prerequisites: senior standing and Honors Program participation. A guided reading and research program ending with an honors thesis under the direction of a faculty member and including a public presentation. Required for graduation with departmental honors in mathematics.

5000*
Research and Thesis. 1-6 credits, maximum 6. Prerequisite: consent of advisory committee. Directed reading and research culminating in the master's report or master's thesis.

5010*
Seminar in Mathematics. 1-3 credits, maximum 12. Prerequisite: consent of instructor. Topics in mathematics.

5013*
Modern Algebra II. Prerequisite: 4613. Continuation of 4613. An introduction to the theory of rings, linear transformations and fields.

5023*
Advanced Linear Algebra. Prerequisite: 3013. A rigorous treatment of vector spaces, linear transformations, determinants, orthogonal and unitary transformations, canonical forms, bilinear and hermitian forms, and dual spaces.

5133*
Stochastic Processes. Prerequisites: 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, queueing theory. Same course as IEM 5133 and STAT 5133.

5143*
Real Analysis I. Prerequisite: 4153. Measure theory, measurable functions, integration and differentiation with respect to measures.

5153*
Real Analysis II. Prerequisite: 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.

5213*
Fourier Analysis. Prerequisite: 4013 or 4023. Orthogonal series expansions, Fourier series and integrals and boundary value problems. Applications.

5233*
Partial Differential Equations. Prerequisite: 4013 or 4233. Classification of second order equations, characteristics, general theory of first order equations, Dirichlet problem for Laplace's equation and Green's functions, eigenvalue problems, and variational methods.

5243*
Ordinary Differential Equations I. Prerequisites: 4143; 5013 or 5023. Existence and uniqueness of solutions, linear systems and their asymptotic behavior, oscillation and comparison and singularities.

5253*
Ordinary Differential Equations II. Prerequisite: 5243. Stability and asymptotic behavior of systems of nonlinear differential equations, Liapunov Theory, perturbation and the Poincare-Bendixon theory for planar autonomous systems, bifurcation, basins and attractors, chaotic behavior, and invariant tori.

5283*
Complex Analysis I. Prerequisite: 4143. Basic topology of the plane, functions of a complex variable, analytic functions, transformations, infinite series, integration and conformal mapping.

5293*
Complex Analysis II. Prerequisite: 5283. Riemann Mapping Theorem, meromorphic functions, analytic continuation, Dirichlet problem, and entire functions.

5303*
General Topology. Prerequisite: 4143 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.

5313*
Geometric Topology. Prerequisites: 4613, 5303. Manifolds, complexes, the fundamental group, covering spaces, combinatorial group theory, the Seifert-Van Kampen theorem, and related topics.

5413*
Differential Geometry. Prerequisite: 4013 or 4143. Differential manifolds, vector fields, differential forms, connections, Riemannian metrics, geodesics, completeness, curvature, and related topics.

5543*
Numerical Analysis for Differential Equations. Prerequisites: 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.

5553*
Numerical Analysis for Linear Algebra. Prerequisites: 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.

5580*
Case Studies in Applied Mathematics. 1-3 credits, maximum 6. Prerequisites: 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.

5593*
Methods of Applied Mathematics. Prerequisites: 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.

5613*
Algebra I. Prerequisite: 4613. A rigorous treatment of classical results in group theory and ring theory.

5623*
Algebra II. Prerequisite: 5613. A rigorous treatment of classical results in module theory and field theory.

5902*
Seminar and Practicum in the Teaching of College Mathematics. Prerequisite: 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.

6000*
Research and Thesis. 1-9 credits, maximum 24. Prerequisite: consent of advisory committee. Directed reading and research culminating in the Ph.D. or Ed.D. thesis.

6010*
Advanced Seminar in Mathematics. 1-3 credits, maximum 12. Prerequisites: consent of instructor and student's advisory committee. Directed reading on advanced topics in mathematics.

6143*
Functional Analysis I. Prerequisites: 4613 or 5023, 5153, 5303. Theory of topological vector spaces including metrizability, consequences of completeness, Banach spaces, weak topologies, and convexity.

6153*
Functional Analysis II. Prerequisite: 6143 or consent of instructor. Introduction to and basic results in several subfields of analysis which employ functional analytic methods. Topics from bounded and unbounded operator theory, Banach algebras, distributions, Fourier analysis, and representation theory.

6213*
Harmonic Analysis. Prerequisites: 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.

6233*
Theory of Partial Differential Equations. Prerequisites: 5233, 5153. Tempered distributions, Sobolev spaces, distribution solutions of PDEs, fundamental solutions. Existence, well-posedness and uniqueness theorems for Cauchy problem and boundary value problems.

6283*
Several Complex Variables. Prerequisite: 5293. Elements of function theory of several complex variables, including extension phenomena, domains of holomorphy, notions of convexity, holomorphic maps, and complex analytic varieties.

6290*
Topics in Analysis. 1-3 credits, maximum 9. Prerequisite: consent of instructor. Advanced topics in analysis.

6323*
Algebraic Topology I. Prerequisite: 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.

6333*
Algebraic Topology II. Prerequisite: 6323. Homotopy groups, the Hurewicz and Whitehead theorems, Eilenberg-MacLane spaces, obstruction theory, fibrations, spectral sequences, and related topics.

6390*
Topics in Topology. 1-3 credits, maximum 9. Prerequisite: consent of instructor. Advanced topics in topology.

6433*
Algebraic Geometry. Prerequisite: 5623. Affine and projective varieties, dimension, algebraic curves, divisors, and Riemann-Roch theorem for curves.

6453*
Complex Geometry. Prerequisite: 5283. Complex manifolds, analytic sheaves, differential forms, Dolbeault cohomology, Hodge theory, line bundles, divisors, Kodaira embedding, and vanishing.

6490*
Topics in Geometry. 1-3 credits, maximum 9. Prerequisite: consent of instructor. Advanced topics in geometry.

6513*
Theoretical Numerical Analysis. Prerequisites: 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.

6590*
Topics in Applied Mathematics. 1-3 credits, maximum 9. Prerequisite: consent of instructor. Advanced topics in applied mathematics.

6613*
Commutative Algebra. Prerequisite: 5623. Commutative rings, exactness properties of modules, tensor products, integral dependence, chain conditions, completions, filtrations, local rings, dimension theory, and flatness.

6623*
Homological Algebra. Prerequisite: 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.

6690*
Topics in Algebra. 1-3 credits, maximum 9. Prerequisite: consent of instructor. Advanced topics in algebra.

6713*
Analytic Number Theory. Prerequisite: 4283 or 5283. Arithmetic functions, Zeta and L functions, distribution of primes and introduction to modular forms.

6723*
Algebraic Number Theory. Prerequisite: 5013 or 5623. Number fields, ideal theory, units, decomposition of primes, quadratic and cyclotomic fields, introduction to local fields.

6790*
Topics in Number Theory. 1-3 credits, maximum 9. Prerequisite: consent of instructor. Advanced topics in number theory.

6813*
Lie Groups and Representations. Prerequisites: 4153, 4613, 5303. Differentiable manifolds, vector fields, Lie groups, exponential map, homogeneous spaces, representations of compact Lie groups, and maximal tori.

6823*
Lie Algebras. Prerequisites: 5013 and 5023. Matrix groups, Lie algebras, root systems, structure of semisimple Lie algebras, universal enveloping algebra, and representations of lie algebras.

6890*
Topics in Representation Theory. 1-3 credits, maximum 9. Prerequisite: consent of instructor. Advanced topics in representation theory.

6990*
Topics in Collegiate Mathematics Education. 1-3 credits, maximum 9. Prerequisite: consent of instructor. Advanced topics in collegiate mathematics education.

Mechanical and Aerospace Engineering (MAE)

3033
Engineering Design. Lab 1. Prerequisite: ENGR 1332. Design methodology and practice. Design process, with emphasis on the broad range of technical, economic, and societal factors considered in design decision making. Designing and building a machine to participate in a design competition.

3113
Measurements and Instrumentation. Lab 4. Prerequisites: ENSC 2123 and ENSC 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.

3123
Manufacturing Processes. Prerequisites: 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.

3223
Thermodynamics II. Prerequisite: 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.

3233
Heat Transfer. Prerequisite: 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.

3253
Applied Aerodynamics and Performance. Prerequisites: 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.

3293
Compressible Fluid Flow. Prerequisites: 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.

3323
Mechanical Design I. Prerequisites: 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.

3403
Computer Methods in Analysis and Design. Prerequisite: ENGR 1412. Application of computer methods in the design, analysis, and simulation of mechanical, thermal and fluid systems. Linear algebra and numerical methods. Applied statistics.

3723
Systems I. Prerequisites: 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. Same course as ECEN 3723.

4010*
Mechanical Engineering Projects. 1-6 credits, maximum 6. Lab variable. Prerequisite: consent of instructor. Special projects and independent study in mechanical engineering.

4053*
Automatic Control Systems. Prerequisite: 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.

4063*
Mechanical Vibrations. Prerequisite: 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 bal-ancing, whirl, nonlinear effects, and self-excited vibrations.

4223*
Aerospace Engineering Laboratory. Lab 3. Prerequisites: 3113, 3253, 4283. Experimental study of aerospace principles including topics in aeronautics and astronautics. State-of-the-art instrumentation, diagmostics, and computerized data acquisition equpment 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.

4243*
Gas Power Systems. Prerequisites: 3223 and ENSC 3233. Power and propulsion engines utilizing a gas as the working fluid. Thermodynamic and dynamic equations of one-dimensional compressible flow, including shock waves. Design and analysis of overall aircraft engine systems and individual components of the aircraft engine, as well as engine component matching, using design software packages. Centrifugal and axial flow turbines and compressors.

4263*
Vapor Power Systems. Prerequisites: 3223, 3233. Vapor power cycles, combustion processes applied to power production, power plants, and auxiliary systems associated with power plants. Overall design of power plants as well as component design. Power system economics and loan analysis. Extensive use of software design and analysis packages.

4273*
Experimental Fluid Dynamics. Lab 3. Prerequisites: 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.

4283*
Aerospace Vehicle Stability and Control. Prerequisites: 3253, 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.

4313*
Advanced Processing of Engineered Materials. Prerequisite: 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.

4323*
Design for Manufacturing. Lab 3. Prerequisite: 3123. Integration of concepts of product design with manufacturing principles, including behavior and properties of material, stress analysis, heat transfer and lubrication. Processing techniques and economics. Emphasis on analysis requirements and applications of processing parameters and design variables, in CAD/CAM.

4333*
Mechanical Metallurgy. Lab 2. Prerequisite: 3113, ENSC 3313. Mechanical deformation processes and strengthening mechanisms in engineering materials. Material failure modes including creep, fatigue, stress corrosion, ductile and brittle fractures.

4344*
Design Projects. Lab 4. Prerequisites: 3033, 3113, 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.

4353*
Mechanical Design II. Prerequisites: 3033, 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.

4354*
Aerospace Systems Design for Mechanical Engineers. Lab 8. Prerequisites: 3033, 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 so by enrolling in MAE 4010.

4363*
Experimental Methods in Design. Lab 6. Prerequisites: 3113 and 3323. Laboratory techniques for the experimental analysis of vibration, stress, force and motion. Projects involve the use of strain gages, brittle lacquer techniques, reflection and transmission polariscopes, load cells and accelerometers.

4374*
Aerospace Systems Design. Lab 8. Prerequisites: 4243, 4283, 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.

4513*
Aerospace Structures I. Prerequisite: 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.

4703*
Design of Indoor Environmental Systems. Prerequisites: 3223, 3233. Design of heating, ventilating and air conditioning systems. Calculation of heating and cooling loads.

4713*
Thermal Systems Design, Simulation and Optimization. Prerequisites: 3233, 3223; ENSC 3233; co-requisite MAE 3403. 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.

4733*
Mechatronics Design. Prerequisites: 3033, 3113. 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.

5000*
Thesis. 1-6 credits, maximum 6. A student studying for a master's degree who elects to write a thesis must enroll in this course.

5010*
Mechanical Engineering Projects. 1-12 credits, maximum 12. Project in research or design selected by the student, or assigned by the instructor. A student who wishes to complete a master's degree under Plan III must enroll in this course.

5030*
Engineering Practice. 1-12 credits, maximum 12. Prerequisites: senior or graduate standing and consent of instructor. 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.

5073*
Advanced Mechanical Vibrations. Prerequisite: 4063 or consent of instructor. Analysis of nonlinear vibrations, classical analysis of continuous systems and numerical methods.

5083*
Engineering Acoustics. Acoustical analysis and measurement techniques, with emphasis on design applications for noise and vibration control in machinery and in buildings.

5093*
Numerical Engineering Analysis. Prerequisite: basic FORTRAN programming. Practical digital methods for obtaining steady-state and transient solutions to lumped and distributed mechanical, fluid and thermal problems.

5123*
Metal Cutting. Prerequisite: ENSC 3313. 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.

5133*
Mechanical Behavior of Materials. Prerequisite: 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.

5143*
Tribology. 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.

5153*
Precision Engineering I. Prerequisite: 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 10^6. Design and control of precision machines and instruments, dimensional and surface metrology, scanning probe microscopy, ultra-precision machining and grinding, and precision assembly.

5233*
Viscous Fluid Dynamics. Prerequisite: ENSC 3233. The dynamics of viscous flow over external surfaces, inside channels, and in free shear layers. Boundary layer solutions. Theory of similarity. Approximation methods.

5263*
Combustion. Prerequisite: 3233. Theory, design and performance of combustion systems. Fundamentals of aerothermochemistry fluid dynamics, heat transfer and combustion. Laminar and turbulent flows. Diffusion and premixed flames. Pollutant reduction. Numerical simulation and solution.

5373*
Instrumentation. Lab 2. Analysis and design of instrumentation systems, laboratory experiences with electronic instrumentation and transducers, application of digital and analog integrated circuit components to measurement problems.

5403*
Computer-aided Analysis and Design. Prerequisite: basic FORTRAN programming. 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.

5413*
Optimal Control. Prerequisite: 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.

5433*
Robotics, Kinematics, Dynamics and Control. Prerequisite: 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.

5453*
Fluid Power Control I. Prerequisite: 4053 or concurrent enrollment. Static and dynamic modeling of hydraulic and pneumatic control systems and components. Energy and power transfer and impedance matching concepts. Dynamic performance and stability of open- and closed-loop servodrives. Introduction to system design.

5463*
Nonlinear System Analysis and Control. Prerequisite: 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.

5473*
Digital Control Systems. Prerequisite: 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.

5483*
Digital Data Acquisition and Control. Prerequisite: undergraduate course in programming. Use of microcomputers operating in real-time applied to engineering systems for data acquisition and control, use of analog to digital, digital to analog, and digital input/output, synchronous and asynchronous programming. Competence in the engineering use of microcomputers through lectures and laboratory applications. Same course as ECEN 5483.

5503*
Mechanics of Advanced Composites for Structural Design. Prerequisites: ENSC 2113, ENSC 2143 or consent of instructor. Basic principles governing the micro-mechanics of a lamina, and the macro-mechanics of a laminate. 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.

5513*
Stochastic Systems. Prerequisites: 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 nonstationary random processes. Response of linear systems to stochastic processes. State-space formulation and covariance analysis. Same course as ECEN 5513.

5523*
Estimation Theory. Prerequisite: 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.

5533*
Analysis of Structural Systems. Prerequisite: 3323. Computer-oriented matrix methods in the analysis of linear structural systems; energy principles; matrix equations for static and dynamic analyses of elastic systems; stability.

5543*
Modern Materials. Prerequisite: ENSC 3313. Properties, applications and recent innovations of structural engineering materials. Metals, ceramics, polymers and composites considered.

5553*
Fatigue and Fracture Mechanics. Prerequisite: 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. Same course as CIVE 5553.

5563*
Finite Element Methods. 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.

5573*
Continuum Mechanics. Prerequisite: 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.

5583*
Corrosion Engineering. Lab 2. Prerequisite: ENSC 3313. Modern theory of corrosion and its applications in preventing or controlling corrosion damage economically and safely in service.

5593*
Theory of Viscoelasticity. Prerequisite: 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.

5633*
Advanced Thermal Systems. Prerequisites: 3223, 3233, ENSC 3233. Analysis, design, simulation and optimization of thermal systems. Engineering applications to HVAC systems, refrigeration systems, ground-source heat pump systems.

5663*
Advanced Finite Element Analysis. Prerequisite: 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 implicity 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.

5703*
Optimization Applications. Prerequisite: graduate standing. A survey of various methods of unconstrained and constrained linear and nonlinear 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 and IEM 5023.

5713*
Linear Systems. Prerequisite: 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.

5733*
Neural Networks. Prerequisite: 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 and ECEN 5733.

5743*
Geometric Modeling for Design and Manufacturing. Prerequisite: C programming or consent of instructor. Application of parametric geometry for engineering design and manufacturing. Representation of curves, surfaces and solids. Analytic and relational properties. Fundamentals of solid modeling.

5773*
Intelligent Systems. Prerequisite: 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.

5803*
Advanced Thermodynamics I. Prerequisite: 3223. A rigorous examination of the fundamental principles of engineering thermodynamics; the First Law, the pure substance, flow processes, Second Law availability, properties of substances, thermochemistry, mixtures and equilibrium.

5823*
Radiation Heat Transfer. The mechanism of the transfer of energy by thermal radiation; radiant properties of materials, energy transfer prediction methods and solar energy topics.

5843*
Conduction Heat Transfer. Prerequisite: ENSC 3233. Advanced heat transfer analysis and design, with primary emphasis on conduction.

5853*
Computational Heat Transfer. Prerequisites: 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.

5863*
Building Heat Transfer and Simulation. Prerequisites: 3223, 3233, ENSC 3233. Conduction, convection and radiation heat transfer applied to building thermal simulation. Solar radiation.

5873*
Advanced Indoor Environmental System. Prerequisite: 4703. Heating, air-conditioning, ventilation and refrigeration systems. System and component analysis, design and simulation.

5913*
Advanced Aerodynamics. Prerequisites: 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.

5923*
Guidance and Control of Aerospace Vehicles. Prerequisite: 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.

5933*
Aeroelasticity. Prerequisite: 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.

5943*
Unsteady Aerodynamics and Aeroacoustics. Prerequisite: 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.

6000*
Research and Thesis. 1-15 credits, maximum 30. Prerequisites: consent of the head or the graduate committee of the School and approval by the student's advisory committee. Independent research under the direct supervision of a member of the graduate faculty. For students pursuing study beyond the level of the M.S. degree.

6010*
Advanced Study. 1-12 credits. Prerequisite: 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.

6123*
Non-traditional Machining. Prerequisite: 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.

6133*
Surface Mechanics. Prerequisite: 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.

6143*
Thermal Analysis of Manufacturing Processes. Prerequisites: 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.

6233*
Turbulent Fluid Dynamics. Prerequisite: 5233. Isotropic turbulence, turbulent wakes and jets, bound turbulent shear flows, transition, hydrodynamic stability and integral calculation methods for turbulent boundary layers.

6263*
Computational Fluid Dynamics. Prerequisite: 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.

6423*
System Identification. Prerequisite: 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.

6453*
Adaptive Control. Prerequisite: 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.

6463*
Advances in Nonlinear Control. Prerequisites: 5463 or ECEN 5463. Introduction to vector fields and Lie algebra; controllability and observability of nonlinear systems; local decompositions; input-output and state-space representation on non-linear systems; feedback linearization; controlled invariance and distribution; control of Hamiltonian systems. Same course as ECEN 6463.

6483*
Robust Multivariable Control Systems. Prerequisite: 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.

6823*
Advanced Radiative Transfer. Prerequisite: 5823. Radiative energy transfer within participating media and among real surfaces. Anisotropic scattering, emission, refractive index effects, and wavelength-dependent analysis. Current solution techniques—approximate and exact. Relationship of electric fields to radiative transfer. Combined radiation with conduction and/or convection. A project concerned with a unique radiative transfer problem.

6843*
Convection Heat Transfer. Prerequisite: 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)

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.

1223
Industrial Computer-aided Design. Lab 4. Prerequisite: GENT 1153. Computer-aided design (CAD) generation of engineering drawings. ANSI/ASME and ISO drawing standards.

2103
Industrial Materials. Lab 3. Prerequisite: CHEM 1314. 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.

2213
Three-dimensional Computer-aided Design. Lab 4. Prerequisites: 1223. Development of engineering design drawings of mechanical components using 3-D CAD techniques. Drawing standards emphasized.

2313
Fundamentals of Hydraulic Fluid Power. Lab 2. Prerequisites: EET 1003 or CS 2103 or EET 1003 or ENGR 1412. Basic fluid power concepts. Standard hydraulic symbols, component design and application, fluid power system considerations, design and operation.

3003
Dynamics. Prerequisites: GENT 2323 and MATH 2123. Plane motion of particles and rigid bodies. Force-acceleration, work-energy, and impulse-momentum principles. Graphical analysis, mechanisms and vibrations.

3113
Basic Instrumentation. Lab 2. Prerequisites: GENT 3323, MATH 2123 and PHYS 1214. Data analysis. Theory, operational characteristics and application of transducers for measurement of strain, force, velocity, acceleration, displacement, time, frequency, temperature, pressure, fluid flow.

3313
Applied Fluid Mechanics. Prerequisites: 2313, MATH 2123. Fluid mechanical principles applied to fluid power systems and general fluid systems. Fluid system analysis using Bernoulli and general energy equations, laminar and turbulent flows, flow and pressure measurement, flow forces, lift and drag.

3333
Thermodynamics and Heat Transfer for Electronics. Lab 3. Prerequisites: MATH 2133 and junior standing. Principles of thermodynamics and heat transfer important to the design, construction and operation of electronic systems. Basic heat transfer by conduction, convection, and radiation. Heat removal from electronic systems by heat-sinking, free-air convection, forced-air convection and combinations. Identification of specific over-heating problems in electronics systems and the design of appropriate heat removal techniques.

3343
Physical Metallurgy. Lab 3. Prerequisite: 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.

3413
Fundamentals of Pneumatic Fluid Power. Lab 2. Prerequisites: 2313, ECT 1003, MATH 1513. Basic pneumatics concepts, gas laws, component design and application, system design considerations. Air logic.

3503
Gas Turbines for Non-majors. Lab 2. Prerequisite: MATH 1513 or MATH 1715. Non-analytical, descriptive treatment of the operation of gas turbine engines including accessories and systems. Lab requires student participation in engines disassembly, inspection and reassembly. Field trips to engine overhaul and repair facilities.

3573
Advanced Production Processes. Lab 3. Prerequisites: 1223, 2103, GENT 1153, MATH 1513. 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).

4003
Machine Design I. Prerequisites: GENT 3323, CS 2103 or EET 1003 or ENGR 1412 and MATH 2133. Applications of statics and strength to the design of machine components. Problems of choosing materials, impact and fatigue loading.

4013
Parametric Computer-aided Design Modeling. Lab 4. Prerequisite: 1223. Computer-aided drafting and design using parametric, feature-based solid modeling techniques.

4050
Advanced Mechanical Design. 1-3 credits, maximum 6. Lab 0-2. Prerequisites: junior standing and consent of instructor. Special problems in mechanical engineering technology.

4123
Senior Design Projects. Lab 4. Prerequisites: 1223, 4003 and ENGL 3323. Selected problems in design integrating principles of drafting, analysis, materials and manufacturing. Design projects are typically supplied by industry.

4203
Finite Element Methods. Prerequisite: 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.

4213
Kinematics and Mechanisms. Lab 2. Prerequisites: 1223, 3003, CS 2103 or EET 1003 or ENGR 1412. Analysis and design of mechanisms such as the 4-bar linkage, slidercrank, cam and gear. Graphical and computer techniques.

4303
Computer Integrated Manufacturing. Lab 2. Prerequisite: GENT 1223, 2103, MATH 1613. 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.

4313
Electrohydraulics and Motion Control. Lab 2. Prerequisites: 2313, 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.

4453
Applied Thermodynamics. Prerequisite: ENSC 2213 or GENT 3433. Mixtures, psychro-metrics, combustion, heat engine cycles, heat pumps cycles, internal and external combustion engines. Refrigeration.

4463
Thermal Fluids Laboratory. Lab 3. Prerequisites: 3313, GENT 3433 and GENT 4433. Laboratory and industrial observation and analysis of thermal science applications including heat transfer, heat engines, and heat pumps.

4883
Tool Design. Lab 3. Prerequisite: 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.

4993
Mechanical Engineering Technology Practice. Prerequisites: 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)

1413
Introduction to Engineering in Agriculture. Prerequisite: 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.

2313
Surveying. Lab 3. Prerequisite: 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.

3211
Engines and Power. Lab 4. Prerequisites: 1413, MATH 1513. Theory, operation, performance and diagnostics of internal combustion engines for mobile applications.

3223
Metals and Welding. Lab 3. Prerequisite: 1413. Essential knowledge and theory necessary for understanding the principles of hot and cold metals and welding. Laboratory provides opportunity to apply and develop associated skills.

3311
Surveying. Lab 4. Prerequisites: 1413, MATH 1513. Use of surveying equipment and common applications in agriculture.

3321
Erosion Control Practices. Lab 4. Prerequisites: MATH 1513 and concurrent enrollment in MCAG 3311. Analysis, planning and management of soil and water resources.

4101
Agricultural Electrification. Lab 4. Prerequisites: 1413, MATH 1513. A study of electrical theory and electrical applications in agricultural environments.

4123*
Principles of Food Engineering. Prerequisite: 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.

4200*
Topics in Mechanized Agriculture. 1-4 credits, maximum 4. Investigations in specialized areas of mechanized agriculture.

4203*
Irrigation Principles. Prerequisite: 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.

4212
Safety and Health in Agribusiness. Lab 2. Prerequisite: 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.

4220*
Advanced Methods in Agricultural Mechanics. 1-6 credits, maximum 6. Prerequisite: 4222. Developing agricultural mechanics programs for vocational agriculture and technical schools. Application of agricultural mechanics methods, practices and skills to advanced projects.

4223
Methods and Management of Agricultural Mechanization. Lab 3. Prerequisite: MATH 1513. The role of agricultural mechanics in educational systems. A study of the principles of agricultural mechanics, methods of teaching, instructor responsibility and liability, laboratory safety, project construction, selection of resources, project evaluation, and the selection, use and care of tools.

4311
Technology and Environment. Lab 4. Prerequisites: 1413, MATH 1513. A study of the impact of technology on the environment.

Medical Technology (MTCL)

4117
Clinical Microbiology. Lab 12. Prerequisites: concurrent internship in affiliated hospital, and all degree requirements for B.S. in medical technology except 30 hours MTCL. The theory and laboratory study of pathogenic bacteria, viruses, rickettsiae, fungi, and parasites. Includes isolation, identification, antimicrobial susceptibility testing, and medical significance.

4125
Clinical Chemistry I. Lab 9. Prerequisites: concurrent internship in affiliated hospital, and all degree requirements for B.S. in medical technology except 30 hours MTCL. The theory and laboratory methodology of analytical biochemistry, clinical microscopy, routine and special procedures, and medical significance.

4236
Clinical Hematology. Lab 12. Prerequisites: concurrent internship in affiliated hospital, and all degree requirements for B.S. in medical technology except 30 hours MTCL. Systematized study of diseases, cell maturation and function, principles of hemostasis; methodology used in routine and special hematology studies; and correlation of hematological findings with physiological conditions.

4246
Clinical Immunology. Lab 12. Prerequisites: concurrent internship in affiliated hospital, and all degree requirements for B.S. in medical technology except 30 hours MTCL. 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.

4325
Clinical Chemistry II. Lab 9. Prerequisites: concurrent internship in affiliated hospital, and all degree requirements for B.S. in medical technology except 30 hours MTCL. The theory and laboratory methodology of analytical biochemistry, instrumentation, lab mathematics, routine and special procedures and medical significance.

4351
Topics in Medical Technology. Prerequisites: concurrent internship in affiliated hospital, and all degree requirements for B.S. in medical technology except 30 hours MTCL. Principles and practices of the medical laboratory including basic management, quality assurance, education methodology, computer applications, laboratory safety, and special projects in selected areas.

Microbiology (MICR)

1513
(L,N)Inquiry-based Biology. Lab 3. Prerequisites: CHEM 1413, GEOL 1613, PHYS 1313 recommended. Directed inquiry and hands on study of biological principles. Recommended for elementary education majors as model course to learn and teach science.

2125
Introduction to Microbiology. Lab 4. Prerequisites: one year of chemistry and BIOL 1114. General principles of microbiology.

3143
Medical Mycology. Lab 4. Prerequisite: 2125. Examination of fungi as animal pathogens; laboratory techniques used in the identification of human and animal pathogens, and differentiation from common contaminants.

3154
Food Microbiology. Lab 4. Prerequisites: 2125 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 ANSI 3154.

3224
Advanced Microbiology. Lab 4. Prerequisite: 2125, corequisite: CHEM 3015. Subcellular structure and function of microorganisms. Synthesis, translocation, and metabolism of cellular macromolecular constituents. Substrate transport and metabolism.

3254
Immunology. Lab 3. Prerequisite: 2125. Vertebrate host's ability to defend itself against foreign intrusion. Chemistry and biology of the acquired immune response. Same course as CLML 3254.

4000
Honors in Microbiology. 1-4 credits, maximum 4. Prerequisite: consent of departmental honors committee. Supervised study and research in microbiology.

4001
Professional Transitions in Microbiology and Cell and Molecular Biology. Prerequisites: declared microbiology or cell and molecular biology 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. Same course as CLML 4001.

4123*
Virology. Prerequisites: CLML 3014 or one course in biochemistry. Corequisite: 3224. Virus-host interactions including structure-function of animal, plant and bacterial viruses. Discussion of the molecular biology of virus infection and development. Same course as CLML 4123.

4133*
Molecular and Microbial Genetics. Lab 2. Prerequisites: 2125, BIOL 3024 and one semester of organic chemistry. Corequisite: 3224. 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. Same course as CLML 4133.

4134*
Pathogenic Microbiology. Lab 3. Prerequisite: 2125. Corequisite: 3224. Examination of pathogenic bacteria as they relate to humans, other animals, plants and insects.

4214*
Microbial Ecology. Prerequisites: 2125 and CHEM 3015 or 3053. Corequisite: 3224. 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.

4323*
Bioenergetics. Prerequisites: BIOC 3653 or CLML 3014. Bioenergetics reactions and mechanisms involved in energy production in plants, animals and microbial systems. Same course as CLML 4323.

4990
Special Problems. 2-4 credits, maximum 4. Prerequisite: consent of instructor. Minor investigations in the field of microbiology.

4993
Senior Honors Project. Prerequisites: 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.

5000*
Thesis. 2-6 credits, maximum 6. Prerequisite: consent of major professor. A student studying for the M.S. degree enrolls in this course for six hours credit.

5113*
Advanced Immunology. Prerequisite: 3254. Advanced studies with emphasis on the regulation of vertebrate immune responses.

5142*
Techniques in Molecular Biology. Lab 4. Prerequisite: consent of instructor. Comprehensive laboratory course in research techniques involving classical genetics and molecular biology.

5153*
Emerging Infectious Agents. Prerequisites: 3134, 4123. 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.

5160*
Seminar. 1 credit, maximum 2. Required of all graduate students majoring in microbiology.

5213*
Environmental Microbiology. Prerequisite: 3224, 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.

5254*
Biotechnology Projects. Lab 8. Prerequisites: 4133, MICR 5142. An indepth exposure to the practical application of biological principles. Classical and modern (genetic engineering) biotechnology, within a framework involving the identification of a problem or need, determination of a solution or product, strain development, scale-up technology, and product recovery or process enhancement.

5990*
Special Problems. 1-4 credits, maximum 10. Prerequisite: permission of instructor. Investigations in the field of microbiology.

6000*
Dissertation. 1-15 credits, maximum 45. Prerequisite: consent of major adviser. Research in microbiology for the Ph.D. degree.

6112*
Molecular Biology of Bacterial Viruses. Prerequisites: 4123 and 4133. Advanced study of bacteriaphages.

6120*
Recent Advances in Microbiology. 1-3 credits, maximum 6. Prerequisite: one graduate course in biochemistry. Discussion and evaluation of recent scientific contributions in terms of the living organism.

6143*
Advanced Microbial Physiology. Lab 3. Prerequisite: 3224 or consent of instructor. Discussion of selected topics in microbial physiology. Critical analysis of research papers.

6153*
Advanced Molecular Genetics. Prerequisites: 4133 or CLML 4133. Structure, function and regulation of nucleic acids. Gene transfer mechanisms, genetic recombination and plasmid biology. Recent developments in recombinant DNA technology.

6253*
Microbial Evolution. Prerequisites: 2124, BIOC 3653, BIOL 3024. 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.

6304*
Genetics of Simple Eukaryotes. Prerequisites: solid understanding of basic cellular maintenance and propagation processes and consent of instructor. Indepth discussion of lessons learned from simple eukaryotes such as *S. cerevisiae* (yeast), *A. nidulans* (fungus), *D. melanogaster* (fly) and *C. elegans* (worm).

6323*
Current Topics in Eukarytic Signal Transduction and Gene Regulation. Prerequisites: BIOC 3653, BIOL 3024 and CLML 3014. Discussion of current literature on the mechanisms of eukaryotic signal transduction and gene regulation.

Military Science (MLSC)

1000
Leadership Laboratory. 1 credit, maximum 2. Lab 2. Prerequisites: 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.

1112
Fundamentals of Military Leadership. 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.

1212
Introduction to Leadership. Principles of effective leading, communication skills, and organizational ethical values. Concurrent enrollment in MLSC 1000 recommended. Optional weekend exercise.

2130
Military Physical Conditioning. 1 credit, maximum 2. Lab 3. Prerequisite: 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.

2233
Self and Team Development. 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.

2313
Individual and Team Military Tactics. Lab 2. Prerequisite: 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.

3113
Leading Small Organizations I. Lab 2. Prerequisites: 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.

3223
Leading Small Organizations II. Lab 2. Prerequisite: 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.

4014
Reserve Officers' Training Corps (ROTC) Advanced Camp. Lab 8. Prerequisites: 3113 and 3223. A five-week camp conducted at an Army post. Individual leadership and basic skills performance.

4123
Leadership Challenge and Goal-Setting. Lab 2. Prerequisites: 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.

4223
Military Ethics, Justice and Professionalism. Lab 2. Prerequisites: 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.

4422
The Tactical Planning Process. Prerequisite: 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.

Music (MUSI)

1001
Percussion Techniques. Lab 2. Methods for playing and teaching percussion instruments.

1011
Piano Class Lessons. For students with no previous experience.

1021
Piano Class Lessons.

1031
Voice Class Lessons.

1071
Single Reed Techniques. Lab 2. Methods for playing and teaching the clarinet and saxophone.

1081
Double Reed Techniques. Lab 2. Methods for playing and teaching the oboe and bassoon.

1090
Secondary Harpsichord. 1-2 credits, maximum 8.

1091
High Brass Techniques. Lab 2. Methods for playing and teaching the trumpet and French horn.

1100
Elective Harpsichord. 1-2 credits, maximum 8.

1110
Elective Organ. 1-4 credits, maximum 8.

1120
Elective Piano. 1-4 credits, maximum 8.

1130
Elective Voice. 1-4 credits, maximum 8.

1140
Elective Brass. 1-4 credits, maximum 8.

1150
Elective Strings. 1-4 credits, maximum 8.

1160
Elective Woodwinds. 1-4 credits, maximum 8.

1170
Elective Percussion. 1-4 credits, maximum 8.

1180
Secondary Organ. 1-2 credits, maximum 8.

1190
Secondary Piano. 1-2 credits, maximum 8.

1200
Secondary Voice. 1-2 credits, maximum 8.

1210
Secondary Brass. 1-4 credits, maximum 8.

1220
Secondary String. 1-2 credits, maximum 8.

1230
Secondary Woodwind. 1-2 credits, maximum 8.

1240
Secondary Percussion. 1-2 credits, maximum 8.

1250
Major Organ. 1-4 credits, maximum 8.

1260
Major Piano. 1-4 credits, maximum 8.

1270
Major Voice. 1-4 credits, maximum 8.

1280
Major Violin. 1-4 credits, maximum 8.

1290
Major Viola. 1-4 credits, maximum 8.

1300
Major Cello. 1-4 credits, maximum 8

1310
Major Double Bass. 1-4 credits, maximum 8.

1340
Major Flute. 1-4 credits, maximum 8.

1350
Major Oboe. 1-4 credits, maximum 8.

1360
Major Clarinet. 1-4 credits, maximum 8.

1370
Major Saxophone. 1-4 credits, maximum 8.

1380
Major Bassoon. 1-4 credits, maximum 8.

1390
Major Trumpet. 1-4 credits, maximum 8.

1400
Major French Horn. 1-4 credits, maximum 8.

1410
Major Trombone. 1-4 credits, maximum 8.

1420
Major Euphonium. 1-4 credits, maximum 8.

1430
Major Tuba. 1-4 credits, maximum 8.

1440
Major Percussion. 1-4 credits, maximum 8.

1450
Major Harpsichord. 1-4 credits, maximum 8.

1513
Music Literature. Music of the Baroque, Classical, Romantic, and Contemporary periods, with emphasis on style analysis.

1531
Sightsinging and Eartraining I. Lab 2. Development of skills in sightsinging and aural perception. Taken concurrently with MUSI 1533.

1533
Theory of Music I. Choral and instrumental writing and analysis correlated with keyboard skills. Taken concurrently with MUSI 1531.

1541
Sightsinging and Eartraining II. Prerequisites: 1531 and 1533. A continuation of 1531. Taken concurrently with 1543.

1543
Theory of Music II. Prerequisites: 1531 and 1533. A continuation of 1533, taken concurrently with 1541.

1623
Introduction to Music Business. A survey of music business procedures, opportunities, technologies and trends.

1723
Introduction to Music Education. An entry level course designed to socialize the music education major to the role of the music education teacher within U.S. schools. Motivation and discipline, teaching cycles, stimulus variation, multicultural music, music learning theories, music advocacy, foundations of music introduction, structured observational skills.

2010
Piano Class Lessons. Prerequisites: 1021 and music major status. Class lessons for music majors (non-keyboard concentration) preparing for the piano proficiency examination.

2052
String Instrument Techniques. Methods for playing and teaching the violin, viola, cello and double bass.

2071
Flute Techniques. Lab 2. Methods for playing and teaching the flute.

2091
Low Brass Techniques. Lab 2. Methods for playing and teaching the trombone, euphonium, and tuba.

2250
Major Organ. 1-6 credits, maximum 12. Prerequisite: 1250.

2260
Major Piano. 1-6 credits, maximum 12. Prerequisite: 1260.

2270
Major Voice. 1-6 credits, maximum 12. Prerequisite: 1270.

2280
Major Violin. 1-6 credits, maximum 12. Prerequisite: 1280.

2290
Major Viola. 1-6 credits, maximum 12. Prerequisite: 1290.

2300
Major Cello. 1-6 credits, maximum 12. Prerequisite: 1300.

2310
Major Double Bass. 1-6 credits, maximum 12. Prerequisite: 1310.

2340
Major Flute. 1-6 credits, maximum 12. Prerequisite: 1340.

2350
Major Oboe. 1-6 credits, maximum 12. Prerequisite: 1350.

2360
Major Clarinet. 1-6 credits, maximum 12. Prerequisite: 1360.

2370
Major Saxophone. 1-6 credits, maximum 12. Prerequisite: 1370.

2380
Major Bassoon. 1-6 credits, maximum 12. Prerequisite: 1380.

2390
Major Trumpet. 1-6 credits, maximum 12. Prerequisite: 1390.

2400
Major French Horn. 1-4 credits, maximum 8. Prerequisite: 1400.

2410
Major Trombone. 1-6 credits, maximum 12. Prerequisite: 1410.

2420
Major Euphonium. 1-4 credits, maximum 8. Prerequisite: 1420.

2430
Major Tuba. 1-6 credits, maximum 12. Prerequisite: 1430.

2440
Major Percussion. 1-6 credits, maximum 12. Prerequisite: 1440.

2450
Major Harpsichord. 1-4 credits, maximum 8.

2551
Sightsinging and Eartraining III. Prerequisites: 1541 and 1543. Further development of skills in sightsinging and aural perception. Taken concurrently with 2553.

2553
Theory of Music III. Lab 1/2. Prerequisites: 1541 and 1543. Choral and instrumental writing correlated with sightsinging, melodic and harmonic dictation and keyboard skills. Taken concurrently with 2551.

2561
Sightsinging and Eartraining IV. Prerequisites: 2551 and 2553. A continuation of 2551. Taken concurrently with 2563.

2563
Theory of Music IV. Lab 1/2. Prerequisites: 2551 and 2553. A continuation of 2553. Taken concurrently with 2561.

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.

2600
Chamber Ensembles. 1 credit, maximum 8. Lab 2. Combination of voices, keyboard, and orchestral instruments for performing chamber music, music theater and duo piano repertoire.

2610
University Bands I. 1-2 credits, maximum 6. Lab 3-5.

2620
Symphony Orchestra I. 1-2 credits, maximum 6.

2630
University Choral Ensembles I. 1-4 credits, maximum 6.

2682
Music Education. For certificate/licensure in elementary education. Methods of teaching music in grades K-6.

2832
Elementary Methods I. 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.

2842
Elementary Methods II. Prerequisite: 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.

3022
Piano Skills for Vocal Music Education Majors. Prerequisite: 2010 or consent of instructor. De-velopment of skills in sight-reading, score reading, and general ensemble accompaniment for vocal music education majors.

3100
Elective Harpsichord. 1-2 credits, maximum 8.

3110
Elective Organ. 1-4 credits, maximum 8. Prerequisite: 1110.

3120
Elective Piano. 1-4 credits, maximum 8. Prerequisite: 1120.

3130
Elective Voice. 1-4 credits, maximum 8. Prerequisite: 1130.

3140
Elective Brass. 1-4 credits, maximum 8. Prerequisite: 1140.

3150
Elective String. 1-4 credits, maximum 8. Prerequisite: 1150.

3160
Elective Woodwind. 1-4 credits, maximum 8. Prerequisite: 1160.

3170
Elective Percussion. 1-4 credits, maximum 8. Prerequisite: 1170.

3180
Secondary Organ. 1-2 credits, maximum 8. Prerequisite: 1180.

3190
Secondary Piano. 1-2 credits, maximum 8. Prerequisite: 1190.

3200
Secondary Voice. 1-2 credits, maximum 8. Prerequisite: 1200.

3210
Secondary Brass. 1-2 credits, maximum 8. Prerequisite: 1210.

3220
Secondary String. 1-2 credits, maximum 8. Prerequisite: 1220.

3230
Secondary Woodwind. 1-2 credits, maximum 8. Prerequisite: 1230.

3240
Secondary Percussion. 1-2 credits, maximum 8. Prerequisite: 1240.

3250
Major Organ. 1-4 credits, maximum 8. Prerequisites: upper-division examination, 2250.

3260
Major Piano. 1-4 credits, maximum 8. Prerequisites: upper-division examination, 2260.

3270
Major Voice. 1-4 credits, maximum 8. Prerequisites: upper-division examination, 2270.

3280
Major Violin. 1-4 credits, maximum 8. Prerequisites: upper-division examination, 2280.

3290
Major Viola. 1-4 credits, maximum 8. Prerequisites: upper-division examination, 2290.

3300
Major Cello. 1-4 credits, maximum 8. Prerequisites: upper-division examination, 2300.

3310
Major Double Bass. 1-4 credits, maximum 8. Prerequisites: upper-division examination, 2310.

3340
Major Flute. 1-4 credits, maximum 8. Prerequisites: upper-division examination, 2340.

3350
Major Oboe. 1-4 credits, maximum 8. Prerequisites: upper-division examination, 2350.

3360
Major Clarinet. 1-4 credits, maximum 8. Prerequisites: upper-division examination, 2360.

3370
Major Saxophone. 1-4 credits, maximum 8. Prerequisites: upper-division examination, 2370.

3380
Major Bassoon. 1-4 credits, maximum 8. Prerequisites: upper-division examination, 2380.

3390
Major Trumpet. 1-4 credits, maximum 8. Prerequisites: upper-division examination, 2390.

3400
Major French Horn. 1-4 credits, maximum 8. Prerequisites: upper-division examination, 2400.

3410
Major Trombone. 1-4 credits, maximum 8. Prerequisites: upper-division examination, 2410.

3420
Major Euphonium. 1-4 credits, maximum 8. Prerequisites: upper-division examination, 2420.

3430
Major Tuba. 1-4 credits, maximum 8. Prerequisites: upper-division examination, 2430.

3440
Major Percussion. 1-4 credits, maximum 8. Prerequisites: upper-division examination, 2440.

3450
Major Harpsichord. 1-4 credits, maximum 8.

3460
Secondary Harpsichord. 1-2 credits, maximum 8.

3552
Introduction to Recording Studio Techniques I. Prerequisite: 3592. Introduction to performance and characteristics of studio components. Basic signal flow, basic microphone design and application, recording sessionprocedures, role of assistant engineers.

3562
Recording Studio Techniques II. Prerequisite: 3552. Advanced study of characteristics and performance of recording studio components through observation, reading and personal experience.

3583
(H,I)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.

3592
Introduction to Music Technology. Prerequisite: 2563. Study of specialized computer applications in music, including MIDI basics and sequencing.

3610
University Bands II. 1-2 credits, maximum 6. Lab 3-5. Prerequisite: 4 hours of 2610.

3620
Symphony Orchestra II. 1-2 credits, maximum 6. Lab 4.

3630
University Choral Ensembles II. 1-4 credits, maximum 6. Prerequisite: 4 hours of 2630.

3642
English and Italian Diction and Vocal Literature. 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.

3652
French Diction and Vocal Literature. 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.

3662
German Diction and Vocal Literature. 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.

3712
Basic Conducting. Principles of conducting choral and instrumental groups.

3722
Evaluation Techniques for the Ensemble Conductor. Prerequisite: 3712. Studies in diagnostic and achievement evaluation techniques appropriate for school musicians in ensemble situations.

3732
Teaching Choral Music. Prerequisite: 3712. Repertoire, rehearsal procedures, and vocal techniques for the public school choral teacher.

3743
Foundations of Music Education. Prerequisite: full admission to Teacher Education. Interdisciplinary approach including aspects of philosophy, aesthetics, sociology and psychology as they are applied in music in post-elementary public schools.

3753
History of Music to 1750. Prerequisites: 1513 and 1533, or equivalent. 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 Baroque period.

3763
History of Music from 1750. Prerequisite: 1513, 1533 or equivalent. Aids music majors and other qualified students in understanding the musical styles, forms, schools, composers and instruments that developed in Western civilization from the pre-classical period to the 20th century.

3772
Counterpoint. Prerequisites: 2563 and satisfactory upper-division examination. Analysis and application of contrapuntal techniques of the 18th century.

3783
Form and Analysis. Prerequisites: 2563 and satisfactory upper-division examination. Analysis of standard repertoire with emphasis on form and structural harmonic analysis.

3842
Marching Band Methods. Prerequisite: 2832. Organizational responsibilities and charting for public school marching bands.

3852
Instrumental Methods and Literature. Prerequisite: 3712. This course is designed to give instrumental music education majors an in-depth look at administering a public school band program. History and wind literature, literature selection, preparing budgets, preparing commissioning projects, and working with administration, school boards and parent groups.

3901
Junior Recital. Prerequisites: junior standing and consent of major applied music teacher.

4100
Music Industry Internship. 1-8 credits, maximum 8. Lab 8. Prerequisites: 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.

4250
Major Organ. 1-6 credits, maximum 12. Prerequisites: 3250 and successful completion of recital attendance requirements.

4260
Major Piano. 1-6 credits, maximum 12. Prerequisites: 3260 and successful completion of recital attendance requirements.

4270
Major Voice. 1-6 credits, maximum 12. Prerequisites: 3270 and successful completion of recital attendance requirements.

4280
Major Violin. 1-6 credits, maximum 12. Prerequisites: 3280 and successful completion of recital attendance requirements.

4290
Major Viola. 1-6 credits, maximum 12. Prerequisites: 3290 and successful completion of recital attendance requirements.

4300
Major Cello. 1-6 credits, maximum 12. Prerequisites: 3300 and successful completion of recital attendance requirements.

4310
Major Double Bass. 1-6 credits, maximum 12. Prerequisites: 3310 and successful completion of recital attendance requirements.

4340
Major Flute. 1-6 credits, maximum 12. Prerequisites: 3340 and successful completion of recital attendance requirements.

4350
Major Oboe. 1-6 credits, maximum 12. Prerequisites: 3350 and successful completion of recital attendance requirements.

4360
Major Clarinet. 1-6 credits, maximum 12. Prerequisites: 3360 and successful completion of recital attendance requirements.

4370
Major Saxophone. 1-6 credits, maximum 12. Prerequisites: 3370 and successful completion of recital attendance requirements.

4380
Major Bassoon. 1-6 credits, maximum 12. Prerequisites: 3380 and successful completion of recital attendance requirements.

4390
Major Trumpet. 1-6 credits, maximum 12. Prerequisites: 3390 and successful completion of recital attendance requirements.

4400
Major French Horn. 1-6 credits, maximum 12. Prerequisites: 3400 and successful completion of recital attendance requirements.

4410
Major Trombone. 1-6 credits, maximum 12. Prerequisites: 3410 and successful completion of recital attendance requirements.

4420
Major Euphonium. 1-4 credits, maximum 8. Prerequisites: 3420 and successful completion of recital attendance requirements.

4430
Major Tuba. 1-6 credits, maximum 12. Prerequisites: 3430 and successful completion of recital attendance requirements.

4440
Major Percussion. 1-6 credits, maximum 12. Prerequisites: 3440 and successful completion of recital attendance requirements.

4450
Major Harpsichord. 1-4 credits, maximum 8.

4490*
Lessons in Applied Music (Major Field). 1-4 credits, maximum 4. Prerequisite: bachelor's degree or equivalent performing level in applied major field. Major applied music field.

4600*
Chamber Ensembles. 1-2 credits, maximum 12. Lab 2. Prerequisite: 4 hours of MUSI 2600 or equivalent. Combinations of voices, keyboard, and orchestral instruments for performing chamber music, music theater and duo piano repertoire.

4810*
Problems in Musical Composition. 1-2 credits, maximum 2. Prerequisites: 1543 and consent of instructor. Practical experiences in musical composition.

4840*
Special Studies in Music Literature. 1-2 credits, maximum 4. Prerequisite: junior standing or consent of instructor. Survey of music literature suitable for teaching various levels in applied music.

4890*
Special Studies in Music Pedagogy. 1-2 credits, maximum 4. Prerequisite: junior standing or consent of instructor. Survey of music pedagogical methods suitable for various levels and types of applied music.

4901
Senior Recital. Prerequisites: senior standing and permission of major applied music teacher.

4912
Orchestration and Arranging. Prerequisite: upper-division standing as a music major or consent of instructor. Orchestrating for instrumental ensembles and arranging for choral ensembles.

4940
Student Teaching in Public School Music. 1-12 credits, maximum 12. Prerequisites: 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.

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.

4962*
Music Education Seminar. Research into latest developments of public school choral and instrumental music.

4972
Twentieth Century Music Theory and Literature. Prerequisites: 2563, 3763. Melodic, harmonic and rhythmic techniques in 20th century music.

4990*
Selected Studies in Music and Music Education. 1-3 credits, maximum 8. Short-term area studies in music and music education.

4993
Senior Honors Project. Prerequisites: 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.

5004*
Final Degree Project. Preparation of a recital of significant repertoire to be conducted or played in public performance, depending upon the student's degree track. Submission of a formal paper that is a formal interpretive analysis of each work.

5113*
Introduction to Graduate Studies in Music. Prerequisite: 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.

5480*
Lessons in Applied Music (Minor Field). 1-4 credits, maximum 12. Prerequisite: bachelor's degree or equivalent performance level in applied major field.

5490*
Lessons in Applied Music (Major Field). 1-4 credits, maximum 12. Prerequisite: bachelor's degree or equivalent performing level in applied major field. Private Lessons.

5512*
Advanced Studies in Music Literature and Pedagogy I. Prerequisite: 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.

5522*
Advanced Studies in Music Literature and Pedagogy II. Prerequisite: 3753, 3763 or equivalent. A continuation of 5512, with emphasis upon music of the 20th century and its attendant specialized performance techniques.

5583*
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.

5610*
University Bands. 1-2 credit, maximum 12. Large ensembles.

5620*
Symphony Orchestras. 1-2 credit, maximum 12. Large ensembles.

5630*
University Choral Ensembles. 1-2 credit, maximum 12. Large ensembles.

5712*
Advanced Studies in Conducting I. Prerequisites: 3712 and 3722 or equivalent. Acquisition of an expressive conducting gestural vocabulary as it relates to the student's chosen medium.

5722*
Advanced Studies in Conducting II. Prerequisites: 5712. A continuation of 5712 focusing upon the gestural vocabulary as it relates to the specific complexities of contemporary music.

5733*
Techniques of Pedagogy and Performance. Prerequisites: 3712 and 3722 or equivalent. Advanced techniques and modes for preparing music for performance.

5742*
Conducting Practicum. Lab 2. Prerequisites: 5712, 5722. Supervised conducting opportunities with major OSU ensembles or approved off-campus ensembles.

5750*
Seminar in Music History. 3 credits, maximum 9. Prerequisites: 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.

5842*
Music Repertory. Survey of music literature suitable for teaching various levels in applied music.

5972*
20th Century Music Theory and Literature. Prerequisites: 2563, 3763 or equivalent. Musical techniques and literature in the 20th century.

5973*
Analysis of Musical Styles. Prerequisite: 3783 or equivalent. Exploration of techniques appropriate for the analysis of selected music of various styles from the Middle Ages to the 20th century, including Schenkerian analysis and set theory applications.

Natural Science (NATS)

5050
Report. 1-2 credits, maximum 2. Prerequisite: enrollment in program leading to M.S. in natural science. Guidance in reading and research required for M.S. in natural science degree.

5990*
Topics in Natural and Applied Sciences. 1-3 credits, maximum 9. Prerequisite: 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)

2111
Professional Careers in Nutritional Sciences. Career opportunities in dietetics and foods and nutrition. Roles and responsibilities of nutritional sciences professionals. Routes to professional memberships and current issues in professionalism.

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.

2850
Special Topics in Nutritional Sciences. 1-3 credits, maximum 4. Study of specific consumer education issues or topics in nutritional sciences.

3133*
Science of Food Preparation. Lab 3. Prerequisites: HRAD 1114, organic chemistry. Application of scientific principles to food preparation.

3213
Management in Hospitality and Food Service Systems. Prerequisite: a course in economics. Function and methods of management as related to the hospitality and food service industries.

3223
Nutrition Across the Life Span. Prerequisite: 2114 or equivalent. Nutritional needs and dietary concerns of individuals from conception through old age.

3440
Nutritional Sciences Professional Experience. 1-3 hours, maximum 3. Directed practical experience in an approved work situation related to the foods and nutrition industry.

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.

3553
Purchasing in Hospitality and Food Service Systems. Prerequisite: 3133 or concurrent enrollment. Procurement of food and nonfood materials in hospitality and related industries.

3812
Nutrition Assessment and Counseling Skills. Lab 2. Prerequisites: 2114, 3223 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.

3991
Pre-internship Seminar in Nutritional Sciences. Skills requisite for directed practical experience in a work situation in food and nutrition areas.

4013*
Experimental Foods. Lab 3. Prerequisite: 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.

4023*
Nutrition and Health Issues. Prerequisites: 2114, 3223. Analysis of the role of specific nutrients in health maintenance and in prevention of chronic disease. Communication of nutrition information to the public.

4133*
Nutrition for Exercise and Sport. Prerequisites: 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.

4323*
Human Nutrition and Metabolism. Prerequisites: 2114 or equivalent, organic chemistry, physiology. Digestion, absorption and metabolism of nutrients; functions and health implications in the human organism.

4333*
Food, Beverage and Labor Cost Controls. Prerequisites: ACCT 2203, junior standing. Menu analysis and food/beverage/labor cost controls associated with hospitality industry operations.

4365*
Quantity Food Production Management. Lab 5. Prerequisites: HRAD 2125, HRAD or NSCI 3553 and a course in accounting or mathematics or consent of instructor. Organizing, purchasing, costing, preparation and service of food in a quantity food production setting.

4373*
Creative Teaching of Nutrition. Prerequisites: 2114, 3223 or concurrent enrollment. Analyses of various methods, techniques, resources and evaluation for nutrition education. Experimental component required.

4573*
Food Systems Administration. Lab 3. Prerequisites: HRAD 3553, 4365. Management and integration of financial, human, physical, food and other material resources in various settings.

4643
Critical Issues in Nutrition and Healthcare. Prerequisite: senior standing. Integration of the body of knowledge of nutrition and healthcare through examination of critical issues.

4733*
Community Nutrition. Prerequisites: 2114, 3223. Application of nutrition, education and communication principles to community nutrition programs and services. Field work required.

4850
Special Unit Studies in Nutritional Sciences. 1-3 credits, maximum 6. Special units of study in nutritional sciences.

4853
Medical Nutrition Therapy I. Prerequisites: 3812, 4323 or concurrent enrollment. Physiological and metabolic bases for dietary modifications in disease states.

4863
Medical Nutrition Therapy II. Prerequisite: 4853. A continuation of 4853.

4900
Honors Creative Component. 1-3 credits, maximum 3. Prerequisites: College of Human Environmental Sciences Honors Program participation, senior standing. Guided creative component for students completing requirements for College Honors in College of Human Environmental Sciences. Thesis, creative project or report under the direction of a faculty member in the major area, with second faculty reader and oral examination.

5000*
Research in Nutritional Sciences. 1-6 credits, maximum 6. Prerequisite: consent of adviser. Individual research and thesis that will fulfill the requirements for the master's degree.

5012*
Public Policy Development in Food, Nutrition and Related Programs. Rationale underlying governmental programs in food and nutrition and human environmental sciences and assessment of the effectiveness of the programs.

5123*
Research Developments in Nutritional Sciences. Basic components of the research process and application of research methods to nutritional sciences.

5211*
Contemporary Issues in Food Service and Management. Prerequisite: acceptance as a dietetic intern. Discern contemporary issues in food service and management in dietetics; formulate innovative solutions and processes to enhance effectiveness in the work place. Graded on a pass-fail basis.

5221*
Contemporary Issues in Clinical Nutrition. Prerequisite: acceptance as a dietetic intern. Discern contemporary issues in the practice of clinical dietetics; formulate innovative solutions and processes to enhance effectiveness in the work place. Graded on a pass-fail basis.

5230*
New Findings in Nutrition. 1-3 credits, maximum 6. Prerequisite: 2114 or equivalent. Current emphases in nutrition, with implications for nutrition research, education, and public service.

5231*
Contemporary Issues in Community Nutrition. Prerequisite: acceptance as a dietetic intern. Discern contemporary issues in the practice of community dietetics; formulate innovative solutions and processes to enhance effectiveness in the workplace. Graded on a pass-fail basis.

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.

5343*
Organization and Management of Food Service Systems. Prerequisite: 4573 or equivalent. Contemporary theories of organizational structures as applied in the management of food service systems.

5363*
Maternal and Infant Nutrition. Prerequisite: 2114 or equivalent. Nutritional needs and dietary concerns during pregnancy, lactation and the first year of life. Implications for nutrition intervention, education and policy.

5373*
Childhood Nutrition. Prerequisite: 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.

5393*
Nutrition and Aging. Prerequisite: 2114 or equivalent. Nutritional needs, and dietary concerns of the elderly. Implications for food and nutrition programs, policies, research and education.

5412*
Dietetic Internship Management Practi-cum. Prerequisite: 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.

5422*
Dietetic Internship Clinical Practi-cum. Prerequisite: 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.

5432*
Dietetic Internship Community Nutrition. Prerequisite: 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.

5463*
Advanced Human Nutrition. Prerequisites: a biochemistry course and an upper-level nutrition course. Application to the human being of metabolic processes which involve essential dietary components.

5553*
International Nutrition and World Hunger. Prerequisite: consent of instructor. Advanced study of the magnitude, causes, and nature of hunger and undernutrition in low income countries; emphasis on programs, policies and planning directed toward alleviating hunger.

5563*
Nutritional Assessment. Prerequisites: 3223, 4323, or equivalent. Dietary, physical, and biochemical assessment techniques and their application to patient or client nutritional status assessment in health care systems.

5593*
Quality of Work Life in Food Service Organizations. Prerequisite: one course in personnel management. Analysis of administrative problems in food service organizations. Focus on quality of work life assessment.

5612*
Theory, Research and Practice of Nutrition Education. Prerequisites: 4373 or equivalent and consent of instructor. Analyses of various learning and behavior change theories and application in nutrition education.

5633*
Nutrition and Immunology. Prerequisites: nutrition courses, or relevant training in physiology, immunology or consent of instructor. Principles and issues related to nutrition and immunology. Impact of nutrients and nutritional status on integrity of the immune system.

5643*
Advanced Medical Nutrition Therapy. Prerequisite: admission to dietetic internship or consent of instructor. Physiological and metabolic bases for nutritional support in disease.

5673*
Manpower Management in Health Care and Related Industries. Prerequisite: consent of instructor. Future role, focus, practices and governance of human resources in health care.

5713*
Community Dietetics. Prerequisites: 4373, 4733 or equivalent. Analysis of the impact of political, legislative, economic and cultural diversity factors on dietetic practice in public health and other community nutrition programs.

5743*
Experimental Methods in Nutritional Sciences. Prerequisites: a course in biochemistry, a course in statistics, a graduate course in food or nutrition. Experimental design for research in food and nutrition based on analytical laboratory techniques and other research methodology.

5753*
Management in Health Care Systems. Prerequisite: consent of instructor. Overview of U.S. international and transcultural health care systems. Futuristic managerial roles of health care professionals and how they affect health and health care in various settings.

5783*
Food Product Development. Prerequisite: 4013 or ANSI 3373 or MCAG 4123 or consent of instructor; graduate standing. Principles and pertinent issues in food product development, including concepts, experimental and product design, process development, evaluation, packaging and marketing.

5863*
Sensory Evaluation of Food. Lab 2. Prerequisite: 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.

5870*
Problems in Nutritional Sciences. 1-4 credits, maximum 6. Analysis of emerging problems and trends in nutritional sciences.

5961*
Seminar in Nutritional Sciences. Prerequisite: for Master of Science students. Individual and group seminars on current issues and research in nutritional sciences.

6000*
Doctoral Thesis. 1-12 credits, maximum 30. Prerequisite: consent of major professor.

6113*
Critical Analysis of Current Issues in Nutrition. Prerequisite: 5463 or consent of instructor. Current issues in human nutrition with emphasis on interrelationships of nutrients in metabolism and their impact on health.

6123*
Micronutrients in Human Nutrition. Prerequisite: one course in biochemistry. In depth study of vitamins and minerals and their interrelationships in metabolism.

6233*
Critical Analysis of Current Issues in Food Service Administration. Prerequisites: 5593, 5673. Current issues in food service administration with emphasis on total quality management, robotics, solid waste management and research needs.

6453*
Advanced Research Developments in Nutritional Sciences. Prerequisites: one course in research methods and one course in statistics. Components of the research process for students who have completed an advanced degree. Development, application and interpretation of research methodology.

6870*
Independent Study in Nutritional Sciences. 1-3 credits, maximum 6. In-depth analysis of research issues in nutritional sciences.

6961*
Advanced Studies in Nutritional Sciences. Critical evaluation of research in nutritional sciences. Individual and group seminars on selected topics.

Occupational Education (OCED)

5000*
Thesis or Report. 2-10 credits, maximum 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.

5010*
Seminar. 1-3 credits, maximum 6. Graduate student seminars focusing on current and critical issues and common problems relevant to occupational education.

5113*
Principles of Occupational Education. Underlying principles and evolving concepts in occupational and adult education. Critical analysis of educational programs and service areas and the resulting implications for leadership personnel at all levels of program responsibility.

5123*
Evaluation of Programs and Instruction in OCED. Philosophies, principles and techniques of evaluation and strategies for applying them in planning, managing and improving occupational education programs. Designing, conducting, and reporting evaluations of OCED programs and instruction.

5133*
International Occupational Education. Prerequisite: graduate standing. Ideas, practices and systems of occupational education in other countries compared with contemporary practices in the United States to provide a basis for an enlarged, critical view of technical education.

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.

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.

5232*
Teaching Related Information. Selection of job-related topics common to most occupational programs; procedures for incorporating those topics into the regular curriculum.

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.

5313*
History and Organization of Occupational Education. Prerequisite: graduate standing. Social, political, and economic forces acting upon occupational education studies in depth for leadership development.

5333*
Administration and Supervision of Local Occupational Education Programs. The duties of administrative and supervisory personnel responsible for the development, coordination and promotion of occupational education programs.

5340*
Special Problems in Occupational Education. 1-6 credits, maxumum 6. Prerequisite: consent of instructor. Directed independent study of special topics involving assigned readings, library research, field work or a combination of these.

5413*
Guidance, Placement and Follow-up in Occupational Education. Teacher-counselor cooperation in occupational student advisement, placement and follow-up.

5423*
Individualizing Competency-based Instruction Programs. Development of knowledge and skills utilizing the concept of open entry/open exit necessary for planning, developing and implementing a competency-based occupational education program.

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.

5480*
Modern Technology in Occupational Education. 1-6 credits, maximum 6. Technical developments in specialized occupational areas examined and analyzed for educational curriculum and program implications.

5543*
Occupational Education, Community and Industry Relations. Exploration of strategies for developing meaningful relationships among occupational educators, industry representatives, and community members to increase the likelihood that the needs of students, workers, employers and community members are met.

5553*
Occupational Education for Students with Special Needs. Techniques and procedures by which occupational education may serve individuals with special needs. Field experiences an integral part of the course.

5673*
Principles and Practices of Distance Learning in Occupational Education. Prerequisite: 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.

5720*
Workshop. 1-3 credits, maximum 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.

5773*
School-to-Work Transition. Strategies and procedures for coordinating school-to-work transition programs (e.g., cooperative education, youth apprenticeship, career exploration). Planning, organizing, implementing, and evaluating school-related, work-based learning.

5880*
Internship in Occupational Education. 3-6 credits, maximum 6. Prerequisite: consent of instructor. Supervised experience working in business, industry, human service, or education settings.

5910*
Developing and Analyzing Teaching Content. 1-3 credits, maximum 6. Provides opportunity for experienced teachers to incorporate the latest industrial technology into their course of study.

6000*
Doctoral Dissertation. 1-25 credits, maximum 25. Required of all candidates for the Doctor of Philosophy degree. Credit is given upon completion of the dissertation.

6103*
Philosophy of Occupational Education. Alternative perspectives for developing a philosophic position in occupational and adult education.

6110*
Graduate Reading in Occupational Education. 1-6 credits, maximum 6. Prerequisites: graduate standing and consent of supervising professor. Supervised readings of significant literature not included in regularly scheduled courses.

6113*
Teacher Education and Personnel Development for Occupational Education. Prerequisite: 6103. Research, trends and innovative practices in teacher education and personnel development for occupational education.

6233*
Contextualized Learning and Communities of Practice. An analysis of communities of practice, situated cognition, constructivism, and information on learning through occupations. Expansion of the understanding and knowledge of an active, student centered teachying/learning process, in work-based learning context.

6333*
Strategic and Tactical Planning and Development. Theory, practice and trends in concepts and implementation. Analysis of comparisons and articulation among various public and private sector organizations.

6343*
Financing Occupational Education. Prerequisite: 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.

6354*
Educational Futures. Critical examination of the relationship between learning and facets of post-industrialism such as socio-economic inequities, rapid technological change, organizational change, and the changing nature of work.

6871*
Doctoral Seminar: Level 1. Orientation to doctoral program in OCED. May be taken prior to program application; required of all applicants.

6880*
Doctoral Internship in Occupational Education. 1-8 credits, maximum 8. Prerequisite: 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.

6881*
Doctoral Seminar: Level 2. Preparation of the required tentative proposal for dissertation and the comprehensive doctoral examination. Required for OCED doctoral candidates.

Philosophy (PHIL)

1013
(H)Philosophical Classics. Basic works by great thinkers, including Plato, Descartes and Hume.

1213
(H)Philosophies of Life. Introductory ethics and social philosophy. Moral decision-making, the good life, social values, freedom and responsibility.

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.

2113
(H)Introduction to Philosophy. Selected philosophical problems: the nature of reality, knowledge, value, social ideals and religion.

3003*
(A)Symbolic Logic. Propositional logic and predicate logic with identity. Formal analysis of language.

3113
(**H)Ancient and Medieval Philosophy**. Main systems of Western thought from the Greeks to 15th century Europe. Emphasis on Plato, Aristotle, Augustine and Aquinas.

3213
(H)Modern Philosophy. Major philosophers and problems in Western thought from the 16th through the 19th century. Emphasis on Descartes, Hume and Kant.

3313
(H)19th and 20th Century Philosophy. Major philosophers and problems in Western thought from Hegel to the present.

3413
(H)Ethics. Contemporary and classical views on the nature of moral judgements, moral value, relativity and objectivity, freedom and responsibility.

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.

3613
(H)Philosophy of Religion. Nature of religion, religious experience and religious language. God-concepts, theistic arguments, God and evil, God and immortality.

3713
(H)Philosophy of Education. Classical and contemporary philosophers who have systematically developed their ideas about education, including Plato, Aristotle, Rousseau, Locke and Dewey.

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.

3813
(H)Recent American Philosophy. Dominant trends in American philosophy during the last 100 years, with emphasis on pragmatism.

3823
(H)Engineering Ethics. Philosophical analysis of moral issues in engineering practice, such as whistleblowing, conflicts of interest and product liability. Professional codes of ethics.

3833
(H)Biomedical Ethics. Moral problems brought about by recent developments in scientific research and medical technology. Abortion, euthanasia, genetic engineering, and human experimentation.

3843
(H)Philosophy of Law. Prerequisite: 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.

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.

3920
Contemporary Philosophical Problems. Selected contemporary problems and discussions.

3923
Contemporary Issues in Philosophy. Selected current controversies and recent trends in philosophy.

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.

4003*
Mathematical Logic and Computability. Prerequisites: 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 CS 4003 and MATH 4003.

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.

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.

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.

4453
(H)Philosophy in Literature. Selected literary works examined for philosophical ideas and themes. Attention to the interrelation of form and content. Thematic approach.

4543*
Philosophy in Language. Prerequisites: 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.

4553*
Contemporary Ethical Theory. Debate in ethical theory since Moore. The naturalistic fallacy, intuitionism, and value realism.

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.

4733
(H)Philosophy of Biology. Selected philosophical topics, such as Darwinism and other theories of evolution, physical reductionism, and issues of genetic engineering.

4983*
Metaphysics and Epistemology. Prerequisite: 12 credit hours of philosophy. The study of the fundamental nature of reality and human knowledge of it.

4990*
Special Studies in Philosophy. 1-3 credits, maximum 10. Selected philosophical topics or works.

4991*
Contemporary Philosophy Research. Prerequisites: 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.

4993
Senior Honors Thesis. Prerequisites: 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.

5000*
Thesis in Philosophy. 1-6 credits, maximum 6. Supervised individual work on a thesis for a master's degree.

5210*
Seminar on a Major Philosopher. 3 credits, maximum 9. Prerequisite: three courses in philosophy. The writings of a major philosopher and related material.

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.

5310*
Seminar on a Field of Philosophy. 3 credits, maximum 9. Prerequisite: three courses in philosophy. Selected topics in one field of philosophy.

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).

5323*
Seminar in Ancient Philosophy. Prerequisite: 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.

5333*
Seminar in Modern Philosophy. Prerequisites: 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.

5343*
Seminar in East and West Comparative Philosophy. Prerequisite: 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.

5353*
Seminar in Contemporary Continental Philosophy. Prerequisites: 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.

5363*
Topics in Metaphysics. Prerequisites: 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.

5373*
Contemporary Epistemology. Prerequisites: 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.

5383*
Seminar in American Philosophy. Selected philosophical schools or traditions influential in American thought, such as transcendentalism, pragmatism, or naturalism.

5393*
German Idealism. Prerequisites: 3113 or 3213. Selected major works of post-Kantian German Philosophy, such as the nature of a philosophical system, identity, and self-consciousness.

5423*
Topics in Ethical Theory. Prerequisite: 3413. Central problems in ethical theory, such as ethical realism/anti-realism, motivational internalism/externalism, and problems within specific normative systems.

5433*
Topics in Philosophy of Law. Prerequisite: 3843. In-depth examination of selected topics in philosophy of law, such as punishment, jurisprudence, and principles of legislation. Seminar format.

5443*
Topics in Biomedical Ethics. Prerequisite: 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.

5453*
Topics in Professional Ethics. In-depth study of ethical issues faced by business and engineering professionals (e.g., social effects of advertising, environmental impact of professional practice, product safety and consumer protection, whistleblowing and confidentiality.

5513*
History of Educational Philosophy. Outstanding western educational theories. Emphasis on Plato, Aristotle, Quintilian, Comenius, Locke, Rousseau and Dewey.

5610*
Philosophical Issues in Education. 2-3 credits, maximum 3. Contemporary issues in educational theory and practice. The relation of education to political thought, religion, public law and culture.

5713*
Contemporary Philosophies of Education. Analysis of contemporary educational philosophies, with attention to recommended aims, curricula and methods.

5910*
Research Problems in Philosophy. 1-3 credits, maximum 10. Prerequisite: consent of instructor and department head. Individual or group research on specific philosophical problems.

Physics (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.

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. No credit for students with credit in 1114.

1114
(L,N)General Physics. Lab 2. Prerequisite: high school algebra and trigonometry, or MATH 1483 or MATH 1715. Algebra-based introductory course covering the basic concepts of physics. Practical examples of the role of physics in other disciplines. Newtonian mechanics, fluids, heat, thermodynamics, waves, sound.

1214
(L,N)General Physics. Lab 2. Prerequisite: 1114. Continuation of 1114; electricity, magnetism, optics, quantum physics, atomic and nuclear structure.

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.

2014
(L,N)General Physics. Lab 2. Prerequisite: MATH 2144 or concurrent enrollment. Calculus-based introductory course for science, math and engineering majors. Mechanics, waves, heat, and thermodynamics.

2114
(L,N)General Physics. Lab 2. Prerequisite: 2014 or 2314. Continuation of 2014. Electricity, magnetism and optics.

2314
General Physics for Science Majors I. Lab 2. Prerequisite: MATH 2144. Calculus-based introductory course for science and math majors. Conservation of energy and momentum, energy transfer, Newton's Laws, kinematics, relativity.

2414
General Physics for Science Majors II. Lab 2. Prerequisite: 2014 or 2314. Continuation of 2314. Electrostatics, electric fields and currents, circuits, waves, physical optics, modern physics, nuclear physics, and thermodynamics.

3013*
Mechanics I. Prerequisites: 2114 or equivalent, and MATH 2233 or concurrent enrollment. Mechanics of particles, systems of particles and rigid bodies.

3113*
Heat. Prerequisites: 1214 or equivalent and MATH 2163 or concurrent enrollment. Thermometry, heat transfer, elementary theory of specific heat and the three laws of thermodynamics.

3213*
Optics. Prerequisites: 2114 or 2414 and 3513, or consent of the instructor. Geometrical optics; interference, diffraction, dispersion, absorption and polarization of light.

3313*
Modern Physics for Engineers. Prerequisite: 2114 or equivalent. Emphasis on nuclear, molecular and solid state physics with engineering applications.

3322*
Modern Laboratory Methods I. Lab 6. Prerequisites: 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.

3513*
Mathematical Physics. Prerequisites: 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.

3622
Modern Laboratory Methods II. Lab 6. Prerequisites: 2014, 2114. 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.

3713
Modern Physics I. Prerequisite: 2114. Atomic physics, special theory of relativity, and introduction to solid state and nuclear physics.

4003*
Computer Simulation Methods in Physics. Prerequisites: 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.

4010*
Special Problems. 1-3 credits, maximum 9. Prerequisite: consent of instructor. Individual laboratory work of an advanced nature.

4113*
Electricity and Magnetism. Prerequisites: 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.

4213*
Introduction to Nuclear and Particle Physics. Prerequisites: 2114 and 3713 or consent of instructor. Survey of particle and nuclear phenomena. Fundamental particles and their interactions, conserved quantum numbers, weak, electromagnetic, and strong interactions of quarks, leptons and gauge bosons, modern experiments exploring these phenomena, connection to early universe cosmology.

4263*
Introduction to Solid State Physics. Structure, specific heat, dielectric properties, lattice vibrations, free electron theory, band structure and superconductivity of solids.

4313*
Molecular Biophysics. Prerequisites: 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.

4413*
Modern Physics II. Prerequisites: 3013 and 3713. Atomic and X-ray spectra; one-dimensional Schroedinger equation; nuclear structure; introduction to statistical mechanics and elementary quantum statistics.

4423*
Mechanics II. Prerequisite: 3013. Coupled oscillators, propagation of waves in discrete and continuous media, mechanics of discrete and continuous media and acoustics.

4513*
Introductory Quantum Mechanics. Prerequisite: 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.

4663*
Radioactivity and Nuclear Physics. Prerequisite: 3313. Natural and artificial radioactivity, decay laws; absorption, detection and measurement of radiations; nuclear transformations.

4712*
Senior Project. Lab 6. Advanced individual experimental projects. Project proposal, formal laboratory report, and oral presentation are required.

4813*
Electromagnetic Radiation. Prerequisites: 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.

4993
Senior Honors Thesis. Prerequisites: 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.

5000*
Master's Thesis Research or Report. 1-9 credits, maximum 9. Prerequisite: consent of major professor. Thesis research or report for master's degree.

5110*
Seminar. 1-5 credits, maximum 20. Prerequisite: graduate standing in physics. Special topics in physics.

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.

5133*
Theory of Spectra. Line spectra, hyperfine structure, Lamb shift, band spectra, NMR spectra and ESR spectra.

5163*
Lasers. Prerequisite: 4813 or equivalent. Semiclassical 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.

5213*
Statistical Mechanics. Prerequisites: 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.

5220*
Physics Topics for Teachers. 1-6 credits, maximum 6. Prerequisite: 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.

5263*
Particle Physics. Prerequisite: 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.

5313*
Electromagnetic Theory. Prerequisite: 5453. Electric and magnetic fields in free space and in matter. Boundary value problems, Green's functions, stress tensors, multipole expansions, thermodynamics; electromagnetic waves.

5350*
Special Problems. 1-3 credits, maximum 3. Prerequisite: graduate standing in physics. Special problems of experimental or theoretical nature. Largely individual work with written report required.

5413*
Classical Mechanics. Prerequisite: 4423 or consent of instructor. Generalized coordinates and advanced dynamics; coupled systems, wave motion; theory of elasticity.

5453*
Methods of Theoretical Physics. Prerequisite: 3513. Introduction to the various methods and techniques used in theoretical physics.

5613*
Quantum Mechanics I. Prerequisite: 5453. Postulates of quantum mechanics. Operators, commutation relations, eigenfunctions. Schroedinger, Heisenberg and interaction formalisms, angular momentum and central field problems; nondegenerate perturbation theory.

5663*
Solid State Physics I. Prerequisite: 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.

5713*
Solid State Physics II. Prerequisite: 5663 or equivalent. Symmetry, dielectric properties, ferroelectrics, magnetic properties, mechanical properties and defects of solids.

5813*
General Relativity. Prerequisites: 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.

5960*
Problems in Chemical Physics. 3-6 credits, maximum 6. Prerequisite: consent of instructor. Intermolecular forces, interaction of radiation with matter in bulk form, dielectric properties of matter, polymer physics and quantum theory of biopolymers.

6000*
Doctoral Dissertation Research. 1-15 credits, maximum 60. Prerequisites: admission to candidacy and permission of major professor.

6010*
Advanced Graduate Seminar. 1-3 credits, maximum 15. Prerequisite: consent of instructor. Special topics of an advanced nature in physics.

6113*
Advanced Theory of Solids. Prerequisite: 5663. Many-body techniques, transport processes, band theoretical techniques, superconductivity, dynamics of electrons in a magnetic field, and alloys.

6213*
Group Theory for Physics. Prerequisite: 5453. Group theory and imperfections in crystals. Dislocation theory and color centers.

6243*
Semiconductors I. Prerequisites: 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, intrinssic and extrinsic statistics, trapping and recombination.

6260*
Special Topics in High Energy Physics. 1-3 credits, maximum 9. Prerequisites: 5263 or consent of instructor. Advanced topics of current interest in high-energy physics: collider physics, supersymmetry, unification, flavor physics, string phenomenology, extra dimensions.

6313*
Quantum Mechanics II. Prerequisite: 5613. Scattering theory, many-particle quantum mechanics and application to atomic and molecular systems; degenerate and time-dependent perturbation theory.

6343*
Semiconductors II. Prerequisite: 6243. The second part of the semiconductors sequence. Transport phenomena, junctions, devices, heterostructures and optical properties.

6413*
Modern Optics. Prerequisites: 5313, 5163, 5613. Non-linear optics, higher-order susceptibilities; four-wave mixing; quantum optics and photon statistics, Maxwell-Bloch equations.

6513*
Advanced Topics in Solid State Physics. Prerequisite: 5663 or equivalent. Interaction of radiation and matter, neutron scattering, phase transitions, magnetic resonance and cooperative phenomena.

6613*
Advanced Nuclear and Particle Physics. Prerequisites: 5263, 6313; or consent of instructor. Renormalization of quantum field theories, spontaneous symmetry breaking, Standard model, flavor physics, grand unification, super-symmetry.

6713*
Advanced Electromagnetic Radiation. Prerequisite: consent of instructor. Radiation theory, wave guides, scattering and dispersion relations; relativity.

6803*
Photonics I: Advanced Optics. Lab 9. Prerequisite: 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 and ECEN 6803.

6810*
Photonics II: THz Photonics and THz-TDS. 1 credit, maximum 4. Lab 1. Prerequisite: 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 and ECEN 6810.

6820*
Photonics II: Spectroscopy II. 1 credit, maximum 4. Lab 1. Prerequisite: 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 and ECEN 6820.

6830*
Photonics II: Spectroscopy III. 1 credit, maximum 4. Lab 1. Prerequisite: 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 and ECEN 6830.

6840*
Photonics III: Microscopy I. 1 credit, maximum 4. Lab 1. Prerequisite: 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 and ECEN 6840.

6850*
Photonics III: Microscopy II. 1 credit, maximum 4. Lab 1. Prerequisite: 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 and ECEN 6850.

6860*
Photonics III: Microscopy III and Image Processing. 1 credit, maximum 4. Lab 1. Prerequisite: 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 and ECEN 6860.

6870*
Photonics IV: Synthesis amd Devices I. 1 credit, maximum 4. Lab 1. Prerequisite: 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 and ECEN 6870.

6880*
Photonics IV: Semiconductor Devices, Testing and Characterization. 1 credit, maximum 4. Lab 1. Prerequisite: 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 and ECEN 6880.

6890*
Photonics IV: Semiconductor Synthesis and Devices III. 1 credit, maximum 4. Lab 1. Prerequisite: 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 and ECEN 6890.

Plant Pathology (PLP)

3344
Introductory Plant Pathology. Lab 2. Prerequisite: BIOL 1114 or 1404. 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.

3553
Fungi: Myths and More. Lab 2. Prerequisite: biology. Colorful folklore and myths of fungi and the role of fungi in the ecosystem and human affairs as diseases of plants, animals and humans. Laboratory instruction on mushrooms, mechanisms of dispersal and genetic recombinations. Undergraduate research component on isolation and growth of mushrooms and other fungi.

3663
Turfgrass Integrated Pest Management. Lab 2. Prerequisite: 3344, ENTO 2023. 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.

4400
Undergraduate Research. 1-3 credits, maximum 3. Prerequisite: consent of instructor. Undergraduate research problems in plant pathology.

4922*
Applications of Biotechnology in Arthropod and Pathogen Control. Prerequisites: introductory biology and chemistry or equivalent. Applications of biotechnology in controlling arthropod pests of plants and animals and plant pathogens. Introduction to underlying technology, products being deployed, their effectiveness and associated problems or concerns resulting from their use. Same course as ENTO 4922.

5000*
Research. 1-6 credits, maximum 6. Research for the M.S. degree.

5004*
Plant Nematology. Lab 3. Prerequisite: 3344 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.

5012*
Plant Virology Laboratory. Lab 4. Prerequisite: previous or concurrent enrollment in 5013. Methods of investigating plant viruses.

5013*
Plant Virology. Prerequisites: 3344 or equivalent; one course in biochemistry or physiology. Transmission, characterization, differentiation, replication and control of plant viruses; discussion of current literature.

5043*
Principles of Phytopathology. Lab 2. Prerequisite: elementary botany or plant physiology. An in-depth survey of the basic principles and practices of plant pathology presented at the graduate level. Ecology and epidemiology of plant pathogens. Field trips to view plant diseases in natural settings. Student-planned and conducted hands-on experimentation with plant pathogens.

5104*
Mycology. Lab 4. Prerequisite: 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.

5304*
Phytobacteriology. Lab 4. Prerequisite: 3344. Bacteria as plant pathogens, with examination of the taxonomy, genetics, ecology, physiology, host-parasite interaction and control of phytobacteria.

5413*
Plant Disease Epidemiology. Lab 3. Prerequisite: 3344 or 5043. Introduction to methodology and technical equipment used in epidemiological research and application of epidemiological principles in plant disease control.

5523
Integrated Management of Insect Pests and Pathogens. Prerequisites: 3344 and ENTO 2023 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 5523.

5560*
Problems in Plant Pathology. 1-5 credits, maximum 10. Prerequisite: consent of instructor.

5613*
Host Plant Resistance. Lab 2. Prerequisites: 3344 and ENTO 2023 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.

5724*
Physiology of Host-Pathogen Interactions. Lab 4. Prerequisites: 3344 and BIOC 3653. Physiology of the interactions between plants and pathogens. Mechanisms by which pathogens infect and by which plants resist infection.

5850*
Plant Pathology Seminar. 1 credit maximum per semester. 2 credits for M.S. and 4 credits for Ph.D. required.

5860*
Colloquium. 2 credits, maximum 2. Prerequisite: 3344. Concepts and principles of plant pathology through discussions of pertinent literature.

5870*
Scientific Presentations. 1 credit, maximum 5. Prerequisite: consent of instructor. Preparation and delivery of scientific presentations including 50-minute seminars, 10-minute talks, and posters. Same course as ENTO 5870.

5992*
Career Skills and Professionalism for Scientists. Prerequisite: 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.

6000*
Research. 1-12 credits, maximum 36. Research for the Ph.D. degree.

6102*
Genetics of Plant Disease. Lab 4. Prerequisites: 3344 or equivalent and a course in general genetics. Genetics of host plants, plant pathogens and the interaction between the two. Flor's gene-for-gene hypothesis and its implications in breeding for disease resistance.

6303*
Soilborne Diseases of Plants. Lab 3. Prerequisite: 3344. 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)

1213
Introduction to Plant, Range, and Soil Sciences. Introduction to the concepts of three disciplines. Importance of plant and soil science to the producer, consumer, and citizen; modern management and production practices; maintenance of natural resources.

1223
(N)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.

2013
Principles of Crop Science. Lab 2. Prerequisites: 1213 or BIOL 1404 or FOR 1123 or HORT 1013. Production, management, and improvement of modern agronomic crops. 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.

2041
Career Orientation. Prerequisite: sophomore standing in the Department of Plant and Soil Sciences. Development and improvement of written and oral communicative skills; orientation to research and extension activities related to plant and soil sciences, and academic requirements and procedures. Graded on pass-fail basis.

3111
Weed Control Laboratory. Lab 2. Prerequisites: 1213 and 3112 (or concurrent enrollment). Identification of common weeds, principles and practices of herbicide application, and application equipment, handling and proper use of herbicides.

3112
Principles of Weed Control. Prerequisite: 1213. Weed control principles and practices included in cultural and chemical weed control. Current weed control practices in crops, rangeland and crop situations.

3213*
Forage and Grazinglands Resource Management. Prerequisites: 1213 or BOT 1404. Management of introduced forages and native rangeland for maximum yield potential, economical livestock production, pasture system development and enhancement of wildlife habitat.

3554*
(N)Plant Genetics and Biotechnology. Lab 2. Prerequisite: BIOL 1114. Basic principles of heredity. Interrelationship between classical genetics and molecular genetics emphasized. Mendelian genetics, cytogenetics, mutations, gene regulation and genetic engineering.

3782
Seed Technology. Prerequisite: 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.

3790
Seed and Plant Identification. 1 credit, maximum 2. Lab 3. Prerequisite: 1213. Identification and classification of agronomically important crop and weed species from seed and from seedling, vegetative, flowering or mature plants.

4080
Professional Internship. 1-6 credits, maximum 6. Prerequisite: consent of instructor. Internship must be at an approved agribusiness unit or other agency serving agronomic agriculture. Requires a final conference with on campus adviser and a written report. Graded on a pass-fail basis.

4113*
Advanced Weed Science. Prerequisites: 3111 and 3112. 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.

4123*
Crop Physiology. Prerequisites: 1213 and BOT 3463. Application of basic physiological concepts of growth and cultural management and underlying crop production; environmental and genetic effects on growth of crop plants. Plant ecosystems at the community level relative to optimum yields and quality.

4353*
Plant Breeding. Prerequisite: 3554 or equivalent. Basic principles dealing with the improvement of plants through application of genetic principles.

4470*
Problems and Special Study. 1-3 credits, maximum 12. Lab 1-3. Prerequisite: consent of the instructor. Problems in plant science selected from topics in range and turf, plant breeding and genetics, crop management and physiology, and weed control.

4571
Senior Seminar. Prerequisite: senior standing in plant and soil sciences. Career opportunities (talks and field trips); preparation of resumes and interviews. Graded on a pass-fail basis. Same course as RLEM 4571 and SOIL 4571.

4673*
Grain Crops. Lab 2. Prerequisite: 1213. Production, distribution, classification, utilization and improvement of the major cereal crops.

4772*
Oilseed, Pulse and Mucilage Crops. Prerequisite: 1213. Production, utilization and improvement of oilseed, pulse and mucilage crops with special emphasis on peanuts and soybeans.

4783*
Cotton Production. Prerequisite: 1213. Production, utilization and improvement of cotton. Several other agronomic fiber crops briefly discussed.

5000*
Master's Thesis. 1-6 credits, 6 maximum total credits under Plan I, and 2 maximum total credits under Plan II. Prerequisite: consent of adviser. Research planned, conducted and reported in consultation with a major professor.

5020*
Graduate Seminar. 1 credit, maximum per semester 1 credit on M.S. program and 2 credits on a Ph.D. program required. Prerequisite: graduate standing. Philosophy of research, methods of research, or interpretation of research.

5110*
Problems and Special Study. 1-4 credits, maximum 6. Prerequisite: consent of instructor. Supervised study of special problems and topics not covered in other graduate courses.

5112*
Herbicide Fate in the Environment. Prerequisite: 4112. Processes involved in the behavior and fate of herbicides in air, soil, and water. Reaction, movement and dissipation of herbicides in soil.

5230*
Research. 1-4 credits, maximum 4. Prerequisite: consent of a faculty member supervising the research. Supervised independent research on selected topics.

5293*
Plant Response to Water Stress. Prerequisites: 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.

5403*
Physiological Action of Herbicides. Prerequisite: BOT 3463. The mode of action, uptake and translocation, and metabolism of herbicides in crops and weeds.

5414*
Plant Breeding Theory, Methods and Strategies. Prerequisites: 3554, 4353 and STAT 5013, or consent of instructor. Development and application of statistical and genetic principles to breeding methodology of self- and cross-pollinated crops; emphasis on selection methods pertinent to plant improvement; examination of philosophies and strategies employed in private and public plant breeding programs.

5433*
Biotechnology in Plant Improvement. Prerequisites: 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.

5443*
Advanced Genetics. Prerequisites: 3554; BIOC 3653. Concepts of eukaryotic genetics with emphasis on classical, molecular and quantitative genetics.

5452*
Cytogenetics. Prerequisite: 5443 or concurrent enrollment in BOT 5232. Behavior of chromosomes, cellular organelles and cytoplasm in relation to genetic behavior.

5863*
International Agricultural Research Systems. Organization, management and budgeting agricultural research systems with emphasis on developing countries. Analysis of research and training priorities, budgeting, staffing and management of projects.

6000*
Doctoral Thesis. 1-6 credits, maximum 36. Requisite: consent of adviser. Independent research to be conducted and reported with the supervision of a major professor as partial requirement for the Ph.D. degree.

6010*
Advanced Topics and Conference. 1-6 credits, maximum 12. Prerequisite: M.S. degree. Supervised study of advanced topics. A reading and conference course designed to acquaint the advanced student with fields not covered in other courses.

6410*
Topics in Plant Breeding and Genetics. 1-3 credits, maximum 6. Prerequisite: 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)

1010
Studies in American Government. 1-2 credits, maximum 2. Special study in American government to allow transfer students to fulfill general education requirements as established by Regents' policy.

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.

2013
(S)Introduction to International Relations. 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.

2023
(S)Public Law and Private Rights. Introduction to the U.S. Constitution, legal reasoning, legal research techniques, and topical issues of U.S. public law.

2033
Introduction to Public Administration. Public administration, including administration, administrative organization, decision-making, governmental public relations, and administrative responsibilities.

2113
(S)Comparative Politics. A comparative study of the political processes and institutions of contemporary societies. Introduction to the concepts and methods of comparative politics.

2993
Honors Tutorial in Political Science. Prerequisites: 1013, 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.

3003
(I,S)The Societ 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.

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.

3043
Politics of International Trade and Development. 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.

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 and RUSS 3053.

3063
(I,S)Civilization, Empire and Change in World Politics. Prerequisite: 2013 or consent of instructor. The evolution and nature of interactions among the world's civilizations; the role of cultural power and empire-building in contemporary world politics; theories that attempt to explain international "order" and change.

3100
Political Science Internship. 1-6 credits, maximum 6. Prerequisite: consent of department. Internship education experience in a specific subfield in the discipline of political science.

3123*
(I)Government and Politics of Russia. Political processes, governmental institutions and public policies of post-Soviet Russia. Parties, elections and citizen participation in government.

3133*
(I)Politics of Anglo-American Democracies. Political processes and governmental institutions of the United Kingdom, Ireland, Canada, Australia, and New Zealand with comparisons to the United States.

3143*
(I)Politics of Western Europe. Political processes and governmental institutions of continental West European states, with emphasis on France, Germany and Italy.

3193
(I,S)Government and Politics in 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.

3223*
(I)Politics and Administration in East Asia. Political processes, governmental institutions and administration in China, Japan and Korea.

3233
(I,S)Chinese Politics. Political process, government institutions and experience of development in People's Republic of China.

3243
Foreign Policies in the Former Soviet Bloc. The comparative foreign policies of the territories of the former "Eastern bloc" in the period following the revolutions of 1989-91. The resurgence of nationalism and the effects of defining and pursuing national self-interest on the foreign policies of Eastern European and former Soviet territories.

3313*
(I)Governments and Politics in 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.

3353*
(S)Parties and Interest Groups. Political parties and interest groups as institutions; their role in elections and government.

3414*
Political Campaigns. Lab 2. Planning, fundraising, targeting, public opinion, support operations, voter contact, the mass media and candidate activities. Lab work in campaigns or government offices.

3423
(S)Voting and Elections. Electoral systems and their relationship to political development, political socialization, issue emergence, voting patterns, and electoral cycles.

3453*
(S)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.

3483*
(S)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.

3493*
Public Policy. Prerequisite: 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.

3503
Campaign Research and Technologies. Prerequisite: 1113. An introduction to technical innovations in political management. Political commercial creation and testing involving digital video cameras and audience response systems such as the "perception analyzer." The use of computers for database management, on-line information retrieval and electronic mail systems. Integration of research skills and political techniques by using the advanced information technologies of neural networks, intelligence gathering, computer-mediated political communications and electronic focus groups.

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.

3523
Campaign Fundraising and the Media. Prerequisite: 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.

3533
Political Lobby and Grassroots Organization. Prerequisite: 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. Meets with JB 3533. Same course as JB 3533.

3543
Political Candidacy. Prerequisite: 1113. The dynamics of political candidacy and theories of candidate motivation. The behavior exhibited by candidates will be examined in light of the various organizational roles associated with electoral processes.

3613*
State and Local Government. Political processes, government and administration of American states, cities and counties; special emphasis on Oklahoma.

3663*
Political Thought. The teachings of the three lasting traditions of Western political thought: classical, Christian and modern.

3683
American Politics in Contemporary Film. Prerequisite: 1113. The effect of politics on contemporary film. Exploration of the often subtle political imagery and symbolism contained in film.

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.

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 manmade natural and technological hazards.

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.

3953
(S)Minorities in the American Political System. Prerequisite: 1113. Examination of mass and elite level behavior of minorities in the contemporary U.S. political system.

3973
Race, Politics and Sports. Prerequisite: 1113. Historical, as well as the contemporary relationship, between race, politics and sports in the U.S. political system.

3983*
(S)The Judicial Process: Courts, Judges and Politics. 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.

4003
Political Analysis. Prerequisites: 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. No credit for students with credit in POLS 5003.

4013*
American Foreign Policy. Major problems and policies of American foreign relations since World War II and description of foreign formulation and aid administration.

4053*
(I)World Politics. Foreign policies of major powers, areas of tension and sources of international conflict.

4100*
Problems of Government, Politics and Public Policy. 1-6 credits, maximum 6. Prerequisites: 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.

4113*
International Institutions. The organization, procedures, functions and role of international institutions, with emphasis on the United Nations and related agencies.

4123
(I,S)The Politics of Globalization. Prerequisite: 2113 or consent of instructor. The policies and institutions to manage the economic and political consequences of the deeper integration of national economics into a world economy; how governments can manage the dilemmas placed on national policies and attempts at international cooperation in a rapidly changing and turbulent external environment. No credit for students with credit in POLS 5123.

4133
(I)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 tyoe of European policy that is emerging. No credit for students with credit in POLS 5133.

4213*
(S)Legal Problems of the International Environment. A case survey of diverse areas in which international law finds applicability; problems of territorial jurisdiction, continental shelves, straits, canals and international river systems, maritime law, national and outer space law and the international law of pollution.

4223
Comparative Political and Social Movements and the Politics of Protest. Prerequisite: 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.

4343*
The United States Constitution. An examination of the theoretical, philosophical, and legal underpinnings of the U.S. Constitution, relying heavily on a study of *The Federalist Papers*.

4353*
(S)Administrative Law. Legal powers, limits, and procedures of administrative agencies with emphasis on federal and state administrative procedure acts.

4363*
(S)Environmental Law and Administration. Statutory law, case law, and administrative practices relating to regulation of the environment including environmental impact statements, pollution, public lands, and preservation law.

4403*
(S)Urban Politics. Problems of governing American metropolitan areas.

4413*
Government Budgeting. The politics, planning and administration of government budgets.

4453*
(S)Public Personnel Administration. Problems, processes and procedures of public personnel administration.

4513*
American Politics. Significant developments and issues in American politics, including American political behavior and political leadership.

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.

4593*
(S)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.

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.

4693*
(S)Women in Politics. Changing role of women in government and politics. Voting behavior, public opinion, women in government and the women's movement.

4963
(S)American Constitutional Law: Equal Protection of the Laws. Prerequisite: 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.

4973*
American Constitutional Law: The Division of Governmental Powers. Prerequisite: 2023 or 3983 recommended. Development of principles of constitutional law by the Supreme Court concerning federalism and separation of powers with particular emphasis on political and doctrinal developments surrounding judicial review, regulation of commerce, taxing and spending and presidential power. Introduction to legal research methods.

4983
(S)American Constitutional Law: Due Process of Law. Prerequisite: 2023 or 3983 re-commended. Development of principles of constitutional law by the Supreme Court concerning 5th and 14th Amendment due process concepts, with particular emphasis on suspect's rights, search and seizure, free speech and press, religious liberty, property rights and procedural requirements at national and state level. Legal research techniques.

4993
Political Science Honors Thesis. Prerequisites: 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.

5000*
Thesis. 1-6 credits, maximum 6.

5003*
Political Analysis. Prerequisite: graduate standing. The scope of methods of political science. Scientific methodology applied to political phenomena, hypotheses, measurement, literature review, research designs, introductory data analysis and writing in political science. No credit for students with credit in POLS 4003.

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.

5020*
Research in Public Administration, Public Policy and Politics. 1-6 credits, maximum 6. Individually supervised research.

5030*
Internship in Public Administration and Government. 1-6 credits, maximum 6. Individually supervised internships in administrative and governmental career areas. Paper required.

5040*
Readings in Politics, Public Policy or Public Administration. 1-6 credits, maximum 6. Prerequisite: consent of supervising professor. Readings in the student's major area of study.

5100*
Advanced Problems in Government, Politics, and Public Policy. 3 credits, maximum 6. Special seminar, topics vary from semester to semester.

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.

5123*
The Politics of Globalization. Prerequisite: 2113 or consent of instructor. The policies and institutions to manage the economic and political consequences of the deeper integration of national economics into world economy; how governments can manage the dilemmas placed on national policies and attempts at international cooperation in a rapidly changing and turbulent external environment. No credit for students with credit in POLS 4123.

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. No credit for students with credit in POLS 4133.

5210*
Seminar in International Relations. 3 credits, maximum 6. Research on the dynamics and institutions of international politics.

5213*
Seminar in the International Political Economy. Prerequisite: graduate standing. Research on the mechanics and theories of interaction between economic and political phenomena. Same course as IS 5213.

5300*
Seminar in Emergency Management. 1-3 credits, maximum 6. Topics in emergency management such as terrorism, emergency management planning-mitigation, response, and recovery, or delivering emergency medical services (EMS).

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.

5320*
Seminar in Public Budgeting and Finance. 3 credit hours, maximum 6. Major processes and practices involved in governmental budgeting in the United States at national, state, and local level.

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.

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.

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.

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 and implementation and administrative accountability.

5363*
Public Sector Dispute Resolution. Prerequisite: 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.

5410*
Seminar in Comparative Politics and Government. 3 credits, maximum 6. Research in the political processes and governmental institutions of foreign countries.

5510*
Seminar in Political Behavior. 1-3 credits, maximum 6. Examination of contemporary theories of political behavior with emphasis on empirical studies.

5613*
Seminar in Public Policy. Public policy process including policy design, implementation and change. Approaches to public policy including design science, rational choice, policy sciences, normative models, and institutionalism.

5620*
Seminar in Natural Resource Policy, Law, and Administration. 3 credits, maximum 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.

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.

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.

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.

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.

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.

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.

5710*
Seminar in American Political Institutions. 1-3 credits, maximum 6. American institutions, including Congress, the presidency, courts, political parties and interest groups.

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.

5810*
Seminar in Women and Politics. 3 credits, maximum 9. Prerequisite: graduate standing. Research on a variety of topics concerning women and politics, including women's movements, women and elections, and public opinion.

5903*
Practicum in Fire and Emergency Management Administration. Prerequisite: consent of instructor. Supervised practicum in fire and emergency management administration.

Psychology (PSYC)

1113
(S)Introductory Psychology. Principles, theories, vocabulary, and applications of the science of psychology.

2313
Psychology and Human Problems. Prerequisite: 1113. Personality dynamics and their application to personal, cultural and vocational experience.

2583
(S)Developmental Psychology. Prerequisite: 1113. The nature of pertinent studies, causes, and theories of human developmental phenomena across the life span.

2593
Psychology of Human Sexuality. Prerequisite: 1113. Survey of behavioral, personality and psychophysiological components of human sexuality, with special emphasis on the delineation of facts from sexual myths.

2743
(S)Social Psychology. Theories and applications of social cognition, the self, pro-social and aggressive behavior, groups, attitudes and the environment.

3013
Psychology of Motivation. Prerequisite: 1113. Review of research and theory in such areas of motivation as hunger, sex, frustration, aggression, achievement, affiliation, and altruism.

3073
(N)Neurobiological Psychology. Prerequisite: 1113. Neural bases of human experience and behavior. Topics include sensation and perception, motivation and emotion, learning and thinking.

3113
(N)Comparative Psychology. Prerequisite: 1113. Comparative study of behavior characteristics of selected samples of the animal kingdom from protozoa to humans.

3173
Cognitive Neuroscience. Prerequisite: 1113, 3073. Multidisciplinary approach to understanding how mental activities of the mind are the result of the processing by the brain.

3214
Quantitative Methods in Psychology. Lab 2. Prerequisites: 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.

3413
Psychology of Social Behaviors. Lab 1. Prerequisites: 1113, 3212. 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.

3443
(S)Abnormal Psychology. Prerequisites: 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.

3513
Psychology of Learning. Prerequisites: 1113, 3213. 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.

3713
Psychology of Memory. Prerequisites: 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.

3823
Cognitive Psychology. Prerequisites: 1113, 3214 or equivalent. Cognitive processes. Thinking, problem solving, visual imagery, attention and memory search. Both theory and application emphasized.

3914
Experimental Psychology. Lab 2. Prerequisites: 1113, 3214 or equivalent and five additional hours in psychology. Problems, methods and applications of experimental psychology.

3990
Undergraduate Seminar. 1-6 credits, 6 maximum. Prerequisite: consent of instructor. For honors students and other outstanding students. Special topics in psychology.

4023*
Human Evolutionary Psychology. Prerequisite: 1113. The practical and theoretical application of natural selection to human behaviors including sexuality, gender roles, emotion, personality, politics and religion.

4123*
(S)Psychology of Women. Lab 1. Prerequisite: 1113. Sex differences and the development of sex role behavior. Encompasses the psychological dynamics of developmental and social issues for women.

4133*
(S)Psychology of Minorities. Prerequisite: 1113. Review of psychological theories and research pertinent to minority group status.

4143
(S)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.

4153
Psychology and Mass Media. Prerequisite: 1113. Survey of empirical evidence concerning the role of mass media in human psychological functioning. Psychological correlates of television and movie viewing; psychological needs met by media; the impact of various media content on behavior and cognition; and current social issues such as psychological effects of television violence, television sexuality, social stereotypes and advertising.

4183*
Current Issues in Clinical Psychology. Prerequisites: 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.

4213*
(S)Conflict Resolution. Prerequisite: 1113. Interpersonal conflict studied from psychological perspectives. Types and uses of conflict, and conditions for constructive dispute settlement.

4223*
Decision Making and Problem Solving. Prerequisite: 3823 or consent of instructor, or graduate standing. An examination of the research literature on individual decision making and problem solving with dual emphases on theory and application. Thorough knowledge of human cognitive functioning needed.

4333*
Personality. Prerequisites: 1113, 3443, or consent of instructor. Basic assumptions, research, and clinical issues relating to the major personality theories.

4483*
(S)Psychology of Parent Behavior. Prerequisite: 1113. Historical and contemporary conceptions of parent-child relationship and approaches to communication and discipline; special problems in parenting.

4493*
History of Psychology. Prerequisite: 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.

4813*
Psychological Testing. Prerequisites: 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.

4880
Senior Honors Thesis. 1-6 credits, maximum 6. Prerequisites: 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.

4883
Current Issues in Psychology. Prerequisites: 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.

4990*
Special Problems. 1-6 credits, maximum 6. Prerequisites: 1113, 3214 and consent of instructor. For honors students and other outstanding students. Experimental or library research.

5000*
Thesis. 1-6 credits, maximum 6. Required of all graduate students majoring in psychology and writing a thesis.

5113*
Psychopathology. Prerequisite: graduate standing in psychology or consent of instructor. Principles of diagnosis and treatment of major disorders.

5120*
Psychology Workshop. 2-6 credits, 6 maximum. Provides an opportunity to study specific psychological problems, both applied and theoretical.

5153*
Cognitive Assessment. Lab 1. Prerequisites: 3443, 4813; graduate standing in the clinical program of the Department of Psychology, the doctoral school or counseling psychology program or the psychometry program, or consent of instructor. Cognitive and intellectual assessment of children, adolescents and adults. Fundamental skills in administration, scoring, and interpretation of cognitive tests and report writing. Application of cognitive tests to specific clinical problems.

5193*
Ethics and Professional Development in Psychology. Prerequisite: 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.

5304*
Quantitative Methods in Psychology I. Prerequisite: 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.

5314*
Quantitative Methods in Psychology II. Lab 2. Prerequisite: 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.

5333*
Systems of Psychotherapy. Prerequisites: 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.

5380*
Research. 1-12 credits, maximum 12. Prerequisite: consent of instructor. Research project on some psychological problem.

5620*
Seminar in Psychology. 1-9 credits, maximum 9. Prerequisite: consent of instructor. Consideration of special topics that are particularly timely or technical in nature.

5660*
Teaching Practicum. 1-2 credits, maximum 2. Prerequisite: consent of instructor. Primarily for graduate students with well-defined new teaching responsibilities.

5823*
Cognitive Processes. Theory and experimental research findings dealing with human thought processes from a developmental and functional standpoint.

6000*
Dissertation. 1-16 credits, maximum 60. Research and report thereon by graduate students in partial fulfillment of requirements for the Doctor of Philosophy degree.

6083*
Principles of Behavior Therapy. Prerequisite: graduate standing in the clinical program of the Department of Psychology or consent of instructor. Principles and procedures of behavior therapy and modification.

6133*
Ethnic and Cultural Diversity in Psychotherapy. Prerequisites: 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.

6143*
The Psychology of Substance Abuse. Prerequisite: 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.

6173*
Child Psychopathology and Treatment. Prerequisites: 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.

6223*
Research Design. Prerequisites: 3914 and doctoral level standing. Experimental techniques in psychophysics, sensory processes, attention and perception, motivation and emotion, and learning and memory.

6233*
Clinical Research Design. Prerequisites: 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.

6253*
Seminar in Human Development. Prerequisite: consent of instructor. Behavioral aspects of development from the prenatal period to senescence. Normal development contrasted to exceptional development.

6283*
Factor Analysis. Factor analysis and implications for measurement of mental abilities, personality traits and learning.

6353*
Psychology of Motivation. Prerequisite: 3914. Outline of theory and research in human and animal motivation.

6393*
Psychology of Language. Review of data and theories of speech and language behaviors. Laboratory techniques and experimental designs will also be reviewed to emphasize understanding of psycholinguistic research.

6433*
Psychology of Information Processing: Development and Aging Aspects. Attention, list processing, pattern recognition and re-lated areas in terms of contemporary facts, theory and application. Special attention paid to development and aging aspects of information processing.

6443*
Behavioral Medicine. Prerequisites: graduate standing in the clinical program of the Department of Psychology; consent of instructor. An advanced graduate course for students in training for a Ph.D. 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.

6453*
Pediatric Psychology. Prerequisites: 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.

6483*
Neurobiological Psychology. Prerequisites: 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.

6523*
Family Treatment Methods. Prerequisite: 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.

6553*
Advanced Practice in Marital and Family Treatment. Prerequisites: 6523, concurrent enrollment in counseling or clinical prac-ticum; graduate standing in the clinical program of the Department of Psychology or the doctorate counseling psychology program, or consent of instructor. 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. Same course as ABSE 6553.

6563*
Advanced Social Psychology. Prerequisite: 2743. History, theory and experimentation of dynamic interaction of group membership and individual behavior.

6583*
Developmental Psychobiology. Prerequisites: 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.

6613*
Experimental Learning Theories. Prerequisite: nine credit hours of psychology. Basic concepts and empirical findings in animal and human learning.

6640*
Clinical Practicum. 1-12 credits, maximum 17. Prerequisite: graduate standing in the clinical program of the Department of Pyschology. Practicum experience for graduate students in the clinical psychology program.

6643*
Psychopharmacology. Prerequisites: 3073 or consent of instructor. A comprehensive course dealing with the various classes of drugs that affect the central nervous system. Primary focus is on clinical research with humans. Covers topics ranging from drug-receptor interactions through substance abuse and behavioral disorders.

6650*
Practicum. 1-16 credits, maximum 16. Prerequisite: 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.

6673*
Neuropsychological Assessment. Prerequisites: 5153, 6483, 6753; graduate standing in the clinical program in the Department of Psychology or consent of instructor. Psychological assessments of the effects of cerebral damage or disease.

6723*
Child Diagnostic Methods. Prerequisites: 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.

6753*
Assessment of Personality. Prerequisites: graduate standing in the clinical or counseling 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.

6883*
Seminar in Psychological Testing. Prerequisites: 5153, 6753 and graduate standing in the clinical program of the Department of Psychology, or consent of instructor. The administration, interpretation, and integration of projective and objective personality test data and intelligence test data with adult psychiatric patients.

6933*
Communication and Persuasion. Seminar concerning the communication process at all levels, from face-to-face encounters to the mass media, with emphasis on the social-psychological factors that influence persuasive attempts.

Rangeland Ecology and Management (RLEM)

1011
Professions in Natural Resources. An examination of the profession of the ecology and management of natural resources. Exploration of academic and career options. Graded on a pass-fail basis. Same as course as ZOOL 1011.

2913
(N)Ecology and Natural Resources. Prerequisite: 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.

3883
Aerial Photogrammetry and Information Systems. Lab 3. Prerequisite: MATH 1483, 1493 or 1513. Principles and techniques of aerial photogrammetry, remote sensing, aerial photo interpretation, and geographic information systems. Applications to management of natural resources utilizing photogrammetric instrumentation and geographic information system software. Same course as FOR 3883.

3913
(N)Rangeland Management and Restoration. Prerequisites: 2913 or FOR 3213 or BIOL 3034; SOIL 2124. Managing and restoring rangelands using prescribed burning, grazing and seeding. Managing invasive species with herbicides and mechanical treatments.

4571
Senior Seminar. Prerequisite: senior standing in plant and soil sciences. Career opportunities (talks and field trips); preparation of resumes and interviews. Graded on a pass-fail basis. Same course as PLNT 4571 and SOIL 4571.

4973
Rangeland Resources Planning. Lab 3. Prerequisites: 4954, ANSI 3612. 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.

4983*
Prescribed Fire. Lab 3. Prerequisites: 3913. 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.

4990*
Special Topics in Range Management. 1-3 credits, maximum 3. Prerequisite: 15 hours of range management. Advanced topics and new developments in range management.

4993
Advanced Prescribed Fire. Lab 3. Prerequisite: 4983 or consent of instructor. Preparing fire plans and executing prescribed fires as the fireboss. Same course as RLEM 5993. No credit for both RLEM 4993 and RLEM 5993.

5000*
Master's Thesis. 1-6 credits, 6 maximum total credits under Plan I, and 2 maximum total credits under Plan II. Prerequisite: consent of adviser. Research planned, conducted and reported in consultation with a major professor.

5020*
Graduate Seminar. 1 credit, maximum per semester 1 credit on M.S. program and 2 credits on a Ph.D. program required. Prerequisite: graduate standing. Philosophy of research, methods of research, or interpretation of research.

5230*
Research. 1-4 credits, maximum 8. Prerequisite: consent of a faculty member supervising the research. Supervised independent research in selected topics.

5760*
Special Topics in Rangeland Science. 2-4 credits, maximum 4. Prerequisite: consent of instructor. Selected topics in rangeland research methods or other rangeland topics.

5954*
Ecology of Rangeland Habitats and Landscapes. Lab 3. Prerequisite: graduate standing. 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. No credit for students with credit in RLEM 4954.

5973*
Rangeland Resources Planning. Lab 3. Prerequisites: 4954, ANSI 3612. Detailed analysis of case studies of rangeland and ranch management problems. Resource inventory, evaluation of ranch operations, and economic analysis. Integrated planning for representative ranch firms. Written and oral reports. Field trips required. No credit for students with credit in 4973.

5983*
Prescribed Fire. Lab 3. 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.

5993*
Advanced Prescribed Fire. Lab 3. Prerequisite: 4983 or consent of instructor. Preparing fire plans and executing prescribed fires as the fireboss. Same course as RLEM 4993. No credit for both RLEM 4993 or RLEM 5993.

6000*
Doctoral Thesis. 1-6 credits, maximum 36. Prerequisite: consent of instructor. Independent research to be conducted and reported with the supervision of a major professor as partial requirement for the Ph.D. degree.

6010*
Advanced Topics and Conference. 1-6 credits, maximum 6. Prerequisite: M.S. degree. Supervised study of advanced topics. A reading and conference course designed to acquaint the advanced student with fields not covered in other courses.

Religious Studies (REL)

1103
(H)The Religions of Mankind. 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.

3013
(H)The Old Testament and Its Study. 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.

3023
(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.

3123
(H)The Old Testament Prophets. Recommended: 3013. An interpretive study of the Hebrew prophets in historical perspective. Intensive study given to the more significant prophets.

3223
(H)The Teachings of Jesus in Historical Context. Recommended: 3023. The teachings of Jesus in light of modern historical research. Emphasis on interpreting selected passages from the Gospels.

3243
(H)Paul and the Early Church. Recommended: 3023. The letters of Paul in their historical context with special emphasis on his theology and ethics.

3573
(H)The Religions of Native Americans. Recommended: 1103. Selected tribal worldviews, belief systems and religious ceremonies, as depicted in oral traditions, songs and literature. Emphasis on Northern and Southern Plains Indians.

3613
(H,I)African Cultures and Religion. Key ideas, values and achievements in African culture and tradition as found in literature, art and music viewed in historical and religious perspective.

3713
Religion, Culture and Society. Recommended: 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.

4050
Studies in Religion. 1-6 credits, maximum 6. Independent studies, seminars and courses on selected topics in religion.

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.

4330
Seminar in Biblical Studies. 3 credits, maximum 9. Prerequisites: two courses in Biblical studies. Selected topics in the academic study of the Bible.

Research, Evaluation, Measurement and Statistics (REMS)

4052
Measurement and Evaluation in the School. Prerequisite: full admission to Professional Education. Construction and selection of classroom tests. Contrasts between criterion-referenced and norm-referenced measurement strategies. Grading techniques, rudiments of standardized test selection and score interpretation and the basic statistics used to summarize and analyze test results.

5000*
Master's Thesis. 1-6 credits, maximum 6. Prerequisite: consent of instructor.

5013*
Research Design and Methodology. Required of all graduate students in education. An introduction to the concepts of research design, methodology, sampling techniques, internal and external validity and the scientific method in educational problem solving. Critical analysis of educational research studies and the writing of proposals. No credit for student with credit in 5015.

5320*
Seminar in Research, Evaluation, Measurement and Statistics. 3-6 credits, maximum 6. Prerequisite: consent of instructor. In-depth exploration of contemporary problems of research, evaluation, measurement and statistics.

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.

5953*
Elementary Statistical Methods in Education. Elementary statistical methods needed by consumers of educational research. Descriptive and inferential statistics. No credit for students with credit in 5015.

6000*
Doctoral Dissertation. 1-25 credits, maximum 25. Prerequisite: consent of instructor. Required of all candidates for doctorate in applied behavioral studies. Credit given upon completion and acceptance of dissertation.

6003*
Analyses of Variance. Prerequisite: admission to a doctoral level program. A thorough examination of analysis of variance procedures as they relate to principles of experimental design in education and behavioral sciences.

6013*
Multiple Regression Analysis in Behavioral Studies. Prerequisite: 6003 or consent of instructor. Applications of multiple regression as a general data analysis strategy for experimental and non-experimental research in behavioral sciences.

6023*
Psychometric Theory. Prerequisite: 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.

6373*
Program Evaluation. Prerequisites: 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 nation-wide multi-year projects. Special emphasis on evaluation requirements of federally funded programs.

6663*
Applied Multivariate Research in Behavioral Studies. Prerequisite: 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.

6850*
Directed Reading. 1-6 credits, maximum 6. Prerequisite: consent of instructor. Directed reading for students with advanced graduate standing.

Russian (RUSS)

1115
Elementary Russian I. Lab 1 1/2. Understanding, speaking, reading and writing. Method of instruction is audio-lingual.

1225
Elementary Russian II. Lab 1 1/2. Prerequisite: 1115 or equivalent. Continuation of 1115.

2115
(I)Intermediate Russian I. Prerequisite: 1225 or equivalent. Continuation of 1225. Russian grammar, composition and conversation.

2225
(I)Intermediate Russian II. Prerequisite: 2115 or equivalent. Continuation of 2115.

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 and POLS 3053.

3113
(I)Russian Conversation. Prerequisite: 2225 or equivalent. Development of conversational skills in formal and informal Russian language; study of oral communication and idioms; vocabulary enhancement.

3123
(H,I)Russian Culture and Civilization. Art, literature, music, architecture, and contemporary life of Russia. Course taught in English.

3223
(I)Russian Composition. Prerequisite: 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.

4013
(H)Survey of Russian Literature I. Prequisites: 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.

4023
(H,I)Survey of Russian Literature II. Prerequisites: 20 credit hours of Russian or eqivalent. Survey of Russian literature from late nineteenth century to post-Soviet era with readings in Russian of representative texts. Course conducted in Russian.

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..

4123
(H,I)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.

4223
Russian Reading Skills. Prerequisites: 20 hrs. 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).

Social Foundations (SCFD)

3223
Role of the Teacher in American Schools. Prerequisite: declaration of intention to pursue a program in Professional Education. One half-day per semester on-site lab required. A review of the school as an institution and an introduction to the role of the teacher as a professional in the schools. Socialization of the student socio-economic class and education, the nature of multicultural education, school experiences of women and ethnic groups, school governance, professional organizations, ethics, and the nature of teaching.

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.

4913
(I)International Problems and the Role of the School. Prerequisite: junior or senior standing. Extends the student's intercultural awareness by focusing on international problems and expanding their meaning to include the school and its relationship to existing international concerns in other types of societies. Consideration of such international problems as natural resources, environment, food supply, urbanization and conflict resolution.

5000*
Master's Report or Thesis. 1-6 credits, maximum 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.

5720*
Education Workshop. 1-8 credits, maximum 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.

5850*
Directed Study. 1-3 credits, maximum 3. Directed study for master's level students.

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.

5883*
Educational Sociology. The manner in which social forces and institutions influence education and the educational system in the United States.

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.

6000*
Doctoral Dissertation. 1-25 credits, maximum 25. Required of all candidates for the Doctor of Philosophy degree. Credit is given upon completion of the dissertation.

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.

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. Introductory doctoral level course.

6123*
Qualitative Research I. The traditions, philosophies, and techniques of qualitative research, including participant observation, interviewing and document analysis. Practice in qualitative techniques and in preliminary data analysis.

6133*
Qualitative Research: Interviewing. Prerequisite: a 5000-level research course. Investigation of the traditions, philosophies, and techniques of qualitative interview research. Talking with people about the world they inhabit--how they think about and understand aspects of it, including their interactions with others, and how they come to make sense of it. Designing and conducting a limited interview study in order to get a "hands-on" feel for how to question, listen, transcribe, and undertake initial analyses of textual and narrative data.

6190*
Qualitative Research: Selected Methods. 3 credits, maximum 3. 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.

6193*
Qualitative Research II. Prerequisites: 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.

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.

6823*
Institutional History of Education. History of elementary, secondary, and higher education in Western civilization with emphasis upon the development of the American educational institution. Researching the impact of institutional development in a pluralistic society.

6850*
Directed Reading. 1-6 credits, maximum 6. Directed reading for students with advanced graduate standing to enhance students' understanding in areas where they wish additional knowledge.

6880*
Internship in Education. 1-8 credits, maximum 8. Directed off campus experiences designed to relate ideas and concepts to problems encountered in the management of the school program.

6883*
Transforming Pedagogies. Contemporary pedagogical theories and school reform initiatives, including origins, purposes, underlying philosophical assumptions, cultural contexts, and implications for schooling.

6910*
Practicum. 1-6 credits, maximum 6. The student carries out an acceptable research problem (practicum) in a local school situation. Credit given upon completion of the written report.

6984*
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.

Sociology (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.

2123
Social Problems. Exploration in selected social issues in contemporary American society, such as deviance, poverty, sexism, racism and ageism.

2133
(S)American Racial and Ethnic Relations. The historical and sociological dimensions of race and ethnicity in American life, and understanding of the controversies and conflicts that race and ethnicity have generated in the American experience.

3113
Theoretical Thinking in Sociology. Prerequisites: 6 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.

3213
(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.

3223
(S)Social Psychology. Social basis of personality development and behavior, including symbolic environment, self and group, motivation, attitudes and opinions, and social roles.

3323
(S)Collective Behavior and Social Movements. Analyzes panics, crazes, riots and social movements emphasizing institutional and social psychological origins and consequences.

3413
Rural Sociology. Life in rural America and nonwestern societies examined with special emphasis on social relations, population movement, social change and problems of rural society.

3423
(S)Urban Sociology. Urbanization as a worldwide process. The demography and ecology of cities and metropolitan regions. Urban planning and future development.

3523*
(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.

3623
Clinical Sociology. Prerequisites: nine hours of sociology including introductory sociology and two other sociology courses. Planned positive change through interventions of services, programs and policies. An examination of the field, practice concerns, clinical sociology in specific settings and with special populations.

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.

3823*
(S)Sociology of Death and Dying. Death and dying as social phenomena including cross-cultural perspective. An understanding of occupations and professions dealing with terminal patients in hospitals and with funerals. Students required to engage in original research from community sources.

3952
Applied Sociology. Prerequisite: sociology majors or consent of instructor or adviser. Application of sociological theory and methods to various job situations.

3993
(S)Sociology of Aging. Sociological problems of aging, including the analysis of the behavior of the aged within the framework of social institutions.

4003
Senior Thesis in Sociology. Prerequisites: 3113, 4013, 4133, STAT 4013, and consent of instructor. Conduct a research project (review literature, prepare proposal, gather and analyze data and report results) on a sociologically significant topic or issue.

4013*
Qualitative and Applied Social Research Methods. Prerequisites: 3113 and STAT 4013. Conducting, analyzing and reporting qualitative social research. Research design, data collection, analysis and write-up of evaluation research and social impact assessments. Individual research project included.

4023*
(S)Juvenile Corrections and Treatment Strategies. Prerequisite: 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.

4043
(S)Gender and Work. Prerequisite: 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.

4133*
Social Research Methods. Prerequisites: 3113 and STAT 4013. 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.

4213*
(S)Sexuality in American Society. Prerequisite: 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.

4323*
Sociology of Agriculture. Overview of U.S. agriculture focusing on changing markets and technologies and their impact on farm families and other social institutions and relationships. Emphasis on agricultural problems, policies and alternatives to traditional farming practices.

4333*
(S)Criminology. Summary of sociological and psychological research pertaining to crime causation and crime trends. Modern trends in control and treatment.

4343
(S)Medical Sociology. Health and illness as social and societal phenomena including the doctor-patient relationship, distribution and etiology of disease, the social meaning of health and illness, basic epidemiology, and the social processes involved in medical practice. Cross-cultural comparisons and the sociology of the health professions.

4383*
(S)Social Stratification. Systems of class and caste, with special attention to the United States. Status, occupation, income and other elements in stratification.

4423*
(S)Community Organization and Development. Structure, change and development of the local community in rapidly changing society. Emphasis on community organization and planned change.

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 viewed as social problems, requiring an understanding of the structural conditions producing environmental problems and inhibiting resolutions.

4443*
(S)Sociology of Law and Legal Institutions. Prerequisite: 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 and case loads and related areas. Native American law; federal policy and trust status, criminal and civil law, tribal jurisdiction, tribal courts.

4463
(S)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.

4513*
(S)Demography of Ethnic and Immigrant Population in Global Perspective. The population characteristics of immigrant, ethnic and racial groups along major demographic dimensions. Cross-national comparisons between minority groups on demographic and cultural factors.

4533*
(I,S)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.

4623*
(I)International Industry and Work. Prerequisite: six hours of social sciences. A focus on work, industry and globalization within a sociocultural context. The impact of country cultures upon industry and work and adjustment to cross-cultural problem solving and development of global work teams.

4643*
(S)Women in Society. A sociological exploration of the image and status of women in society, including family, work and politics. Socialization, education and the women's movement. Introduction to feminist theory.

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.

4850
Internship in Sociology. 1-4 credits, maximum 4. Prerequisites: 3952, completion of 12 hours of sociology, or consent of internship coordinator. Field experience in a variety of work settings.

4923*
The Field of Corrections. An overview of correctional work focusing on probation, parole and institutions. A survey of contemporary alternatives to conventional imprisonment.

4950
Current Topics in Sociology. 1-3 credits, maximum 25. Special topics in sociology; topics vary from semester to semester.

4990*
Exploration of Sociological Issues. 1-3 credits, maximum 6. Prerequisite: consent of instructor. Examines sociologically significant topics and issues.

4993
Senior Honors Thesis. Prerequisites: 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.

5000*
Thesis in Sociology. 1-6 credits, maximum 6.

5043*
Advanced Topics in Gender and Work. Prerequisite: graduate standing. In-depth examination of sociological theories of paid, unpaid and volunteer work with special emphasis on gender differences. Case studies including empirical research from the United States and less developed countries.

5113*
Classical Sociological Theory. Prerequisite: 3113 or equivalent. Major trends in sociological thought. The emergence of sociological theory in Europe and America.

5123*
Contemporary Sociological Theory. Prerequisite: 3113 or equivalent. Critical examination of significant theoretical formulations, 1920 to the present. Relation between theoretical development and current research emphasis.

5213*
Techniques of Population Analysis. Prerequisite: 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.

5223*
Culture, History and World Systems. Prerequisites: 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.

5243*
Social Research Design and Analysis. Techniques in design, data collection, analysis and interpretation of data for qualitative and quantitative sociological research.

5263*
Quantitative Methods of Social Research. Prerequisites: 4133, STAT 4013 or equivalent. 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.

5273*
Qualitative Research Methods. Examination of ethnographic studies and implementation issues connected with qualitative research. Research project required.

5323*
Seminar on Collective Behavior and Social Movements. Prerequisite: 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.

5333*
Global Population and Social Problems. Prerequisite: graduate standing. Study in world, regional and national population characteristics, changes and associated problems and cultural influences.

5463*
Seminar in Environmental Sociology. Critical overview of contemporary developments in environmental sociology. Environment concern, disasters, health issues, risk assessment and environmental conflict.

5533*
Correctional Institutions and Residential Treatment. Prerequisite: 4923 or equivalent. Nature and effects of custodial institutions on the inmates. Prison community, its structure, social processes and dynamics. Resocialization of prison inmates in new vocational and social skills.

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.

5563*
Community Treatment of Offenders. Prerequisite: 4923 or equivalent. Treating offenders in the community without incarcerating them in prisons. Probation, parole and other rehabilitative services. Impact of new community treatment centers, group homes, probation hotels and halfway houses. Effectiveness of the individual, group and family therapies on the offenders.

5663*
American Pluralism, Race and Ethnicity in American Life. Prerequisite: 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.

5753*
Complex Organizations. Prerequisite: graduate standing or consent of instructor. Nature and types of complex organizations: organization structure and power; organizational alternatives and change; organizational deviance; and occupations and professions.

5763*
Contemporary Organizational Theory. Prerequisite: graduate standing. Advanced study of contemporary theories used to explain, predict and understand organizations. Behavior of populations of organizations.

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.

5813*
Myths and Realities of Organizational Change. Prerequisite: 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.

5883*
Sociology of Education. Prerequisite: graduate standing or consent of instructor. The manner in which social and economic forces and educational systems exert mutual influence upon each other. Utilizes comparative international examples of how educational systems vary and how they compare to the U.S.

5950*
Seminar in Sociology. 1-3 credits, maximum 25. Prerequisite: graduate standing. Special seminar; topics vary from semester to semester.

5980*
Internship. 1-6 credits, maximum 6. Supervised field placement.

5990*
Advanced Problems and Issues in Sociology. 1-9 credits, maximum 9. Prerequisite: 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.

6000*
Dissertation. 1-12 credits, maximum 18.

6213*
Theory of Social Structure. Prerequisite: six hours of undergraduate sociology or equivalent. Relationship between human thought and the social context within which it arises.

6260*
Seminar in Current Research Literature. 2-3 credits, maximum 6. Methodological analysis of advanced research in major areas of sociology.

6263*
Seminar on Community Policing. A critical overview of the current research literature devoted to community policing. The nature of community policing programs. Strategies of program evaluation. Emerging theoretical frameworks in assessing programmatic success. Police organizational dynamics and change.

6390*
Seminar in the Family, Marriage and Male-Female Roles in American Sociology. 2-3 credits, maximum 6. Analysis of published research in sociology of family, marriage and male-female roles and relationships with special emphasis on American society.

6420*
Seminar in Urban Sociology. 2-6 credits, maximum 6. A theoretical and applied approach to cross-cultural urban studies. Examines different methodologies for urban community analysis.

6450*
Seminar in Industrial Sociology. 2-3 credits, maximum 6. Intensive analysis of selected problems in industrial sociology.

6460*
Advanced Studies in Environmental Sociology. 1-6 credits, maximum 6. Prerequisite: 5463 or consent of instructor. Intensive examination of selected topics in environmental sociology.

6463*
International Issues in Environmental Sociology. Prerequisite: graduate standing. Advanced study of the international context of environmental issues.

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.

6550*
Seminar in Social Organization. 2-3 credits, maximum 6. Research and literature relating to macro-social analysis.

6653*
Seminar in Social Psychology. Development and critical analysis of theory and research in social psychology.

6673*
Development of Social Thought. Historical and analytical studies of major contributions to social thought leading toward the works of modern theorists.

6750*
Seminar in Deviance and Criminology. 2-3 credits, maximum 6. Current research and theory in criminology, penology and deviance in modern society.

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.

6950*
Seminar in Social Gerontology. 2-3 credits, maximum 6. A theoretical and practical examination of the sociological implications, both individual and societal, of an aging population.

Soil Science (SOIL)

2124
(N)Fundamentals of Soil Science. Lab 2. Prerequisite: 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.

3433*
(N)Soil Genesis, Morphology, and Classification. Lab 3. Prerequisite: 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.

3893*
Soil Chemistry and Environmental Quality. Prerequisite: 2124. Soil chemical processes that affect plant nutrition, nutrient cycling, and fate of environmental pollutants. Chemistry of soil surfaces and soil solution, of important soil processes, and of agronomic and environmental topics such as water quality, soil acidity, pesticide residues, environmental chemistry and risk assessment, soil remediation and contaminant bioavailability, land application of municipal and industrial wastes, long-term reactions and environmental fate.

4210*
Describing and Interpreting Soils. 1 credit, maximum 3. Lab 3. Prerequisite: 2124. Describe and classify soil properties in the field and interpret for suitable agriculture, urban, and other land uses.

4213*
Precision Agriculture. Lab 2. Prerequisites: 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.

4234*
Soil Nutrient Management. Lab 2. Prerequisite: 2124. Soil fertility and use of fertilizer materials for conservation, maintenance, and improvement of soil productivity and to minimize environmental concerns.

4363*
Environmental Soil Science. Prerequisites: BIOL 1114 and CHEM 1215. Presentations of soil processes and interpretation for natural resource management; land reclamation; identification of wetlands; oil and soil damages; impact of fertilizer, pesticide and other agricultural chemicals on soil and water quality; water resources; long-term soil erosion and landscape formation; transformations of manure, sewage sludge and other organic by-products.

4463*
Soil and Water Conservation. Prerequisite: 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 desertification, salinization and deforestation.

4470*
Problems and Special Study. 1-3 credits, maximum 12. Lab 1-3. Prerequisite: 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.

4483*
Soil Microbiology. Prerequisite: 2124 and BIOL 1114 or consent of instructor. A comprehensive overview of microorganisms living in soil and activities that are of agricultural and environmental significance.

4563*
Dynamics of Wetland, Forest and Rangeland Soils. Prerequisite: 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.

4571
Senior Seminar. Prerequisite: senior standing in plant and soil sciences. Career opportunities (talks and field trips); preparation of resumes and interviews. Graded on a pass-fail basis. Same course as PLNT 4571 and RLEM 4571.

4683*
Physical Properties of Soils. Prerequisites: 2124 and PHYS 1114. Soil physical properties and processes, and their influence on plant growth.

4863*
Animal Waste Management. Prerequisite: 2124. Aspects of animal waste management related to animal nutrition, system design, land application and economic acceptance.

5000*
Master's Thesis. 1-6 credits, 6 maximum total credits under Plan I, and 2 maximum total credits under Plan II. Prerequisite: consent of adviser. Research planned, conducted and reported in consultation with a major professor.

5020*
Graduate Seminar. 1 credit, maximum per semester 1 credit on M.S. program and 2 credits on a Ph.D. program required. Prerequisite: graduate standing. Philosophy of research, methods of research, or interpretation of research.

5110*
Problems and Special Study. 1-4 credits, maximum 6. Prerequisite: consent of instructor. Supervised study of special problems and topics not covered in other graduate courses.

5193*
Spatial and Non-spatial Data Base Management of Natural Resources. Prerequisites: 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.

5224*
Soil Chemical Processes and Impact on Environmental Quality. Lab 3. Prerequisites: 3893 and CHEM 2113 or CHEM 3324 or equivalent. A comprehensive study of chemical processes in soil systems that impact biogeochemical cycles and environmental quality. Modern theory of soil solution thermodynamics, kinetics of soil chemical processes, soil colloid chemistry, and soil geochemistry. Environmental soil science applications including environmental fate of toxic substances and remediation of contaminated soil. Laboratory component provides hands-on experience with techniques used for soil chemical investigations and with chemical speciation computer models.

5230*
Research. 1-4 credits, maximum 4. Prerequisite: consent of a faculty member supervising the research. Supervised independent research on selected topics.

5353*
Advanced Soil Genesis and Classification. Lab 2. Prerequisite: 3433. Processes and factors of soil formation. Comparison of world soil morphology and classification systems.

5483*
Soil Biodegradation and Bioremediation. Prerequisite: 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.

5583*
Soil Physics. Prerequisites: MATH 2265 or 2365, PHYS 1214. Fluid flow through saturated and unsaturated soils; temperature change and heat flow in soil; soil strength and deformation as it applies to plant response.

5613*
Laboratory Methods of Soil, Plant and Environmental Analysis. Lab 3. Prerequisites: CHEM 2122, 3324 or equivalent. Theory, principles and techniques of laboratory methods used for chemical analysis of soil, plant material and environmental samples. Modern analytical methods used for soil testing of plant available nutrients, determination of environmental contaminants, and chemical characterization of soil. Operational theory of applicable instruments including atomic spectroscopic (ICP, AA, UV-VIS, XRF), chromatographic (GC, GC-MS, HPLC, IC), and potentiometric methods. Laboratory component hands-on experience of chemical methods.

5813*
Soil-Plant Nutrient Cycling and Environmental Quality. Prerequisite: 4234 or equivalent. Theory and application of soil plant relationships in production and nonproduction 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.

5990*
Soil Physical Analyses. 1-2 credits, maximum 2. Lab 1 or 2. Prerequisite: 4683. Principles and techniques.

6000*
Doctoral Thesis. 1-6 credits, maximum 36. Prerequisite: consent of instructor. Independent research to be conducted and reported with the supervision of a major professor as partial requirement for the Ph.D. degree.

6010*
Advanced Topics and Conference. 1-6 credits, maximum 12. Prerequisite: M.S. degree. Supervised study of advanced topics. A reading and conference course designed to acquaint the advanced student with fields not covered in other courses.

Spanish (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.

1153
Accelerated Elementary Spanish I. Prerequisites: 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.

1225
Elementary Spanish II. Prerequisite: 1115, or equivalent. Continuation of 1115. Includes language lab work.

1253
Accelerated Elementary Spanish II. Prerequisites: 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.

2115
(I)Intermediate Spanish I. Prerequisite: 1225 or equivalent. Further development of speaking, listening, reading and writing skills, along with short cultural and literary readings.

2222
(I)Intermediate Composition and Grammar. Prerequisite: 2115 or equivalent. Skill consolidation with emphasis on composition and grammar, with some conversation. May be taken concurrently with 2223.

2223
(I)Intermediate Reading and Conversation. Prerequisite: 2115 or equivalent. Skill consolidation with emphasis on short literary readings ad conversation. May be taken concurrently with 2222.

3003
(H,I)Survey of Peninsular Literature. Prerequisites: 20 credit hours of Spanish or equivalent. Development of literature from Spain to the present.

3013
(I)Survey of Latin-American Literature. Prerequisites: 20 hours of Spanish or the equivalent. Development of the literature written in Spanish in the new world.

3203
(I)Advanced Conversation. Prerequisites: 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.

3213
(I)Advanced Grammar and Composition. Prerequisites: 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.

3463
(I)Advanced Diction and Phonetics. Lab 1. Prerequisite: 2222 and 2223, or equivalent. Required course for teacher certification/licensure. Spanish speech sounds and intonation patterns, with practice to improve the student's pronunciation.

4163
(H)Don Quixote. Prerequisites: one 3000- level Spanish course or equivalent. Seminar devoted to Cervantes' novel.

4173
(H,I)Hispanic Drama. Prerequisite: one 3000-level Spanish course, or equivalent. Reading and interpretation of dramatic works selected from the Hispanic literatures.

4223
(I)20th Century Hispanic Literature. Prerequisite: one 3000-level Spanish course, or equivalent. Major 20th century Hispanic writers.

4253
(H)Masterpieces of Hispanic Literature I. Prerequisite: one 3000-level Spanish course, or equivalent. Reading and analysis of classics selected from the Hispanic literatures.

4263
(H,I)Masterpieces of Hispanic Literature II. Prerequisite: one 3000-level Spanish course, or equivalent. Reading and analysis of classics selected from the Hispanic literatures. A continuation of 4253.

4323
(H,I)Hispanic Civilization I. Prerequisite: 2222 and 2223, or equivalent. Reading and discussion of selected texts outlining the development of contemporary Spanish civilization.

4333
(H,I)Hispanic Civilization II. Prerequisite: 23 credit hours of Spanish or equivalent. Reading and discussion of selected texts outlining the development of contemporary Hispanic civilization outside the Iberian peninsula.

4550
(I)Seminar in Spanish. 1-3 credits, maximum 9. Prerequisite: one 3000-level Spanish course, or equivalent. Readings and discussion of vital subjects in Spanish.

5110*
Advanced Hispanic Studies. 1-3 credits, maximum 9. Lab TBA. Prerequisite: 22 hours of Spanish or graduate standing in foreign language.

Special Education (SPED)

3202
Education of Exceptional Learners. 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.

3633
Assessment and Intervention for Exceptional Infants and Children-Birth to Age 6. Assessment techniques and intervention strategies appropriate for exceptional infants and young children. Basic theories of development and research supportive of various intervention strategies and assessment techniques.

4640
Student Teaching in Special Education. 1-12 credits, maximum 12. Supervised teaching experience in the area of special education in which the student is preparing to qualify for a teaching certificate. Graded on a pass-fail basis.

4653*
Education of the Mentally Retarded. Education program needs and social-cultural environment of mentally retarded children, adolescents and adults.

4723*
Curriculum and Methods for Teaching Mentally Retarded Adolescents and Adults. Techniques for teaching the mentally retarded individual from adolescence through adulthood.

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.

5000*
Master's Thesis. 1-6 credits, maximum 6.

5320*
Seminar in Applied Behavioral Studies. 3-6 credits, maximum 6. In-depth exploration of contemporary problems of applied behavioral studies.

5523*
Characteristics of Students with Severe and Profound Disabilities. Educational, sychological and physiological characteristics of students with severe and profound disabilities.

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.

5583*
Methods for Teaching Persons with Severe and Profound Disabilities. Instructional procedures and resources available for working with the severely or profoundly disabled learner.

5620*
Practicum with Exceptional Learners. 1-8 credits, maximum 8. Lab 1-8. Prerequisite: 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.

5624*
Characteristics and Teaching Techniques for Individuals with Disabilities. Educational, psychological and physiological characteristics of individuals with mild and moderate disabilities. Professional roles of the teacher; current techniques, models and approaches used to teach, and their theoretical bases.

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.

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.

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.

5673*
Developmental Language and Intervention Strategies for the Exceptional Individual. 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.

5683*
Techniques and Consultation Models for Teaching Individuals with Disabilities. Current techniques, models and approaches used to teach students with mild and moderate disabilities and the theoretical bases for these techniques and approaches. Professional roles of the teacher of students with mild and moderate disabilities including communication with other teachers.

5733*
Teaching Strategies for Students with Physical and Health Disabilities. Prerequisites: 5523 and graduate student standing. Design and implementation of educational programs, collaboration with families and other professionals, and advocacy for students with disabilities.

5743*
Curriculum Modifications for Exceptional Individuals. Materials and resources designed for use by teachers and other professionals, paraprofessionals and parents in working with exceptional individuals. Includes commercial and teacher-student-made materials.

5783*
Psycho-educational Testing of Exceptional Individuals. Intensive practice in the selection, administration and interpretation of individual tests, appropriate for exceptional individuals.

5824*
Characteristics of Interventions for Individuals with Emotional Behavioral Problems. Characteristics, identification, intervention instructional strategies, and resources available for working with learners with emotional and behavioral disorders. Exploration of a wide range of theoretical approaches.

5873*
Instructional Strategies and Resources for the Emotionally Disturbed Learner. Instructional procedures and resources available for working with the emotionally disturbed/behavior-disordered learner. A wide range of theoretical approaches explored.

5883*
Behavior Management and Affective Education. The utilization of various approaches to the management of individual and group behavior; affective education in a wide range of instructional settings.

5993*
Diversity 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. Applicable educational approaches.

6000*
Doctoral Thesis. 1-25 credits, maximum 25. Required of all candidates for doctorate in applied behavioral studies. Credit given upon completion and acceptance of thesis.

6063*
Research Topics in Special Education. Prerequisites: REMS 6003, 6013. Classic and current significant research topics; review and reinforcement of professional inquiry skills in reading, utilizing, planning, conducting and reporting research in special education.

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.

6563*
Program Development in Special Education. Physical, social and psychological factors in communities such as power structure, economics, prejudice, religion, as well as national activities influential in establishing programs for the exceptional student.

6603*
Current Trends and Issues in Special Education. Current research and literature regarding the education of exceptional children.

6850*
Directed Reading. 1-6 credits, maximum 6. Prerequisite: consent of instructor. Directed reading for students with advanced graduate standing.

6880*
Internship in Education. 1-8 credits, maximum 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)

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.

3010
Speech Activity Participation. 1-3 credits, maximum 6. Preparation for, and participation in, speech communication and speech pathology activities.

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.

3720
Practicum I. 1-2 credits, maximum 2. Prerequisite: speech communication major. Communication facilitation for the speech communication major, with student's initial role as interventionist.

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.

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.

3743
Advanced Public Speaking. The preparation and delivery of various types of public speeches.

3793*
Communication in Interviews. General principles of interviewing. Specific guidelines for the interviewer in survey, journalistic, counseling, selection, appraisal, legal, medical, and sales interviews.

4010
Independent Study in Speech Communication. 1-3 credits, maximum 3. Prerequisite: consent of instructor. Supervised research projects in speech communication.

4703
Communication Theory. Survey of current theories and models dealing with symbolic and communicative behavior.

4710
Topics in Speech Communication. 1-3 credits, maximum 6. Selected current topics in speech communication.

4720
Practicum II. 1-3 credits, maximum 3. Prerequisite: consent of instructor. Individual research projects providing practical experience for advanced undergraduate students on and off campus.

4723*
History of Public Address. Analysis of speeches of selected American orators as artifacts and rhetorical responses. Content, structure and style of the speeches and the historical situations in which they were given.

4733
Legal Communication. Analysis and applications of oral communication and analytical skills required for effective performance in trial courts. Course culminates in a day-long mock trial.

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.

4753*
(I)Intercultural Communication. Social and cultural differences between individuals from diverse backgrounds as possible barriers to effective communication.

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.

4783
Research Methods in Speech Communication. Critical examination of experimental and nonexperimental methods used in the study of speech communication.

4793*
(S)Nonverbal Communication. Nonverbal aspects of speech communication.

4993
Senior Honors Thesis. Prerequisites: 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 speech communication.

5000*
Research and Thesis. 1-3 credits, maximum 6. Prerequisite: approval of major professor. Research in speech and audiology.

5013*
Introduction to Graduate Study. Research methods with special emphasis on those used most frequently in communication research; professional opportunities in the various speech fields; practical experience in outlining a piece of research.

5023*
Introduction to Quantitative Research in Speech. Methods and major findings of empirical research in speech.

5210*
Advanced Practicum. 1-3 credits, maximum 9. Prerequisite: consent of instructor. Practical experience for advanced students on and off campus.

5710*
Seminar in Speech. 1-3 credits, maximum 9. Individual and group investigations of problems in speech communication, theater, and speech pathology and audiology.

5713*
Rhetorical Theory. Contemporary rhetorical theory focusing on the processes of social influence.

5723*
Oral Communication Theory. Modern theories dealing with symbolic and communicative behavior.

5733*
Human Relations in Organizations. The place of oral communication in decision-making in organizations. Relationship of oral communication to organizational structure, organizational needs, patterns of leadership and techniques of information collection.

5763*
Seminar in Organizational Communication Consultancy. Diagnostic measures for identifying communication problems in organizations and the development of consulting or interventionist programs to solve such problems.

Statistics (STAT)

2013
(A)Elementary Statistics. Prerequisite: 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 credit for students with credit in 2023 or 2053.

2023
(A)Elementary Statistics for Business and Economics. Prerequisite: 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 credit for students with credit in 2013 or 2053.

2053
(A)Elementary Statistics for the Social Sciences. Prerequisite: MATH 1513. An introductory course in the theory and methods of statistics. Descriptive measures, elementary probability, sampling, estimation, hypothesis testing, correlation and regression. No credit for students with credit in STAT 2013 or 2023.

3013*
Intermediate Statistical Analysis. Prerequisite: 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.

4013
(A)Statistical Methods I. Lab 2. Prerequisites: 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 credit for students with credit in 4053.

4023
Statistical Methods II. Lab 2. Prerequisites: 3013 or 4013, 4033, 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 credit for students with credit in 4063.

4033
Engineering Statistics. Prerequisite: MATH 2163. Probability, random variables, probability distributions, estimation, confidence intervals, hypothesis testing, linear regression. No credit for students with credit in STAT 4073.

4043*
Applied Regression Analysis. Prerequisite: one of 4013, 4033, 4053, 5013 or equivalent. Matrix algebra, simple linear regression, residual analysis techniques, multiple regression, dummy variables.

4053
(A)Statistical Methods I for the Social Sciences. Prerequisite: MATH 1513. Basic experiemental statistics, basic probability distributions, methods of estimation, tests of significance, linear regression, calculation and analysis of variance for one and two-way classifi- cations. No credit for students with credit in STAT 4013.

4063*
Statistical Methods II for the Social Sciences. Prerequisite: 3013 or 4013 or 4033. Basic concepts of experimental design. Analysis of variance, covariance, split-plot design. Factorial arrangements of treatments, multiple and curvilinear regression, enumeration data. No credit for students with credit in STAT 4023.

4073
Engineering Statistics with Design of Experiments. Prerequisite: 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 credit for students with credit in STAT 4033.

4091*
Statistical Analysis System. Prerequisite: 4013 or equivalent. SAS dataset construction, elementary statistical analysis, and use of statistics and graphics procedures available in the SAS package.

4203*
Mathematical Statistics I. Prerequisite: MATH 2163. 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.

4213*
Mathematical Statistics II. Prerequisites: 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.

4910*
Special Studies. 1-6 credits, maximum 6. Prerequisite: consent of instructor. Special subjects in statistics.

4993
Senior Honors Project. Prerequisites: 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.

5000*
Research in Statistics. 1-6 credits, maximum 6. Methods of research and supervised thesis or report.

5013*
Statistics for Experimenters I. Prerequisites: 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.

5023*
Statistics for Experimenters II. Prerequisites: 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.

5033*
Nonparametric Methods. Prerequisite: 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.

5043*
Sample Survey Designs. Prerequisite: 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, nonsampling errors, use of random number tables, sample size estimation and other topics related to practical conduct of surveys.

5053*
Time Series Analysis. Prerequisite: 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.

5063*
Multivariate Methods. Prerequisites: 4043 and 4023 or 5023. Use of Hotelling's T-squared statistic, multivariate analysis of variance, canonical correlation, principal components, factor analysis and linear discriminant functions.

5073*
Categorical Data Analysis. Prerequisites: 5223, 5023 or equivalent or concurrent enrollment. Analysis of data in-volving 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.

5123*
Probability Theory. Prerequisites: 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.

5133*
Stochastic Processes. Prerequisites: 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, queueing theory. Same course as IEM 5133 and MATH 5133.

5213*
Bayesian Decision Theory. Prerequisite: 5223. Statistical spaces, decision spaces, loss and risk, minimum risk decisions, conjugate families of distributions, Bayesian decisions.

5223*
Statistical Inference. Prerequisites: 5123 and MATH 3013. Sampling distributions, point estimation, maximum likelihood methods, Rao-Cramer inequality, confidence intervals, hypothesis testing, sufficiency, completeness.

5303*
Experimental Design. Prerequisite: 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 2^n and 3^n series of factorials, single and fractional replication optimum seeking designs, pooling of experiments over time and space, crossover and switch back designs.

5323*
Theory of Linear Models I. Prerequisites: 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.

5333*
Theory of Linear Models II. Prerequisite: 5323. Maximum likelihood estimation; missing data structures; balanced incomplete block design; less than full rank models; general mixed models; intrinsically linear models; sequential estimation.

5403*
Theory of Sample Design. Prerequisite: 4203 or 5123. Deriving estimates and variances of estimates for different sampling designs. Mathematical development of sampling. Consideration of simple probability sampling including simple random, stratified random, cluster and multistage sampling. Estimation techniques including ratio and regression techniques. Determination of sample sizes and allocations.

5513*
Multivariate Analysis. Prerequisite: 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.

5910*
Seminar in Statistics. 1-6 credits, maximum 12. Special studies for master's students. Survey and discussion of research in mathematical statistics and statistical methods.

6000*
Research and Thesis. 2-10 credits, maximum 30. Prerequisite: consent of advisory committee. Directed research culminating in the Ph.D. thesis.

6113*
Probability Theory. Prerequisites: 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.

6203*
Large Sample Inference. Prerequisites: 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.

6223*
Advanced Statistical Inference. Prerequisite: 6113. Point estimation, maximum likelihood, Cramer-Rao inequality, confidence intervals, Neyman-Pearson theory of testing hypothesis and power of test.

6910*
Special Problems. 1-6 credits, maximum 12. Investigation of special problems in the theory and application of statistics using current techniques. Special studies for Ph.D. level students.

Student Development (SDEV)

3013
Leadership Concepts. Prerequisite: 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.

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.

5000*
Master's Thesis. 1-6 credits, maximum 6. Prerequisite: consent of instructor.

5320*
Seminar in Student Development. 3-6 credits, maximum 6. Prerequisite: consent of instructor. In-depth exploration of contemporary problems of applied behavioral studies.

5333*
Effective Leadership in Student Services. Prerequisite: 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.

6000*
Doctoral Dissertation. 1-25 credits, maximum 25. Prerequisite: consent of instructor. Required of all candidates for doctorate in applied behavioral studies. Credit give upon completion and acceptance of dissertation.

6173*
Higher Education Student Personnel Administration. Develops an understanding of the history, philosophy, student life, critical issues and administration of student personnel work in higher education.

6213*
Higher Education Student Personnel Services. Prerequisite: 6173 or consent of instructor. Higher education student personnel services such as: admissions, orientation, student activities, financial aids, housing and counseling.

6220*
Internship in Higher Education Student Personnel. 2-6 credits, maximum 6. Prerequisite: 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.

6850*
Directed Reading. 1-6 credits, maximum 6. Prerequisite: consent of instructor. Directed reading for students with advanced graduate standing.

Technical and Industrial Education (TIED)

2000
Field Experience in Industrial Practice. 2-6 credits, maximum 16. 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.

3000
Trade and Industrial Occupational Experience. 1-24 credits, maximum 24. Credit to be determined by a special skill competency examination.

3203
Foundations and Services of Technical and Industrial Education. Opportunities provided by technical and industrial education, with special emphasis on trade and industrial education and its relationship to other elements of the educational system. Legislative aspects of technical and industrial education, general education, student guidance, and programs for students with special needs.

3900
Seminar in Professional Education. 1-3 credits, maximum 3. 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. Graded on a pass-fail basis.

4010*
Technical and Industrial Education Workshop. 1-3 credits, maximum 6. 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.

4103*
Instructional Procedures in Technical and Industrial Education. Methods and techniques for effective teaching and learning in the technical and industrial classroom and laboratory. The use of instructional aids and competency development.

4110*
Trade Technical Information. 1-6 credits, maximum 6. New developments in scientific and technical information and knowledge that are relevant to current trade practices.

4113
Technical and Industrial Education in American Society. Characteristics of technical and industrial education and its development, role and function in a changing American society. Economic and sociological considerations of technical and industrial-oriented programs. Exploration of the interrelationship of technical and industrial and academic subject strategies for teaching multicultural and special needs in technical and industrial, and adult education.

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.

4213*
Safety, Organization and Management of Learning Facilities. Techniques and procedures for organizing and managing shop and 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.

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.

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.

4333
(I)International Technical Education. Comparison and analysis of international occupational education.

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.

4470
Teaching Practicum in Technical and Industrial Education. 1-12 credits, maximum 12. Prerequisite: full admission to Professional Education. Organized teaching experiences under the guidance and direction of a local school cooperating teacher and university teacher educator. Participant assigned to a cooperating teacher with responsibility for planning, implementing and evaluating the classroom, laboratory or shop. Graded on a pass-fail basis.

4773
Practices and Problems of School-to-Work Transition Programs. Problems of school-to-work transition and examination of practices designed to improve it. Planning, organizing and developing strategies to implement and evaluate school related work-based learning.

4883*
Practices and Problems in Integrating Academic and Vocational Education. Prerequisite: 4103 or consent of instructor. Experiences in learning, designing, and practicing strategies that technical and industrial teachers can use to integrate academic competencies into their particular curricula. Design and presentation of cognitive psycho-motor and affective occupational lessons that integrate math, social studies, science and/or English-related competencies.

5123*
Evaluation of Programs and Instruction in OCED. Philosophies, principles and techniques of evaluation and strategies for applying them in planning, managing and improving occupational education programs. Designing, conducting, and reporting evaluations of OCED programs and instruction.

Telecommunications Management (TCOM)

3203
Telecommunications Industry Foundations. Prerequisite: consent of instructor. Emerging trends in the telecommunications industry. Past events, regulatory and legal implications, strategic direction of organizations with respect to telecommunications.

3223
Network Design Principles. Prerequisite: MSIS 3223. Management science principles applied to telecommunications network design. Specific topics will include mathematical programming, network models, simulation, and queueing theory.

5012*
Telecommunications Laboratory. Prerequisite: 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.

5113*
Industry Overview and Telecommunications Applications. Prerequisites: 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.

5123*
Telecommunications Systems II. Prerequisites: ECEN 5553 and consent of program director. Applied technical coverage of selected topics from the upper layers of the OSI model. Network and Transport layers using, TCP/IP, IPX/SPX, and Netbeui, as well as security issues and other multi-layer protocol suites. Flow control, RSVP, encryption, compression, and LAN/WAN applications.

5143*
Telecommunications Systems Analysis, Planning and Design I. Prerequisites: 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.

5153*
International Telecommunications Management. Prerequisites: 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.

5163*
Telecommunications Practicum. Lab 3. Prerequisites: graduate standing and consent of program director. 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.

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.

5213*
Telecommunications Systems Analysis, Planning and Design II. Prerequisites: 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.

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.

5233*
Applied Information Systems Security. Prerequisite 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 mat 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.

5310*
Advanced Topics in Telecommunications Management. 3-9 credits, maximum 9. Prerequisites: 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.

5350*
Advanced Telecommunications Management Lab. 2-3 credits, maximum 3. Lab 2-3. Prerequisites: 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.

5990*
Directed Studies in Telecommunications Management. 1-6 credits, maximum 6. Prerequisites: graduate standing and consent of program director. Special advanced topics, projects and independent study in telecommunications management.

Theater (TH)

1322
Acting I. Lab 3. 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.

1332
Voice and Movement I. Techniques and exercises to build the actor's awareness and ability to use the vocal and physical instruments on stage. Alignment, breathing, centers essence, tempo-rhythm, and movement patterns. Freeing and natural voice, resonance and range, and articulation.

1500
Theater Practicum. 1 credit, maximum 6. Lab 2. Laboratory experience in theater production, acting and crew assignments. Graded on a pass-fail basis.

1664
Stage Technology. Lab 6. Elementary techniques of stagecraft for the stage. Basic stagecraft skills. Practical experience preparing departmental productions.

1674
Costume Technology. Lab 6. Elementary techniques of costume craft for the stage. Basic costuming skills. Practical experience preparing departmental productions.

2322
Acting II. Lab 4. Prerequisite: 1322. Continuation and refinement of 1322. Textual and character analyses, characterization and inner techniques. Audition techniques and realistic comedy through scene work with contemporary plays.

2332
Voice and Movement II. Prerequisite: 1332. Continued development of strength of the vocal and physical instrument. Introduction to analysis and interpretation of heightened text. Study of the International Phonetic Alphabet, General American Speech, and the American Stage Speech dialect.

2413
(H)Introduction to the Theater. Character, plot, thematic, historical and production analyses of various types of play scripts; understanding the work of various theater artists; developing appreciative audiences.

2553
Introduction to Stage Design. Lab 2. Prerequisites: 2663, 2673 or consent of instructor. An integrated overview of the theory and practice of design for the stage.

3373
Acting III. Prerequisites: 1322, 2322. Continuation and refinement of 2322. Performance techniques in classic to modern styles. Shakespeare to Miller.

3383
BFA Acting Studio I. Lab 2. Prerequisites: 3373 and admission to Bachelor of Fine Arts program. In-depth acting study for BFA candidates. Special emphasis on performing classic and poetic realism.

3400
Upper-division Projects. 1-3 credits, maximum 6. Prerequisite: consent of instructor. Individual or group study of techniques, history, or literature of the theater. Required written survey of the project and self-evaluation of its results, or a term paper.

3412
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.

3422
Theatrical Dance: Jazz II. Lab 4. Requisites: 3412, or consent of instructor. Techniques for theatrical performance at the intermediate level emphasizing stamina, control, speed, and dynamics. Artistic development of dance performers.

3432
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.

3442
Theatrical Dance: Tap II. Lab 4. Tap dance techniques for theatrical performance at the intermediate level emphasizing stamina, control, speed, and dynamics. Artistic development of dance performers.

3500
Theater Practicum II. 1 credit, maximum 4. Lab 4. Advanced laboratory experience in theater production, acting, and major crew assignments. Graded on a pass-fail basis.

3903
(H)History of Costume and Decor for the Stage. Comprehensive history of theatrical costume and interior decor from ancient Egypt to the present.

3913
Dramatic Literature and Analysis. Survey of critical approaches to dramatic literature focusing on the transfer of literature to live theatrical production and performance.

3923
(H)Theater History I. Aesthetic and social relationships of theater and western civilization from Ancient Greece to the Italian Renaissance.

3933
(H)Theater History II. Aesthetic and social relationships of theater and western civilization from the Italian Renaissance through the 20th century.

3971
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.

4183*
Scene Design for Theater and Television. The designer's approach to the script; execution of sketches, models and working drawings.

4223*
Sound Design and Technology. Prerequisites: 2553, 2663. Use and design of sound in theatrical productions, including voice reinforcement, scoring, script analysis and effects.

4363
BFA Acting Studio II. Lab 2. Prerequisites: 3383 and admission to Bachelor of Fine Arts program. In-depth acting study for BFA candidates. Special emphasis on performing physical comedy and related styles.

4373
BFA Acting Studio III. Lab 2. Prerequisites: 4363 and admission to Bachelor of Fine Arts program. In-depth acting study for BFA candidates. Special emphasis on performing restoration, comedy of manners and other dramatic literature which requires heightened performance style.

4383*
Stage Combat. Lab 3. Prerequisites: 2332, 3373. 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.

4393*
Stage Dialects. Lab 4. Prerequisites: 1332, 2332. Development of techniques for learning and speaking dialects commonly required in theatrical productions, as well as an application of these dialects.

4403
Senior Honors Project. Prerequisites: 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 theater.

4593*
Lighting for Theater and Television. Lab 2. Stage lighting design, elementary electricity, design of lighting instruments. Practical experience in lighting in preparing and running departmental productions.

4653
Advanced Stage Mechanics. Lab 2. Prerequisite: 1664. Advanced study in theatrical stage mechanics and production techniques including special steel fabrication, automated scenery, and structural support systems.

4663
Scenograhic Techniques. Lab 2. Prerequisites: 2553, 2663, 2673. Development of computer and hand drafting techniques specific to the design, planning, and execution of stage scenery, lighting, and sound. Emphasis will be placed on USITT graphic standards.

4673
Seminar in Advanced Costume Construction. Lab 2. Prerequisites: 2673 and 4123. Sewing and craft techniques for the construction of period costumes. Boned garments, fabric manipulation and millinery.

4683
Costume and Prop Crafts. Lab 2. Prerequisites: 2663, 2673. Use of advanced materials and techniques in the fabrication of specialized stage and costume props.

4753*
Stage Management. Prerequisite: 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. Practical experience in stage managing student directed scenes.

4953*
Directing. Prerequisite: 2543. Play analysis for production, problems in staging, and the role of the director. Planning and direction of scenes in laboratory situations.

4963*
Theater Graphic Techniques. Fundamental theater graphic techniques to communicate theatrical design ideas.

4973*
Stage Costume Design. Lab 4. Approaches to basic costume design including research, conceptual analysis, figure drawing, and executions of sketches and renderings.

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.

4990
BFA Jury. Lab 1. Prerequisite: consent of the department. Portfolio and audition technique development and review. Required for all BFA candidates.

5000*
Masters Thesis and Research. 1-6 credits, maximum 6. Prerequisite: consent of department head. Masters level research in theater for thesis option graduate students.

5013*
Theater Research Methods. Diverse methods of theater research appropriate to performance, design and technology, and history and theory. Developing familiarity with standard references and journals of the field, and introduction to professional organizations.

5063*
Scenography. Prerequisites: proven experience in scenery, lighting or costume design and consent of instructor. Scenographic design processes for the advanced theater design student. Investigation of design styles and theories and the designers whose works advanced these theories; practical application of designing scenery, lighting and costumes.

5213*
Script Analysis. Analytical and interpretive techniques in studying play scripts for theatrical production. Emphasis on writing skills appropriate to script analysis.

5243*
Problems in Advanced Acting. Prerequisites: 4143 and graduate standing or consent of instructor. Experimentation in psychological realism. Concentration on analysis, technical skills, and contacting the emotions. Special preparations for professional interviews and auditions.

5253*
Problems in Advanced Acting II. Lab 3. Prerequisite: 5243. In-depth exploration of three theatrical acting styles. Scene study, monologue study, lecture, discussion, reading and various in-class exercises. Utilizing language in these plays and creating a physical life reflective of the character's social customs and values.

5400*
Seminar in Theater. 1-3 credits, maximum 12. Prerequisite: consent of instructor. Individual or group studies of techniques, history or literature of the theater. A term paper or written report and self-evaluation of the study or project required.

5413*
Dramatic Theory. Concepts of play construction and audience effects: classic, neoclassic, romantic, realist, to post-modern.

5500*
Individual Theater Projects. 1-3 credits, maximum 6. Prerequisite: consent of instructor. Individual projects in directing, acting, or design and technology for a specified theater production, with concept, realization, and self-evaluation under faculty guidance.

5953*
Problems in Advanced Directing. Prerequisites: 4953, consent of instructor. Problems in directing period styles, especially Shake-speare. Restoration comedy, absurdist drama, and avant garde drama. Preparation, rehearsal and staging of a complete production by each student.

University (UNIV)

0111
Developmental Science Process Skills. Instruction on what scientists do as they 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. Graded on a satisfactory-unsatisfactory basis.

1111
University Academic Services Freshman Orientation. Prerequisite: 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.

2001
Academic Assessment and Evaluation. Required for students in University Academic Assessment Program and available campuswide 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.

2510
Innovative Studies. 1-3 credits, maximum 6. Lab 0-6. May be used for not more than two semesters for new or experimental topics or techniques.

2511
Introduction to Health Careers. An introduction to medical professions related to all areas of human and animal health. Graded on pass-fail basis.

3110
Directed Study. 1-18 credits, maximum 18. Prerequisite: written application approved by instructor, the department head, and the dean of the student's college. Independent study, research, field work or internship.

Veterinary Biomedical Sciences (VBSC)

5000*
Masters Research and Thesis. 1-6 credits, maximum 6. Prerequisite: graduate standing. Research problem for meeting requirements of the Masters degree.

5010*
Career Skills in Veterinary Biomedical Sciences. 1-3 credits, maximum 3. Prerequisites: graduate standing in veterinary biomedical sciences program, 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.

5102*
Biochemical Toxicology. Prerequisite: 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.

5110*
Special Problems. 1-6 credits, maximum 20. Prerequisites: graduate standing and consent of instructor. Special research problems in the various fields of veterinary biomedical sciences.

5120*
Current Topics in Veterinary and Biomedical Science. 1 credit, maximum 4. Prerequisite: 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.

5404*
Techniques in Parasitology. Lab 1. Prerequisites: 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.

5553*
Bacterial Pathogenesis. Prerequisites: 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.

5613*
Biology of Parasites. Prerequisites: 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.

5723*
Parasitic Protozoa. Lab 3. Prerequisite: graduate standing in zoology or entomology or consent of instructor. Structure, life cycle, physiology, host-parasite relationships, and diagnosis concerned with protozoan parasites.

6000*
PhD Research and Thesis. 1-15 credits, maximum 45. Prerequisite: graduate standing. Research problem for meeting requirements of the Ph.D. degree.

6110*
Seminar. 1-6 credits, maximum 6. Prerequisite: graduate standing. Literature and research problems pertaining to veterinary biomedical sciences.

6120*
Advanced Physiology of Selected Systems. 2-10 credits, maximum 10. Prerequisite: 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.

6200*
Topics in Advanced Pharmacology and Toxicology. 1-4 credits, maximum 4. Prerequisite: consent of instructor. Selected topics in advanced pharmacology, including xenobiotic kinetics and dynamics.

6203*
Advanced Concepts in Veterinary Immunology. Prerequisite: 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.

6210*
Advanced Toxicology. 1-3 credits, maximum 3. Prerequisites: graduate standing, consent of instructor. An integrated systems-based approach to toxicology from molecular, cellular, organ, organismal and ecological perspectives.

6220*
Advanced Topics in Cell Biology. 1-5 credits, maximum 12. Prerequisite: consent of instructor. Selected topics in cell biology including membrane traffic, cell signalling, ion transport, cytoskeleton, cell cycle, cell junctions and adhesion.

6233*
Laboratory in Electron Microscopy. Lab 12. Prerequisite: 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.

6410*
Endocrine Control of Fuel Metabolism. 1-5 credits, maximum 5. Lab 0-2. Prerequisite: consent of instructor. Emphasis on cellular and molecular aspects of hormone action in target tissues as basis for understanding endocrine regulation of organ and whole body metabolism. Special reference to endocrine pancreas regulation of ketone, carbohydrate (glucose) and lipid (FFA) metabolism in pregnancy, lactation, fasting, obesity and diabetes. Content ap-plicable to health and disease in humans and domestic animals. Course offered in spring semester of alternate years.

6550*
Problems in Functional Morphology. 1-3 credits, maximum 12. Lab 3-9. Prerequisite: consent of instructor. Investigations in comparative, gross, developmental or histologic morphology for graduate students.

6560*
Advanced Pathology Techniques and Special Problems. 1-6 credits, maximum 20. Prerequisites: graduate standing in biological sciences and consent of instructor. Investigations of contemporary techniques and methods used in diagnosis, technical work and research in pathology.

6650*
Current Topics in Bacterial Pathogenesis. 1-3 credits, maximum 9. Prerequisites: 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.

6710*
Seminar in Veterinary Clinical Sciences. 1-3 credits, maximum 3. Prerequisite: 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.

6910*
Veterinary Pathology Slide Conference. 1-2 credits, maximum 6. Prerequisite: medical degree. Guided weekly exercises based on veterinary diagnostic microscopy.

6920*
Diagnostic Pathology. 1-4 credits, maximum 20. Lab 3-9. Prerequisite: 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.

6930*
Comparative Anesthesiology. 1-3 credits, maximum 3. Prerequisite: graduate standing in the College of Veterinary Medicine or consent of the head of the department. Anesthesiology of animals.

6950*
Advanced Systemic Pathology. Prerequisites: VMED 5264, graduate standing, consent of instructor. Total credit not to exceed six for the M.S. degree and 12 for the Ph.D. 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.

6960*
Current Topics in Veterinary Clinical Pathology. 1-3 credits, maximum 9. Prerequisites: 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.

6963*
Advanced Clinical Pathology. Prerequisites: VMED 5362 or equivalent, graduate standing and consent of instructor. Applied clinical biochemistry, organ function tests and related cytologic examination.

6973*
Advanced Hematology. Prerequisites: 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)

6900*
Clinical Problems and Investigation. 1-6 credits, maximum 6. Prerequisite: third-year standing in the College of Veterinary Medicine. Diseases of animals.

7003
Elective I. Prerequisite: 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.

7013
Elective II. Prerequisite: 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.

7023
Elective III. Prerequisite: 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.

7033
Elective IV. Prerequisite: 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.

7700
Preceptorship Clinic. 1-8 credits, maximum 8. Prerequisite: 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.

7703*
Intensive Care Clinic. Prerequisite: fourth-year standing in the College of Veterinary Medicine. Clinical rotation in small animal intensive care/ critical and emergency medicine. Letter graded.

7710
Non-OSU Clinic. 1-8 credits, maximum 8. Prerequisite: fourth-year standing in the College of Veterinary Medicine. Approved clinical rotations off the OSU campus. Graded on a pass-fail basis.

7713*
Radiology Clinic. Prerequisite: fourth-year standing in the College of Veterinary Medicine. Diagnostic radiography, ultrasound, and other special imaging modalities.

7720
Special Clinics. 1-8 credits, maximum 8. Prerequisite: 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.

7723*
Equine Medicine Clinic. Prerequisite: fourth-year standing in the College of Veterinary Medicine. Diagnosis, prognosis, treatment and prevention of equine medical diseases.

7730*
Anesthesiology Clinic. Prerequisite: fourth-year standing in the College of Veterinary Medicine. Management of clinical anesthesia in various domestic species.

7733*
General Medicine and Surgery Clinic. Prerequisite: fourth-year standing in the College of Veterinary Medicine. Receiving and managing emergency and general medical and surgical cases in companion animals.

7743*
Small Animal Medicine Clinic. Prerequisite: fourth-year standing in the College of Veterinary Medicine. Diagnosis, treatment and prevention of companion animal medical diseases.

7753*
Small Animal Surgery Clinic. Prerequisite: fourth-year standing in the College of Veterinary Medicine. Diagnosis, prognosis, treatment and prevention of companion animal surgical diseases.

7763*
Food Animal Medicine Clinic. Prerequisite: fourth-year standing in the College of Veterinary Medicine. Diagnosis, prognosis, treatment and prevention of diseases of food animal medical and surgical diseases.

7793
Equine Surgery Clinic. Prerequisite: fourth-year standing in the College of Veterinary Medicine. Diagnosis, prognosis, treatment and prevention of equine surgical diseases.

7803
Clinic Pool. Prerequisite: fourth-year standing in the College of Veterinary Medicine. Semi-elective clinical assignment. Graded on a pass-fail basis.

Veterinary Medicine (VMED)

3123
Animal Disease Control and Prevention. Prerequisite: junior standing in the College of Agriculture. Principles of sanitation and of prevention and control of common diseases of livestock and other animals.

7110*
Veterinary Physiology I. 3-6 credits, maximum 6. Lab 15. Prerequisite: 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.

7120*
Veterinary Physiology II. 3-6 credits, maximum 6. Lab 15. Prerequisite: 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.

7123*
Veterinary Histology. Lab 45. Prerequisite: first-year standing in the College of Veterinary Medicine or consent of instructor. Organization and structure of cells and tissues of domestic animals.

7144*
Gross and Developmental Anatomy. Prerequisite: 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.

7152
Zootechnology. Prerequisite: first-year admission to College of Veterinary Medicine fall semester. Animal breeds and identificaiton, animal production and marketing systems and animal handling and restraint as it applies to production and marketing.

7162
Jurisprudence and Ethics. Prerequisite: 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.

7223*
Veterinary Parasitology I. Lab 2. Prerequisite: 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.

7230*
Veterinary Physiology III. 3-6 credits, maximum 6. Prerequisite: 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.

7243*
Comparative Anatomy. Prerequisite: 5144 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.

7250*
Veterinary Immunology. 3-4 credits, maximum 4. Lab 2. Prerequisite: first-year standing in College of Veterinary Medicine or consent of instructor. Basic principles of immunology and their application to veterinary medicine. Variable credits hours distributed among Veterinary Immunology, Infectious Diseases I and II not to exceed a total of 11 credit hours.

7264
General Pathology. Prerequisite: 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.

7311
Clinical Techniques I. Lab 40. Prerequisite: second-year standing in College of Veterinary Medicine or consent of instructor. Clinical orientation including rotations in instruction and service units in the College. Graded on a pass-fail basis.

7323*
Veterinary Parasitology II. Lab 2. Prerequisite: 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.

7333*
Pharmacology I. Prerequisite: 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.

7342*
Clinical Anatomy. Lab 6. Prerequisite: second-year standing in the College of Veterinary Medicine. Aspects of gross anatomy as they relate to clinical applications.

7350*
Infectious Diseases I. 3-4 credits, maximum 4. Lab 2. Prerequisite: second-year standing in College of Veterinary Medicine or consent of instructor. Important animal diseases caused by bacteria, fungi and viruses covered on a systems 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. Variable credit hours distributed among Veterinary Immunology, Infectious Diseases I and II not to exceed a total of 11 credit hours.

7363*
Clinical Pathology. Lab 30. Prerequisite: second-year standing in the College of Veterinary Medicine or graduate standing with consent of instructor. Basic concepts pertinent to data interpretation and laboratory methods used in evaluation of disease.

7412*
Anesthesiology. Lab 6. Prerequisite: 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.

7413*
Epidemiology, Food Safety and Public Health. Prerequisite: second-year standing in the College of Veterinary Medicine or consent of instructor. Principles and uses of epidemiology in veterinary medicine. Introduction to public health and diseases transmissible to humans. Potential human health hazards in foods of animal origin and principles of safe food production, processing, handling, and inspection, including pathogen reduction, HACCP regulations, and pre-harvest food safety.

7432*
Pharmacology II. Prerequisite: 5333 or consent of instructor. A continuation of 5333 that includes the mechanisms of action, spectra of activity, dipositions, adverse effects and clinical indications for antimicrobial agents, antiparasitic agents, anticancer agents, anti-inflammatory agents, and drugs used in the therapy of respiratory, gastrointestinal, and endocrine diseases.

7443*
Diagnostic Imaging. Lab 13. Prerequisite: second-year standing in the College of Veterinary Medicine. Radiographic theory, techniques, and interpretation. Introduction to alternate methods, including ultrasonography.

7450*
Infectious Diseases II. 3-4 credits, maximum 4. Lab 2. Prerequisite: first- or second-year standing in the College of Veterinary Medicine or consent of instructor. Continuation of 5353. Variable credit hours distributed among Veterinary Immunology, Infectious Diseases I and II not to exceed a total of 11 credit hours.

7482*
Hemolymphatic and Oncology. Prerequisite: 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).

7501*
Ophthalmology. Prerequisite: 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.

7510*
Research Elective. 2-4 credits, maximum 8. Lab 60-90. Prerequisite: 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 reserach by developing a research proposal, participating in a competitive peer-review process, and reporting on completed research project.

7511*
Correlation Discussion. Lab 15. Prerequisite: third-year standing in the College of Veterinary Medicine. Case-based integration of previously discussed systems (1.5 week module at end of semester).

7521*
Veterinary Practice Management. Prerequisite: 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.

7522*
Signs and Symptoms of the Small Animal Medical Diagnosis. Prerequisite: 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.

7523*
Surgery. Lab 48. Prerequisite: third-year standing in the College of Veterinary Medicine. Introduction to fundamental principles of surgery. Didactic material followed by surgical laboratories.

7532*
Molecular Genetics. Prerequisite: second-or third-year or higher in good standing in the College of Veterinary Medicine or BIOC 5753. The expression, purification, characterization, and application of biological macromolecules in therapeutics and diagnostics relevant to animal and human health.

7533*
Toxicology. Prerequisite: third-year standing in the College of Veterinary Medicine. Diagnosis and management of intoxications involving plant, chemical and biological toxins.

7542
Diagnostic and Therapeutic Endocrinology. Prerequisite: second or third-year standing in the College of Veterinary Medicine. Advanced course in medical endocrinology. Two components of diagnostic endocrinology and therapeutic endocrinology. Diagnostic endocrinology and examination of the physiological and medical basis for selecting provocative or nonprovocative testing procedures as an adjunct to completing a definitive diagnosis. Therapeutic endocrinology and 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.

7562*
Avian and Exotic Pet Medicine. Lab 6. Prerequisite: second or 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.

7563*
Musculoskeletal System. Lab 9. Prerequisite: 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.

7564*
Alimentary System. Lab 12. Prerequisite: 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.

7571*
Introduction to Behavioral Medicine. Prerequisite: 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.

7583*
Dermatology and Endocrinology. Prerequisite: 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).

7610*
Basic Science Elective. 1-8 credits, maximum 8. Prerequisite: second-or-third-year standing in the College of Veterinary Medicine. Problems in the basic sciences taught as lecture or lab.

7611*
Applied Pharmacology. Lab 7. Prerequisite: 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 avoicance of residues in food products.

7612*
Clinical Neurology. Prerequisite: third-year standing in the College of Veterinary Medicine. Pathogenesis, diagnosis, pathology, medical and surgical treatment and prevention of nervous system diseases.

7614*
Cardiopulmonary System. Lab 24. Prerequisite: 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.

7620*
Clinical Science Elective. 1-8 credits, maximum 8. Prerequisite: second-or-third-year standing in the College of Veterinary Medicine. Problems in the clinical sciences taught as lecture or lab.

7622*
Problem Solving in Internal Medicine. Prerequisite: second-or-third-year standing in the College of Veterinary Medicine. Clinic cases that provide a review of basic pathophysiology.

7631*
History of Veterinary Medicine. Prerequisite: second-or third-year standing in the College of Veterinary Medicine. History of the veterinary medical profession, especially in North America.

7632*
Exercise Physiology. Prerequisite: 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.

7651*
Equine Palpation Lab. Lab 3. Prerequisites: second- or third-year standing in the College of Veterinary Medicine. For 2nd and 3rd year veterinary students. Introduction to palpation, ultrasonographic examination and breeding preparation of the mare reproductive tract. Restricted to students entering equine practice. Second year students may repeat the course in their third year for additional experience.

7652*
Clinical Techniques II. Lab 120. Prerequisite: 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.

7661*
Infectious and Parasitic Diseases of Wild Animals. Lab 11. Prerequisite: 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.

7662*
Urinary System. Prerequisite: 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).

7672*
Swine Production and Diseases. Prerequisite: second or third-year standing in the College of Veterinary Medicine. Problem-based course related to swine diseases and production systems.

7674*
Theriogenology. Prerequisite: 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.

7682*
Small Ruminant Production, Management, Medicine and Surgery. Prerequisite: 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.

7701*
Small Animal Diagnostic Ultrasound. Lab 10. Prerequisite: second- or 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.

7711*
Problem and Case Based Learning in Advanced Ophthalmology. Prerequisite: 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.

7731*
Advanced Small Animal Medicine I: Problem-based Learning. Prerequisite: 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.

7732*
Advanced Medical and Surgical Oncology. Lab 7. Prerequisite: third-year standing in the College of Veterinary Medicine. Investigates cancer as the leading cause of death among dogs and cats. Diagnosis, staging and treatment of common malignancies in veterinary medicine. A systematic approach to the cancer patient while dispelling common misconceptions about cancer treatment and prognosis. Emphasis on fundamental skills, such as diagnostic evaluation of the cancer patient, principles of oncologic surgery, and critical evaluation of journal articles. Safe chemotherapy drug handling and biopsy techniques will be learned in a laboratory setting.

7741*
Bovine Palpation Laboratory. Lab 27. Prerequisite: third-year standing in the College of Veterinary Medicine. Palpation techniques in cows. An elective restricted to students entering food animal practice.

7751*
Poultry Medicine and Diseases. Prerequisite: 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.

7752*
Applied Bovine Nutrition. Lab 14. Prerequisite: 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.

7771*
Advanced Equine Medicine I. Lab 3. Prerequisite: third-year standing in the College of Veterinary Medicine. An in-depth study of topics pertinent to equine practice. Supplemental information presented in core sources and critical analysis of current literature, pathophysiological concepts and case management issues.

7801*
Business Management for Veterinary Practice. Prerequisite: third-year standing in the College of Veterinary Medicine. VMED 5521 recommended. Skills and background to be successful in the business of veterinary practice. Business and financial management of private veterinary practices.

7811*
Advanced Equine Medicine II. Lab 3. Prerequisite: third-year standing in the College of Veterinary Medicine. A continuation of 7771 presenting in-depth study of topics pertinent to equine practice. Supplemental information presented in core sources and critical analysis of current literature, pathophysiological concepts and case management issues.

7821*
Equine Radiology. Lab 12. Prerequisite: third-year standing in the College of Veterinary Medicine. Diagnostic imaging (radiology, nuclear scintigraphy and ultrasound) of horses.

7822*
Food Animal Production Medicine. Prerequisite: third-year standing in the College of Veterinary Medicine. Production animal agriculture and the veterinarian's present ad 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.

7831*
Advanced Small Animal Medicine II: Problem-based Learning. Prerequisite: 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.

7841*
Food Animal Surgery. Lab 9. Prerequisite: 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.

7842*
Special Surgical Problems and Techniques, Advanced Wound Management and Introduction to Reconstructive Surgery. Lab 9. Prerequisite: third-year standing in the College of Veterinary Medicine. Principles of wound management and reconstructive surgery. Lecture and laboratory format.

7851*
Advanced Small Animal Neurology. Prerequisite: 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.

7861*
Small Animal Cytology. Lab 10. Prerequisite: third-year standing in the College of Veterinary Medicine. Case discussion of diagnosis cytologic methods.

7871*
Advanced Equine Reproduction. Lab 3. Prerequisite: third-year student in the veterinary medicine curriculum. 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.

7872*
Special Surgical Problems and Techniques, Advanced Small Animal Orthopedics and Neurosurgery. Lab 12. Prerequisite: third-year standing in the College of Veterinary Medicine. Diagnosis and surgical management of small animal orthopedic and neurological diseases. Lecture and laboratory format.

7891*
Equine Surgical Laboratory. Lab 12. Prerequisite: 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.

7912*
Veterinary Medical Clinic Conference. Prerequisite: fourth-year standing in the College of Veterinary Medicine. Presentation and discussion of selected clinical cases by fourth-year students and interdepartmental faculty groups. Graded on a pass-fail basis.

7933
Diagnostics. Prerequisite: fourth-year standing in the College of Veterinary Medicine. Participation in animal necropsy, clinical pathology, and other investigative methods to study diagnosis, prognosis, prevention and treatment of diseases. Graded on a pass-fail basis.

Zoology (ZOOL)

1011
Professions in Natural Resources. An examination of the professions of the ecology and management of natural resources. Exploration of academic and career options. Graded on a pass-fail basis. Same course as RLEM 1011.

1604
(N)Animal Biology. Lab 2. Prerequisite: 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.

2104
Human Anatomy. Lab 3. Prerequisite: ZOOL 1604. Gross anatomy of the human body and its systems based on comparisons with nonhuman mammals dissected in the laboratory. Minor emphasis on embryology and histology.

3104*
Invertebrate Zoology. Lab 4. Prerequisite: ZOOL 1604. Morphology, physiology, reproduction and ecology of major invertebrate groups.

3113
(N)Human Evolution. An evolutionary perspective on human biology. No credit for students with prior credit in 3133.

3114*
Vertebrate Morphology. Lab 3. Prerequisite: 1604. Comparative morphology of representative vertebrates with emphasis on phylogeny and ontogeny and consideration of histology and function.

3123*
(N)Human Heredity. The impact of genetics on human endeavor. No credit for students with prior credit in BIOL 3024.

3133*
Evolution. Prerequisite: 3123 or BIOL 3024. Development of the evolutionary concept: speciation, evolutionary mechanisms and phylogenetic concepts.

3143
Oceanography. Prerequisite: CHEM 1225. Ocean basins, geology, chemistry, biology, waves, tides, ocean exploration, ocean communities, and resources.

3153
(N)Animal Behavior. Prerequisite: 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.

3204*
Physiology. Lab 2. Prerequisites: BIOL 1114; CHEM 1215 or 1314. Anatomy and function of the human body. Human and domestic animal physiology considered in laboratories. No credit for students with prior credit in 4215.

3500
Colloquium on the Environment and Conservation. 1 credit, maximum 4. Current conservation and environmental concerns presented by scholars and experts emphasizing discovery and solutions. Natural resource agencies and conservation organizations.

3502
Wildlife Law Enforcement. Prerequisites: 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.

3513*
Principles of Conservation Biology. Prerequisites: 60 credit hours including BIOL 3034. Application of ecological principles to the maintenance and restoration of biological diversity at genetic, population, and community levels.

3700
Readings and Special Studies in Zoology. 1-3 credits, maximum 6. Prerequisites: ZOOL 1604 and consent of instructor. Discussion of selected readings.

4102*
Genetics Laboratory Investigations. Lab 4. Prerequisites: completion of BIOL 3024 with a minimum grade of "C" or consent of instructor. Laboratory course to complement BIOL 3024 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.

4103*
General Parasitology. Lab 2. Prerequisite: ZOOL 1604; ZOOL 3104 recommended. Fundamentals of parasitism with emphasis on: life cycles, disease conditions, epidemiology, diagnosis, treatment, historical significance, terminology, taxonomy and parasi- tological techniques.

4113
Conservation Genetics. Prerequisites: BIOL 3024 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.

4115*
Biology of Fishes, Amphibians and Reptiles. Lab 5. Prerequisite: 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.

4134*
Embryology. Lab 4. Prerequisite: 3115, BIOL 3014. 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.

4164*
Ornithology. Lab 3. Prerequisite: 1604. Classification, evolution, distribution, identification, life histories, and morphological, ecological, and behavioral adaptations of birds. Two weekend field trips required.

4174*
Mammalogy. Lab 3. Prerequisite: 1604. Taxonomy, identification, evolution, zoogeography, life history traits, and techniques of study of wild mammals. Weekend field trips required.

4215*
Mammalian Physiology. Prerequisites: ZOOL 1604; 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 premedical, pre-dental and pre-veterinary) sciences.

4222*
Mammalian Physiology Laboratory. Lab 6. Prerequisite: 4215. Laboratory experiments that illustrate function of organs, organ systems or mechanisms of whole body physiological control. For students majoring in basic biological sciences.

4231*
Seminar in Physiology. Prerequisite: 3204 or 4215. Oral and written communication in the physiological sciences; critical review of physiological literature.

4243*
Introductory Pharmacology. Prerequisite: 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.

4273
Comparative Physiology. Prerequisite: 3204 or 4215. Comparative, environmental 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. Same course as 5273.

4283*
Endocrinology. Prerequisites: 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.

4303*
Environmental Toxicology. Prerequisites: BIOL 1114 or equivalent; CHEM 1215 or 1314; junior standing. Introduction to the basic theories, principles, and techniques of environmental toxicology. Comparative study of the groups of toxicants (e.g. heavy metals, PCB's, insecticides) and discussion of the environmental problems created by these chemicals and their implications for survival of populations (including humans) on earth.

4403*
Wetland Ecology and Management. Lab 3. Prerequisites: 3513 or BIOL 3034, or FOR 3213, or RLEM 4954 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.

4414*
Fisheries Management. Lab 4. Prerequisite: BIOL 3034. Techniques and principles involved in management of fishes. Field trip fee required.

4434*
Limnology. Lab 3. Prerequisite: BIOL 3034. Physical, chemical and biological factors in lakes and streams.

4513*
Wildlife Management. Prerequisite: BIOL 3034 or FOR 3213. Biological basis for the management of wildlife populations and habitats, with emphasis on current management problems.

4523*
Wildlife Management Techniques. lab 3. Prerequisite: 4513, 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.

4533*
Zoo Biology and Management. Prerequisite: 4 hours of zoology or biology. Conservation and propagation of endangered species, animal acquisition and transport, restraint, sanitation and animal health, exhibit planning and design, public relations, administration and research. Lectures by professional zoo staff members. Extension course taught at the Oklahoma City and Tulsa zoos.

4700
Undergraduate Research Problems. 1-4 credits maximum 4. Prerequisite: consent of instructor. Participation in faculty research or execution of a problem formulated by the student.

4710
Internships in Zoology. 1-3 credits, maximum 3. Prerequisites: 2.50 GPA and consent of department head. Zoology related experiences in professional work settings. Graded on a pass-fail basis.

4720
Zoo Careers Internship. 1-3 credits, maximum 3. Prerequisite: 4533. Hands-on career experience working under the direction of zoo professionals.

4750
Honors Study in Zoology. 1-5 credits, maximum 5. Prerequisite: 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.

5000*
Research for Master's Thesis. 1-6 credits, maximum 6. Independent research for the M.S. thesis under the supervision of graduate faculty member.

5010*
Graduate Seminar. 1-3 credits, maximum 10. Discussion of selected topics.

5020*
Special Problems. 1-4 credits, maximum 10. Prerequisites: graduate standing and consent of instructor. A report of results obtained is to be placed in department files.

5030*
Teaching Zoology. 1-4 credits, maximum 4. Prerequisite: consent of instructor. Supervised teaching in the department laboratories. Attendance at seminar on problems involved in teaching zoology in college.

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.

5113*
Conservation Genetics. Prerequisite: 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.

5123*
Behavioral Ecology. Prerequisite: 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.

5133*
Evolutionary Ecology. Lab 2. Prerequisite: course in ecology strongly recommended. Ecological concepts dealing with contemporary evolutionary processes, not phylogeny. Life history traits, R and K selection, 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.

5163*
Population Ecology. Lab 3. Prerequisites: 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.

5173*
Systematic Mammalogy. Lab 1. Basic principles of systematics as they apply to advanced aspects of mammalian biology including evolution, bigeography, ecology; spring-break field trip required to meet laboratory requirement.

5273*
Comparative Physiology. Prerequisites: 3204 or 4215 or equivalent. Comparative, environmental 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. Same course as 4273.

5413*
Ecotoxicology. Integration of the major abiotic and biotic processes involved in transport, exposure and response of biological systems (organism, population and community) to environmental toxicants.

5424*
Techniques in Environmental Toxicology. Lab 4. Practical understanding of modern techniques used to quantify exposure and effects of environmental toxicants. Laboratories include gas chromatography, HPLC, atomic absorption spectroscopy, protein/nucleic acid isolation, immunoassay, genetic toxicology, and immunotoxicology.

5433*
Fisheries Science. Prerequisite: 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.

5463*
Stream Ecology. Lab 1. Prerequisite: course in ecology strongly recommended. Ecology of streams and rivers with emphasis on physical and chemical processes, adaptations of aquatic biota to riverine environments, and human impacts on riverine ecosystems.

5563*
Woodland Wildlife Ecology. Lab 3. Prerequisite: 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.

5573*
Grassland and Desert Wildlife Ecology. Prerequisite: 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.

5583*
Wetland Wildlife Ecology. Lab 3. Prerequisite: 4513 or consent of instructor. Ecology of various types of wetlands with emphasis on the management problems for waterfowl and furbearers.

6000*
Research for Ph.D. Dissertation. 1-15 credits, maximum 30. Independent research for the Ph.D. dissertation under the supervision of a graduate faculty member.