COURSES OF INSTRUCTION

This list includes for each course the catalog number, title, credit hours, class and laboratory hours per week, description and prerequisites.

A secondary listing in parentheses indicates that this course is cross-listed with another program.

Graduate credit may be earned only for courses numbered 6000 or above. Each 6000-level course carries a 4000-level undergraduate counterpart. Students who receive graduate credit in such courses must do extra work of an appropriate nature as determined by the department and are graded according to graduate standards. Students who receive credit for the 4000-level course may not receive credit later for the same course at the 6000 level.

Courses at the 7000 level are designed primarily for the degrees that emphasize professional practice rather than research.

COURSE ABBREVIATIONS

Art and Architectural History .................. AAH
Accounting ........................................ ACCT
Agricultural Education ......................... AGED
Agricultural Mechanization and Business .... AGM
Athletic Leadership ................................ AL
Anthropology ..................................... ANTH
Applied Economics .............................. APEC
Architecture .................................... ARCH
Art .................................................... ART
Astronomy ........................................ ASTR
Audio Technology ................................ AUD
Automotive Engineering ....................... AUE
Animal and Veterinary Sciences ............. AVS
Biochemistry .................................... BCHM
Biosystems Engineering ....................... BE
Bioengineering ................................... BIE
Biology ............................................. BIOL
Biomolecular Engineering ..................... BMOL
Civil Engineering ................................ CE
Chemistry ......................................... CH
Chemical Engineering .......................... CHE
Communication Studies ....................... COMM
Computer Science ............................. CPSC
City and Regional Planning .................... CRP
Crop and Soil Environmental Science ......... CSEN
Construction Science and Management ...... CSN
Digital Production Arts ....................... DPA
Electrical and Computer Engineering ....... ECE
Economics ........................................ ECON
Education ....................................... ED
Educational Counseling ..................... EDC
Early Childhood Education .................. EDEC
Elementary Education ......................... EDEL
Educational Foundations ..................... EDF
Educational Leadership ....................... EDL
Literacy .......................................... EDLT
Middle Level Education ....................... EDML
Secondary Education ......................... EDSC
Special Education .............................. EDSP
Environmental Engineering and Science .... EES
Executive Leadership and Entrepreneurship . ELE
English .......................................... ENGL
Environmental and Natural Resources ...... ENR
Environmental Science and Policy .......... ENSP
Entomology ...................................... ENT
Engineering and Science Education ....... ESED
Environmental Toxicology .................. ETOX
Family and Community Studies ............. FCS
Food Science ..................................... FDSC
Food Technology .............................. FDTH
Finance .......................................... FIN
Forestry and Natural Resources ............. FNR
Forestry .......................................... FOR
French ............................................. FR
Graphical Communications ................. GC
Genetics ......................................... GEN
Geography ...................................... GEOG
Geology .......................................... GEOL
German .......................................... GER
Graduate Studies ............................... GS
Human-Centered Computing .................. HCC
Healthcare Genetics ......................... HCG
Health, Education and Human Development . HEHD
History ........................................... HIST
Health .............................................. HLTH
Horticulture ...................................... HORT
Historic Preservation ......................... HP
Human Resource Development .............. HRD
Historic Preservation (College of Charleston) ........ HRP
Humanities ...................................... HSPV
Industrial Engineering ....................... IE
Integrated Pest Management ............... IPM
Language ......................................... LANG
Landscape Architecture ...................... LARC
Law ................................................ LAW
Mathematical Sciences ....................... MTHS
Business Administration ..................... MBA
Mechanical Engineering ........................ ME
Management ..................................... MGT
Health Administration ....................... MHA
Microbiology .................................... MICR
Marketing ....................................... MKT
Materials Science and Engineering ........ MSE
Music ............................................. MUSIC
Nursing .......................................... NURS
Nutrition ......................................... NUTR
Public Administration ....................... PADM
Pan African Studies ......................... PAS
Planning, Design and the Built Environment . PDBE
Plant and Environmental Sciences .......... PES
Physics ........................................... PHYS
Packaging Science ............................ PKSC
Plant Pathology ............................... PLPA
Political Science ............................. POSC
Policy Studies ................................... POST
Parks, Recreation and Tourism ............ PRTM
Psychology ...................................... PSYC
Rhetorics, Communication and Interpretation . RCID
Real Estate Development .................... RED
Religion .......................................... REL
Rural Sociology .................................. RS
Sociology ......................................... SOC
Spanish .......................................... SPAN
Systems Engineering ......................... SYSE
Theatre ........................................... THEA
Vocational-Technical Education .......... VTED
Wildlife and Fisheries Biology ............ WFB
Women’s Studies .............................. WS

ART AND ARCHITECTURAL HISTORY

AAH 6110 Directed Research in Art History I 3 (3) Comprehensive studies and research of special topics not covered in other courses. Emphasis is on field studies, research activities, and current developments in art history.

AAH 6120 Directed Research in Art History II 3 (3) Continuation of AAH 6110.

AAH 6230 Studies in the Art and Architecture of the Renaissance 3 (3) Consideration of the visual arts and architectural monuments of the Renaissance (Western Europe from the 15th-16th centuries), with a study in depth of selected examples from the period. Preq: AAH 6110 or consent of instructor.

AAH 6240 Studies in the Art and Architecture of the Renaissance II 3 (3) Consideration of the visual arts and architectural monuments of the Renaissance (Western Europe from the 15th-16th centuries), with a study in depth of selected examples from the period. Preq: AAH 6230.

AAH 6300 Twentieth Century Art 3 (3) Acquaints students with the major artists' monuments and issues of the Modern period in art. Through lecture/discussions and the reading of primary sources, course places the major modern movements in the context of the period (1860s-1945). Preq: Consent of instructor.

AAH 6320 Twentieth Century Art II 3 (3) Overview of trends in art and architecture since World War II. Specific artists, artworks, and movements are presented in a socio/historic context with specific emphasis on the transition from a late-modernist to a post-modern perspective. Preq: Consent of instructor.

AAH 8150 Art and Architectural History Seminar I 3 (3) Particular aspect of period of art/architectural history. Preq: Consent of instructor.

AAH 8160 Art and Architectural History Seminar II 3 (3) Continuation of AAH 8150.

AAH 8400 Selected Topics 3 (3) Independent/directed study; tutorial work in linguistics, professional communication, or American, British or European literature not offered in other courses. May also be offered as COMM 8400 or ENGL 8400. Preq: Consent of director of MA in English or MA in Professional Communication program.

ACCOUNTING

ACCT 6040 Individual Taxation 3 (3) Interpretation of Federal income tax laws, regulations, and court decisions with practice in application of these laws to the returns of individuals, partnerships, and corporations. Preq: ACCT 3110 with a C or better.
Courses of Instruction

ACCT 6100 Contemporary Reporting and Management Control Systems 3 (3) Application of analyses and management control systems for contemporary business needs, including sustainability reporting, lean systems, capacity management, performance measures and incentive measures and incentive systems, and target costing. Preq: ACCT 3030 with a C or better.

ACCT 8210 Controllership 3 (3) Advanced internal accounting emphasizing accounting implications for management decision making. Preq: Enrollment in the MPAcc program.

ACCT 8510 Tax Research 3 (3) Tax research methodology as applied to the solution of routine and complex tax problems emphasizing the methodology of solution rather than a specific tax area. Preq: Enrollment in the MPAcc program.


ACCT 8540 Ethical, Professional and Societal Responsibilities 3 (3) Study of ethical and societal responsibilities and constraints that define and affect the practice of accountancy. Includes selected readings and cases. Preq: Enrollment in the MPAcc program.

ACCT 8550 Governmental and Nonprofit Accounting 3 (3) Provides an in-depth understanding of the unique environment, concepts and procedures of accounting, financial reporting, auditing and budgeting of governmental and nonprofit organizations. Preq: Enrollment in the MPAcc program.

ACCT 8560 CPA Exam Review-A 0 (0) Preparation for the auditing and attestation section of the Certified Public Accountant exam. Must be completed prior to receiving MPAcc degree. Does not contribute hours toward degree completion. To be taken Pass/No Pass only. Preq: Enrollment in the MPAcc program.

ACCT 8570 CPA Exam Review-B 0 (0) Preparation for the financial accounting and reporting section of the Certified Public Accountant exam. Must be completed prior to receiving MPAcc degree. Does not contribute hours toward degree completion. To be taken Pass/No Pass only. Preq: Enrollment in the MPAcc program.

ACCT 8580 CPA Exam Review-C 0 (0) Preparation for the regulatory section of the Certified Public Accountant exam. Must be completed prior to receiving MPAcc degree. Does not contribute hours toward degree completion. To be taken Pass/No Pass only. Preq: Enrollment in the MPAcc program.

ACCT 8590 CPA Exam Review-D 0 (0) Preparation for the regulation section of the Certified Public Accountant exam. Must be completed prior to receiving MPAcc degree. Does not contribute hours toward degree completion. To be taken Pass/No Pass only. Preq: Enrollment in the MPAcc program.

ACCT 8610 Operational Auditing 3 (3) Provides in-depth understanding of concepts underlying operational auditing and experience in planning, conducting and reporting in operational auditing using a risk-based, process and controls focused approach. Preq: Enrollment in the MPAcc program.

ACCT 8620 Financial Auditing 3 (3) Advanced course in financial auditing to provide a framework for thinking about contemporary auditing and assurance issues and evaluating alternative rationales regarding the value and purpose of an audit as well as conducting financial audit research. Preq: Enrollment in the MPAcc program.

ACCT 8630 Forensics and Analysis 3 (3) Study of financial statement analysis with quality assessments and forensic analysis. Includes forecasting, asset and business valuation approaches and other special topics. Preq: Enrollment in the MPAcc program.

ACCT 8640 Accounting Information Systems 3 (3) Accounting systems including database concepts, systems design and evaluation, systems controls and systems implementation. Preq: Enrollment in the MPAcc program.

ACCT 8650 Taxation of Business Decisions 3 (3) Discusses the interrelationship of taxation and business decisions. Designed for students not specializing in taxation. Preq: Enrollment in the MPAcc program.


ACCT 8720 Taxation of Flowthrough Entities 3 (3) Covers federal income taxation of entities treated as partnerships, S corporations, estates and trusts. Preq: Enrollment in the MPAcc program.

ACCT 8730 International and Special Topics in Taxation 3 (3) Seminar on international and special topics areas that impact practicing tax professionals. Preq: Enrollment in the MPAcc program.


ACCT 8750 State, Local and Advanced Topics in Taxation 3 (3) Explores state and local income taxation issues and planning, retirement plans, deferred compensation plans, IRS practice and procedures and current sophisticated developments in taxation. Preq: Enrollment in the MPAcc program.

AGRICULTURAL EDUCATION

AGED 6010 Instructional Methods in Agricultural Education 3 (2) Appropriate methods of teaching vocational agriculture in high schools. Includes procedures for organizing teaching programs, teaching high school students, and directing FFA activities. Coreq: AGED 6011.

AGED 6070 Principles of Adult/Extension Education 3 (3) Overview of adult/extension education and adult learning. Selection of adult education providers is reviewed with emphasis on extension. Preq: Junior standing.

AGED 6150 Leadership of Volunteers 3 (3) Provides an overview of volunteer management. Examines the knowledge, skills, and abilities required of professional managers to involve volunteers effectively in the work of organizations.

AGED 6160 Ethics and Issues in Agriculture and the Food and Fiber System 3 (3) Explores ethical theories, concepts of critical thinking, and major ethical issues in American agriculture. The major social, political, economic, and ethical issues that arise in connection to the food and fiber system are examined and potential solutions considered.

AGED 6230 Curriculum 3 (3) Curriculum goals and related planning for career and continuing education programs.

AGED 6250 Teaching Agricultural Mechanics 2 (1) Instruction in organizing course content, conducting and managing an agricultural mechanics laboratory, shop safety, microteaching demonstrations of psychomotor skills, and methods of teaching manipulative abilities. Coreq: AGED 6251.

AGED 6251 Teaching Agricultural Mechanics Laboratory 0 (3) Non-credit laboratory to accompany AGED 6250. Coreq: AGED 6250.

AGED 6280 Special Studies in Agricultural Education 1-3 (1-3) Students study, individually or collectively, selected topics and/or problems in agricultural education to meet the particular needs of the clientele enrolled. May be repeated for a maximum of six credits.

AGED 6400 Program Development in Adult/Extension Education 3 (3) Principles, theory, and practice in planning and conducting educational programs in adult/extension settings. Preq: Junior standing.

AGED 6500 Modern Topics and Issues 3 (3) Students select a major area of concern to teachers of agriculture and county agents for intensive study at least one semester prior to offering the course. When feasible, team teaching with faculty from other departments in the College of Agriculture, Forestry and Life Sciences is utilized.

AGED 6800 Foundations of Digital Media and Learning 3 (2) Critical use of digital media for leadership and learning within societal and educational contexts. Course focuses on learner impact while exploring, developing, and evaluating technology-enhanced applications. Further develops competencies with new media literacies and addresses societal, cultural, ethical, and participatory issues and uses of digital media. Coreq: AGED 6801.

AGED 6801 Foundations of Digital Media and Learning Laboratory 0 (2) Non-credit laboratory to accompany AGED 6800. Coreq: AGED 6800.
AGED 6810 Web Design for the Life Sciences and Agriculture 3 (2) Addresses basic principles and theories of Web design and site construction, including usability and accessibility considerations. Web and graphics design software are used to develop sites suitable for life science and agricultural organizations. Service-learning is used with student projects. Preq: AGED 2000 and CPSC 1200. Coreq: AGED 6811.

AGED 6811 Web Design for the Life Sciences and Agriculture Laboratory 0 (2) Non-credit laboratory to accompany AGED 6810. Coreq: AGED 6810.

AGED 6820 Advanced Educational Applications of Microcomputers 3 (2) Provides students with the knowledge and skills needed to apply microcomputer technology to the utilization and generation of educational software in accordance with sound educational principles. Preq: AGED 4800 or EDF 4800. Coreq: AGED 6821.

AGED 6821 Advanced Educational Applications of Microcomputers Laboratory 0 (2) Non-credit laboratory to accompany AGED 6820. Coreq: AGED 6820.

AGED 7360 Internship Teaching 3 (1) Increases professional competency and program development through classroom and practical experiences in planning, conducting and evaluating educational programs. Offered spring semester only. Coreq: AGED 7361.

AGED 7361 Internship Teaching Laboratory 0 (6) Non-credit laboratory to accompany AGED 7360. Coreq: AGED 7360.

AGED 7370 Internship in Agribusiness Firms 3 (1) Provides classroom and practical experiences in selected agricultural businesses and industries. Students identify and practice entry-level competencies required in selected agribusiness and natural resource management enterprises. Offered summer session only. Coreq: AGED 7371.

AGED 7371 Internship in Agribusiness Firms Laboratory 0 (6) Non-credit laboratory to accompany AGED 7370. Coreq: AGED 7370.

AGED 7500 Special Institute Course: Selected Topics in Agricultural Education 1-3 (1-3) Subject areas organized according to institute needs. Topics vary from course to course. May be repeated for a maximum of nine credits. Preq: Consent of instructor.

AGED 8010 Systems for Technology Transfer 3 (3) Development of a philosophical foundation and utilization of cooperative learning strategies and techniques to disseminate effectively technology change for expanding clientele and diverse socioeconomic environments.

AGED 8040 Special Problems 3 (2) Planning, conducting and reporting a special problem in agricultural and vocational education appropriate to students’ needs. Coreq: AGED 8041.

AGED 8041 Special Problems Laboratory 0 (3) Non-credit laboratory to accompany AGED 8040. Coreq: AGED 8040.

AGED 8100 Clinical Research in Agricultural Education 1-6 (1-6) Individual work on an assigned research topic in agricultural education. May be repeated for a maximum of nine credits. Preq: ENST 8010; and AGED 8890 or ED 8890.

AGED 8120 Development of Supervised Agricultural Experience Programs 3 (3) Provides secondary agriculture teachers with strategies for supervising and guiding students’ supervised agricultural experiences (SAE).

AGED 8150 Teaching Agricultural and Power Mechanics 3 (2) Methods of determining course content, organizing teaching modules in logical sequence, equipping shop, teaching agricultural and power mechanics to farm and agribusiness clientele, providing individualized instruction and developing of-farm experience programs. Offered summer session of odd numbered years only. Coreq: AGED 8151.

AGED 8151 Teaching Agricultural and Power Mechanics Laboratory 0 (3) Non-credit laboratory to accompany AGED 8150. Coreq: AGED 8150.

AGED 8210 Theories and Practices of Adult Education 3 (3) Study of recent research on adult learning. Includes a comparison of the assumptions supporting pedagogy and andragogy and teaching adults through formal classes and community organizations. Offered spring semester only. Preq: ED 3020 or PSYC 2010.

AGED 8690 Seminar 1-3 (1-3) Students and faculty review current topics in agricultural education.

AGED 8890 Research in Education 3 (3) Includes problem selection. Investigates types of educational research and techniques employed. Includes the use of ERIC system and computer program packages. Requires interpretation of research findings. May also be offered as ED 8890.

AGM 6010 Landscape Drainage and Irrigation 3 (2) Uses basic soil-water-plant relationships to determine the need for and methods of irrigation and drainage. Topics include irrigation methods, drainage needs and drainage methods. Preq or concurrent enrollment: AGM 3010. Coreq: AGM 6021.

AGM 6021 Landscape Drainage and Irrigation Laboratory 0 (3) Non-credit laboratory to accompany AGM 6020. Coreq: AGM 6020.

AGM 6050 Environmental Control in Animal Structures 3 (2) Design of environmental control systems for animal production facilities. Topics include effects of the thermal and chemical environment on animals, ventilation system design, thermal design of structural envelopes, design of heating, cooling, and lighting systems. Emphasis is on practical, energy-efficient applications to modern animal production facilities. Preq: AGM 3030 or AVS 3010. Coreq: AGM 6051.

AGM 6051 Environmental Control in Animal Structures Laboratory 0 (3) Non-credit laboratory to accompany AGM 6050. Coreq: AGM 6050.

AGM 6060 Mechanical and Hydraulic Systems 3 (2) Study of power transmission systems for agricultural production emphasizing mobile equipment. Characteristics, requirements, and design of both V-belt drive and roller-chain drives are presented. Emphasizes hydraulic power transmission systems, including pumps, actuators, control devices, and hydraulic circuitry. Preq: AGM 2060, and PHYS 2000 or PHYS 2070. Coreq: AGM 6061.

AGM 6061 Mechanical and Hydraulic Systems Laboratory 0 (3) Non-credit laboratory to accompany AGM 6060. Coreq: AGM 6060.

AGM 6100 Precision Agriculture Technology 3 (2) Includes principles and hands-on application of technologies supporting precision agriculture. Topics include global positioning system (GPS), geographic information system software, variable rate technologies, collection of spatial data, automated guidance of equipment, spatial data mapping and analysis, remote sensing, and economic considerations. Preq: Junior standing. Coreq: AGM 6101.

AGM 6101 Precision Agriculture Technology Laboratory 0 (3) Non-credit laboratory to accompany AGM 6100. Coreq: AGM 6100.

AGM 6520 Mobile Power 3 (2) Study of tractors, emphasizing internal combustion engines and support systems necessary for their proper functioning. Also considers application of power, maintenance, adjustment, and general repair. Preq: PHYS 2000 or PHYS 2070. Coreq: AGM 6521.

AGM 6521 Mobile Power Laboratory 0 (3) Non-credit laboratory to accompany AGM 6520. Coreq: AGM 6520.

AGM 6600 Electrical Systems 3 (2) Students in agriculture and related curricula study electric and other utilities on the farm and in the home. Emphasizes selection, installation, and maintenance of wiring systems, lighting systems, motors, controls, water systems, and waste disposal systems. Preq: Junior standing. Coreq: AGM 6601.

AGM 6601 Electrical Systems Laboratory 0 (3) Non-credit laboratory to accompany AGM 6600. Coreq: AGM 6600.

AGM 8710 Selected Topics in Agricultural Mechanization 1-3 (1-3) Selected topics not covered in other courses. Performance is measured by oral or written reports or examinations. May be repeated for a maximum of six credits.

AGM 8810 Special Problems 1-3 (1-3) Independent analysis through literature review and laboratory or field research. Requires written documentation. May be repeated for a maximum of six credits.

ATHLETIC LEADERSHIP

AL 6530 Athletic Injuries Prevention, Assessment and Rehabilitation 3 (3) Gives students an understanding of prevention, treatment, and rehabilitation procedures of injured athletes. Preq: AL 3490.

AL 8490 Athletic Leadership Development 3 (3) Investigation of leadership principles and theories as they relate to collegiate athletic coaching and the effect they have on the performance of the collegiate athletic. Collegiate coaching responsibilities and requirements for various levels of appointment are examined. Preq: Consent of instructor.

AL 8610 Athletic Leadership for Intercollegiate Administration 3 (3) Investigates effective leadership principles and theories relative to the supervision and administrative responsibilities of intercollegiate athletics. Preq: Consent of instructor.
AL 8620 Psychological Issues in Collegiate Athletics 3 (3) Investigation and intervention of psychological issues that athletes, coaches and administrators face at the collegiate level. Prq: Consent of instructor.

AL 8640 Ethical Issues in Collegiate Athletic Administration 3 (3) Investigation of current ethical issues and the promotion of positive character development in collegiate athletic programs. Prq: Consent of instructor.

ANTHROPOLOGY

ANTH 6030 Qualitative Methods 3 (3) Methods and techniques of qualitative field research, including participant observation, ethnographic interviewing, data analysis, and report writing. Prq: ANTH 2010.

ANTH 6230 Women in the Developing World 3 (3) Comparative anthropological study of women and their status in developing countries around the world. A survey of women’s daily lives in a global context, emphasizing education, economics, and the environment. Case studies include microfinance, literacy, reproductive rights and practices, and the impact of religious fundamentalism on women. May also be offered as WS 6230. Prq: Sophomore standing.

ANTH 6660 Evolution of Human Behavior 3 (3) Familiarizes students with the evolutionary basis of human behavior. Examines topics such as altruism, cooperation, mating systems, parental investment, and social systems using diverse examples, from hunter-gatherer to technological societies. May also be offered as BIOL 6660. Prq: ANTH 3510 or BIOL 3350 or BIOL 4700 or BIOL 6700 or PSYC 2100.

ANTH 6740 Primatology 4 (3) Biology of nonhuman primates, including their evolution, taxonomy, physiology, life history, behavioral ecology and conservation. Three field trips are required, during which students conduct behavioral observations and later analyze their data and present it in report format. May also be offered as BIOL 6740. Prq: ANTH 3510; and either BIOL 1110 or both BIOL 1040 and BIOL 1060. Coreq: ANTH 6741.

ANTH 6741 Primatology Laboratory 0 (3) Non-credit laboratory to accompany ANTH 6740. May also be offered as BIOL 6741. Coreq: ANTH 6740.

APPLIED ECONOMICS

APEC 6020 Production Economics 3 (3) Economic analysis of agricultural production involving the concept of the farm as a firm; principles for decision making; the quantitative nature and use of production and cost functions and the interrelations and applications of these principles to resource allocation in farms and among areas. Prq: APEC 3080; and ECON 3360 or ECON 3140.

APEC 6090 Commodity Futures Markets 3 (3) Introduction to the economic theory, organization, and operating principles of agricultural commodity futures markets in the United States. Emphasizes speculating, hedging, and investing in agricultural commodity futures contracts from the standpoint of the agribusiness entrepreneur. Prq: APEC 2020 or ECON 2110.

APEC 6110 Regional Impact Analysis 3 (3) Techniques for analysis of the growth and decline of regions, including economic-base theory, shift share, regional input-output, regional econometric models, and fixed impact models. Prq: APEC 2020; or both ECON 2110 and ECON 2120.


APEC 6130 Advanced Real Estate Appraisal 3 (3) Topics include highest and best use analysis, data collection, and analyses. Stresses advanced appraisal procedures for income, cost, and comparable sales approach to real estate valuation. Covers eminent domain, the appraisal of property in transition, and specialized property. Prq: APEC 3130 or FIN 3070.

APEC 6210 Globalization 3 (3) Utilizes basic principles of international economics (comparative advantage, free trade versus protectionism, exchange rate determination, etc.) to analyze the contemporary problems and issues of the world economy. Emphasizes application of economic principles to current globalization trends. Prq: APEC 2020 or ECON 2000 or ECON 2110.

APEC 6260 Cropping Systems Analysis 3 (2) Application of agronomic and economic principles in solving problems related to the production and marketing of agronomic crops. Major part of the course is a case study in which detailed analysis of a farm, agribusiness, or environmental situation is made with students making oral presentations of results. May also be offered as ECON 6260. Prq: ECON 1040 and ECON 2020 or ECON 2110. Coreq: APEC 6261.

APEC 6261 Cropping Systems Analysis Laboratory 0 (2) Non-credit laboratory to accompany APEC 6260. May also be offered as ECON 6261. Coreq: APEC 6261.

APEC 6520 Agricultural Policy 3 (3) Review of public agricultural policy programs in the United States and a critical examination of current and proposed government policies and programs affecting the agricultural sector of the economy. Includes economic considerations as related to past and current farm price and income problems. Prq: APEC 2020 or ECON 2000 or ECON 2110.

APEC 6560 Prices 3 (3) Review of the basic theory of price under competitive conditions and various modifications; nature, measurement, and causes of daily, seasonal, and cyclical price fluctuations; geographical price relationships; nature, function, and behavior of futures markets; government price programs. Includes Honors sections. Prq: APEC 3080 or ECON 4050; and ECON 3060 or ECON 3140.

APEC 6570 Natural Resource Use, Technology, and Policy 3 (3) Focuses on economic analyses of actual, efficient, and sustainable uses of natural resources, impacts of technologies that affect these uses, and policies that affect development and use of such technologies. Resource-technology-policy combinations may vary, but an example is crude oil, hybrid automotive engines, and fuel economy standards. May also be offered as ECON 6570. Prq: MATH 1020 or MATH 1060; and ECON 3570 or CRD 3570 or ECON 3140.

APEC 6600 Agricultural Finance 3 (3) Study of the principles and technique of financing in the agricultural sector. Topics include the capital situation in agriculture, concepts of farm financial management, use of credit, capital markets, lending agencies, and estate planning. Prq: ACCT 2010; and APEC 2020 or ECON 2000 or ECON 2110.

APEC 6750 Economics of Wildlife Management and Policy 3 (3) Integrated approach to the study of the economics of wildlife. Topics include determination of market and nonmarket value, single and multiple species management, enterprise cost and returns, marketing wildlife, leasing methods, complementarity and competitiveness with agricultural and forestry enterprises, and timber and crop damage cost estimates and control. May also be offered as WFB 6750. Prq: APEC 2020 or ECON 2000 or ECON 2110. Coreq: APEC 2020.

APEC 8000 History of Economic Thought 3 (3) Development of economic thought from early Greek to Keynesian economics; writings of major economists such as Smith, Ricardo, Marx, Marshall and Keynes; development of major economic theories. May also be offered as ECON 8000.

APEC 8010 Microeconomic Theory 3 (3) Microeconomic theory and its use to analyze and predict the behavior of industries, firms and consumers under various market conditions. Offered fall semester only. May also be offered as ECON 8010.

APEC 8020 Advanced Economic Concepts and Applications 3 (3) Rigorous development of price theory under alternative product and resource market structures. May also be offered as ECON 8020. Prq: Consent of instructor.

APEC 8040 Applied Mathematical Economics 3 (3) Discusses mathematical tools needed in economic analysis; matrix algebra, differentiation, unconstrained and constrained optimization, integration and linear programming. May also be offered as ECON 8040.

APEC 8060 Econometrics I 3 (3) Application of econometric techniques and stochastic models to economic problems. Considers distribution theory, simple and multiple regression modeling, hypothesis testing and other issues in regression analysis. May also be offered as ECON 8060.

APEC 8080 Econometrics III 3 (3) Continuation of ECON 8070. Covers current economic models and estimation procedures. Offered spring semester only. May also be offered as ECON 8080. Prq: ECON 8070.
APEC 8090 Advanced Natural Resource Economics
3 (3) Applications of economic theory to problems of natural resource management, epistemological considerations, rent theory, public and private investment criteria, benefit-cost analysis and general equilibrium management models. Offered spring semester only. May also be offered as ECON 8090. Preq: ECON 3140.

APEC 8100 Natural Resources Management and Policy
3 (3) Economic, institutional and legal aspects of control and management of natural resources; concepts of economic science applied to public policy questions related to land and water resources. Specialized background in economics is not necessary. Offered fall semester only. May also be offered as ECON 8100. Preq: ECON 3140.

APEC 8110 Economics of Environmental Quality
3 (3) Pricing and distribution emphasizing effects upon economic welfare; goods allocated by government purchase for joint consumption and those distributed by rationing; alternate plans for allocating public goods. Offered fall semester of even-numbered years only. May also be offered as ECON 8110. Preq: ECON 3140.

APEC 8130 Water Resource Economics
3 (3) Discusses benefit-cost analysis of public water development programs, economic analysis of selected water allocation issues, groundwater management, pollution abatement, efficient pricing and valuation, multiple use management, reservoir management, wetland protection, minimum stream flows for endangered species and environmental and developmental trade-offs. Preq: ECON 3140.

APEC 8160 Labor Economics
3 (3) Wage and employment theory, labor markets, labor history, current problems in labor and manpower economics. May also be offered as ECON 8160.

APEC 8170 Advanced Production Economics
3 (3) Discusses production economics theory in a quantitative framework; technical and economic factor-product, factor-factor, and product-product relationships in single- and multi-product firms under conditions of perfect and imperfect competition in both factor and product markets. Offered spring semester only. May also be offered as ECON 8170. Preq: APEC 4020; and APEC 3080 or ECON 4050.

APEC 8190 Futures and Options Markets
3 (3) Introduction to the economic theory and operation of futures and options markets in the United States. Includes determination of prices and price differences, speculation and the use of these markets for forward pricing and price risk management. Preq: APEC 4090 or APEC 6090.

APEC 8200 Public Finance
3 (3) Impact of government on resource allocation, income distribution and stability, role of regulation; principles of taxation. May also be offered as ECON 8200.

APEC 8220 Public Policy Economics
3 (3) Covers contemporary public policy, including price and resource policy, affecting rural areas. Discusses public participation, or the lack thereof, related to programs designed to implement public policy. Offered spring semester only. May also be offered as ECON 8220. Preq: ECON 3140.

APEC 8240 Organization of Industry
3 (3) The structure of markets and firms; forces that determine the size of firms and the boundaries of markets; the behavior of firms, both singly and in concert, to exploit market positions. May also be offered as ECON 8240.

APEC 8260 Economic Theory of Government Regulation
3 (3) The scope of governmental regulation in the economy of the United States, its evolution and development; the application of the tools of economic analysis to the issues of regulated enterprise. May also be offered as ECON 8260. Preq: ECON 3140.

APEC 8270 Economics of Property Rights
3 (3) Analyzes the evolution and impact of various property rights institutions on individual behavior and the subsequent use of resources. Particular attention is paid to the importance of property rights structures in the organization of business and in managerial decision making. Preq: ECON 8010.

APEC 8280 Applied Demand Analysis
3 (3) Analysis of demand by individual households and consumers in aggregate. Modern approaches to estimation of demand systems and valuation methods. May also be offered as ECON 8280. Preq: ECON 3140; and APEC 3080 or ECON 4050.

APEC 8310 Economic Development
3 (3) Economic analysis of development of urban areas within the system of cities; central place theory and general equilibrium models of interregional economic activity emphasizing central place systems, spatial interaction and stochastic processes; internal development of the city focusing on housing and land use patterns, transportation and urban form.

APEC 8320 Community and Regional Economics
3 (3) Covers economic theory and research methods needed to understand happenings in the regional and community economy and how local and non-local decisions influence local economic change. Offered fall semester only. May also be offered as ECON 8320. Preq: APEC 4120 or APEC 6120 or CRD 4120 or CRD 6120.

APEC 8360 Dynamic Optimization with Economic Applications
3 (3) Dynamic optimization entails the use of optimal control to solve minimization or maximization problems in which choice variables affect how state variables change over time. Differential or difference equations describe the temporal changes. Economic applications pertain to actual use and efficient management over time of financial, human, physical and natural capital. Preq: ECON 8040 or ECON 8040 or MATH 2060 or MATH 2070.

APEC 8400 International Trade Theory
3 (3) Theory of free trade from Ricardo to the present; theory and application of optimal and second-best tariffs; recent empirical testing of trade and tariff theory. May also be offered as ECON 8400. Preq: ECON 3140; and either APEC 8020 or ECON 8020; or consent of instructor.

APEC 8410 International Finance
3 (3) Financial economics of decision making in a multinational environment featuring autonomous governments and multiple currencies. Typical topics include the macroeconomic problems of unemployment and inflation in an international economy, management of exchange rate risk, credit risk, political risk and taxation. May also be offered as ECON 8410. Preq: ECON 3150.

APEC 8550 Financial Economics
3 (3) Study of modern theory of corporate finance. Includes basic theories of efficient markets, portfolio selection, capital asset pricing, option pricing and agency costs. May also be offered as ECON 8550.

APEC 8810 Internship in Community and Resource Development
1-12 (1-12) Supervised employment in an agency dealing with socioeconomic aspects, community development and/or natural resource management. Monthly reports covering the student's experience are required. Students are expected to have completed at least 18 semester hours of graduate credit before enrolling in this course.

APEC 8910 Master's Thesis Research
1-12 (1-12) Master's Thesis Research

APEC 8990 Selected Topics
1-3 (1-3) Selected topics under the guidance of a professor. May be repeated for a maximum of six credits.

APEC 9010 Price Theory
3 (3) Neoclassical paradigm of market price and quantity; rigorous consideration of consumer behavior, the theory of the firm and market equilibrium, production and resource demands and the supply of resources. May also be offered as ECON 9010. Preq: ECON 8010 or ECON 8040.

APEC 9030 General Equilibrium and Welfare Theory
3 (3) Second in a two-course sequence in advanced price theory covering the capital theory and the determination of the rate of interest. Offered spring only. Preq: ECON (APEC) 9010.

APEC 9040 Seminar in Resource Economics
3 (3) Special problems and recent periodical literature relating to the control, management, development, and use of land and water resources in the U.S. and in other parts of the world. Offered fall semester only. Preq: APEC 6050.

APEC 9060 Seminar in Area Economic Development
3 (3) Consideration of recent research developments in economic development. Includes a review of research publications, journal articles and other literature. Objectives, analytical techniques and procedures are used in area or regional development efforts. Offered spring semester only. May also be offered as ECON 9060. Preq: APEC 8060 or ECON 8060.

APEC 9170 Advanced Seminar in Labor Economics
3 (3) Continuation of ECON 8160, bridging the gap between theory and modern empirical research in labor economics. Emphasizes reading recent empirical research papers to understand the techniques of modern research in labor economics. Preq: ECON 8160 or ECON 8160. May also be offered as ECON 9170.

APEC 9500 Monetary Economics
3 (3) Economic analysis of money in our economy and effects of monetary policy on prices, interest rates, output and employment. May also be offered as ECON 9500.

APEC 9910 Doctoral Dissertation Research
1-12 (1-12) Doctoral Dissertation Research. May also be offered as ECON 9910.
ARCH 6050 American Architectural Styles 1650-1950 3 (3) Survey of American architectural styles and of the architects responsible for them, from the Colonial period to our recent past. Considerable emphasis is placed on identifying those architectural elements which serve as clues in determining a building’s architectural style.

ARCH 6120 Architectural History Research 3 (3) Directed investigations related to the art and architectural history of Europe. May be repeated for a maximum of six credits. Prereq: Junior standing or consent of instructor.

ARCH 6140 Design Seminar 3 (3) Exploration of topical issues in architecture, art, construction, and planning. May be repeated for a maximum of six credits. Prereq: Junior standing or consent of instructor.

ARCH 6160 Field Studies in Architecture and Related Arts 3 (3) Documentation and analysis of architectural structures observed during European travels in graphic and written form. May be repeated for a maximum of six credits. Prereq: Junior standing or consent of instructor.

ARCH 6240 Product Design 3 (9) Furniture and product system design with emphasis on ergonomics and the relationship of form and materials. Prereq: Senior standing.

ARCH 6250 Energy in Architecture 3 (3) Climate design methodology and its influence on building energy patterns and architectural form. Prereq: Senior standing and consent of instructor.

ARCH 6260 Architectural Color Graphics 3 (3) Architectural color graphics by computer. Theories of color classification and interaction; application of color theories to art and architecture. Prereq: Consent of instructor.

ARCH 6270 Advanced Color Graphics 3 (3) Theories of color classification and interaction; three-dimensional color modeling by computer; advanced application of color theories to art and architecture. Prereq: ARCH 4260 or consent of instructor.

ARCH 6280 Computer-Aided Design 3 (2) Introduction to the concepts, skills, and applications of computer-aided design as they relate to the practice of architecture. Prereq: Senior standing or consent of instructor. Coreq: ARCH 6281.

ARCH 6281 Computer-Aided Design Laboratory 0 (3) Non-credit laboratory to accompany ARCH 6280. Coreq: ARCH 6280.

ARCH 6290 Architectural Graphics 3 (3) Provides students with an understanding of the concepts, skills, techniques, and strategies of visual presentation/graphics as they relate to the design professions – architects/landscape architects. Prereq: Junior standing or consent of instructor.

ARCH 6300 Theories and Philosophies of Technology and Architecture 3 (3) Theoretical and practical examination of technology and architecture from pre-modern and modern viewpoints to study its nonneutral role in shaping and reflecting knowledge, beliefs, and actions within a cultural context.

ARCH 6400 New York Field Study 3 (3) Study of architecture, art, planning, and urban design of New York. Two weeks of residence are required with scheduled field trips to relevant sites in all five boroughs, with counseling to determine research interests. Guidance is provided to resources in the city. A final report is required. Offered in the summer only.

ARCH 6770 Introduction of Craft 1-3 (1-3) Architectural craft lab offered under different material specializations, all of which introduce students to design as informed by craft through a hands-on lab. Basic design operations and material properties are introduced for the subject material (wood, stone, etc.) May be repeated for a maximum of six credits.

ARCH 6850 History and Theory of Architecture + Health 3 (3) Introduces relationships between health and architectural settings for health. Examines connections between cultural context, medical thought, health-care delivery, and health facility design within different time periods. Introduces contemporary theories on the relationships between human beings, their health and well-being, and the design of the physical environment. Prereq: Consent of instructor.

ARCH 6880 Architectural Programming and Predesign 3 (3) Introduces the theory, mechanics, and practice of architectural programming and post-occupancy evaluation. Presents programming as a means to create architectural settings sensitive to the needs of their inhabitants. Emphasizes collaborative methodologies that involve identifying relevant goals, factors, project issues, needs, and concepts. Students develop an architectural program. Prereq: Consent of instructor.

ARCH 6990 Selected Topics in Architecture 1-3 (1-3) Study of selected topics in architecture. May be repeated for a maximum of nine credits, but only if different topics are covered. Prereq: Junior standing or consent of instructor.

ARCH 8010 Architecture Seminar 3 (3) Contemporary issues in the architectural profession.

ARCH 8030 Theories of Architecture 3 (3) Evolution of architectural theories from Vitruvius to the present. Emphasis is on the writings of leading architects and theorists and the impact of these theories on architectural solutions.

ARCH 8040 Seminar in Modern Masters 3 (3) In-depth examination of one or more related works of architects from the 20th century (Kahn, Scarpa, Barragan, Wright, Corbusier, etc.). Content varies from semester to semester. Prereq: ARCH 8610.

ARCH 8100 Visualization and Representation I 3 (3) Develops students’ capacity for graphic representation of architectural form and space. Intended as a corollary to ARCH 8400; provides the tools necessary to analyze and translate concepts into two-dimensional constructions through the utilization of manual and digital drawing techniques. Coreq: ARCH 8410.

ARCH 8110 Visualization and Representation II 3 (3) Develops and improves student’s capacity for the digital and graphic representation of three-dimensional architectural form and space. Introduces and explores the latest technologies from advanced digital modeling tools to equipment for computer-controlled fabrication. Prereq: ARCH 8100 or consent of instructor.

ARCH 8120 Computational Design Methods 3 (3) Examines computing in architecture, particularly through the use of parametric and generative systems. Students learn how to structure and process information to communicate and enhance the design process. Prereq: ARCH 8110 or consent of instructor.

ARCH 8190 Selected Topics in Visualization and Representation 1-5 (1-5) Critical consideration of a special topic in architectural visualization and representation from which students construct their own informed and reasoned ideas about what this topic means for their own developing architectural practices. May be repeated for a maximum of six credits. Prereq: ARCH 8100 or consent of instructor.

ARCH 8200 Building Design and Construction Principles 3 (3) Essential principles for quality design and construction. Emphasis is on design, programming and sustainability issues for different project types. Nature and characteristics of construction materials, equipment and systems used in modern buildings are presented as well as how they affect function and feasibility. Prereq: Consent of instructor.

ARCH 8210 Community 1:1 3 (3) Engages full-scale design and construction projects that are community-based and offer opportunities in field research, studio design-centric problems and documentation. Projects focus on sustainable and sinusuous public space and how design and planning can improve the interface between the built and natural environment while enhancing the human experience. Prereq: ARCH 8520 or consent of instructor.

ARCH 8400 Design Studio 6 (12) Studio for students entering the Master of Architecture program with undergraduate degrees in subjects other than Architecture or Environmental Design. Considers aspects of visualisation and representation of architecture, the history and theory of architecture, architectural technology and strategies of design. Coreq: ARCH 8100.

ARCH 8410 Architecture Studio I 6 (12) Studio course focused on increasingly complex works of architecture at various scales for different physical site conditions. Coreq: ARCH 8100.

ARCH 8420 Architecture Studio II 6 (12) Studio course focused on architectural materials and assembly. Course is comprised of architectural design explorations of increasing complexity. Students develop a detailed sectional model of their design proposal. Prereq: ARCH 8410.

ARCH 8500 Architecture Studio 6 (18) Architectural design studies in the context of the Genoa urban setting. May substitute for ARCH 8530 or 8540 and for ARCH 8570 with consent of advisor.

ARCH 8510 Design Studio III 6 (12) Design studio for projects of relative complexity, with varied scales and programs, focusing on investigative skills, fundamental design skills, sustainability, and technical documentation. Emphasizes the relationship between architecture, site, and context in preparation for more advanced design projects and off-campus study.
ARCH 8520 Design Studio IV 6 (12) Design studio for projects of relative complexity, with varied scales and programs, with an emphasis on pre-design, sustainability, site design, and collaborative processes. Emphasizes the relationship between architecture, site, and context. Studio may be located in Clemson, Charleston, Barcelona, or Genoa. Preq: ARCH 8510.

ARCH 8550 Studio South 6 (12) Addresses architectural problems with varied scales and programs in the context of the South. Emphasizes the relationship between architecture, community and context. Projects involve collaboration with other disciplines in the studio to result in architectural solutions for the built environment. Design problems vary according to current issues in the South. May be repeated for a maximum of 12 credits. Preq: ARCH 8420 or consent of program coordinator.

ARCH 8570 Design Studio V 6 (18) Design studio for increasingly comprehensive design projects, with varied scales and programs, with an emphasis on pre-design, site design, sustainability, and collaborative processes. Emphasizes the relationship between architecture, site and context. Studio may be located in Clemson, Charleston, Barcelona or Genoa. Preq: ARCH 8520.


ARCH 8590 Thesis Manuscript 1-3 (1-3) Architectural predesign synthesis of research for the thesis project. Preq: ARCH 8580.

ARCH 8600 Architectural History and Theory I 3 (3) Overview of architecture and urbanism from the Renaissance to the Industrial Revolution, emphasizing the trajectory of western modernity, historical transformations of architectural practices, and the theoretical, philosophical and cultural foundations of changing design approaches. Close readings of primary and secondary sources are complemented by analytical studies of noteworthy precedents.

ARCH 8610 Architectural History and Theory II 3 (3) Study of architecture and urbanism from 1850 to 1950 through thematic investigations, historical narratives and social critiques in order to reveal past theorists' and practitioners' responses to those cultural and technological changes that remain similar today. Close readings of primary and secondary sources complement analytical studies of noteworthy precedents. Preq: ARCH 8600.

ARCH 8620 Architectural History and Theory III 3 (3) Study of architecture and urbanism from 1950, emphasizing challenges to early twentieth century modernism, the emergence of new urban, suburban, ecological, cultural and technological sensibilities, and the roots of contemporary architecture. Close readings of primary and secondary sources complement analytical studies of noteworthy precedents.

ARCH 8630 History and Theory of Landscape and Urbanism 3 (3) Cultivates different ways of seeing, representing and understanding the landscape and the city. Both landscape and city are viewed as dynamic, living systems evolving from Roman, Medieval, Baroque, Industrial, Idealized and non-Western roots and shaped by political, economic, social, cultural and physical intentions and incidents.

ARCH 8640 Architectural History and Theory IV 3 (3) Investigation of emerging architectural trends and urban phenomena prepares students for advanced history/theory electives, independent research and architectural practice in the decades ahead through the study of such topics as globalization and non-western architecture, megacities, sprawl and urbanization, energy and infrastructure, landscape and urban design, science and sustainability. Preq: ARCH 8620.

ARCH 8680 Architectural Robotics 3 (3) Focuses on understanding, developing and testing robotic systems for the built environment. Collaborative teams of students from Electrical and Computer Engineering and Architecture and their allied disciplines study and develop working robotic prototypes responsive to challenges and opportunities of living in today's built and natural environments. May also be offered as ECE 8680. Preq: Consent of instructor.

ARCH 8690 Selected Topics in History, Theory and Criticism 1-5 (1-5) Critical consideration of special topics in architectural history, theory and criticism from which students construct their own informed and reasoned ideas about what the topic means for their own developing architectural practices. May be repeated for a maximum of six credits. Preq: ARCH 8600 and ARCH 8610.

ARCH 8700 Structures I 3 (3) Forces and their applications to statically determinant structural components and systems such as shear, moment and other stress strain patterns are explored in multiple structural materials.

ARCH 8710 Structures II 3 (3) Addresses advanced topics in structures, exterior envelopes and contemporary production technologies. Continues the exploration of structural elements and systems, expanding to include more complex determinant, indeterminate, long-span and high-rise systems. Preq: ARCH 8700 or consent of instructor.

ARCH 8720 Productions and Assemblies 3 (3) Overview of traditional and contemporary materials and methods of construction. Combines lectures with hands-on lab experience to examine traditional and contemporary modes of construction, their selection, impact and reuse. Coreq: ARCH 8721.

ARCH 8721 Productions and Assemblies Laboratory 0 (2) Non-credit laboratory to accompany ARCH 8720. Coreq: ARCH 8720.

ARCH 8730 Environmental Systems 3 (3) Examines in detail the relationship between human comfort and the design of building envelopes and environmental systems. Covers the evolution of contemporary environmental systems and their appropriate application and integration with other design issues. Coreq: ARCH 8731.

ARCH 8731 Environmental Systems Laboratory 0 (2) Non-credit laboratory to accompany ARCH 8730. Coreq: ARCH 8730.


ARCH 8741 Building Processes: Technical Resolution Laboratory 0 (3) Non-credit laboratory to accompany ARCH 8740. Coreq: ARCH 8740.

ARCH 8750 Construction and Building Systems 3 (3) Sets a standard level of building technology preparation for entering graduate Architecture students who have an undergraduate architectural degree that included courses in architectural technology. Main focus is on analyzing how construction and building systems contribute to architectural design.

ARCH 8760 Smart Materials and Kinetic Structures 3 (3) Study of adaptive and kinetic systems and structures in architecture using smart and emergent materials. This course explores the materials, methods and means for buildings to transform and adjust to different functions or climatic conditions and allow various performances. Preq: Consent of instructor.

ARCH 8780 Lighting for Architecture 3 (3) Studies interrelationships among the fields that constitute lighting and impact on building form, materials and spatial use. Also considers contributions of daylight and electric light to human response and performance. Preq: Consent of instructor.

ARCH 8790 Selected Topics in Architectural Technology 1-5 (1-5) Critical consideration of special topics in architectural technology from which students construct their own informed and reasoned ideas about what the topic means for their own developing architectural practices. May be repeated for a maximum of six credits.

ARCH 8810 Professional Practice Survey 3 (3) Provides an understanding of the basic principles and legal aspects of architectural practice organization: financial management; risk mitigation and arbitration; business planning; time, project and personnel management; client, owner and user needs; selecting consultants; project delivery methods; internship, licensure and registration; professional leadership; ethical standards; and expanding practice settings.

ARCH 8820 Building Economics, Costs and Legal Issues 3 (3) Explores economic factors determining materials, building components and methods of construction. Legal aspects of design are discussed in the context of building cost. Preq: ARCH 8810 or consent of instructor.

ARCH 8860 Health Facilities Planning and Design 3 (3) Current planning and design considerations for healthcare facilities. Conducted as a series of professional seminars examining overall infrastructural planning and design considerations and detailed considerations for specific areas in hospitals. Topics are covered by Architecture + Health faculty and nationally recognized practitioners. Coreq: ARCH 8970.

ARCH 8890 Mentorship 16 (1-6) Mentorship in professional practice. Paid work/study in a variety of related disciplines provides students with hands-on experience in design and fabrication fields relevant to the environmental design professions. Consists of two parts: a professional component, managed by an approved sponsor and an academic component, taught by the instructor. May be repeated for a maximum of 18 credits. Preq: Consent of instructor and acceptance by sponsor.

ARCH 8990 Directed Studies 1-5 (1-5) Special topics in architecture undertaken on an individual basis with faculty guidance. Preq: Consent of advisor.
ARCH 8910 Thesis Project 3-9 (3-9) Complex architectural project emphasizing design exploration and independent work. To be taken Pass/No Pass only. Preq: ARCH 8570 and ARCH 8580.

ARCH 8920 Comprehensive Studio 6 (18) Architectural design studies addressing comprehensive building projects. Topics include site design, programming, building systems design and materials selection. Final product is a complete building design with detailed drawings and models. Preq: ARCH 8570.

ARCH 8930 Synthesis Studio 6 (12) Studio themes and programs, defined by individual critics, carry an educational objective and present an opportunity for the critic to develop with his/her students a specific area of work or research. Culminates in a comprehensive proposal. Students are expected to have completed their second-year studio before enrolling in this course.

ARCH 8940 Research Studio 6 (12) Themes and programs, defined by individual critics, carry an educational objective and present an opportunity for the critic to develop with his/her students a specific area of work or research. Preq: ARCH 8930.

ARCH 8950 Architecture + Health Studio Selected Projects 3-6 (3-6) Studio for students in Architecture + Health Concentration offering selected projects engaging a variety of health-related topics from health community design, sustainable/green architecture, long-term care and community healthcare projects associated with health and wellbeing. Projects executed are similar to professional practice, combining teamwork with individual design alternatives. May be repeated for a maximum of 12 credits. Preq: Consent of instructor.

ARCH 8960 Architecture + Health Studio Tectonic Projects 6 (12) Studio for students in Architecture + Health Concentration focused on the design and technical development of small-scale healthcare projects and spaces. Projects are often conducted by interdisciplinary teams as design-build projects where full-scale mock ups are conceived and constructed for evaluation and research. May be repeated for a maximum of 12 credits. Preq: Consent of instructor.

ARCH 8970 Architecture + Health Studio Hospital and Urban Design 3-6 (3-6) Studio course for students in Architecture + Health Concentration, focused on the master planning and conceptual design of an academic medical center or hospital within an urban context. The master planning and design problem is preceded by a comparative analysis of both urban structures and hospital structures. May be repeated for a maximum of 12 credits. Coreq: ARCH 8860.

ART

ART 6050 Advanced Drawing 3 (6) Advanced level studies of drawing which explore the synthesis of refined drawing skills and philosophies of art. Students’ understanding of drawing as a form of art is developed through studio practice augmented by critiques, demonstrations, lectures, field trips, and independent research. Preq: ART 3050 or consent of instructor.

ART 6070 Advanced Painting 3 (6) Advanced studio course in painting. Students select painting media and develop a strong direction based on prior painting experience. Includes study of contemporary painters and directions. Preq: ART 3070 or consent of instructor.

ART 6090 Advanced Sculpture 3 (6) Intensive independent studio concentration to further develop personal direction and content. Emphasizes continued investigation of sculptural context, materials and processes, and relative historical research. Preq: ART 3090 or consent of instructor.

ART 6110 Advanced Printmaking 3 (6) Culmination of process, techniques, and individual development. Students are expected to have mastered process and technique for the benefit of the image produced. Creativity and self-expression are highly emphasized as students select a process for concentrated study. Preq: ART 3110 or consent of instructor.

ART 6130 Advanced Photography 3 (6) Continuation of ART 3130. Advanced problems in photography. Preq: ART 3130 or consent of instructor.

ART 6120 Advanced Ceramic Arts 3 (6) Students are directed toward further development of ideas and skills. Glaze calculation and firing processes are incorporated to allow for a dynamic integration of form and ideas. Preq: ART 3120 or consent of instructor.

ART 6200 Selected Topics in Art 1-3 (1-3) Intensive course in studio art. May be repeated for a maximum of six credits, but only if different topics are covered. Preq: Senior standing or consent of instructor.

ART 6900 Directed Studies 1-5 (1-5) Study of areas in the visual arts not included in other courses or additional advanced work. Must be arranged with a specific instructor prior to registration. May be repeated for a maximum of 18 credits. Preq: Consent of instructor.

ART 8030 Fundamentals of Visual Art 3 (6) Intensive introduction of visual art and design fundamentals. Includes two- and three-dimensional studio work with emphasis on time-based media and design.

ART 8050 Visual Arts Seminar on Theories and Practice I 3 (3) Issues related to the practice of the artist, emphasizing theories and criticism of contemporary art.

ART 8060 Visual Arts Seminar on Theories and Practice II 3 (3) Continuation of ART 8050.

ART 8130 Photo-Based Imaging Theories and Techniques 3 (6) Offers in-depth examination of photographic imaging processes for artistic expression, utilizing both traditional and digital tools and concepts. Preq: Master of Fine Arts student or consent of instructor.

ART 8210 Visual Narrative 3 (3) Students develop visual communication skills through the vernacular of cinema, and express concepts and ideas in sequential narrative design. Preq: Consent of instructor.

ART 8400 Visual Arts Studio 3-6 (3-6) Studio work in visual arts with adjunct lectures and gallery tours. May be substituted for ART 800-level visual arts studio.

ART 8500 Visual Arts Studio 3 (9) Concentrated and advanced work in ceramics, drawing, painting, printmaking, sculpture, photography, graphic design, or multimedia. Preq: Consent of department chair or instructor.

ART 8510 Visual Arts Studio 3-6 (3-6) Continuation of ART 8500. May be repeated for maximum of six credits. Preq: Consent of department chair or instructor.

ART 8700 Visual Arts Studio 3-6 (9-18) Advanced theory; directed research in art criticism; applied work in ceramic arts, drawing, painting, sculpture, photography, graphic design, or multimedia. May be repeated for a maximum of six credits. Preq: Consent of department chair or instructor.

ART 8710 Visual Arts Studio 3-6 (3-6) Continuation of ART 8700. May be repeated for maximum of six credits. Preq: Consent of department chair or instructor.


ART 8910 Master’s Thesis Research 3-15 (3-15) May be repeated for maximum of 15 credits. Preq: Consent of department chair or instructor.

ASTRONOMY

ASTR 8020 Stellar Structure and Evolution 3 (3) Physical principles governing the structure, power, luminosity and evolution of stars; equation of state, equations for pressure and thermal balance, heat transport, thermonuclear power and numerical techniques of structure calculation. Preq: PHYS 4550 or consent of instructor.

ASTR 8300 Galactic Structure 3 (3) Kinematics, dynamics and content of the Milky Way galaxy; galactic rotation, galactic distance scale, stellar populations, spiral structure, the galactic center and the evolution of the Milky Way and other galaxies. Preq: Consent of instructor.

ASTR 8100 Astrophysics I: Radiation Processes and Measurements 3 (3) Physical principles governing radiative processes in and measuring radiation from astrophysical environments. Coverage includes approaches to radiative transfer, fundamental theory of radiation fields, emission and absorption processes, plasma effects, telescope optics and image formation, astronomical instrument design, photon detector and function. Preq: Consent of instructor.

ASTR 8200 Astrophysics II: Stellar Astrophysics 3 (3) Physical and observational parameterization of stars, statistical mechanics and equations of state applied to stellar interiors, stellar energy transport mechanisms, nuclear reactions in astrophysics, construction of stellar models, adiabatic stellar pulsations, stellar evolution and nucleosynthesis, degenerate stars, and supernovae. Preq: Consent of instructor.
ASTR 8300 Astrophysics III: Galactic Astronomy 3 (3) Physical processes in the interstellar medium, physics of dust grains, physical models of and observational constraints on star formation and protostellar evolution and protoplanetary disks, (thermo)dynamics of stellar systems, models of galaxy formation, the Milky Way as a galaxy, stellar populations, galactic dynamics and chemical evolution. Prereq. Consent of instructor.

ASTR 8400 Astrophysics IV: Cosmology 3 (3) Course covers galaxies and cosmology. Topics include observed cosmological properties of the universe, physics and observed properties of active galactic nuclei and quasars and their use as cosmological probes, cosmological models, galaxy formation and evolution, large-scale structure in the universe, and primordial nucleosynthesis. Prereq. Consent of instructor.

ASTR 8750 Selected Topics 1-3 (1-3) Study of one or more advanced topics in contemporary astrophysics. May be repeated for credit, but only if different topics are covered. Prereq. Consent of instructor.

AUDIO TECHNOLOGY

AUD 6800 Audio Engineering II 3 (2) Advanced course in music technology focused on music production integrating digital audio and virtual instruments. Prereq: AUD 2850; and AUD 3800; and PHYS 2080 or PHYS 2210; each with a C or better. Coreq: AUD 6801.

AUD 6801 Audio Engineering II Laboratory 0 (2) Non-credit laboratory to accompany AUD 6800. Coreq: AUD 6800.

AUD 6990 Independent Study in Audio Technology 1-3 (1-3) Tutorial work for students with special interests in audio study outside the scope of existing courses. May be repeated for a maximum of six credits. Prereq: Consent of department chair.

AUTOMOTIVE ENGINEERING

AUE 8160 Engine Combustion and Emissions 3 (2) Spark and compression ignition engines are investigated in terms of design, performance and emissions. Includes exergy models. Integrates theory of fuel air cycles with laboratory breakdown and dynamometer testing to correlate prevalent mathematical models with test results. Coreq: AUE 8161.

AUE 8161 Engine Combustion and Emissions Laboratory 0 (3) Non-credit laboratory to accompany AUE 8160. Coreq: AUE 8160.

AUE 8170 Alternative Energy Sources 3 (3) Demand for petroleum alternative propulsion sources has focused attention on hybrid vehicles with fuel cells, electric motors and battery packs and internal combustion engines burning hydrogen and reformulated fuels. Comparison of performance, emissions, fuel efficiency, operational requirements and vehicle configurations is studied.

AUE 8260 On-Board Vehicle Diagnostics and Reliability 3 (3) Discussion of legislated state, federal and international requirements. On-board automotive sensors to monitor vehicle operation and typical diagnostic algorithms are studied. Includes analytical methods for designing fault-tolerant systems and assessing vehicle reliability including safety-critical systems and “limp-home” modes, as well as use of handheld scanners and specialized diagnostic equipment to classify faults.

AUE 8270 Automotive Control Systems Design 3 (3) Investigation into derivation of models and design of control systems for automotive engines. Also covers software design, sensor selection, system architecture, diagnostics and reliability issues. Application is made to engine management, transmission and chassis systems with a consideration of vehicle performance, safety and information provision. Prereq: ME 4160.

AUE 8280 Fundamentals of Vehicle Drivelines and Powertrain Integration 3 (3) Study of vehicle powertrain arrangement, manual and automatic transmissions, automotive axles, four-wheel and two-wheel drives and design and manufacturing of gear systems. Other topics, such as powertrain control to address dynamics in shifting, engine balancing and fuel economy, are addressed. Modeling and computer simulation are used extensively to analyze dynamic performance of various transmissions. Prereq: AUE 4580 and ME 4160; or consent of instructor.

AUE 8290 Tire Behavior and Its Influence on Vehicle Performance 3 (3) In-depth analysis of the tire and its influence on vehicle performance including design, construction, structural response, rolling resistance, force and moment generation and behavior under dry/wet conditions. Tire models, their limitations and governing equations, tire characteristics on vehicle handling and safety and advanced control concepts in vehicle stability/braking are investigated. Prereq: ME 4530.

AUE 8320 Vehicle Development and Integration Processes, Methods and Tools 3 (3) Overview of the vehicle development process and the tools used in it, including voice of the customer, concept creation, packaging, product specification and target setting, including cost structures, lifecycle product management, prototype development and the role of the supplier. Prereq: AUE 8810.

AUE 8330 Automotive Manufacturing Process Development, Methods and Tools 3 (3) Overview of automotive manufacturing systems. Issues such as supplier integration, flexible manufacturing, aggregate planning, quality engineering and their applications to manufacturing systems are presented. Emphasizes opportunities and challenges presented with automotive manufacturing in a global environment, integrated processes, product development and automotive supply chain management.

AUE 8340 Automotive Production Preparation, Management and Launch 3 (3) Effective leadership and management of the product development and launch process. Includes responsibility and role definition, process management tools and software systems, detailed management of the supply chain, performance metrics and cost models and factors affecting launch success. Case studies of historic launch data and improvements are utilized.

AUE 8580 Automotive Electronics Integration 3 (3) Addresses the integration of electronic components and systems in automotive designs. Provides an overview of the major electronic systems in automobiles and describes how automotive manufacturers specify, integrate and evaluate these systems.

AUE 8585 Automotive Stability and Safety Systems 3 (3) Discussion of passive/active systems and design philosophies. Investigates stability issues associated with vehicle performance and use of sensors and control system strategies for stability enhancement. Implementation and application to intelligent cruise control, lane departure warning systems, ABS, traction control, active steering systems and vehicle dynamic control systems are also discussed. Prereq: ME 4530.

AUE 8580 Structural/Thermal Analysis Methods for Automotive Structure, Systems and Components 3 (3) Methods to analyze the response of automotive structure, systems and components to static, dynamic and thermal loading. Includes coverage of critical loading conditions and system response objectives. Analysis methods focus on finite element approaches supplemented by simple computational methods when appropriate.

AUE 8660 Advanced Materials for Automotive Applications 3 (3) In-depth study of the broad range of engineering materials used in the construction of motor vehicles. Considers interrelations between materials microstructure, components manufacturing process and components service behavior. Prereq: Consent of instructor.

AUE 8667 Vehicle Manufacturing Processes 3 (3) In-depth analysis of main component and subsystem prototyping, fabrication assembly and integration processes used during production of automotive vehicles. Also discusses design for manufacturing, computer-aided manufacturing and rapid tooling technologies. Prereq: Consent of instructor.

AUE 8690 Quality Assurance for Automotive Manufacturing Systems 3 (3) Overview of manufacturing process control, including evolution of the quality movement, Lean Six Sigma framework, and quality system standards for the automotive industry. In addition to metrology and measurement systems, tools covered include Measurement Systems Analysis, Statistical Quality Control, Advanced Product Quality Planning, and Design of Experiments for manufacturing improvement.

AUE 8770 Light-Weight Vehicle Systems Design 3 (3) Methodological approaches to weight trade-off during design of vehicle systems, accounting for other functions, cost, safety, materials characteristics and manufacturing constraints. Includes topology optimization, multimaterial approaches and identification of the function optimal materials and material combinations using multi-objective formulations.

AUE 8800 Vehicle Design/Manufacture Project 3 (3) Development of management, leadership, sociocultural and technical skills training for the successful management of an automotive development or research team. Includes problem identification, team dynamics, decision making, ethics, strategy setting, project planning, scope management and implementation, target costing, marketing, design methods and design for Xconcepts.
Courses of Instruction

AUE 8810 Automotive Systems: An Integrated Overview 3 (2) Promotes understanding of the vehicle as a complex system and interactions of its subsystems in terms of performance. Topics include propulsion systems, suspensions and steering systems, tire-road interface, structural behavior and crashworthiness, materials and manufacturing, driver/occupants-vehicle interactions and on-board electronics. Modeling and simulation are used. Coreq: AUE 8811.

AUE 8811 Automotive Systems: An Integrated Overview Laboratory 0 (3) Non-credit laboratory to accompany AUE 8810. Coreq: AUE 8810.

AUE 8820 Systems Integration Concepts and Methods 3 (2) Study of methods and tools to handle functional, geometric, production and IT integration. Includes instruction in managing performance trade-offs from the combination of systems designed for individual functions. Topics also include optimization methods, complexity, validation, signal and IT design and testing methods, robustness, architecture and quality. Coreq: AUE 8821.

AUE 8821 Systems Integration Concepts and Methods Laboratory 0 (3) Non-credit laboratory to accompany AUE 8820. Coreq: AUE 8820.

AUE 8830 Applied Systems Integration 3 (2) Application of integration methods to practical and complex vehicle design and manufacturing systems. Includes prototyping, measurements, tolerancing and validation, as well as diagnosis and sensitivities, methods to diagnose sporadic software errors with hardware in the loop, design reviews, FMEA on function signal, geometry, production. Also includes Fault Tree analysis, innovation and change management, risk analysis and value analysis. Preq: ME 8820 and consent of instructor. Coreq: AUE 8831.

AUE 8831 Applied Systems Integration Laboratory 0 (3) Non-credit laboratory to accompany AUE 8830. Coreq: AUE 8830.

AUE 8850 Vehicle Layout Engineering and Ergonomic Design 3 (2) Study of vehicle layout specifications and considerations related to exterior and interior design. Ergonomics methods and tools as related to occupant accommodation and driver function are presented. Issues of assembly and manufacturing ergonomics are also covered. Case studies are utilized. Coreq: AUE 8851.

AUE 8851 Vehicle Layout Engineering and Ergonomic Design Laboratory 0 (3) Non-credit laboratory to accompany AUE 8850. Coreq: AUE 8850.

AUE 8860 Vehicle Noise, Vibration and Harshness 3 (3) Application of engineering tools and specifications for noise, vibrations and harshness. Sources, mitigation methods, complexity and influences on other vehicle functions are considered. Utilizes design, simulation and validation methods. Preq: ME 8450.

AUE 8870 Methods for Vehicle Testing 3 (2) Investigates test planning for various performance regimes, data acquisition and analysis, uncertainty analysis, sensor selection, noise filtering, data reduction methods and track testing methods. Project includes actual vehicle tests. Coreq: AUE 8871.

AUE 8871 Methods for Vehicle Testing Laboratory 0 (3) Non-credit laboratory to accompany AUE 8870. Coreq: AUE 8870.

AUE 8900 Automotive Engineering Project 1-3 (1-3) Industrial project work culminating in writing engineering reports. Projects cover comprehensive analytical and/or experimental treatment of phenomena of current interest in automotive engineering emphasizing modern technological problems. May be repeated for a maximum of nine credits.

AUE 8920 Sustainable Vehicle Systems Seminar 1 (1) Sustainable vehicle systems seminar.

AUE 8930 Selected Topics in Automotive Engineering 3 (3) Advanced concepts in multibody systems dynamics including kinematics and kinetics of multibody systems, various methods for equation formulation and their limitations, numerical solutions methods, and applications to automotive systems and subsystems.

AUE 9910 Doctoral Dissertation Research 1-12 (1-12) Doctoral Dissertation Research

ANIMAL AND VETERINARY SCIENCES

AVS 6100 Domestic Animal Behavior 3 (3) Provides knowledge and understanding of behavior related to perception, learning, sociality, reproduction, feeding, and health for application in production, training, and design of environments for optimum health and welfare of domestic animals. Preq: AVS 1500 and AVS 1510; and Junior standing.

AVS 6110 Animal Growth and Development 3 (3) Integration of the nutritional, physiological, and genetic basis for animal growth and development with application to livestock and poultry production. Includes the cellular and molecular mechanisms controlling these processes and emphasizes the genes that regulate animal products (meat, eggs, wool, and milk). Preq: AVS 3010.

AVS 6120 Advanced Equine Management 4 (3) Further discussion of special considerations of the equine regarding housing, manure management, nutrition, reproduction, transportation, and behavior. Students gain insight into how horses differ from other livestock species and their unique requirements for the above systems. Preq: AVS 3700. Coreq: AVS 6121.

AVS 6121 Advanced Equine Management Laboratory 0 (2) Non-credit laboratory to accompany AVS 6120. Coreq: AVS 6120.

AVS 6130 Animal Products 3 (2) Introduction to the safe and humane production of red meat, poultry, and dairy products. Includes HACCP principles and production of value-added animal products. Coreq: AVS 6131.

AVS 6131 Animal Products Laboratory 0 (3) Non-credit laboratory to accompany AVS 6130. Coreq: AVS 6130.

AVS 6140 Basic Immunology 3 (3) Introduction to the immune system of vertebrate animals, with an emphasis on structure, function, regulation, and cellular and molecular mechanisms of immune responses. May also be offered as BIOL 6140 or MICR 6140. Preq: BIOL 4610 and MICR 3050.

AVS 6150 Contemporary Issues in Animal Science 3 (3) Provides knowledge, understanding, and critical analytical skills on current issues in animal agriculture in diverse regional, national, and global social-cultural and political environments as they impact animals and man. Preq: Junior standing.

AVS 6160 Equine Exercise Physiology 4 (3) Integration of muscle, bone, cartilage, cardiovascular, and respiratory systems as related to the equine athlete. Encompasses biomechanics, kinetics, and kinesiology related concepts specific to the horse. Further discussion of diseases related to specific systems is covered. Preq: AVS 3010. Coreq: AVS 6161.

AVS 6161 Equine Exercise Physiology Laboratory 0 (2) Non-credit laboratory to accompany AVS 6160. Coreq: AVS 6160.

AVS 6170 Animal Agribusiness Development 2 (1) Team-based development of a business relating to the animal industries. Students develop the business from the initial idea through operations. Focuses on the development of the business plan, including financials, personnel management, and resources needed. Preq: ACCT 210D; and ECON 2110 or ECON 2120. Coreq: AVS 6171.

AVS 6171 Animal Agribusiness Development Laboratory 0 (2) Non-credit laboratory to accompany AVS 6170. Coreq: AVS 6170.

AVS 6200 Poultry Science On-line 3 (3) On-line course covering the physiology, nutrition, health, reproduction, genetics, breeding, housing, and management of commercial poultry species, including the processing of meat and egg products. AVS 6430 AVS International Experience 1-3 (1-3) Preplanned and approved international education/cultural experience supervised by an Animal and Veterinary Sciences faculty member. Periodic reports or record keeping are required. Final report and oral presentation are required at the end of the experience. May be repeated for a maximum of four credits. To be taken Pass/No Pass only. Preq: Consent of instructor.

AVS 6530 Animal Reproduction 3 (2) Reproductive physiology and endocrinology of mammals with emphasis on farm animals and frequent reference to reproduction in laboratory animals and humans. Preq: AVS 1500 and AVS 3010. Coreq: AVS 6531.

AVS 6531 Animal Reproduction Laboratory 0 (2) Non-credit laboratory to accompany AVS 6530. Coreq: AVS 6530.

AVS 6550 Animal Reproductive Management 2 (0) Physiology and endocrinology of pregnant and non-pregnant cows are discussed. Emphasizes methods of artificial insemination, pregnancy detection, and computer record keeping to achieve a high level of reproductive efficiency in cattle. Preq: AVS 1500 and AVS 3010. Preq or concurrent enrollment: AVS 4530. Coreq: AVS 6551.

AVS 6551 Animal Reproductive Management Laboratory 0 (3) Non-credit laboratory to accompany AVS 6550. Coreq: AVS 6550.

AVS 6650 Animal Physiology 3 (3) Advanced study of the physiological systems of domestic animals as these systems relate to the integrated functions of the body. Exposes students to advanced physiological concepts and current literature perspectives on a variety of body systems and processes. Students are expected to have completed introductory coursework in physiology and biochemistry.
AVS 6670 Animal Physiology II 3 (3) Advanced course extending coverage of major and current topics in animal physiology across species not previously covered in AVS 4650. Major topics include digestive physiology in nonruminant and ruminant species, reproductive physiology, muscle physiology, and general aspects of avian physiology. Students are expected to have completed introductory coursework in physiology and biochemistry.

AVS 6700 Animal Genetics 3 (3) Fundamental principles relating to the breeding and improvement of livestock, including variation, heredity, selection, linebreeding, inbreeding, crossbreeding, and other related subjects.

AVS 6800 Vertebrate Endocrinology 3 (3) Introduction to the basic principles of neuroendocrine integration and homeostatic maintenance in vertebrates. Comparative morphology and physiology of various endocrine tissues and hormone chemistry and modes of action are considered. May also be offered as BIOL 6800. Prng: BIOL 3030. Students who have not completed BIOL 3030, but who have completed coursework in organic chemistry, may request an override from the instructor.

AVS 8010 Selected Topics 1-3 (1-3) Current topics of special interest in animal, dairy, or veterinary sciences not covered in other courses. May be repeated for credit. Prng: Consent of coordinating instructor.

AVS 8030 Physiology of Reproduction and Milk Secretion 3 (3) Advanced concepts of steroidogenesis, gametogenesis, fertilization, placentation, embryogenesis, embryonic-endometrial relationships, parturition and lactation and the influence of hormones on these processes. Students evaluate the most recent scientific literature in these areas for information, experimental methods and validity of authors' conclusions and select a problem, review related literature and write a research proposal for solving the problem. Prng: AVS 4530 and AVS 4610; or consent of instructor.

AVS 8080 Monogastric Nutrition 3 (3) Basic concepts and current research related to nutrient requirement and metabolism of poultry, swine and other monogastric species. Prng: NUTR 4010 or NUTR 4510.

AVS 8090 Ruminant Nutrition 3 (3) Microbiological, biochemical and physiological processes involved in the synthesis of amino acids, proteins and B-vitamins; relation of these processes to utilization of proteins, lipids, and fibrous and nonfibrous feed ingredients; properties and functions of nutrients, nonprotein nitrogen compounds and growth-promoting substances for dairy cattle, beef cattle and sheep. Prng: NUTR 4010 or consent of instructor.

AVS 8200 Animal and Veterinary Sciences Graduate Seminar 1 (1) Ongoing research, evaluation of research needs, research techniques, critical reviews and discussions of published research in all areas of the animal, dairy and veterinary sciences.

AVS 8210 Nutritional Bioenergetics 2 (2) Quantitative approach to the losses of dietary energy during digestion and metabolism; factors governing the energetic efficiency of different biological functions in animals and man; regulation of energy balance; body temperature regulation; techniques of calorimetry. Prng: BCHM 6230; and either NUTR 6010 or NUTR 6510; or consent of instructor.

AVS 8220 Special Problems 1-3 (1-3) Laboratory, library, or field study of problems related to animal, dairy and veterinary sciences emphasizing development and testing of hypotheses and reporting of results. May be repeated for a maximum of four credits. Prng: Consent of instructor supervising study.

AVS 8250 Immunobiology 3 (3) Conceptual approach to immunobiology emphasizing the molecular and cellular aspects. Classical and current literature is the major source for the discussion/lecture format. Offered spring semester only. Prng: Consent of instructor.

AVS 8910 Master’s Thesis Research 1-12 (1-12) Master’s Thesis Research

AVS 9910 Doctoral Dissertation Research 1-12 (1-12) Doctoral Dissertation Research

BIOCHEMISTRY

BCHM 6060 Physiological Chemistry 3 (3) Studies chemical basis of the mammalian physiological processes of muscle contraction, nerve function, respiration, kidney function, and blood homeostasis. Discusses composition of specialized tissue such as muscle, nerve, blood, and bone and regulation of water, electrolytes, and acid-base balance. Prng: Consent of instructor.

BCHM 6230 Principles of Biochemistry 3 (3) Study of the chemistry of amino acids, monosaccharides, fatty acids, purines, pyrimidines, and associated compounds leads to an understanding of their properties and the relationship between structure and function that makes them important in biological processes. The use of modern techniques is stressed. Prng: Consent of instructor.

BCHM 6310 Physical Approach to Biochemistry 3 (3) Study of chemical and physical properties of amino acids, lipids, nucleic acids, sugars, and their biopolymers. Physical and mathematical analyses are correlated with biological structure and function. Prng: Consent of instructor.

BCHM 6320 Biochemistry of Metabolism 3 (3) Study of the central pathway of carbohydrate, lipid, and nucleotide metabolism. Emphasizes bioenergetics, limiting reactions, and the regulation and integration of the metabolic pathways. Prng: Consent of instructor.

BCHM 6330 General Biochemistry Laboratory I 2 (4) Experiments to illustrate current methods used in biochemical research. Prng: Consent of instructor.

BCHM 6340 General Biochemistry Laboratory II 2 (4) Continuation of BCHM 6330. Prng: Consent of instructor.

BCHM 6360 Molecular Biology Genes to Proteins 3 (3) Examines how nucleic acids and proteins are synthesized in prokaryotic and eukaryotic cells. Designed for students interested in biochemistry, cell biology, molecular biology, and cell physiology. Prng: Consent of instructor.

BCHM 6400 Bioinformatics 3 (3) Theory and application of computational technology to analysis of the genome, transcriptome, and proteome. May also be offered as GEN 6400. Prng: Consent of instructor.

BCHM 6430 Molecular Basis of Disease 3 (3) Topics in heritable human metabolic disorders, including clinical features and newborn screening, genetic testing, the biochemical basis, and treatment. Prng: Consent of instructor.

BCHM 8050 Issues in Research 3 (3) Scientific writing, oral presentations and critical evaluation of them; legal and ethical issues associated with modern biochemical research. Science job hunting, time management and creativity for professional scientists are treated. May also be offered as GEN 8050. Prng: Enrollment in Biochemistry and Molecular Biology program.

BCHM 8100 Principles of Molecular Biology 3 (3) Introduction to the principles and techniques used to analyze prokaryotic and eukaryotic gene and genome structure, regulation of transcription initiation, regulation of protein synthesis and protein function. May also be offered as GEN 8100. Prng: Enrollment in Biochemistry and Molecular Biology program.

BCHM 8140 Advanced Biochemistry 3 (3) Contemporary topics of functional and cellular aspects in biochemistry with particular focus on new observations, emerging ideas and important techniques. Prng: Consent of instructor.

BCHM 8150 Lipids and Biomembranes 3 (3) Discusses isolation, chemical and physical properties, and metabolism of lipids; purification, structure, function and biosynthesis of biomembranes. Prng: BCHM 6320 or consent of instructor.

BCHM 8180 Cellular Metabolism 3 (3) Evolution, regulation, characterization and manipulation of metabolic pathways. Prng: BCHM 8140 and GEN (BCHM) 8200, or consent of instructor.

BCHM 8200 Genomics and Proteomics 3 (3) Genomes, transcriptomes and proteomes of a variety of organisms are studied along with the technology used to obtain them. Bioinformatics tools and access to this information are developed, and the significance of this information for the life sciences is made clear. May also be offered as GEN 8200. Prng: BCHM 8140 or GEN 8140.

BCHM 8210 Proteins 3 (3) Isolation, composition, structure and properties of proteins; methods of isolation, analysis and characterization; properties of “unusual” protein systems. Prng: BCHM 6230 or BCHM 6310; or consent of instructor.

BCHM 8220 Enzymes 3 (3) Kinetics, mechanisms of action, inhibitions and general properties of enzymes. Prng: BCHM 6230 or 6310.

BCHM 8250 Seminar I 1 (1) Special topics and original research in genetics reviewed by students, faculty and invited lecturers. May be repeated for credit. May also be offered as GEN 8250. Prng: Enrollment in Biochemistry and Molecular Biology program.
Courses of Instruction

**BCHM 8280 Supramolecular Structure** (3) Cellular structures such as viruses, ribosomes and various membrane systems, including rafts and some organelles, are described using modern methods of structural characterization. The methods and the theory of the methods are discussed along with the structures and their functions. Prereq: BCHM 8140 or consent of instructor.

**BCHM 8320 Structure and Function of Nucleic Acids** (3) Physical, chemical and biochemical properties of nucleotides, oligonucleotides, RNA and DNA; antisense oligonucleotides and aptamers; unusual structures of RNA and DNA; nucleic acids-protein interactions; nucleic acids-metal interactions; small RNAs and RNA interference; catalytic nucleic acids; nucleic acids repair. Prereq: BCHM 8140 or GEN 8140 or consent of instructor.

**BCHM 8410 Biochemical Genetics** (3) Regulation of replication and transcription. Students present papers from recent literature and write a research proposal. Prereq: One year of biochemistry or consent of instructor.

**BCHM 8510 Seminar II** (1) Investigation of current topics in biochemistry. May be repeated for a maximum of ten credits. To be taken Pass/No Pass only. May also be offered as GEN 8510. Prereq: Enrollment in Biochemistry and Molecular Biology program or the Genetics program.

**BCHM 8900 Special Topics in Biochemistry** (1-6) Group discussions of recent developments in biochemical research. May be repeated for a maximum of six credits, but only if different topics are covered. Prereq: Consent of instructor.

**BCHM 8910 Master’s Thesis Research** (1-12) Master’s Thesis Research

**BCHM 9910 Doctoral Dissertation Research** (1-12) Doctoral Dissertation Research

**BIOSYSTEMS ENGINEERING**

**BE 6080 Land Treatment of Wastewater and Sludges** (3) Principles for designing environmentally acceptable land application systems using municipal and industrial wastewater and sludges are presented. Topics include land-limiting constituent analysis; soil-plant interactions; system equipment and design; system operation and management; public acceptance, social, and regulatory issues. Case studies and field trips are planned. Prereq: Senior standing. May also be offered as NES 6080.

**BE 6100 Biological Kinetics and Reactor Modeling** (3) Fundamentals of microbial and biochemical kinetics used in analysis and design of biological systems. Topics include mathematical and computer modeling of microbial kinetics and systems, estimating model coefficients, and development of microbial kinetic models as basis for batch and continuous reactor design. Prereq: BE 6101.

**BE 6101 Biological Kinetics and Reactor Modeling Laboratory** (3) Non-credit laboratory to accompany BE 6100. Coreq: BE 6100.

**BE 6120 Heat and Mass Transport in Biosystems Engineering** (3) Fundamentals of heat and mass transport used in engineering design and analysis of biological systems; principles of steady state and transient energy and mass balances, including chemical and biological generation terms.

**BE 6140 Biosystems Engineering Unit Operations** (3) Applies the basic principles of statics, dynamics, and thermodynamics to design of mechanical and electrical systems supporting biological operations and processes. Coreq: BE 6141.

**BE 6141 Biosystems Engineering Unit Operations Laboratory** (3) Non-credit laboratory to accompany BE 6140. Coreq: BE 6140.

**BE 6150 Instrumentation and Control for Biosystems Engineers** (3) Overview of modern instrumentation techniques and digital electronic components and subsystems to integrate them into digital data acquisition and control systems for biosystems. Laboratory use of equipment is emphasized. Topics include characteristics of instruments, signal conditioning, transducer theory and applications, programmable logic controllers, and digital data acquisition and control. Coreq: BE 6151.

**BE 6151 Instrumentation and Control for Biosystems Engineers Laboratory** (3) Non-credit laboratory to accompany BE 6150. Coreq: BE 6150.

**BE 6170 Applied Instrumentation and Control for Biosystems 2** (1) Hardware and software implementation of digital data acquisition and control systems for application to agriculture, aquaculture, biotechnology, and other biosystems. Topics include digital electronic circuits and components, microcomputer architecture, interfacing, and programming. Prereq: BE 4150 or consent of instructor. Coreq: BE 6171.

**BE 6171 Applied Instrumentation and Control for Biosystems Laboratory 0** (3) Non-credit laboratory to accompany BE 6170. Coreq: BE 6170.

**BE 6220 Hydrologic Modeling of Small Watersheds 3** (3) Design of structures and development of best management practices for runoff, flood, and sediment control from rural and urban areas, including natural and disturbed watersheds. Topics include modeling of prismatic and non-prismatic channels, culverts, and detention/retention ponds.

**BE 6280 Biochemical Engineering 3** (3) Use of microorganisms and enzymes for the production of chemical feedstocks, single-cell protein, antibiotics, and other fermentation products. Topics include kinetics and energetics of microbial metabolism, design and analysis of reactors for microbial growth and enzyme-catalyzed reactions, and considerations of scale-up, mass transfer, and sterilization during reactor design.

**BE 6350 Applications in Biotechnology Engineering 3** (2) Bioengineering principles applied to the expanding fields of agricultural biotechnology, ecotechnology, and biomedical technology. Specific applications include waste treatment and ecological engineering, bioreactor propagation of plant and animal cells and tissues, applied genomics and synthetic seed production, biosensors and biomonitoring, biological implants and materials biocompatibility. Coreq: BE 6351.

**BE 6351 Applications in Biotechnology Engineering Laboratory 0** (3) Non-credit laboratory to accompany BE 6350. Coreq: BE 6350.

**BE 6380 Bioprocess Engineering Design** (3) Design and analysis of systems for processing biological materials. Topics include biotechnology, thermodynamics, transport processes, and biological properties related to bioprocess design and computational simulation. Unit operations include basic bioreactor operation, bioseparations, and preservation techniques. Coreq: BE 6381.

**BE 6381 Bioprocess Engineering Design Laboratory 0** (2) Non-credit laboratory to accompany BE 6380. Coreq: BE 6380.

**BE 6400 Sustainable Energy Engineering** (3) Investigation into merging renewable energy resources, including detailed study of solar, wind, and bioenergy alternatives. Also includes principles, technologies, and performance evaluation of components for these technologies and an introduction to tidal, hydro, geothermal, and other energy; energy conservation; cogeneration; financial, economical, and other issues related to alternative energy sources. May also be offered as CE 6401. Coreq: BE 6401.

**BE 6401 Sustainable Energy Engineering Laboratory 0** (2) Non-credit laboratory to accompany BE 6400. May also be offered as CE 6401. Coreq: BE 6400.

**BE 6510 Newman Seminar and Lecture Series in Natural Resources Engineering** (1) Topics dealing with development and protection of land, air, water, and related resources are covered by seminar with instructor and invited lecturers. Current environmental and/or resource conservation issues are addressed. May also be offered as EES 6510 or FOR 6510.

**BE 6640 Non-Point Source Management in Engineered Ecosystems** (3) Fundamentals of non-point source pollution, including quantification of environmental impact and ecosystem management related to contaminants and nutrients and to planning and design of ecological systems. Coreq: BE 6641.

**BE 6641 Non-Point Source Management in Engineered Ecosystems Laboratory 0** (3) Non-credit laboratory to accompany BE 6640. Coreq: BE 6640.

**BE 6840 Municipal Solid Waste Management 3** (3) Introduction to the problems, regulations, collection, handling, recycling and disposal of municipal solid wastes in the urban and rural sectors. Emphasizes an integrated waste-management system with resource recovery, composting, incineration, landfill disposals, and their costs. May also be offered as EES 6840.

**BE 7810 Special Problems 1-3** (1-3) Students select subjects and conduct library, laboratory and/or field research. A technical report documenting the study is required. May be repeated for a maximum of six credits.

**BE 8220 Principles and Practice of Stream Restoration 3** (2) Introduction to hydraulic and sediment transport processes associated with stream restoration practice. Emphasis is on learning to research, document and present a rationale for a recommended alternative to a degraded stream. Research centers around a degraded stream system. Coreq: BE 8221.

**BE 8221 Principles and Practice of Stream Restoration Laboratory 0** (3) Non-credit laboratory to accompany BE 8220. Coreq: BE 8220.
Courses of Instruction

BE 8350 Industrial Biotechnology Techniques 4 (3) Introduces industrial biotechnology techniques with emphasis on bioproduction, pilot bioprocessing equipment operation, biopharmaceutical storage, process simulation and economics, project management, good laboratory practice (GLP), and current good manufacturing practice (cGMP) geared toward the biotechnology industry. Coreq: BE 8351.

BE 8351 Industrial Biotechnology Techniques Laboratory 0 (3) Non-credit laboratory to accompany BE 8350. Coreq: BE 8350.

BE 8380 Advanced Bioprocess Engineering 3 (3) Advanced bioprocessing techniques with emphasis on processing and modeling aspects of eukaryotic systems and associated bioproducts. Modules include thermal processing, supercritical fluid extraction, and advanced biological thermodynamics, chromatography and spectroscopy.

BE 8650 Advanced Biological Transport Processes 3 (3) Study of transient transport processes in biological materials and systems. Incorporates mathematics describing active and passive cellular transport. Emphasizes numerical solution techniques for coupled transport relationships in nonideal, heterogeneous systems, including biological kinetic and thermodynamic considerations. Preq: BCHM 3050 and CHE 6010 and MATH 6340; or consent of instructor.

BE 8710 Selected Topics in Biosystems Engineering 1-3 (1-3) Supervised, in-depth study of an area related to biosystems engineering not covered in other courses. May be repeated for a maximum of six credits.

BE 8910 Master’s Thesis Research 1-12 (1-12) Master’s Thesis Research

BE 9010 Special Problems in Agricultural Engineering 3 (3) Library and/or laboratory research on one of the following subjects, depending on student’s field of study or interests: power and machinery, soil and water resources, farm structures, electric power and processing, food engineering, forest engineering or waste management. A technical report is required.

BE 9910 Doctoral Dissertation Research 1-12 (1-12) Doctoral Dissertation Research

BIOENGINEERING

BIOE 6230 Cardiovascular Engineering and Pathology 3 (3) Medical and bioengineering aspects of artificial cardiovascular and vascular devices; physiology and pathological aspects of patients with need for such devices; diagnostic techniques and surgical management of diseases and pathology; design aspects of current devices and selection; state of the art in experiments and human clinical trials. Preq: BIOE 3020 and BIOE 3210 and BIOL 3150; or consent of instructor.

BIOE 6310 Medical Imaging 3 (2) Introduction to the theory, physics, and basis of medical imaging devices; including X-ray, Computed Tomography, Magnetic Resonance Imaging, and Ultrasound. Students will understand imaging from both an engineering and clinical perspective. Students will have the opportunity to work with real medical images, to understand the trade-offs between modalities. Preq: MATH 2080; and one of ECE 2020 or ECE 2070. Preq or concurrent enrollment: BIOE 3700.

BIOE 6311 Medical Imaging Laboratory 0 (2) Non-credit laboratory to accompany BIOE 6310. Coreq: BIOE 6310.

BIOE 6350 Computer Modeling of Multiphysics Problems 3 (3) This course will introduce students to a holistic way to deal with complicated engineering problems using a computer modeling approach. For example, a real-world problem governed by combined mechanical, electrical, thermal, electrochemical, and mass-transport phenomena will be dealt with in an integrated and multidisciplinary way rather than the conventional piecewise single-discipline way. Preq: MATH 2080.

BIOE 6400 Biotechnology for Bioengineers 3 (3) Explores the principles necessary to use microorganisms, tissue culture, and enzymes in bioengineering applications, including molecular techniques, fermentation, process scale-up, purification processes, and FDA regulations. Emphasizes production of biopharmaceuticals derived from recombinant systems, including uses in medical systems. Preq: BCHM 3050; or consent of instructor.

BIOE 6710 Biophotonics 3 (3) Biophotonics is an interdisciplinary subject of applying photonics to study biological samples from individual cells to the entire body. Introduces fundamental and frontier topics in optical imaging aspects of biophotonics for senior-level undergraduates and graduate students to gain the ability to solve bioimaging-related biomedical problems. Preq: MATH 2080; and PHYS 2210; and either ECE 2070 or ECE 3200; or consent of instructor.

BIOE 6820 Biomaterials 3 (2) Provides training in the planning and conduct of experimental surgery, including laws and regulations, institutional requirements, selection of animal models, ethical considerations of animal research, preparation of animals for surgery; general and special surgical techniques; aseptic surgical techniques; and basic and applied instrumentation. Preq: Junior standing in Bioengineering.

BIOE 6821 Biomaterials Laboratory 0 (3) Non-credit laboratory to accompany BIOE 6820. Coreq: BIOE 6820.

BIOE 8000 Seminar in Bioengineering Research 1 (2) Original research in bioengineering; weekly one-hour seminar associated with weekly recitation covering seminar preparation, presentation, professional writing, bioengineering ethics and related topics. To be taken Pass/No Pass only.

BIOE 8010 Biotechnology for Bioengineers 3 (2) Determining compatibility of biomaterials with the physiological environment; optical microscopy, microcomputed tomography and ultraviolet fluorescence; normal histology of tissues, basic pathological reactions and tissue reactions to materials. Coreq: BIOE 8021.

BIOE 8021 Biotechnology for Bioengineers 0 (6) Non-credit laboratory to accompany BIOE 8020. Coreq: BIOE 8020.

BIOE 8030 Polymeric Biomaterials 3 (3) The emerging field of biotechnology and its relation to solving bioengineering and health-related problems is treated. Also considers the promise of nanotechnology in the creation and utilization of materials and devices at the level of atoms and molecules. New scientific approaches, research tools, clinical tools, and devices are presented.

BIOE 8110 Sterilization and Cleaning Engineering for Medical Devices 3 (2) Detailed overview of sterilization, cleaning and packaging requirements for reprocessing medical devices. Emphasizes evaluation methods for materials analysis, biocompatibility, and sterilization/cleaning methods in manufacturing and healthcare sectors. Compliance with industry and government regulations are addressed, including packaging processes, container types, and equipment design and processing for sterilization and cleaning. Coreq: BIOE 8111.

BIOE 8111 Sterilization and Cleaning Engineering for Medical Devices Laboratory 0 (3) Non-credit laboratory to accompany BIOE 8110. Coreq: BIOE 8111.

BIOE 8130 Industrial Bioengineering 3 (3) A broad-based understanding of industry-related functions; knowledge base to allow a bioengineering graduate to quickly adapt to an industrial career in medical device research and development, and understand the additional roles and interplay between quality, sales, product development methodology, and regulatory.

BIOE 8140 Medical Device Commercialization 3 (3) Overview of design control and regulations for medical device reprocessing and their practical application in the scope of project management and commercialization. Introduction to a cross-disciplinary approach for launching and marketing a new device, including device lifecycle management and intellectual property laws relative to the medical device reprocessing industry. Preq: Consent of instructor.
BIoE 8150 Design, Manufacturing and Validation Methods for Reusable Medical Devices 3 (3) Overview of design theories, methods and best practices governing the medical device reprocessing industry. Materials, fabrication processes and manufacturing techniques with an emphasis on remanufacturing, reprocessing and sustainability. Knowledge and skills needed to comply with process verification and validation requirements for Quality System Regulations with emphasis on a reprocessing approach. Preq: BIoE 8110 or consent of instructor.

BIoE 8220 Implantable Cardiac Devices 3 (3) Design of clinically used pacemakers, defibrillators, and cardiac resynchronization devices. Covers modes and basic timing cycles of pacemakers; testing of leads for sensing, impedances, and capture thresholds; pacemaker malfunction assessment; programming of antitachycardia pacing and defibrillation threshold testing for defibrillators; and device surgical implantation and explanation and methods of lead extraction. Preq: BIoE 8260 or consent of instructor. Coreq: BIoE 8281.

BIoE 8280 Implantable Cardiac Devices Laboratory 0 (6) Non-credit laboratory to accompany BIoE 8280. Coreq: BIoE 8280.

BIoE 8290 Interventional Electrophysiology Procedures 3 (1) Interventional electrophysiology procedures, including baseline interval measurements, pulser stimulator control for diagnostic information, conduction system and refractory periods assessment. Supraventricular and ventricular tachyarrhythmias assessment, post-pacing and pacing protocols; radiofrequency ablation and complications; radiofrequency generator and irrigated tip ablation systems and transseptal punctures. Preq: BIoE 8260 and BIoE 8270, or consent of instructor. Coreq: BIoE 8291.

BIoE 8291 Interventional Electrophysiology Procedures Laboratory 0 (6) Non-credit laboratory to accompany BIoE 8290. Coreq: BIoE 8290.

BIoE 8300 Interventional Electrophysiology Imaging 2 (6) Methods of imaging utilized during electrophysiologic procedures. Three-dimensional CT images of the heart editing echocardiographic planar images for three-dimensional cardiac chambers; standard radiographic imaging techniques, including rotational angiography; 3-D electroanatomic maps for arrhythmia assessment and ablative treatment. Preq or concurrent enrollment: BIoE 8290; or consent of instructor.

BIoE 8310 Advanced Electrophysiology Procedures 2 (6) Electrophysiologic procedures and methods to treat atrial fibrillation and ventricular tachycardia; recording, imaging, mapping and ablative methods; and setup and maintenance of robotic mapping and ablation. Preq: BIoE 8280 and BIoE 8290; or consent of instructor.

BIoE 8320 Advanced Electrophysiology Problem Solving 2 (6) Trouble shooting of electrical noise, grounding problems, fractured cables, insulation breaks, computer and imaging errors. Covers treatment of complications from procedures such as respiratory failure, cardiac tamponade, cardiac arrest, stroke, loss of pacing capture, use of transcutaneous pacing, external defibrillation, inappropriate shocks, placement of pericardial drains, chest tubes, and hemotoma expansion. Preq or concurrent enrollment: BIoE 8310; or consent of instructor.

BIoE 8410 Drug Delivery 3 (3) Comprehensive principles of drug design, development and delivery in the context of creating biomaterial-based prodrugs and applying pharmaceutical therapies in tissue engineering/regenerative medicine. The relationship between drug physico-chemical properties and pharmacokinetics/pharmacodynamics and drug delivery systems to improve therapeutic efficiency and reduce toxicity through targeting and controlled release is covered. Students are expected to have completed undergraduate courses in organic chemistry and cell biology before enrolling in this course.

BIoE 8460 Biomedical Basis for Engineered Replacement 3 (3) Form and function of human organs, major systems and examples of engineering repair and replacement methods are presented in light of pathological or traumatic organ malfunction. Core course for all Bioengineering graduate students, taken preferably during their first fall semester.

BIoE 8470 Transport Processes in Bioengineering 4 (4) Mathematical modeling of blood flow through capillaries and solute transfer from capillaries to tissues by diffusion and convection, pharmacokinetic analysis of drug adsorption, transport and elimination routes in body, and analysis of the design and performance of extracorporeal devices for organ replacement, including hemodialysis, blood oxygenation and immobilized enzyme reactors. Preq: MATH 2080.

BIoE 8480 Cellular Interactions with Biomaterials 4 (2) Cell biological concepts and issues relevant to cell-biomaterial interactions; methods for studying cell structure and function including basic cell culture techniques and in vitro biocompatibility analyses; biomaterial physico-chemical properties which influence cellular interactions; interactions between implant materials and host tissues at the cellular and molecular level; overview of tissue engineering. Coreq: BIoE 8481.

BIoE 8481 Cellular Interactions with Biomaterials Laboratory 0 (2) Non-credit laboratory to accompany BIoE 8480. Coreq: BIoE 8480.

BIoE 8490 Tissue Engineering 3 (3) Principles and practices of bioartificial organ and tissue development; cellular/material interaction and translation of information from two-dimensional surfaces to threedimensional scaffolds; selection and processing of biomaterials to form tissue scaffolds; analysis of tissue engineered devices, standards and regulation. Preq: BIoE 8101 and BIoE 8460.

BIoE 8500 Selected Topics in Biomedical Engineering 1-4 (1-4) Advanced topics in bioengineering intended to develop in-depth areas of particular student interest. Credit may be earned for more than one semester.

BIoE 8510 Mentoring Undergraduate Research Teams 2 (2) Provides students with training and practical experience for managing and leading teams engaged in scientific research and medical device design/development. Students receive training from a faculty instructor while mentoring teams of undergraduate researchers. Preq: Consent of instructor.

BIoE 8700 Bioinstrumentation 3 (2) Concepts and techniques of instrumentation in bioengineering emphasizing effects of instrumentation on the biological system under investigation; transducers and couplers; data conversion; conditioning and transmission; experimental problems in acute and chronic procedures with static and dynamic subjects. Coreq: BIoE 8701.

BIoE 8701 Bioinstrumentation Laboratory 0 (2) Non-credit laboratory to accompany BIoE 8700. Coreq: BIoE 8700.

BIoE 8880 Biomaterials Implantology 4 (2) All phases of experimental surgery including selection of animal models, preparation of animals for surgery, general and special surgical techniques, and basic and applied instrumentation. Preq: BIOL 4590. Coreq: BIoE 8821.
BIOE 8821 Biomaterials Implantology Laboratory
0 (6) Non-credit laboratory to accompany BIOE 8820. Coreq: BIOE 8820.

BIOE 8900 Internship I 1-5 (1-5) Observation and assignment in a medical college, dental college, hospital, veterinary clinic, dental clinic, health service, or industrial department. Preq: Consent of department chair.

BIOE 8910 Master’s Thesis Research 1-12 (1-12) Master’s Thesis Research

BIOE 8920 Nonthesis Independent Study in Bioengineering 1-6 (1-6) Independent study in bioengineering for work necessary to complete requirements for the Master of Science degree in Bioengineering, nonthesis option. May be repeated for additional credit. To be taken Pass/No Pass only.

BIOE 9910 Doctoral Dissertation Research 1-12 (1-12) Doctoral Dissertation Research

BIOLOGY

BIOI 6000 Insect Morphology 4 (3) Study of insect structure in relation to function and of the variation of form in insects. May also be offered as ENT 6000. Preq: ENT 3010. Coreq: BIOL 6001.

BIOI 6001 Insect Morphology Laboratory 0 (3) Non-credit laboratory to accompany BIOL 6000. May also be offered as ENT 6001. Coreq: BIOL 6000.

BIOI 6010 Plant Physiology 3 (3) Relations and processes pertaining to maintenance, growth, and reproduction of plants, including absorption of matter and energy, water relations of the plant, utilization of reserve products and liberation of energy. Preq: BIOL 1040 and BIOL 1060; or BIOL 1110; and CH 1020. Preq or concurrent enrollment: BIOL 4020.

BIOI 6020 Plant Physiology Laboratory 1 (3) Laboratory exercises and experiments designed to indicate the relations and processes which pertain to maintenance, growth, and reproduction of plants, including absorption of matter and energy, water relations of the plant, utilization of reserve products, and liberation of energy. Preq or concurrent enrollment: BIOL 4010.

BIOI 6050 Molecular Genetics of Eukaryotes 3 (3) Molecular genetic analyses of eukaryotes in relation to mutations and repair, complex phenotypes, biochemical pathways, short- and long-term regulation of gene expression, and evolution. May also be offered as GEN 6050. Preq: Consent of instructor.

BIOI 6060 Introductory Plant Taxonomy 3 (3) Introduction to the basic principles and concepts of plant systematic with emphasis on the plants of South Carolina. Preq: BIOL 1040 and BIOL 1060; or BIOL 1110. Coreq: BIOL 6070.

BIOI 6070 Plant Taxonomy Laboratory I 1 (3) Introduction to basic techniques of plant taxonomy with laboratory and field emphasis on the flora of South Carolina. Coreq: BIOL 6060.

BIOI 6080 Comparative Vertebrate Morphology 3 (3) Phylogeny and diversity of vertebrates and study of their comparative morphology, leading to an understanding of the relationships and functioning of living organisms. Preq: BIOL 1040 and BIOL 1060; or BIOL 1110. Coreq: BIOL 6090.

BIOI 6090 Comparative Vertebrate Morphology Laboratory 2 (5) Comparative anatomy of representative vertebrates; methods used in preparing specimens for study and display. Coreq: BIOL 6080.

BIOI 6100 Limnology 3 (3) Detailed introduction to the physical, chemical, and biological interrelationships that characterize inland water environments. A fundamental approach to the interactions of components of the environment is developed at a theoretical level. Preq: BIOL 1040 and BIOL 1060; or BIOL 1110.

BIOI 6110 Limnological Analyses 2 (1) Examines a broad range of topics covered with both standing and running fresh waters. About one-third of the laboratory exercises address the major physical components of lakes and streams. The remainder provides rationale and methods for quantitative analyses of biota, as well as some integrated analyses of whole ecosystems. Preq or concurrent enrollment: BIOL 4100 or BIOL 4430. Coreq: BIOL 6111.

BIOI 6111 Limnological Analyses Laboratory 0 (2) Non-credit laboratory to accompany BIOL 6110. Coreq: BIOL 6110.

BIOI 6130 Restoration Ecology 3 (3) Applies ecological principles to the restoration of disturbed terrestrial, wetland, and aquatic ecosystems. Includes the restoration of soils and waterways, of flora and fauna, and of natural ecological processes such as plant succession and nutrient cycling. May also be offered as ENR 6130, Preq: BIOL 3130 or BIOL 4410 or WFB 3130.

BIOI 6140 Basic Immunology 3 (3) Introduction to the immune system of vertebrate animals, with an emphasis on structure, function, regulation, and cellular and molecular mechanisms of immune responses. May also be offered as AVS 6140 or MIRC 6140. Preq: BIOL 4610 and MIRC 3050.

BIOI 6150 Insect Taxonomy 3 (1) Identification of the principal families of the major orders of adult insects. Laboratory work consists of intensive discussion of taxonomic features observed in the laboratory. May also be offered as ENT 6150, Preq: BIOL 4000 or ENT 4000. Coreq: BIOL 6151.

BIOI 6151 Insect Taxonomy Laboratory 0 (6) Non-credit laboratory to accompany BIOL 6150. May also be offered as ENT 6151. Coreq: BIOL 6150.

BIOI 6170 Marine Biology 3 (3) Survey of the organisms that live in the sea and their adaptations to the marine environment. Emphasizes characteristics of marine habitats, organisms, and the ecosystems. Preq: BIOL 1040 and BIOL 1060; or BIOL 1110.

BIOI 6200 Neurobiology 3 (3) Broad background in neurobiology. Topics include neuroanatomical structure-function; conduction in the neuron; neurite growth and development; neuromuscular junction; chemistry, physiology, and pharmacology of specific neurotransmitters and receptors; visual process; axoplasmic transport; hypothalamic-pituitary regulation; theories of behavior; theories of learning and memory. Preq: BIOL 1040 and BIOL 1060; or BIOL 1110.

BIOI 6250 Introductory Mycology 3 (3) Introduction to the biology of all the groups of fungi and some related organisms, with considerations of the taxonomy, morphology, development, physiology, and ecology of representative forms. May also be offered as PLPA 6250. Preq: BIOL 1040 and BIOL 1060; or BIOL 1110. Preq or concurrent enrollment: BIOL 4260 or PLPA 4260.

BIOI 6260 Mycology Practicum 2 (1) Application of the principles of mycological techniques, microscopic study of fungi. Examples from all major groups of fungi are included. May also be offered as PLPA 6260. Preq or concurrent enrollment: BIOL 4250 or PLPA 4250. Coreq: BIOL 6261.

BIOI 6261 Mycology Practicum Laboratory 0 (2) Non-credit laboratory to accompany BIOL 6260. May also be offered as PLPA 6261. Coreq: BIOL 6260.

BIOI 6280 Quantitative Biology 4 (3) Applies quantitative methods to a wide range of biological problems. Main focus is on building modeling skills using population, physiological, genetic, and evolutionary problems. Also includes a review of statistical principles and introduces basic bioinformatics techniques. Preq: BIOL 1040 and BIOL 1060; or BIOL 1110; and MATH 1080 or MATH 1110. Coreq: BIOL 6281.

BIOI 6281 Quantitative Biology Laboratory 0 (3) Non-credit laboratory to accompany BIOL 6280. Coreq: BIOL 6280.

BIOI 6320 Animal Histology 3 (3) Structural and functional study of the basic tissues of animals and tissue makeup of organs. Emphasizes light microscopy level with selected tissue studied at the electron microscope level. Preq: BIOL 1040 and BIOL 1060; or BIOL 1110. Coreq: BIOL 6330.

BIOI 6330 Animal Histology Laboratory 2 (1) Microscopic examination of basic animal tissue types and the tissue makeup of organs which comprise systems. Coreq: BIOL 4320 and BIOL 6331.

BIOI 6331 Animal Histology Laboratory 0 (2) Non-credit laboratory to accompany BIOL 6330. Coreq: BIOL 6330.

BIOI 6360 Insect Behavior 3 (2) Fundamentals of insect behavior in an evolutionary and ecological perspective. Laboratory emphasizes generation and testing of hypotheses and observation, description, and quantification of insect behavior. May also be offered as ENT 6360. Preq: ENT 3010. Coreq: BIOL 6361.

BIOI 6361 Insect Behavior Laboratory 0 (3) Non-credit laboratory to accompany BIOL 6360. May also be offered as ENT 6361. Coreq: BIOL 6360.

BIOI 6400 Developmental Animal Biology 3 (3) Events and mechanisms responsible for the development of multicellular animals. Gametogenesis, fertilization, embryonic development, cellular differentiation, morphogenesis, larval forms and metamorphosis, asexual reproduction, regeneration, malignancy, and aging are analyzed in terms of fundamental concepts and control processes. Preq: BCHM 3010 or 3050.

BIOI 6410 Ecology 3 (3) Study of basic ecological principles underlying the relationships between organisms and their biotic and abiotic environments. Includes physiological, population, and community ecology, with applications of each to human ecological concerns.
BIOL 6420 Biogeography 3 (3) Study of patterns of distribution of plants and animals in space and time.

BIOL 6430 Freshwater Ecology 3 (3) Study of basic ecological principles and concepts as they apply to freshwater environments: rivers and streams, wetlands, lakes and ponds, and reservoirs.

BIOL 6440 Freshwater Ecology Laboratory (Lecture Portion) 2 (1) Laboratory-based course providing a synthesis of major components of freshwater ecosystems. Activities are hypothesis driven and relate to each other to form an overall synthesis of the field. Hands-on experience allows engagement in creative inquiry. Preq or concurrent enrollment: BIOL 6430. Coreq: BIOL 6441.

BIOL 6441 Freshwater Ecology Laboratory 0 (2) Non-credit laboratory to accompany BIOL 6440. Coreq: BIOL 6440.

BIOL 6450 Ecology Laboratory (Lecture Portion) 2 (1) Modern and classical approaches to the study of ecological problems discussed in BIOL 6410. Students are introduced to field, laboratory and computer-based analyses of plant and animal populations and communities. Preq or concurrent enrollment: BIOL 6410. Coreq: BIOL 6451.

BIOL 6451 Ecology Laboratory 0 (2) Non-credit laboratory to accompany BIOL 6450. Coreq: BIOL 6450.

BIOL 6460 Plant Ecology 3 (3) Ecology of plants in relation to their biotic and abiotic environments. Individual organisms, populations, and communities are considered with an emphasis on seed plants in terrestrial environments.

BIOL 6470 Plant Ecology Laboratory (Lecture Portion) 2 (1) Experimental and observational approach to addressing principles discussed in BIOL 6460. Students are introduced to field and laboratory methods involving individual organisms, populations, and communities. Preq or concurrent enrollment: BIOL 6460. Coreq: BIOL 6471.

BIOL 6471 Plant Ecology Laboratory 0 (2) Non-credit laboratory to accompany BIOL 6470. Coreq: BIOL 6470.

BIOL 6500 Developmental Biology Laboratory (Lecture Portion) 2 (1) Examines a broad range of topics concerned with the development of multicellular animals such as gametogenesis, fertilization, embryonic development, cell differentiation, morphogenesis, larval metamorphosis, and regeneration. Laboratory exercises provide the rationale and methods for the descriptive and experimental analysis of development in representative invertebrates and vertebrates. Preq or concurrent enrollment: BIOL 6400. Coreq: BIOL 4501.

BIOL 6501 Developmental Biology Laboratory 0 (2) Non-credit laboratory to accompany BIOL 6500. Coreq: BIOL 6500.

BIOL 6540 Plant Virology 4 (3) Study of plant viruses: their morphology, biochemistry, purification, and transmission; symptoms resulting from virus infection; virus vector relationships. Serological and nucleic acid hybridization procedures. Diagnosis of viral diseases and the identification of causal agents. Replication of plant viruses, the interaction between viral host and plant genome. Control of plant viral diseases. Students are expected to have completed coursework in biochemistry or introductory microbiology before enrolling in this course. May also be offered as PLPA 6540. Coreq: BIOL 6541.

BIOL 6541 Plant Virology Laboratory 0 (3) Non-credit laboratory to accompany BIOL 6540. Coreq: BIOL 6540. May also be offered as PLPA 6541.

BIOL 6560 Medical and Veterinary Parasitology 3 (3) Introduction to parasitism in the animal kingdom. Emphasizes basic and applied principles related to economically and medically important diseases. Classical and experimental approaches to the study of parasitism are examined in reference to protozoa, helminths, and arthropods. May also be offered as MCR 6560.

BIOL 6570 Medical and Veterinary Parasitology Laboratory (Lecture Portion) 2 (1) Laboratory to reinforce material presented in BIOL 6560. Introduces students to both live and preserved human/animal parasites. Also introduces techniques used in collection, preservation, and examination of animal parasites. Preq or concurrent enrollment: BIOL 6560. Coreq: BIOL 6571.

BIOL 6571 Medical and Veterinary Parasitology Laboratory 0 (2) Non-credit laboratory to accompany BIOL 6570. Coreq: BIOL 6570.

BIOL 6580 Cell Physiology 3 (3) Study of the chemical and physical principles of cell function emphasizing bioenergetics and membrane phenomena. Students are expected to have completed coursework in biochemistry before enrolling in this course.

BIOL 6590 Systems Physiology 3 (3) Physiological systems of vertebrates and their homeostatic controls. Describes the function of the major physiological systems in terms of anatomical structure and chemical and physical principles. Students are expected to have completed coursework in physics before enrolling in this course.

BIOL 6600 Systems Physiology Laboratory (Lecture Portion) 2 (1) Modern and classical experimental methods are used to demonstrate fundamental physiological principles discussed in BIOL 6590. Students are introduced to computer-aided data acquisition and computer simulations of physiological function. Preq or concurrent enrollment: BIOL 6590. Coreq: BIOL 6601.

BIOL 6601 Systems Physiology Laboratory 0 (2) Non-credit laboratory to accompany BIOL 6600. Coreq: BIOL 6601.

BIOL 6610 Cell Biology 3 (3) In-depth analysis of how and where intracellular and extracellular molecules control general and specific cellular functions such as gene expression, secretion, motility, signaling, cell-cycle control and differentiation. Taught and graded at a level where students are expected to infer from and integrate cellular events. Students are expected to have completed coursework in biochemistry before enrolling in this course.

BIOL 6620 Cell Biology Laboratory (Lecture Portion) 2 (1) Lecture portion of the laboratory that accompanies BIOL 6610. Focuses on molecular and microscopic analysis of eukaryotic cells. Preq or concurrent enrollment: BIOL 6610. Coreq: BIOL 6621.

BIOL 6621 Cell Biology Laboratory 0 (2) Laboratory to accompany BIOL 6610. Note: This laboratory has a lecture portion (BIOL 6620). Coreq: 6620.

BIOL 6640 Mammalogy 3 (3) Origin, evolution, distribution, structure, and function of mammals, with laboratory emphasis on the mammals of the Southeast. Field trips are required. Coreq: BIOL 6641.

BIOL 6630 History of Modern Biology 3 (3) Examines the intellectual and social factors defining the study of life from the scientific revolution of the 1600s to the modern biological sciences. Investigates the historical origins of biological disciplines and explores the differing cultures, methodologies, and philosophical commitments of these communities.
BIOL 6740 Primatology 4 (3) Biology of nonhuman primates, including their evolution, taxonomy, physiology, life history, behavioral ecology and conservation. Three field trips are required, during which students conduct behavioral observations and later analyze their data and present it in report format. May also be offered as ANTH 6740. Coreq: BIOL 6741.

BIOL 6741 Primatology Laboratory 0 (3) Non-credit laboratory to accompany BIOL 6740. May also be offered as ANTH 6741. Coreq: BIOL 6740.

BIOL 6750 Comparative Physiology 3 (3) Physiological systems of invertebrates and vertebrates emphasizing environmental adaptation. Physiological principles as they relate to metabolism, thermoregulation, osmoregulation, respiration, and neural and integrative physiology.

BIOL 6760 Comparative Physiology Laboratory (Lecture Portion) 2 (1) Modern classical experimental methods are used to demonstrate fundamental physiological principles discussed in BIOL 6750. Introduces students to computer-aided data acquisition and manipulation as well as computer simulations of physiological function. Prq or concurrent enrollment: BIOL 6750. Coreq: BIOL 6761.

BIOL 6761 Comparative Physiology Laboratory 0 (2) Non-credit laboratory to accompany BIOL 6760. Coreq: BIOL 6760.

BIOL 6767 Ichthyology 3 (2) Systematics, life history, distribution, ecology, and current literature of fish. Laboratory study of morphology and identification of U.S. genera, as well as all southeastern species. Field trips are required. Coreq: BIOL 6767.

BIOL 6771 Ichthyology Laboratory 0 (3) Non-credit laboratory to accompany BIOL 6770. Coreq: BIOL 6770.

BIOL 6800 Vertebrate Endocrinology 3 (3) Introduction to the basic principles of neuro-endocrine integration and homeostatic maintenance in vertebrates. Comparative morphology and physiology of various endocrine tissues and hormone chemistry and modes of action are considered. Students are expected to have completed coursework in biochemistry before enrolling in this course. May also be offered as AVS 6800.

BIOL 6820 Laboratory Techniques for Teaching Science 3 (3) Focuses on basic lab skills needed to plan, prepare, and conduct inquiry-based laboratories and to familiarize pre-service teachers with a variety of scientific equipment and their methodologies. Topics include ways to integrate technology into the classroom, lab safety, and the development of inquiry-based classroom activities. Coreq: BIOL 6821. May also be offered as EDSC 6820.

BIOL 6821 Laboratory Techniques for Teaching Science 0 (6) Non-credit laboratory to accompany BIOL 6820. Coreq: BIOL 6820. May also be offered as EDSC 6821.

BIOL 6830 Stem Cell Biology 3 (3) Stem cells are the focus of intense interest because of their utility for treating human diseases. This course provides a broad treatment of the biology of stem cells and assesses their current therapeutic capacity in clinical medicine. Students are expected to have completed coursework in cell biology before enrolling in this course.

BIOL 6840 Human and Comparative Vertebrate Embryology 3 (3) Study of human and comparative vertebrate embryology with an introduction to related clinical correlations. Students develop an understanding of normal and abnormal human and comparative vertebrate embryonic development.

BIOL 6870 Electron and Optical Microscopy Theory 3 (2) Offers a theoretical and practical introduction to light and electron microscopy. Topics include Koehler illumination, polarization, interference, phase contrast, DIC epifluorescence, laser scanning light microscopy, SEM, TEM, EDS, ultramicrotomy, tomography, and digital imaging. Prq: Consent of instructor. Coreq: BIOL 6871.

BIOL 6871 Electron and Optical Microscopy Theory Laboratory 0 (2) Non-credit laboratory to accompany BIOL 6870. Coreq: BIOL 6870.

BIOL 7300 SC Life: Topics for Teachers 3 (2) Topics relating to the SC Life curriculum. Lectures, laboratories and extensive field studies focus on the natural history and biodiversity of South Carolina. Restricted to elementary and secondary school teachers. May be repeated for credit, but only if different topics are covered. Prq: Consent of instructor. Coreq: BIOL 7301.

BIOL 7301 SC Life: Topics for Teachers Laboratory 0 (2) Non-credit laboratory to accompany BIOL 7300. Coreq: BIOL 7300.

BIOL 7310 SC Life: DNA Technology for Teachers 3 (2) Lectures and laboratories focus on application of DNA technology in society. Restricted to elementary, middle and secondary school teachers. May be repeated for credit, but only if different topics are covered. Prq: Consent of instructor. Coreq: BIOL 7311.

BIOL 7311 SC Life: DNA Technology for Teachers Laboratory 0 (2) Non-credit laboratory to accompany BIOL 7310. Coreq: BIOL 7310.

BIOL 7320 SC Life: Forensic Science Topics for Teachers 3 (2) Application of a broad spectrum of forensic science to answer questions of interest to the legal system. Lectures, laboratories and field trips focus on different subdivisions of forensic science. Restricted to elementary and secondary school teachers. May be repeated for credit, but only if different topics are covered. Prq: Consent of instructor.

BIOL 7321 SC Life: Forensic Science Topics for Teachers Laboratory 0 (2) Non-credit laboratory to accompany BIOL 7320. Coreq: BIOL 7320.

BIOL 7330 SC Life: Technology Topics for Teachers 3 (2) Lectures and laboratories focus on ways to help teachers integrate technology into the classroom. Restricted to elementary, middle, and secondary school teachers. May be repeated for credit, but only if different topics are covered. Prq: Consent of instructor.

BIOL 7331 SC Life: Technology Topics for Teachers Laboratory 0 (2) Non-credit laboratory to accompany BIOL 7330. Coreq: BIOL 7330.

BIOL 8020 Conservation Genetics 3 (3) Introduction to theoretical population genetics and empirical studies of evolutionary genetics. Emphasizes exploring conservation genetics issues from an applied perspective by doing exercises using real data sets and population genetics analyses programs as well as discussions of empirical studies of species of conservation concern. Students are expected to have completed coursework in evolutionary biology or genetics before enrolling in this course.

BIOL 8030 Population Dynamics 4 (2) Fundamental mechanisms basic to regulation of natural animal populations. Laboratory research project in population dynamics complements theory.

BIOL 8031 Population Dynamics Laboratory 0 (6) Non-credit laboratory to accompany BIOL 8030. Coreq: BIOL 8030.

BIOL 8070 Readings in Biology 1 (1) Students learn and practice interpretation, presentation, and discussion of articles in relevant and current scientific journals. May be repeated for a maximum of eight credits. To be taken Pass/No Pass only.

BIOL 8100 Evolutionary Behavioral Ecology 3 (3) Behavior of animals and the ecological context in which various behaviors are shown; empirical and theoretical aspects of behavioral ecology at individual, population and community levels. Students are expected to have completed coursework in ecology or behavioral ecology before enrolling in this course.

BIOL 8110 Immunotoxicology 3 (3) Study of how environmental contaminants, drugs and natural biotoxins affect the immune system of man and animals; cellular and molecular mechanisms of action by immunotoxic agents. Students are expected to have completed coursework in immunology before enrolling in this course. May also be offered as ETOX 8110. Prq: ETOX 4300 OR ETOX 6300.

BIOL 8120 Seminar 1 (1) Review and presentation of current topics in biological sciences. May be repeated for a maximum of four credits. To be taken Pass/No Pass only. Prq: Enrollment in a graduate biological sciences or microbiology program.

BIOL 8130 Graduate Teaching Assistant Colloquium 1 (1) Designed for graduate teaching assistants (GTAs) during their first year of laboratory instruction. Covers a variety of topics designed to prepare GTAs for departmental instructional duties, as well as information concerning safety and professional ethics in the laboratory classroom. To be taken Pass/No Pass only. Prq: Graduate teaching assistant in Biological Sciences.

BIOL 8160 Advanced Ecosystem Analysis 4 (3) Description and analysis of ecological systems; biogeochemical, physicochemical and ecological principles emphasizing fundamental unity of ecosystems and their abiotic environment. Laboratory focuses on application of theory to actual field and laboratory research problems. Students are expected to have completed coursework in ecosystem ecology before enrolling in this course. Coreq: BIOL 8161.

BIOL 8161 Advanced Ecosystem Analysis Laboratory 0 (3) Non-credit laboratory to accompany BIOL 8160. Coreq: BIOL 8160.
BIOL 8200 Community Ecology 3 (3) Examines species interactions in plant and animal communities and uses experimental, observational and theoretical approaches to study competition, predation, facilitation, habitat selection and succession. Emphasizes how species diversity is maintained and the consequences of diversity at local and regional scales. Students are expected to have completed coursework in ecology before enrolling in this course.

BIOL 8210 Inorganic Plant Metabolism 3 (3) Study of plant, soil, water and nutrient relations. Topics include permeability, uptake and translocation, transpiration, and mineral nutrition. Students are expected to have completed coursework in plant physiology before enrolling in this course.

BIOL 8220 Organic Plant Metabolism 3 (3) Discusses respiration and photosynthesis; synthesis, translocation, storage, transformation and degradation of organic materials, fats, carbohydrates, proteins, pigments and nucleic acids. Students are expected to have completed coursework in plant physiology before enrolling in this course.

BIOL 8240 Mode of Action of Growth Substances 4 (3) Study of the physiology and biochemistry of both natural and synthetic growth regulators, hormones, growth retardants, herbicides and other inhibitors. Considers methodology and mechanism of action. Students are expected to have completed coursework in plant physiology and biochemistry before enrolling in this course. Coreq: BIOL 8241.

BIOL 8241 Mode of Action of Growth Substances Laboratory 0 (3) Non-credit laboratory to accompany BIOL 8240. Coreq: BIOL 8240.

BIOL 8250 Comparative and Veterinary Immunology 3 (3) Survey of the evolutionary relationships, the physiology and the cellular/molecular biology of the immune systems of animals; demonstrations that focus on those animals having high economic input, biomedical importance, or a key ecological position; current research with a historical perspective. Students are expected to have completed coursework in immunology before enrolling in this course.

BIOL 8260 Epigenetics in Eukaryotes 3 (3) Focuses on epigenetics in eukaryotes and discusses how epigenetic changes modulate gene expression and post-translational modification. Topics include specific decorations of the DNA, the proteins that help compact DNA, and the importance of chromatin structure in maintaining characteristics of cell or organism, such as immortalization or aging. Students are expected to have completed coursework in cell biology or genetics before enrolling in this course.

BIOL 8300 Mechanistic Toxicology 3 (3) Detailed biochemical toxicology: control, regulation and activity of metabolic enzymes; molecular and cellular mechanisms of toxic action; proposed mechanisms for initiation and development of cancer; mode of action and kinetics of cholinesterase inhibitors; structure/activity relationships of ion channel blockers; biochemical and molecular biomarkers. May also be offered as ETOX 8300. Prq: ETOX 4300 or ETOX 6300.

BIOL 8310 Biomarkers in Toxicology 3 (1) Methodology used in biomarker identification and evaluation of the effects of toxic substances on living systems using biomarkers in sentinel organisms and surrogate biomarkers. Students are expected to have completed coursework in organic chemistry and coursework and labwork in biochemistry before enrolling in this course. May also be offered as ETOX 8310. Prq: ETOX 4300 or ETOX 6300.

BIOL 8311 Biomarkers in Toxicology Laboratory 0 (6) Non-credit laboratory to accompany BIOL 8310. May also be offered as ETOX 8311. Coreq: BIOL 8310.

BIOL 8400 Understanding Biological Inquiry 3 (3) Online course for teachers and others who want to apply inquiry methods to biological problems. Provides a broad background into the scientific methods utilized in the biological sciences and the application of inquiry-based teaching methods in the classroom. Prq: Consent of instructor.

BIOL 8410 Understanding Ecology and Ecosystems 3 (3) Online course for teachers and others who want to understand ecological interactions and systems. Provides a broad background in ecology that includes populations, habitats, communities, trophic interactions and ecosystems; and provides a foundation for understanding interactions between organisms and their environments. Prq: Consent of instructor.

BIOL 8420 Understanding Cellular Processes 3 (3) In-depth analysis of essential cell biology topics. Students study how and where intracellular and extracellular molecules control cellular functions such as gene expression, secretion, motility, signaling, cell-cycle control and differentiation. Prq: Consent of instructor.

BIOL 8430 Understanding Genetics and Evolutionary Biology 3 (3) Online course for teachers who want to increase their content knowledge in genetics and evolution. Topics include Mendelian genetics, molecular genetics, gene expression and regulation, population genetics, forces of evolutionary change, and the role of evolutionary change in the origin of new species. Prq: Consent of instructor.

BIOL 8440 Understanding the Human Body 3 (3) Online course for teachers and others who want to increase their content knowledge about the anatomy and physiology of the human body. Studies include food processing and nutrient allocation, circulation and respiration, excretion, communication via hormones and nervous transmission, reproduction, behavior, locomotion and support. Prq: Consent of instructor.

BIOL 8450 Understanding Vertebrate Biology 3 (3) Online course for teachers and others who want to increase their content knowledge about the taxonomy, morphology, adaptations and evolution of vertebrates. Prq: Consent of instructor.

BIOL 8460 Understanding Plant Biology 3 (3) Online course for teachers and others who want to increase their content knowledge about plants. Study of plants from bryophytes to angiosperms, including growth, photosynthesis, nutrition, reproduction, ecology and evolution. Prq: Consent of instructor.

BIOL 8470 Understanding Microbiology 3 (3) Online course for teachers and others who want to increase their knowledge of microorganisms. Topics include prokaryotic cell structure and function, microbial growth and growth control, food microbiology, bacterial genetics, immunology, virology, microbial diseases, and epidemiology. Laboratory concepts are emphasized. Prq: Consent of instructor.

BIOL 8480 Understanding Scientific Research 3 (3) Research problems in selected areas of biological sciences to provide an introduction to research planning and techniques. Teachers undertake an instructor-approved, individual research project or a group research project involving their classroom during the academic year. Both are assisted by and under the supervision of the instructor. Prq: Consent of instructor.

BIOL 8500 Plant Tissue and Cell Culture 3 (2) Methods and principles of plant tissue and cell culture: cloning, embryogenesis, protoplast fusion, plant regeneration, potential of plant genetic engineering. Students are expected to have completed coursework in plant physiology before enrolling in this course. Coreq: BIOL 8501.

BIOL 8501 Plant Tissue and Cell Culture Laboratory 0 (3) Non-credit laboratory to accompany BIOL 8500. Coreq: BIOL 8500.

BIOL 8540 Aquatic Toxicology 3 (3) Combines concepts of solution chemistry with toxicology to establish stressor-response relationships for aquatic organisms at various trophic levels. Bioavailability is a unifying concept and concepts of contaminant exposure and organism response are set in an ecological risk assessment framework. May also be offered as ETOX 8540. Prq: ETOX 4300 or ETOX 6300.

BIOL 8600 Plant Anatomy and Cell Biology 4 (3) Covers the subcellular structure and the comparative organization and function of plant cell-types, tissues and organs. Emphasizes the interplay between the environment and the plant body and among genomes, membrane compartments and the cytoplasm as these relate to the highly orchestrated stages in development. Coreq: BIOL 8601.

BIOL 8601 Plant Anatomy and Cell Biology Laboratory 0 (3) Non-credit laboratory to accompany BIOL 8600. Coreq: BIOL 8600.

BIOL 8630 Special Problems 1-4 (1-4) Research not related to thesis. Prq: Consent of instructor.

BIOL 8710 Selected Topics 1-4 (1-4) Cellular and developmental biology, ecology, behavior, evolutionary biology, molecular biology, physiology, systematics and other topics of interest to graduate students in the biological sciences. May be repeated for credit, but only if different topics are covered.
BIOL 8720 Selected Topics Laboratory 1-4 (2-8) Specialized laboratory experiences in cellular and developmental biology, ecology, behavior, evolutionary biology, molecular biology, physiology, systematics and other topics of interest to graduate students in the biological sciences. May be repeated for credit, but only if different topics are covered.

BIOL 8880 Electron and Light Microscopy Practicum 3 (1) Continuation of BIOL 6870, offering graduate students practical training on light and electron microscopes. Proficient students become approved end users by performing approved, independent imaging projects. Preq: BIOL 6870 and consent of instructor. Coreq: 8881.

CE 6120 Geotechnical Engineering Design 3 (3) Study of the relationship of local geology to soil formations, groundwater, planning of site investigation, sampling procedures, determination of design parameters, foundation design, and settlement analysis. Preq: CE 3210 or consent of instructor.

CE 6240 Earth Slopes and Retaining Structures 3 (3) Considers the principles of geology, groundwater and seepage, soil strength, slope stability, and lateral earth pressure and their application to the design of excavations, earth fills, dams, and earth-retaining structures. Preq: CE 3210 or consent of instructor.

BIOL 6030 Biotransport Phenomena 3 (3) Analysis of single and multidimensional steady-state and transient problems in momentum, mass, and energy transfer in biological systems. Mathematical similarities and differences in these mechanisms are stressed, and mathematical descriptions of physiological and engineering systems are formulated. Preq: CHE 3300 and MATH 2080.

BMOL 6300 Bireceptors and Bioelectronic Devices 3 (3) Study of methodologies in design, fabrication and application of biosensors and bioelectronic devices for monitoring the environmental, medical and chemical industries. Includes measurement science fundamentals applied to optical, electrochemical, mass and thermal means of signal transduction. Also considers surface science fundamentals to interpret immobilization, biofouling and nonspecific interactions of enzymes, antibodies and DNA at surfaces. Preq: Consent of instructor.

CIVIL ENGINEERING

CE 5810 Matrix Structural Analysis 3 (3) Analysis of determinate and indeterminate structures using the matrix formulation of the direct stiffness method. Consideration is given to commonly faced computer modeling issues and the nonlinear analysis of structures. Preq: CE 3010 or consent of instructor.

CE 5804 Masonry Structural Design 3 (3) Introduction to design of structural elements for masonry buildings, including lintels, walls, shear walls, columns, pilasters, and retaining walls. Reinforced and unreinforced elements of concrete or clay masonry are designed by allowable stress and strength design methods. Introduces construction techniques, materials, and terminology used in masonry. Preq: CE 3010 or consent of instructor.

CE 6070 Wood Design 3 (3) Introduction to wood design and engineering; properties of wood and wood-based materials; design of beams, columns, walls, roofs, panel systems, and connections. Preq: CE 3010 or consent of instructor.

CE 6080 Structural Loads and Systems 3 (3) In-depth discussion of minimum design loads and load combinations. Includes overview of various steel and concrete systems. Discusses practical selection and design issues and design of proprietary building materials and components such as steel joists, diaphragms, engineered wood products, etc. Preq: CE 3010 or consent of instructor.

CE 6100 Traffic Engineering Operations 3 (3) Basic characteristics of motor-vehicle traffic, highway capacity, applications of traffic control devices, traffic design of parking facilities, engineering studies, traffic safety, traffic laws and ordinances, and public relations. Preq: CE 3110 or consent of instructor.

CE 6110 Roadway Geometric Design 3 (2) Geometric design of roadways, at-grade intersections, and interchanges in accordance with conditions imposed by driver ability, vehicle performance, safety, and economics. Preq: CE 3110 or consent of instructor. Coreq: CE 6111.

CE 6111 Roadway Geometric Design Laboratory 0 (3) Non-credit laboratory to accompany CE 6110. Coreq: CE 6110.

CE 6120 Urban Transportation Planning 3 (3) Consideration of urban travel characteristics, characteristics of transportation systems, transportation and land-use studies, trip distribution and trip assignment models, city patterns and subdivision layout. May also be offered as CRP 6120. Preq: CE 3110 or consent of instructor.

CE 6330 Construction Planning and Scheduling 3 (3) Study of principles and applications of the Critical Path Method (CPM) and Project Evaluation and Review Techniques (PERT). Includes project breakdown and network graphics; identification of the critical path and resulting floats; definition and allocation of materials, equipment, and manpower resources; resource leveling, compression, and other network adjustments; and computer applications using packaged routines. Preq: CE 3310 or consent of instructor.

CE 6340 Construction Estimating and Project Control 3 (3) Instruction in specifications, contracts, and bidding strategies; purchasing and subcontracting policies; accounting for materials, supplies, subcontracts, and labor; procedural details for estimating earthwork, reinforced concrete, steel, and masonry. Also considers overhead and profit items. Preq: CE 3310 or consent of instructor.

CE 6350 Infrastructure Project Planning 3 (3) Covers concepts related to planning, cost estimating, financing and executing public works projects from the agency owner perspective. Advanced concepts of engineering economic analysis, risk analysis and database management systems are addressed. Traditional and innovative project contracting strategies, including incentive contracts and public-private partnerships, are discussed. Preq: CE 3520.

CE 6360 Sustainable Construction 3 (3) Presents the why, what and how for sustainable construction projects. Students gain a working understanding of how to minimize the negative impacts of buildings and other large construction projects. Preq: CE 3310 or consent of instructor.

CE 6370 Sustainable Energy Project Design and Analysis 3 (3) Students develop their technical and creative ability to plan and design for a sustainable future. Students perform quantitative analyses of the environmental and economic impacts of engineering alternatives. Students work in small groups and learn techniques for the collaborative, multidisciplinary approach required for sustainable solutions. Preq: CE 3310 or consent of instructor.

CE 6380 Construction Support Operations 3 (3) Describes activities necessary for the completion of a construction job although not specifically recognized as direct construction activities—general conditions, safety, security, quality assurance, value engineering, organizational support features and typical implementation procedures. Preq: CE 3310 and STAT 3010.
Courses of Instruction

CE 6390 Construction Equipment Selection and Maintenance 3 (3) Methodology of selecting the right equipment of the right size for each task of the construction job on the basis of power-train characteristics, crew size, terrain conditions, and job requirements. Cycle time, cost, specifications, maintenance, replacement policy, monitoring. Preq: CE 3310.

CE 6400 Sustainable Energy Engineering 3 (2) Investigation into merging renewable energy resources, including detailed study of solar, wind, and bioenergy alternatives. Also includes principles, technologies, and performance evaluation of components for these technologies and an introduction to tidal, hydro, geothermal, and other energy; energy conservation, cogeneration, financial, economical, and other issues related to alternative energy sources. May also be offered as BE 6400. Coreq: CE 6401.

CE 6401 Sustainable Energy Engineering Laboratory 0 (2) Non-credit laboratory to accompany CE 6400. May also be offered as BE 6401. Coreq: CE 6400.


CE 6460 Flood Hazards and Protective Design 3 (3) Study of flood hazards and methods of protective design of the built environment; floodplain mapping and delineation; methods for determining base flood elevations. Discusses flood-resistant construction, flood proofing, and governmental regulations. Includes case studies and design projects. Preq or concurrent enrollment: CE 3420.

CE 6470 Stormwater Management 3 (3) Evaluation of peak discharges for urban and rural basins, design of highway drainage structures such as inlets and culverts; stormwater and receiving water quality; best management practices, detention and retention ponds, and erosion and sediment control. Preq: CE 3420. Preq or concurrent enrollment: EES 4010.

CE 6560 Pavement Design and Construction 3 (3) Introduction to design methods, construction practices, maintenance strategies, and decision making process related to pavements. Other topics, such as environmental considerations and special pavement types and materials, are also covered. Preq: CE 3110 and CE 3510. Preq or concurrent enrollment: CE 3210.

CE 6570 Materials Testing and Inspection 3 (3) Introduction to the role of testing and inspection professionals in civil engineering projects. Uses a practical approach to applying concepts to real-world situations through the completion of several team projects such as material characterization, construction QC/QA, forensic evaluation, and proposal development. Preq: CE 3210 and 3510.

CE 6620 Coastal Engineering I 3 (3) Introduction to coastal and oceanographic engineering principles, including wave mechanics, wave-structure interaction, coastal water-level fluctuations, coastal zone processes, and design considerations for coastal structures and beach nourishment projects. Preq: CE 3410 or consent of instructor.

CE 6910 Selected Topics in Civil Engineering 1-6 (1-6) Structured study of civil engineering topics not found in other courses. May be repeated for a maximum of six credits, but only if different topics are covered. Preq: Consent of instructor.

CE 8010 Finite Element Analysis 3 (3) Finite element methods in solution of engineering problems; stiffness matrices for bar, beam, triangular, rectangular and quadrilateral elements in plane systems; plate bending, shell and 3-D elements; applications to solutions of structural and soil mechanics problems using special and general purpose programs. Preq: CE 4010 or consent of instructor.

CE 8020 Advanced Reinforced Concrete Design 3 (3) Second course in design of reinforced concrete structures; advanced concepts in analysis and design of beams, columns, shear walls and slabs; introduction to the seismic design of concrete structures. Preq: CE 4020 or consent of instructor.

CE 8030 Advanced Steel Design 3 (3) Advanced design of structural steel buildings emphasizing the relationship between design and response of the structural system. Includes theoretical basis of building code provisions, limit state design, beam-columns, plate girders and composite sections and connections. Also includes the seismic design of steel structures. Preq: CE 4060 or consent of instructor.

CE 8040 Prestressed Concrete 3 (3) Introduction to the analysis, behavior and design of prestressed concrete members and structures. Covers allowable stress design and strength design of P/C members, shear design, loss of prestress force, design of continuous structures. Preq: CE 4010 and 4020, or consent of instructor.

CE 8050 Advanced Structural Mechanics 3 (3) Development and utilization of mechanics principles in solution of structural problems; unsymmetrical bending and curved beams; beams on elastic foundations; plastic structure analysis of beams and frames; eigenvalue problems; plastic stress-strain relations; strain energy; and introduction to finite element analysis. Preq: CE 3010 or consent of instructor.

CE 8060 Dynamic Analysis of Structures 3 (3) Analysis of structures subjected to dynamic loading; response of lumped and distributed parameter systems of one or many degrees of freedom; and introduction to earthquake analysis, including modal and time history analysis. Preq or concurrent enrollment: CE 4010.

CE 8070 Wind Engineering 3 (2) Effects of wind on buildings, bridges and other structures; meteorological aspects of wind generation; types and characteristics of various wind events; aerodynamics of flow around structures; wind-induced loads; structural responses; design basis safety and serviceability criteria. Coreq: CE 8071.

CE 8071 Wind Engineering Laboratory 0 (2) Non-credit laboratory to accompany CE 8070. Coreq: CE 8070.

CE 8080 Earthquake Engineering 3 (3) Effects of earthquake-induced forces on buildings, bridges and other structures; development of design codes and their application to the design of structures to resist seismic forces; fundamental structural dynamics and analysis techniques used to compute the response of structures or obtain design forces. Includes an introduction to performance-based seismic design concepts and displacement-based design methods. Preq: CE 8060 or consent of instructor.

CE 8090 Structural Health Monitoring 3 (3) Structural health monitoring involves the use of low-cost, long-term monitoring systems to keep civil infrastructure under constant surveillance to ensure the integrity of the structural system. This course covers the concepts of continuous monitoring due to long-term degradation, as well as rapid after disaster assessment of civil infrastructure. Students are required to engage in a significant amount of out-of-class lab work. Preq: CE 3010 or consent of instructor.

CE 8130 Highway and Airport Pavement Design 3 (3) Structural design of rigid and flexible pavements; design of bases and subbases; theory of stresses and application of plate bearing, triaxial and California Bearing Ratio design methods to flexible pavements; Westergaard analysis for rigid pavements; pavement evaluation methods. Preq: CE 3110 and CE 3210 and CE 3510; or consent of instructor.

CE 8140 Intelligent Transportation Systems 3 (3) Students learn concepts of Intelligent Transportation Systems (ITS), including traffic flow principles, advanced traffic sensor and communications technologies and real-time management strategies, to increase the safety and efficiency of the surface transportation system. Covers the process of planning, design and operations of ITS. Preq: Consent of instructor.

CE 8150 Transportation Safety Engineering 3 (3) Methodology for conducting transportation accident studies; accident characteristics as related to operator, facility and mode; statistical applications to accident data; current trends and problems in transportation safety. Preq: CE 3110 or consent of instructor.

CE 8200 Geotechnical Site Characterization 3 (3) Study of advanced methods of subsurface investigation for design of civil structures in soil and rock. Includes field reconnaissance, interpretation of geologic maps and cross sections, drilling, in-situ testing, sampling, characterization of soil and rock formations and selection of engineering properties. Preq: CE 3210.

CE 8210 Advanced Soil Mechanics 3 (3) Study of stresses in soils, stress-strain and shear strength properties of soil, plastic equilibrium of soil masses, failure conditions, earth pressures, with applications to geotechnical engineering design. Preq: CE 3210 or consent of instructor.

CE 8220 Foundation Engineering 3 (3) Requirements for satisfactory foundations; theory and design of shallow foundations; pressure distribution beneath rigid and flexible shallow foundations; bearing capacity and settlement of deep foundations; foundation failures. Preq: CE 3210 or consent of instructor.
CE 8230 Asphalt Concrete Properties 3 (3) Includes identification and suitability of aggregates for construction. Covers characteristics and properties of bituminous materials and materials behavior, construction and design problems. Requires use of microcomputers and the mainframe. Prq: CE 3510 or consent of instructor.

CE 8240 Infrastructure Corrosion 3 (3) Discussion of technologically important material/environment combinations. Course provides a basic but thorough review of causes of corrosion and the methods by which it can be identified, monitored, and controlled. Prq: Consent of instructor.

CE 8250 Soil Dynamics and Geotechnical Earthquake Engineering 3 (3) Fundamentals of soil dynamics, plate tectonics and earthquakes; application of the concepts to seismic ground response, design ground motions, soil liquefaction, seismic slope stability, dynamic lateral earth pressures, and soil improvement. Prq: CE 3210 or consent of instructor.

CE 8260 Properties of Portland Cement Concrete 3 (3) Material science and engineering of Portland cement concrete. Topics include physical and chemical properties of cements; mixture proportioning; mixing; placement; curing techniques; specifications, tests and evaluation of fresh and hardened concrete; durability issues; and considerations in specialized applications. Prq: CE 3510 or consent of instructor.

CE 8270 Special Cements and Concrete 3 (3) Study of material science and engineering aspects of specialty concretes that are used in unique civil engineering applications, including high-strength concrete, high-performance concrete, highly flowable concrete, underwater concrete, shotcrete and others. Exposes students to properties and applications of specialty cements and admixtures that are often used in these special applications. Prq: CE 8260.

CE 8280 Repair and Rehabilitation of Concrete Structures 3 (3) Provides students with a knowledge of different types of failures in concrete associated with material durability, construction and design (load) related failures. Also provides knowledge to identify, assess and remediate damage in concrete pavements and structures. Introduces the concepts and tools related to structural health monitoring. Prq: CE 8260.

CE 8290 Geosynthetics 3 (3) Study of geosynthetics including geotextiles, geogrids, geomembranes, geonets, geosynthetic clay liners, geopipe and geocomposites which are used in many aspects of civil engineering for soil structures, retaining walls, pavement construction and rehabilitation, drainage, filtration and containment facilities. Covers production of geosynthetics, material properties, design aspects and field installation. Prq: CE 3210 and CE 3510.

CE 8320 Capital Project Management Fundamentals 3 (3) Fundamental concepts of designing and constructing capital projects; what they are, why they are done, who is involved and how to best design and build them; phases of a capital project; and variations of organizational and contractual structures used for capital projects. Prq: Consent of instructor.

CE 8330 Capital Project Controls 3 (3) Principles and best practices of project controls for capital construction projects, including conceptual and detail estimating, scheduling and earned value management (EVM); development of project baseline incorporating scope, schedule and budget; use of baseline to monitor and manage cost and schedule performance; and shortcomings of EVM. Prq: CE 8320 and consent of instructor.

CE 8340 Key Topics in Capital Project Management 3 (3) Investigates key topics associated with planning and managing capital construction projects, how these topics are integrated into a capital construction project management plan that achieves business and project objectives and how the project team uses the project management plan to successfully complete the construction project. Prq: CE 8320 and consent of instructor.

CE 8350 Construction Project Modeling 3 (3) Mathematical and computer models are used to simulate construction operations. Covers linear models and optimization applications to construction materials, scheduling and equipment allocation; typical computer models used in construction using simple modeling examples. Prq: CE 3310 or consent of instructor.

CE 8360 Civil Engineering Quality Management 3 (3) Principles of total quality management (TQM) and their applications in the engineering and construction industry; TQM implementation techniques emphasizing the construction environment; concepts of quality assurance (QA) and quality control (QC) in construction.

CE 8370 Construction Specifications and Contracts 3 (3) Elements of specifications delineating responsibilities of all involved parties and identifying courses of action during abnormal circumstances; necessary parts of a contract dealing with governmental regulations and institutional preferences; licenses, bonds, insurance and taxes. Prq: CE 3310 or consent of instructor.

CE 8380 Materials Management 3 (3) Functions of construction materials management including design interface, purchasing, expediting, transportation, field control and warehousing; design and application of integrated materials management computer systems; new technology that impacts materials management including bar coding, electronic data interchange and voice recognition. Prq: Consent of instructor.

CE 8390 Sustainable Infrastructure Systems 3 (3) Covers sustainable infrastructure systems with emphasis on science-based tools to design and analyze these systems. Examines theoretical background and specific cases for topics including life-cycle assessment, systems analysis and economic valuation for sustainability. Prq: CE 4360 or consent of instructor.

CE 8400 Project Management Applications 3 (3) Quantitative tools for effective management and control of engineered projects from design through construction; cost coding and control, advanced schedule management techniques and quality management principles; extensive hands-on use of the microcomputer. Prq: CE 4330 and CE 4340; or consent of instructor.

CE 8460 Flow in Open Channels 3 (3) Free surface flow problems; applications of digital computer; concepts of boundary layer theory; uniform and varied flow; hydraulic jump; design criteria for prismatic channels and transitions; applications of unsteady flow. Prq: CE 3420 or consent of instructor.

CE 8510 Reliability 3 (3) Elements of probabilistic methods; classical theory of structural reliability and reliability-based design methods. Term project required on reliability design in a relevant field of civil engineering.

CE 8530 Applications in Traffic Engineering 3 (2) Highway capacity analysis; design of unsignalized intersections; intelligent transportation systems; parking; traffic signal coordination; microscopic and macroscopic traffic simulation. Prq: CE 4100 or consent of instructor. Coreq: CE 8531.

CE 8531 Applications in Traffic Engineering Laboratory 0 (3) Non-credit laboratory to accompany CE 8530. Coreq: CE 8530.

CE 8540 Travel Demand Forecasting 3 (2) In-depth coverage of travel-demand forecasting theory and the four-step process; site impact analysis; disaggregate demand models. Students work in groups to develop a computer-based travel forecasting model for a small city. Prq: CE 4120 or consent of instructor. Coreq: CE 8541.

CE 8541 Travel Demand Forecasting Laboratory 0 (3) Non-credit laboratory to accompany CE 8540. Coreq: CE 8540.

CE 8550 Transportation Seminar 1 (1) Practical discussion of the transportation profession featuring faculty and off-campus experts. Course is highlighted by a retreat where students present their transportation research.

CE 8600 Advanced Fluid Mechanics 3 (3) Laminar and turbulent flows; boundary layer and free shear flows (jets, wakes, etc.); descriptions of velocity, shear stress and pressure measurements, and aerodynamic drag.

CE 8610 Mechanics of Sediment Transport 3 (3) Characterization of sediments; physical principles governing fluvial, estuarial and coastal transport of cohesionless and cohesive sediments, including incipient motion, stable channel design, bedforms, and bedload and suspended transport. Prq: CE 3420 or consent of instructor.

CE 8680 Environmental Fluid Mechanics and Hydraulics 3 (3) Study of turbulence and basic flow equations as they impact the environment. Includes slender flows including circular and plane turbulent jets, jets in crossflows, wall, surface jets and plumes; near-field and far-field analysis of discharge in rivers including continuous momentum discharges, nonbouyant plumes and passive slugs; mixing in lakes and reservoirs; and stratified flows.

CE 8750 Numerical Models in Hydraulics 3 (3) Students learn applications of numerical modeling, finite difference, finite volume and finite element, as tools for solving complex problems in the areas of hydraulics/fluid mechanics. Students learn techniques of developing and analyzing computational models for parabolic, elliptic and hyperbolic equations used in the area of hydraulics. Prq: CE 3420 or consent of instructor.
CHEMISTRY

CH 6010 Organometallic Chemistry 3 (3) Organometallic compounds are useful in applications ranging from large-scale industrial reactions to antibiotics, and this versatility arises from the chemically unique metalcarbon bond. Corequisite begins with fundamental coordination chemistry, then progresses through ligand substitution, oxidative addition/reductive elimination, catalytic transformations and polymerization reactions. Includes honors sections. Prereg: Consent of instructor.

CH 6020 Inorganic Chemistry 3 (3) Basic principles of inorganic chemistry are discussed with special emphasis on atomic structure, chemical bonding, solid state, coordination chemistry, organometallic chemistry, and acid-base theories. The chemistry of certain selected elements is treated. Prereg: CH 3310 and CH 3320.

CH 6040 Bioinorganic Chemistry 3 (3) Covers fundamentals of bioinorganic chemistry with review of necessary inorganic and biochemical concepts. Topics include metal uptake, transport, and storage in biological systems; functions of metals in proteins; metal ion interactions with nucleic acids; physical methods used in bioinorganic chemistry; heavy element toxicity; radiopharmaceuticals and other metallotherapeutics. Prereg: BCHM 3010 or CH 2050.

CH 6110 Instrumental Analysis 3 (3) Principles of operation and application of modern chemical instrumentation in the field of analytical chemistry. Topics include basic electronics, statistics, optical, mass, magnetic resonance, electron and x-ray spectroscopies, radiochemistry, and separation science. Prereg: CH 3310 and CH 3320.

CH 6140 Bioanalytical Chemistry 3 (3) Survey of selected areas of importance in bioanalytical chemistry. Fundamental principles, advanced topics, and applications of analytical measurements of biomolecules, bioassays, immunoassays, separations, mass spectrometry, method validation, macromolecular crystallography, microscopy, and imaging. Prereg: CH 3130 and 4110; or consent of instructor.


CH 6250 Medicinal Chemistry 3 (3) Survey of the pharmaceutical drug discovery process. Covers discovery of candidate compounds, bioassay methods, and associated regulatory and commercial issues. Case studies are selected from the current literature. Prereg: CH 2240 or consent of instructor.

CH 6270 Organic Spectroscopy 3 (2) Survey of modern spectroscopic techniques used in the determination of molecular structure. Emphasizes the interpretation of spectra: nuclear magnetic resonance, ultraviolet, infrared, mass spectroscopy, optical rotatory dispersion, and circular dichroism. Students are expected to have completed one year each of organic chemistry and physical chemistry. Coreq: CH 6271.

CH 6271 Organic Spectroscopy Laboratory 0 (3) Non-credit laboratory to accompany CH 6270. Coreq: CH 6270.

CH 6350 Atomic and Molecular Structure 3 (3) Introduction to quantum theory and its application to atomic and molecular systems. Topics include harmonic oscillator, hydrogen atom, atomic and molecular orbital methods, vector model of the atom, atomic spectroscopy, and molecular spectroscopy. Prereg: CH 3320 or consent of instructor.

CH 6510 Frontiers in Polymer Chemistry 3 (3) Survey of selected areas of current research in polymer science with particular emphasis on polymer synthesis. Although a text is required for review and reference, course is primarily literature based and focused on areas of high impact to multidisciplinary technology. Prereg: CH 2230 and CH 2240 and MSE 4150 or consent of instructor.

CH 6710 Teaching Chemistry 3 (3) Study of topics in chemistry addressed in the context of constructivist methodologies. Also considers laboratory work and management, laboratory safety, and the use of technology in the chemistry classroom. Prereg: 3000-level chemistry course or high school teaching experience or consent of instructor.

CH 7040 Selected Topics for Chemistry Teachers 1-6 (1-6) Directed individual study in designing experiments and teaching materials or an in-depth study of one or more advanced topics. For graduate students in Elementary and Secondary Education. May be repeated, but only if different topics are covered. Offered spring semester of odd-numbered years only. Coreq: CH 7041.

CH 7041 Selected Topics for Chemistry Teachers Laboratory 0 (99) Non-credit laboratory to accompany CH 7040. Coreq: CH 7040.

CH 8000 Professional Development Issues in Chemistry 1 (1) Covers development of professional behavior for graduate students in chemistry, including communication skills, teaching techniques, research ethics, career management, “grantsmanship,” and intellectual property issues in science. Prereg: Graduate standing in Chemistry.

CH 8050 Theoretical Inorganic Chemistry 3 (3) Application of group theory to structure and properties of inorganic molecules. Offered spring semester of odd-numbered years only. Prereg: CH 4350 or consent of instructor.

CH 8070 Chemistry of the Transition Elements 3 (3) Structure, spectroscopy and Reactivity of transition metals and their compounds. Offered fall semester only.

CH 8080 Chemistry of the Nonmetallic Elements 3 (3) Development and application of a bonding model for descriptive inorganic chemistry of boron, carbon, silicon, nitrogen, phosphorus, oxygen and sulfur. Offered spring semester of odd-numbered years only.

CH 8090 Chemical Applications of X-Ray Crystallography 3 (2) Physical description of the crystal lattice, symmetry in crystals, X-ray diffraction, modern methods of structure determination, and chemical interpretation of structural results. Offered spring semester of odd-numbered years only. Prereg: CH 3310 and CH 3320; or consent of instructor. Coreq: CH 8091.

CH 8091 Chemical Applications of X-Ray Crystallography Laboratory 0 (2) Non-credit laboratory to accompany CH 8090. Coreq: CH 8090.

CH 8120 Chemical Spectroscopic Methods 3 (2) Emission and absorption spectroscopy, chemical microscopy, X-ray diffraction, and fluorescence techniques in analytical chemistry; theory and operation of instruments. Coreq: CH 8121.

CH 8121 Chemical Spectroscopic Methods Laboratory 0 (2) Non-credit laboratory to accompany CH 8120. Coreq: CH 8120.

CH 8130 Electrochemical Science 3 (3) Theory and experimental study of electrochemical thermodynamics, electrified interfaces, interfacial charge transfer, electrolyte solutions, electrode processes, and membrane electrochemistry; amperometric, voltammetric, electrolytic and potentiometric methods; practical applications of electrochemistry in analysis, materials synthesis and energy technology. Prereg: Graduate standing in Chemistry or Chemical Engineering or consent of instructor.

CH 8140 Analytical Imaging 3 (3) Covers fundamental principles and application of major imaging techniques, including light, electron and scanning probe microscopy, magnetic resonance imaging, and computer tomography. Students are expected to have completed coursework in physics, physical chemistry or the equivalent or to receive consent of instructor.

CH 8150 Mass Spectrometry 3 (3) The fundamental and practical aspects of mass spectrometry are presented. Topics include vacuum technology, ion optics, mass analyzers, ionization techniques, and hyphenated methods. Prereg: Undergraduate students may receive consent of instructor to enroll in this course.

CH 8160 Separation Science 3 (3) Fundamental thermodynamic and kinetic concepts of separation and practical aspects of current separation techniques used in analytical chemistry. Offered spring semester of odd-numbered years only.

CH 8180 Surface and Thin Film Analysis 3 (2) Fundamental principles underlying the most commonly employed techniques for surface and thin films analysis. Representative techniques include atomic force microscopy, scanning electron microscopy, secondary ion mass spectrometry, Auger electron spectroscopy and Rutherford backscattering. Laboratory exercises give insights into analytical methods. Coreq: CH 8181.

CH 8181 Surface and Thin Film Analysis Laboratory 0 (2) Non-credit laboratory to accompany CH 8180. Coreq: CH 8180.
CH 8210 Organic Chemistry I 3 (3) Theoretical concepts of organic chemistry, stereochemistry and mechanisms of organic reactions. Offered fall semester only. Preq: CH 4210 or satisfactory performance on the organic chemistry placement examination.

CH 8220 Organic Chemistry II 3 (3) Continuation of CH 8210; mechanisms of organic reactions including photochemistry and Woodward-Hoffman rules; modern synthetic organic chemistry. Offered spring semester only. Preq: CH 8210 or consent of instructor.

CH 8300 Fundamentals of Physical Chemistry 3 (3) Principles of classical thermodynamics, chemical kinetics and quantum chemistry. Offered fall semester only. Preq: CH 3310.

CH 8310 Chemical Thermodynamics 3 (3) Classical thermodynamics emphasizing theory and significance of energetics and systems of variable composition. Offered fall semester of odd-numbered years only. Preq: CH 3310.

CH 8340 Statistical Thermodynamics 3 (3) Study of statistical thermodynamics including ensemble method, ideal gases, internal degrees of freedom, solid state, imperfect gases, distribution function method in fluids, and time-dependent fluctuations. Preq: CH 8310.

CH 8350 Chemical Kinetics 3 (3) Rate processes and reaction mechanisms; order of reaction; theory of rate processes; relation of reaction rates to mechanism; homogeneous and heterogeneous catalysis; experimental methods; chain reactions; diffusion; effects of solvent, temperature and pressure on reaction rates and mechanisms. Lectures are supplemented by assigned problems, paper and oral examination of topic of special interest to the student. Offered spring semester of odd-numbered years only.

CH 8370 Quantum Chemistry 3 (3) Mathematical and conceptual formulation of quantum theory of electronic structure of atoms and molecules; eigenvalue solutions of one-dimensional Schrödinger equation and application of this method to chemical problems. Offered fall semester of odd-numbered years only.

CH 8380 Computational Chemistry 3 (3) Theoretical methods and software used in computational chemistry; quantum chemical methods including molecular orbital methods and density functional theory; classical simulation techniques including potential energy functions, molecular mechanics, molecular dynamics and Monte Carlo. Advanced topics vary with interests of students. Preq: CH 3310 and CH 3320.

CH 8400 Techniques of Experimental Chemistry 3 (1) Theory and practice in major experimental techniques used in chemical research; chromatography; NMR, IR, visible, UV, and ORD/CD spectrophotometry; glassblowing and high vacuum techniques; mass spectrometry; ESR; Mössbauer spectrometry and tracer analysis. Consec: CH 8401.

CH 8401 Techniques of Experimental Chemistry Laboratory 0 (6) Non-credit laboratory to accompany CH 8400. Consec: CH 8400.

CH 8410 Chemical Applications of NMR Spectroscopy 3 (2) Basic concepts of NMR spectroscopy with application to organic, inorganic, physical and analytical chemistry; design of spectroscopic experiments and interpretation of spectra; modern techniques including multiple, multinuclear and two-dimensional methods. Offered fall semester only. Preq: CH 3310 and CH 3320; or consent of instructor. Consec: CH 8411.

CH 8411 Chemical Applications of NMR Spectroscopy Laboratory 0 (2) Non-credit laboratory to accompany CH 8410. Consec: CH 8410.

CH 8420 Actinide Chemistry 3 (3) Chemical and physical aspects of actinide metals and compounds (including properties, structure and bonding, reactions, kinetics, thermodynamics), coordination and solution chemistry, behavior and speciation in the environment, separation and purification, chemistry of the nuclear fuel cycle and waste treatment and related topics; fundamental concepts, history and recent developments. Preq: Consent of instructor. May also be offered as EES 8420.

CH 8510 Graduate Student Seminar 1-2 (1-2) Students and faculty review current topics in chemistry. May be taken more than one semester.

CH 8520 Departmental Seminar 1-2 (1-2) Off-campus speakers are invited to present aspects of their research to the chemistry faculty and graduate students every week during the academic year. Some of these talks may form the basis for cumulative examination questions. Attendance is mandatory. May be taken more than one semester. Students are expected to have earned a bachelor’s degree in an approved major before enrolling in this course.

CH 8600 Chemical Biology 3 (3) Covers fundamentals of chemical biology by examining the structure, function, bonding and reactivity of nucleic acids, proteins, carbohydrates and lipids. Topics are covered from the perspective of organic, inorganic, analytic and physical chemistry. Credit will be given for only one of CH 8600 or BCHM 6310. Students are expected to have completed undergraduate coursework in organic, inorganic, physical and analytic chemistry; or to have obtained consent of instructor before enrolling in this course.

CH 8910 Master’s Thesis Research 1-12 (1-12) Master’s Thesis Research

CH 9000 Selected Topics in Inorganic Chemistry 1-4 (1-4) Metal-metal bonding; homogeneous catalysis; photochemistry; bioinorganic chemistry; solid state chemistry. Topics vary with interests of students. May be repeated for credit if different topics are covered.

CH 9100 Selected Topics in Analytical Chemistry 1-4 (1-4) New techniques and their applications in analytical chemistry; laser methods; data acquisition processing; electronics, instrument/computer interfacing; field methods of sampling and analysis. Topics vary with interests of students. May be repeated for credit, but only if different topics are covered.

CH 9200 Selected Topics in Organic Chemistry 1-4 (1-4) Heterocyclic compounds; stereochemistry; natural products; organometallic chemistry; photochemistry. Topics vary with interests of students. May be repeated for credit, but only if different topics are covered.

CH 9300 Selected Topics in Physical Chemistry 1-4 (1-4) Special problems in molecular spectroscopy, molecular orbital treatments, applications of group theory to chemical structure, irreversible thermodynamics and special topics in statistical mechanics. Topics vary with interests of students. May be repeated for credit, but only if different topics are covered.

CH 9910 Doctoral Dissertation Research 1-12 (1-12) Doctoral Dissertation Research

CHE 6010 Transport Phenomena 3 (3) Mathematical analysis of single and multidimensional steady-state and transient problems in momentum, energy, and mass transfer. Both the similarities and differences in these mechanisms are stressed. Preq: CHE 3320 and MATH 2080.

CHE 6120 Polymer Engineering 3 (3) Design-oriented course in synthetic polymers. Topics include reactor design used in polymer production, effect of step versus addition kinetics on reactor design, epoxy curing reactions, polymer solubility, influence of polymerization and processing conditions on polymer crystallinity. Preq: CH 2240 and CH 3320.

CHE 6450 Selected Topics in Chemical Engineering 3 (3) Topics not covered in other courses, emphasizing current literature, research and practice of chemical engineering. Topics vary from year to year. May be repeated, but only if different topics are covered. Preq: Consent of instructor.

CHE 6500 Chemical Reaction Engineering 3 (3) Review of kinetics of chemical reactions and an introduction to the analysis and design of chemical reactors. Topics include homogeneous and heterogeneous reactions, batch and continuous flow reaction systems, catalysis, and design of industrial reactors. Preq: CHE 3210 and CHE 3300 and CH 3320.

CHE 8300 Advanced Transport Phenomena 3 (3) Analysis of heat, mass and momentum transfer; derivation and application of the governing equations; solution of steady and unsteady-state multi-dimensional problems in fluid flow, heat transfer and mass transfer.

CHE 8540 Chemical Engineering Thermodynamics 3 (3) Study of equilibria of physical and chemical systems and generalized properties of hydrocarbons. Includes application of thermodynamic methods in equipment design.

CHE 8550 Chemical Engineering Kinetics 3 (3) Kinetics of chemical reactions, particularly in design and operation of chemical reactors.

CHE 8640 Applied Numerical Methods in Process Simulation 3 (3) Numerical solution techniques as applied to chemical process systems; finite difference techniques for partial differential equations stressing applied numerical methods rather than theoretical numerical analysis. Standard methods for ordinary differential equations are reviewed. May also be offered as EES 8640. Preq: Consent of instructor.

CHE 8680 Polymer Processing 3 (3) Processing of polymeric materials; polymer flow characterization; extrusion; mixing; filtration; injection molding; fiber and film formation; physical science principles such as fluid flow, heat transfer, crystallization and rheology applied to polymer processing operations.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>CHe 9910</td>
<td>Communication Studies</td>
<td>1-6 (1-6)</td>
</tr>
<tr>
<td>COMM 6511</td>
<td>Film Theory and Criticism Laboratory</td>
<td>0 (3)</td>
</tr>
<tr>
<td>COMM 6640</td>
<td>Advanced Organizational Communication</td>
<td>3 (3)</td>
</tr>
<tr>
<td>COMM 6700</td>
<td>Communication and Health</td>
<td>3 (3)</td>
</tr>
<tr>
<td>COMM 6910</td>
<td>Classical Rhetoric</td>
<td>3 (3)</td>
</tr>
<tr>
<td>COMM 6920</td>
<td>Modern Rhetoric</td>
<td>3 (3)</td>
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<tr>
<td>COMM 7000</td>
<td>Communication Pedagogy</td>
<td>1 (1)</td>
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<tr>
<td>COMM 8000</td>
<td>Communication Research Methods I</td>
<td>3 (3)</td>
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<tr>
<td>COMM 8020</td>
<td>Communication Theory II</td>
<td>3 (3)</td>
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<tr>
<td>COMM 8040</td>
<td>Fundamentals of Health Communication</td>
<td>3 (3)</td>
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<tr>
<td>COMM 8050</td>
<td>Communication and Social Movements</td>
<td>3 (3)</td>
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<tr>
<td>COMM 8060</td>
<td>Health Communication and Culture</td>
<td>3 (3)</td>
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<tr>
<td>COMM 8070</td>
<td>Health Communication Campaign Planning and Evaluation</td>
<td>3 (3)</td>
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<tr>
<td>COMM 8080</td>
<td>Representation and Popular Culture</td>
<td>3 (3)</td>
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<tr>
<td>COMM 8090</td>
<td>Communication, Culture and the Social Net</td>
<td>3 (3)</td>
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<tr>
<td>COMM 8100</td>
<td>Communication Research Methods I</td>
<td>3 (3)</td>
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<tr>
<td>COMM 8110</td>
<td>Communication Research Methods II</td>
<td>3 (3)</td>
</tr>
<tr>
<td>COMM 8270</td>
<td>Sports Media</td>
<td>3 (3)</td>
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</table>
COMM 8400 Selected Topics 3 (3) Independent/ directed study; tutorial work in linguistics, profes- sional communication, or American, British or European literature not offered in other courses. May also be offered as AAH 8400 or ENGL 8400. Preq: Consent of director of MA in English or MA in Professional Communication program.

COMM 8500 Research Methods in Professional Communication 3 (3) Covers various research methods with emphasis on humanistic and empiri- cal inquiry. Readings and research examine how professional communication creates new knowl- edge and affects the daily lives of others. May also be offered as ENGL 8500.

COMM 8560 Trends in Public Relations Theory and Research 3 (3) Seminar surveys the major theoretical approaches to public relations, as well as major and recent trends in public relations research and theory development.

COMM 8640 Communication and Organizing 3 (3) Explores theoretical and research literature on hu- man communication and organizing processes from numerous methodological perspectives. Topics may include organizational culture, organizational socialization, power and politics, identification and communication networks and technology.

COMM 8690 Political Communication 3 (3) Semi- narin examines various forms of political communi- cation through the application of multiple critical methodologies. Participants become familiar with traditional public address scholarship and con- temporary study of campaigns, policy, leadership, mass media and popular culture.

COMM 8710 Leadership Communication 3 (3) Develops ability and knowledge of communicative aspects of leadership. Students integrate theories and practices of persuasion, motivation and media to actualize a leadership vision. Students explore issues and research in ethical and intercultural ap- plications, including implications of institutional structures and their impact on society.

COMM 8740 Special Topics in Communication Studies 3 (3) Varying topics within the field of communication studies. May be repeated for a maximum of six credits, but only if different top- ics are covered.

COMM 8900 Communication Studies Graduate Internship 3 (3) Preplanned, preapproved, faculty- supervised internship provides Communication Studies graduate students with 8-10 hours per week of field experience in areas related to their curriculum. Unpaid internship provides applied component to advanced study of communication theory and professional development for industry and research careers. May be repeated for a maximum of six credits. Preq: Consent of advisor.

COMM 8910 Master’s Thesis Research 1-9 (1-9) Students complete research toward production of a Master’s thesis. A maximum of six hours may be applied toward a degree, though additional hours may be taken for credit. May be repeated for a maximum of nine credits. Preq: Successful completion of core program requirements and all additional courses as approved by the department director of graduate studies.

COMM 8990 Independent Study 1-3 (1-3) Course for graduate students with special interests or proj- ects in communication studies outside the scope of existing courses. Preq: Consent of instructor.

COMPUTER SCIENCE

CPSC 6040 Computer Graphics Images 3 (3) Presents the theory and practice behind the generation, manipulation and visualization of two-dimensional digital images within a computer graphics context. Image representation and storage, sampling and reconstruction, color systems, affine and general warps, enhancement and morphology, composit- ing, morphing, and non-photorealistic transforma- tions. Students are expected to have completed coursework in data structures and linear algebra.

CPSC 6050 Computer Graphics 3 (3) Computa- tional, mathematical, physical and perceptual principles underlying the production of effective three-dimensional computer graphics imagery. Stu- dents are expected to have completed coursework in data structures and linear algebra.

CPSC 6060 General Purpose Computation on Graphical Processing Units 3 (3) Instruction in the design and implementation of highly parallel, GPU-based solutions to computationally inten- sive problems from a variety of disciplines. The OpenCL language with interoperable OpenCL components is used. Applications to models of physical systems are discussed in detail. Students are expected to have completed coursework in data structures and linear algebra.

CPSC 6100 Virtual Reality Systems 3 (3) Design and implementation of software systems necessary to create virtual environments. Discusses techniques for achieving real-time, dynamic display of pho- torealistic, synthetic images. Includes hands-on experience with electromagnetically-tracked, head- mounted displays and requires, as a final project, the design and construction of a virtual environ- ment. Students are expected to have completed coursework in data structures.

CPSC 6120 Eye Tracking Methodology and Applications 3 (3) Introduction to the human visual system; visual perception; eye movements; eye tracking systems and applications in psychol- ogy, industrial engineering, marketing, and com- puter science; hands-on experience with real time, corneal-reflection eye trackers, experimental issues. Final project requires the execution and analysis of an eye tracking experiment. Students are expected to have completed coursework in data structures and statistics.

CPSC 6140 Human and Computer Interaction 3 (3) Survey of human and computer interaction, its literature, history, and techniques. Covers cognitive and social models and limitations, hardware and software interface components, design methods, support for design, and evaluation methods. Stu- dents are expected to have completed coursework in data structures.

CPSC 6160 2-D Game Engine Construction 3 (3) Introduction to tools and techniques necessary to build 2-D games. Techniques draw from subject areas such as software engineering, algorithms, and artificial intelligence. Students employ tech- niques such as sprite animation, parallax scrolling, sound, AI incorporated into game sprites, and the construction of a game shell. Students are expected to have completed coursework in data structures.

CPSC 6200 Computer Security Principles 3 (3) Covers principles of information systems secu- rity, including security policies, cryptography, authentication, access control mechanisms, system evaluation models, auditing, and intrusion detect- ion. Computer security system case studies are analyzed. Students are expected to have completed coursework in operating systems and networking.

CPSC 6240 System Administration and Security 3 (3) Covers topics related to the administration and security of computer systems. Primary emphasis is on the administration and security of contem- porary operating systems. Students are expected to have completed coursework in operating systems and networking.

CPSC 6280 Design and Implementation of Pro- gramming Languages 3 (3) Overview of program- ming language structures and features and their implementation. Control and data structures found in various languages are studied. Also in- cludes runtime organization and environment and implementation models. Students are expected to have completed coursework in assembly language and formal language theory.

CPSC 6550 Computational Science 3 (3) Introduc- tion to the methods and problems of computa- tional science. Uses problems from engineering and science to develop mathematical and computa- tional solutions. Case studies use techniques from Grand Challenge problems. Emphasizes the use of networking, group development, and modern programming environments. Students are expected to have completed coursework in calculus and linear algebra.

CPSC 6620 Database Management Systems 3 (3) Introduction to database/data communications concepts as related to the design of online infor- mation systems. Problems involving structuring, creating, maintaining, and accessing multiple-user databases are presented and solutions developed. Comparison of several commercially available teleprocessing monitor and database management systems is made. Students are expected to have completed coursework in data structures.

CPSC 6630 On-line Systems 3 (3) In-depth study of the design and implementation of transaction processing systems and an introduction to basic communications concepts. A survey of commer- cially available software and a project using one of the systems are included. Preq: CPSC 6620.
CPSC 6720 Software Development Methodology
3 (3) Advanced topics in software development methodology. Techniques such as chief programmer teams, structured design and structured walkthroughs are discussed and used in a major project. Emphasizes the application of these techniques to large scale software implementation projects. Also includes additional topics such as mathematical foundations of structured programming and verification techniques. Students are expected to have completed coursework in software engineering.

CPSC 6810 Selected Topics I
1-3 (1-3) Areas of computer science in which non-standard problems arise. Innovative approaches to problem solutions which draw from a variety of support courses are developed and implemented. Emphasizes independent study and projects. May be repeated, but only if different topics are covered.

CPSC 6820 Special Topics in Computing
3 (3) In-depth treatment of topics not fully covered in regular courses. Topics vary from semester to semester. May be repeated, but only if different topics are covered.

CPSC 7400 Computer Science for High School Teachers I
3 (3) Modern problem-solving and programming methods for high school teachers; algorithm development, software life cycle concepts, system hardware and software components and an introduction to programming in PASCAL. Restricted to graduate students and in-service teachers in secondary education. Students are expected to have completed coursework in introductory computer programming before enrolling in this course. Coreq: CPSC 7401.

CPSC 7401 Computer Science for High School Teachers I Laboratory
0 (2) Non-credit laboratory to accompany CPSC 7400. Coreq: CPSC 7404.

CPSC 8040 Data Visualization
3 (3) Introduction to material on the theory and practice of designing effective visualizations of data from numerous sources. A broad overview of the field is presented, covering principles, methods and techniques foundational to both information and scientific visualization. Students are expected to have basic programming skills and introductory knowledge of linear algebra and calculus. Previous coursework in computer graphics is helpful but not required.

CPSC 8050 Advanced Computer Graphics
3 (3) Advanced techniques used in the artificial rendering of natural scenes; current practice in computer graphics; full software implementation of each technique; extensive coding. Prereq: CPSC 6050.

CPSC 8070 3D Modeling and Animation
3 (3) Foundation principles and practice of modeling, animating and rendering of 3D computer graphics scenes. Students complete a series of projects using industry standard software. Topics include modeling techniques, technical animation, rigging, materials, lighting, scripting and post production. Prereq: Digital Production Arts major.

CPSC 8080 Advanced Animation
3 (3) Foundation principles of the production of computer animation, from original concept development and character design, through rigging of articulated figures, character animation methods, and digital cinematography. Prereq: CPSC 8070.

CPSC 8090 Rendering and Shading
3 (3) The art and science of lighting and shading for effective computer graphic imagery, including the mathematical, physical and perceptual elements contributing to the simulation of a desired visual look. Shading languages, advanced rendering tools, global illumination effects, production of photoreal and non-photoreal imagery. Prereq: CPSC 8070.

CPSC 8100 Introduction to Artificial Intelligence
3 (3) Problem solving and game playing knowledge representation; expert systems; natural language processing; perception and learning.

CPSC 8110 Character Animation
3 (3) Introduction to state-of-the-art character animation algorithms and techniques and motion perception. Course begins with fundamental methods in computer animation, including transformations, kinematics, motion capture, and motion graphs, and moves into providing an overview of current research in topics such as animation controllers, emotions, gestures and facial animation. Prereq: CPSC 8070 and DPA 6010 or consent of instructor.

CPSC 8150 Special Effects Compositing
3 (3) Video special effects, compositing problems, effects animation, matchmoving and 3D geometry, color and texture reconstruction from 2D images; extensive use of scripting languages and high-end software platforms. Prereq: CPSC 6050 or CPSC 8070.

CPSC 8170 Physically Based Animation
3 (3) Physically based modeling and dynamic simulation techniques as used for the automatic description of motion and geometry for animation and computer graphics. A variety of approaches are explored, with a special emphasis on the use of particle systems to represent complex phenomena.

CPSC 8190 Physically Based Visual Effects
3 (3) The use of physically based dynamic simulation techniques in the production of digital special effects. Course emphasizes tools, techniques and pipeline. Laboratory assignments are done using both commercial software and student's custom code. Prereq: CPSC 8170.

CPSC 8200 Parallel Architecture
3 (3) Study of parallel processing issues including vector and pipeline processors, arrays of processing elements, associative processors, data flow computers, networks of processors. Also includes survey of parallel programming languages, design and implementation of parallel algorithms, and future trends. Students are expected to have completed coursework in computer organization.

CPSC 8220 Case Study in Operating Systems
3 (2) Case study of the design of an operating system. Class periods are devoted to reviewing source code and deducing the structure of the system. Lab exercises require students to make major changes to the system to enhance its performance on particular workloads. Students are expected to have completed coursework in operating systems. Coreq: CPSC 8221.

CPSC 8221 Case Study in Operating Systems Laboratory
0 (2) Non-credit laboratory to accompany CPSC 8220. Coreq: CPSC 8220.

CPSC 8240 Advanced Operating Systems
3 (3) Recent trends in system design and implementation; operating system structures to support reliable secure systems; verification techniques; fault tolerant systems; operating system considerations for closely coupled multiprocessor systems; network operating systems. Students are expected to have completed coursework in operating systems.

CPSC 8270 Translation of Programming Languages
3 (3) Theoretical foundations and algorithms for compiling and interpreting programming languages. Topics include lexical analysis, syntactic analysis, semantics analysis, optimization and code generation. Implementation of a compiler or a major component of a compiler is normally a term project. Students are expected to have completed coursework in formal language theory and survey of programming languages.

CPSC 8280 Theory of Programming Languages
3 (3) Syntax and semantics of programming languages; finite state and pushdown processors; context-free models of syntax; parsing algorithms and semantic models. Students are expected to have completed coursework in formal language theory and survey of programming languages.

CPSC 8290 Advanced Compiler Topics
3 (3) Code generation, register allocation, program optimization, data flow, interprocedural operations, parallel compilation and distributed compilation. Prereq: CPSC 8270.

CPSC 8300 Systems Modeling
3 (3) Fundamental concepts and techniques used in the stochastic modeling of computer and computer-based communication systems. Applications include hardware configuration design, software performance evaluation and reliability estimation of fault-tolerant systems. Prereq: MATH 6000 or MATH 8000.

CPSC 8380 Advanced Data Structures
3 (3) Search trees; data structures for sets; index structures for data bases; data abstraction and automated implementation; implicit data structures; storage compaction of lists; data structures for decision trees; data structures in areas such as computer graphics, artificial intelligence, picture processing and simulation.

CPSC 8390 Foundations of Theoretical Computer Science
3 (3) Preparation for the study of advanced issues in computational complexity, algorithm correctness and inherent limits to computing; set theory and proof techniques; classes of the Chomsky hierarchy. Students are expected to have completed coursework in formal languages and automata.

CPSC 8400 Design and Analysis of Algorithms
3 (3) Basic techniques for design and analysis of algorithms; models and techniques for obtaining upper and lower time and space bounds; time/space trade-offs; inherently difficult problems. Students are expected to have completed coursework in discrete mathematics.

CPSC 8450 Bioinformatics Algorithms
3 (3) Covers algorithms such as dynamic programming for biological problems, including sequence alignment and phylogeny tree constructions; statistical and mathematical modeling of high throughput data, such as differentially expressed genes from microarray data and HMM for gene prediction; graph and network theory for biological networks.
CPSC 8480 Network Science 3 (3) Networks and network models arise in many places, from physical complex systems, communications, and electrical circuits, to social science and bioinformatics. This course teaches the common theory of abstract and real-world networks, including models, metrics, visualization, representation, comparison and organization. Students are expected to have basic programming skills and introductory knowledge of linear algebra, probability and statistics.

CPSC 8510 Software Systems for Data Communications 3 (3) Structure of software systems supporting communications among computing devices having diverse processing and communication capabilities; characterization of data communications software in terms of unified network architectures consisting of several functional layers; evaluation of several network architectures.

CPSC 8520 Internetworking 3 (3) Network architecture and communication protocols underlying the global interoperability of the Internet. Topics include addressing and routing, interconnection of autonomous networks, naming and name resolution, connection management, flow and congestion control and network management. Preq: CPSC 8510 and ECE 6380.

CPSC 8530 Implementation of TCP/IP Protocols 3 (3) Case study of the architecture of a widely-used implementation of the TCP/IP protocol stack. Source code reviews illustrate layered design and use of core kernel services. Student projects include implementation of a complete IP transport protocol. Preq: CPSC 8220 and CPSC 8520.


CPSC 8550 Embedded Network Systems 3 (3) Discusses hardware fundamentals, technology applications, operating systems, programming platforms, software design and implementation, energy conservation techniques, self-stabilization paradigm, routing algorithms, clustering algorithms, time synchronization algorithms and sensor-actuator integration.

CPSC 8620 Database Management System Design 3 (3) Concepts and structures for design and implementation of a DBMS; theoretical foundations for query systems; data modeling and information representation; user interface and internal system design considerations; system performance modeling and measurement; topics from the literature. Preq: CPSC 6620.

CPSC 8630 Multimedia Systems and Applications 3 (3) Principles of multimedia systems and applications; techniques in effectively representing, processing and retrieving multimedia data such as sound and music, graphics, image and video; operating system and network issues in supporting multimedia; advanced topics in current multimedia research. Term project requires implementing some selected components of a multimedia system.

CPSC 8650 Data Mining 3 (3) Study of principles of data mining: concepts and techniques of data analysis including regression, clustering, classification, association, prediction, etc.; efficient data mining algorithms; data mining applications in various areas including market analysis and management, WWW mining, bioinformatics, etc. Course projects for designing and using data mining algorithms in the applications are required. Students are expected to have knowledge of statistics and database systems.

CPSC 8700 Software Design 3 (3) Fundamental concepts of object modeling using object-oriented analysis and design; realistic application of software engineering principles within a variety of problem domains; mainstream language with facilities for object-oriented programming. Students who enroll in this course are expected to be proficient in programming in a procedural language.

CPSC 8710 Foundations of Software Engineering 3 (3) Techniques and issues in software design and development; tools, methodologies and environments for effective design, development and testing of software; organizing and managing the development of software projects. Preq: Enrollment in Computer Science program.

CPSC 8720 Software Specification and Design Techniques 3 (3) Techniques, tools, environments and formal methods for software specification and design; verification of design correctness. Students are expected to have completed coursework in software engineering.

CPSC 8730 Software Verification, Validation and Measurement 3 (3) Proofs of correctness; test planning; static and dynamic testing; symbolic execution; automated testing; verification and validation over the software life cycle; software metrics; software maintenance. Students are expected to have completed coursework in software engineering.

CPSC 8750 Software Architecture 3 (3) Creation, analysis and maintenance of architectures for software systems. Basic principles, patterns and techniques. Quality attributes of the architecture are used to make a quantitative analysis. Students create and analyze two architectures from different domains.

CPSC 8770 Fundamentals of Biometric Systems 3 (3) Methods and principles for the automatic identification/authentication of individuals. Technologies include fingerprint, face, iris and hand geometry. Additional topics include biometric system design, performance evaluation, multi-modal biometrics and ethics/privacy issues.

CPSC 8810 Selected Topics 1-3 (1-3) Advanced topics from current problems of interest in computer science. Topics vary from semester to semester. May be repeated for credit, but only if different topics are covered.

CPSC 8880 Directed Research 1-6 (1-6) Directed individual project supervised by department faculty. To be taken Pass/No Pass only.

CPSC 8910 Master’s Thesis Research 1-12 (1-12) Master’s Thesis Research

CPSC 9400 Topics in Advanced Algorithms 3 (3) Study of selected topics in advanced algorithms drawn from graph algorithms (network flows, matchings, cuts, planarity testing), approximation algorithms (traveling salesman, linear relaxation techniques), distributed algorithms (mutual exclusion, synchronization, self-stabilization), parallel algorithms (parallel prefix, models, sorting), or randomized algorithms (sampling, probabilistic methods, random walks). May be repeated for a maximum of nine credits, but only if different topics are covered. Preq: CPSC 8400.

CPSC 9500 Selected Topics in Computer Science 1-3 (1-3) Study of advanced topics from current problems of interest in computer science. May be repeated for a maximum of 12 credits, but only if different topics are covered. To be taken Pass/No Pass only.

CPSC 9510 Seminar in Algorithms 1-3 (1-3) Advanced topics from current problems of interest in algorithms. May be repeated for credit.

CPSC 9550 Seminar in Programming Languages 1-3 (1-3) Advanced topics from current problems of interest in programming languages. May be repeated for credit.

CPSC 9570 Seminar in Software Engineering 1-3 (1-3) Advanced topics from current problems of interest in software engineering. May be repeated for credit.

CPSC 9810 Seminar in Computer Science 1-3 (1-3) Topics of current research interest. May be repeated for credit.

CPSC 9910 Doctoral Dissertation Research 1-12 (1-12) Doctoral Dissertation Research

CITY AND REGIONAL PLANNING

CRP 6010 Introduction to City and Regional Planning 3 (3) Introduces students from other disciplines to city and regional planning. Spatial and nonspatial areas of the discipline are explored through a wide ranging lecture/seminar program. Preq: Consent of instructor.

CRP 6030 Seminar on Planning Communication 3 (3) In-depth analysis of methods to communicate planning and policy decisions effectively. Familiarizes students with the various communication skills needed by planners, policy makers, and other professionals to become successful practitioners. Preq: Consent of instructor.

CRP 6120 Urban Transportation Planning 3 (3) Consideration of urban travel characteristics, characteristics of transportation systems, transportation and land-use studies, trip distribution and trip assignment models, city patterns and subdivision layout. May also be offered as CE 6120. Preq: CE 3110 or consent of instructor.

CRP 6360 The Nature of Geographic Information Systems (GIS) 3 (2) Introduction to the theory and practical use of Geographic Information Systems (GIS). The course emphasizes geographic and statistical information and how it is represented and analyzed with computers. It introduces the concepts and components of a GIS and how they affect societal issues. Coreq: CRP 6301.
<table>
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<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>CRP 8030</td>
<td>Quantitative Analysis 4 (2) Basic tools of quantitative analysis and planning methods in the context of analytical, procedural and institutional needs of the planner. Students learn data collection, analysis and interpretation of different planning problems. Emphasis is placed on understanding the logic of statistical analysis, methods of planning analysis and policy formation. Prereq: Consent of instructor.</td>
</tr>
<tr>
<td>CRP 8031</td>
<td>Quantitative Analysis Laboratory 0 (6) Non-credit laboratory to accompany CRP 8030. Consen: CRP 8030.</td>
</tr>
<tr>
<td>CRP 8040</td>
<td>Land Use Analysis and Assessment 4 (2) Introduction to basic methods of land use planning including land suitability analysis, land market forecasts and formulating alternative land use plans. Development impact assessment and project appraisal methods are introduced to evaluate land use plans. Prereq: CRP 8030. Consen: CRP 8041.</td>
</tr>
<tr>
<td>CRP 8041</td>
<td>Land Use Analysis and Assessment Laboratory 0 (6) Non-credit laboratory to accompany CRP 8040. Consen: CRP 8040.</td>
</tr>
<tr>
<td>CRP 8050</td>
<td>Planning Theory and History 3 (3) Development of the planning practice and theories of planning process: historical evolution of planning practice in the U.S., social issues in planning, theories of planning and critiques of those theories and ethical issues in planning practice. Prereq: Consent of instructor.</td>
</tr>
<tr>
<td>CRP 8060</td>
<td>Urban Systems and Growth Management 3 (3) Overview of basic principles of resource allocation including public finance and project appraisal techniques. Introduces infrastructure planning and capital improvement plans followed by basic concepts of growth management and an overview of growth management laws and tools. Course is team-taught to address diverse subject matter. Prereq: Consent of instructor.</td>
</tr>
<tr>
<td>CRP 8070</td>
<td>Professional Studio 4 (1) Serves as a vehicle for synthesis and application of skills developed in other courses and includes participation in one or more real-world planning projects in addition to seminars and readings devoted to development of professional practice skills. Prereq: Consent of instructor.</td>
</tr>
<tr>
<td>CRP 8071</td>
<td>Professional Studio Laboratory 0 (9) Non-credit laboratory to accompany CRP 8070. Consen: CRP 8070.</td>
</tr>
<tr>
<td>CRP 8090</td>
<td>Current Issues in Planning 1 (1) Students are exposed to current practice issues in various fields of the planning profession through a series of guest speakers representing various areas of planning practice. The course is organized around various concentration areas of the Clemson MCRP program. Prereq: Enrollment in MCRP program.</td>
</tr>
<tr>
<td>CRP 8130</td>
<td>Fundamentals of Transportation Planning 3 (3) Identifies issues and questions transportation planners face, characterizes policy shaping transportation, instructs on methods to solve transportation planning problems and portrays the political and organizational environment in which transportation planners operate. Students integrate concepts and considerations via a systems approach with sensitivity to the transportation planning environment. Prereq: Consent of instructor.</td>
</tr>
<tr>
<td>CRP 8140</td>
<td>Public Transit 3 (3) Familiarizes students with core concepts and practices in public transit. Course modules examine modes and design, planning issues and organizational environments inherent to public transit, and technical operations. Course concludes with an examination of comprehensive transit systems. Prereq: Consent of instructor.</td>
</tr>
<tr>
<td>CRP 8150</td>
<td>Transportation Innovation 3 (3) Through lectures, seminar discussions and collaborative learning activities, course interaction develops students' transportation knowledge, research and ideas. Students are encouraged to use information already obtained to create visionary planning and interaction skills needed to become transportation leaders. Prereq: CRP 8130.</td>
</tr>
<tr>
<td>CRP 8200</td>
<td>Negotiation and Development Dispute Resolution 3 (3) Skill-building course in conflict resolution and consensus building through bargaining and negotiation, primarily in the design professions. Students play active roles in discovering, applying, reflecting on and critiquing the theories, styles and techniques of conflict resolution and consensus building that work in different types of disputes. Students must be enrolled in a graduate-level design related field of study to enroll in this course.</td>
</tr>
<tr>
<td>CRP 8220</td>
<td>Urban Design 3 (3) Urban design theory and practice covering both project design and regulatory frameworks; analysis of historical precedents and current theories; review of the urban design process, including urban landscape analysis, problem identification, development of alternatives, and plan generation; special focus on form-based codes. Prereq: Consent of instructor.</td>
</tr>
<tr>
<td>CRP 8340</td>
<td>Spatial Modeling Using GIS 3 (2) Use of geographic information systems (GIS) in spatial analysis, information management and synthesis of spatial patterns and processes. Emphasizes developing an operational understanding of the modeling techniques and data used in different applications such as land use allocation, corridor location, site location and market analysis, environmental assessment and cost-benefit analysis. Prereq: CRP 6340 or CRP 8040; or consent of instructor.</td>
</tr>
<tr>
<td>CRP 8350</td>
<td>Spatial Modeling Using GIS Laboratory 0 (3) Non-credit laboratory to accompany CRP 8340. Consen: CRP 8340.</td>
</tr>
<tr>
<td>CRP 8351</td>
<td>GIS and Remote Sensing Applications for Trend Analysis Laboratory 0 (3) Non-credit laboratory to accompany CRP 8350. Consen: CRP 8350.</td>
</tr>
<tr>
<td>CRP 8400</td>
<td>Seminar in Coastal Planning 3 (3) Issues relating to development and conservation of coastal environments, focusing on inherent trade-offs between growth and environmental quality. Discusses ecology and carrying capacity of coastal areas and appropriate management approaches to balance coastal resource demand. Prereq: Consent of instructor.</td>
</tr>
<tr>
<td>CRP 8440</td>
<td>Outdoor Recreation Resource Management and Planning 3 (3) Issues relating to planning and development of natural areas for recreational purposes. Emphasis is on the policy-making process at the federal, state, regional and local levels. May also be offered as PRMT 8440. Prereq: Consent of instructor.</td>
</tr>
<tr>
<td>CRP 8450</td>
<td>Water Policy and Law 3 (3) Surveys the history, science, economics, politics, legal framework and current debates regarding the allocation of freshwater resources in the U.S., with emphasis on relevant Southeastern issues. Scientists, engineers, planners, landscape architects, policy makers and economists will benefit from understanding water allocation and associated conflicts. May also be offered as POST 8450.</td>
</tr>
<tr>
<td>CRP 8850</td>
<td>Research Design 3 (3) Provides opportunity for students in their final year of study in the planning program to develop a proposal for the terminal project or thesis. Students are responsible for completing the research, writing and editing necessary for an acceptable proposal. Prereq: Consent of faculty. Consen: CRP 8600.</td>
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</tbody>
</table>
CRP 8590 Planning Terminal Project 3 (3) Students select, with approval of advisor, and conduct research on individual planning problems of suitable scope. Oral, written, and, where appropriate, visual presentations of solution are required. Students must enroll during final semester. Prereq: CRP 8580.

CRP 8600 Terminal Project/Thesis Proposal 1 (3) Taken in conjunction with CRP 8580, this lab provides students the opportunity to apply concepts learned in CRP 8580 to their own thesis or terminal project research. Coreq: CRP 8580.

CRP 8700 Seminar in Sustainable Development 3 (3) Concept of sustainable development traced from its historical roots through the popularization of the term in the international development literature; scientific basis and the application of sustainability through economic sectors and building practice. Students conduct individual/group research projects. May also be offered as POST 8700.

CRP 8720 Housing Issues in the United States 3 (3) Regulation, stimulation, salvage and replacement of housing through public policy administrative procedures. Specific housing programs are analyzed in detail. Prereq: Consent of instructor.

CRP 8730 Economic Development Planning 3 (3) Economic development planning process, focusing on applied programmatic techniques, especially at the state, local and neighborhood levels. Emphasizes theoretical models, economic development process, private/public partnerships, economic development tools, political context, and economic development planning administration and organization. Prereq: Consent of instructor.

CRP 8890 Selected Topics in Planning 3 (3) Topics emphasizing current literature and results of current research. May be repeated for credit. Prereq: Consent of instructor.

CRP 8900 Directed Studies in City and Regional Planning 1-6 (1-6) Students pursue individual professional interests under guidance of City and Regional Planning graduate faculty. May be repeated for credit.

CRP 8910 Planning Thesis 6 (18) Students, working individually, program a planning problem of appropriate scope and conduct research. Oral, written, and, where appropriate, visual presentations of theses are required. To be taken Pass/No Pass only. Prereq: Consent of faculty.

CRP 8930 City and Regional Planning Internship 1 (3) Ten weeks of supervised professional employment with an approved planning entity. To be taken Pass/No Pass only. Students are expected to have completed two semesters of City and Regional Planning or the equivalent before enrolling in this course.

CRP 8940 Planning Internship Seminar 1 (1) Seminar-based analysis of student internships, enabling students to compare experiences and gain greater understanding of professional practice by reflecting on planning issues. To be taken Pass/No Pass only. Prereq: CRP 8930.

CROP AND SOIL ENVIRONMENTAL SCIENCE

CSEN 7010 Soils and Man 3 (3) Different kinds of soils, their properties, uses, management, conservation and relationship with the environment and other human endeavors.

CSEN 8010 Crop Physiology and Nutrition 3 (3) Basic concepts and physiologic aspects of growth and culture applied to crop management practices. Offered fall semester of odd-numbered years only. Prereq: BIOL 4010 and BIOL 4020.

CSEN 8020 Pedology 3 (3) Current concepts and theories in soil genesis and morphology; advanced study of soil taxonomy. Offered fall semester of odd-numbered years only. Prereq: CSEN 4030.

CSEN 8040 Theory and Methods of Plant Breeding 3 (3) Concepts and principles of plant breeding and genetics as applied to development and maintenance of improved crop varieties; theoretical considerations of various breeding methods. Offered fall semester of even-numbered years only. Prereq: CSEN 4050 or STAT 8010.

CSEN 8050 Soil Fertility 3 (3) Soil properties affecting nutrient availability and plant growth; inventory of major soil groups with reference to plant stress features; behavior of essential elements in soils in relation to plant availability; current soil fertility research. Offered spring semester of even-numbered years only. Prereq: CSEN 4030 or CSEN 4520.

CSEN 8060 Special Problems 1-3 (1-3) Research not related to a thesis.

CSEN 8070 Soil Physics 4 (3) Principles and applications of transport of water and solutes in soils emphasizing unsaturated flow phenomenon. Offered fall semester of even-numbered years only. Prereq: MATH 1080. Coreq: CSEN 8071.

CSEN 8071 Soil Physics Laboratory 0 (3) Non-credit laboratory to accompany CSEN 8070. Coreq: CSEN 8070.

CSEN 8080 Soil Chemistry 3 (2) Principles and theories concerning the structure and chemical properties of soil colloids, ion exchange and surface phenomena, chemical equilibria, soil acidity and oxidation-reduction reactions. Offered fall semester of odd-numbered years only. Coreq: CSEN 8081.

CSEN 8081 Soil Chemistry Laboratory 0 (3) Non-credit laboratory to accompany CSEN 8080. Coreq: CSEN 8080.

CSEN 8100 Soil Microbiology 3 (3) Biological nitrogen fixation, mycorrhizal fungi and pesticide interactions in soils with emphasis on microbial-plant-soil relationships. Offered fall semester of even-numbered years only. Prereq: CSEN 6900 or MIRC 6100; and consent of instructor.

CSEN 8120 Crop Ecology and Land Use 3 (3) Concepts and factors affecting adaptation and distribution of crop plants; microclimate and crop response to environmental factors with modifications of microclimate by agricultural operations; interactions among crop plants and between weeds and crop plants under field conditions. Offered fall semester of even-numbered years only.

CSEN 8240 Mode of Action of Growth Substances 4 (3) Study of the physiology and biochemistry of both natural and synthetic growth regulators, hormones, growth retardants, herbicides and other inhibitors. Considers methodology and mechanism of action. Offered spring semester of odd-numbered years only. Prereq: BIOL 6010 and BIOL 6020 and general biochemistry; or BIOL 8220; or consent of instructor. Coreq: CSEN 8241.

CSEN 8241 Mode of Action of Growth Substances Laboratory 0 (3) Non-credit laboratory to accompany CSEN 8240. Coreq: CSEN 8240.


CSN 8900 Special Topics in Agronomy 1-3 (1-3) Group discussion of recent developments in agronomic research. May be repeated for a maximum of six credits. Prereq: Consent of instructor.

CONSTRUCTION SCIENCE AND MANAGEMENT

CSM 6550 Reducing Adversarial Relations in Construction 3 (3) Focuses on the study of the delivery of projects and how adversarial relations can affect the successful completion of the venture. Topics include management of human resources, understanding the needs and processes of the participants, where problems lie, methods of avoiding and settling disputes. Prereq: Construction Science and Management or Architecture major, and senior standing; or consent of department chair.

CSM 8520 Construction Management Research 3 (3) Research methodology applied to the construction industry. Prereq: Consent of instructor.

CSM 8600 Construction Financial Planning and Analysis 3 (3) Theory of financial management as it relates to the financial challenges faced by the construction firm. Prereq: Consent of instructor.

CSM 8610 Construction Control Systems 3 (3) Development and analysis of cost, resource and quality control programs for a company's construction projects. Prereq: Consent of instructor.

CSM 8620 Project Management and Negotiations 3 (3) The role of management and unions in the construction industry. Topics include contract negotiation, collective bargaining, dispute resolution and management for productivity improvement. Prereq: Consent of instructor.

CSM 8630 Advanced Planning and Scheduling 3 (3) Analysis and control of construction projects using advanced techniques for planning, scheduling and resources control. Prereq: Consent of instructor.

CSM 8640 Construction Business Strategy and Marketing 3 (3) Techniques for business strategy development and marketing of various types of construction companies. Prereq: Consent of instructor.

CSM 8650 Project Management 3 (3) Theory of project administration and control with special emphasis on the role and responsibilities of the project manager. Prereq: Consent of instructor.
DPA 6000 *Technical Foundations of Digital Production I* 3 (3) The technical, conceptual, and algorithmic foundations of computer graphics. Covers the Unix operating system, scripting, C programming, and an interactive graphics API. Not open to Computer Engineering, Computer Information Systems, or Computer Science majors.

DPA 6010 *Technical Foundations of Digital Production II* 3 (3) The mathematical and algorithmic foundations of computer graphics. Covers spatial data structures, object oriented programming in C++, mathematics for graphics, and 3-D graphics API. Prereq: DPA 6000 or consent of instructor. Not open to Computer Science, Computer Engineering, or Computer Information Systems majors.

DPA 6020 *Visual Foundations of Digital Production I* 3 (6) Presents the visual foundations underlying computer graphics production. Covers perspective, observational drawing, color and value, principles of composition and design, and storyboarding. Incorporates the studio method, involves students in hands-on work and the critique process, and stresses examples from the history of art, animation, and film. Not open to Architecture or Visual Arts majors.

DPA 6030 *Visual Foundations of Digital Production II* 3 (6) Extends the foundational visual principles underlying computer graphics production begun in DPA 4020. Stresses representation of the figure in drawing and the use of cameras. Incorporates the studio method and the critique process, and stresses examples from the history of art, animation, and film. Prereq: DPA 4020 or consent of instructor. Not open to Architecture or Visual Arts majors.

DPA 8600 *Digital Production Studio I* 1-6 (1-6) Students develop as accomplished visual problem solvers in a digital production team setting. As part of the studio experience, students take a production project from concept, through story development, character design, modeling and rigging, animation, lighting, and post production. May be repeated for a maximum of 12 credits. Prereq: Enrollment in the Digital Production Arts program.

DPA 8800 *Graduate Research Studio I* 1-6 (1-6) Students complete a project or projects, under the direction of a faculty advisor, in an area supporting personal goals and vision. Work may be individually or team oriented, and may be of a technical or an artistic nature. May be repeated for a maximum of six credits. Prereq: Enrollment in the Digital Production Arts program.

ECE 6040 *Semiconductor Devices* 3 (3) Consideration of the principles of operation, external characteristics, and applications of some of the more important semiconductor devices presently available. Students are expected to have completed a course comparable to ECE 3200 before enrolling in this course. Additionally, students are expected to have completed, or be concurrently enrolled in, a course comparable to MATH 3110 or MATH 4340 when enrolling in this course.

ECE 6060 *Introduction to Microelectronics Processing* 3 (3) Microelectronic processing, MOS and bipolar monolithic circuit fabrication, thick and thin film hybrid fabrication, applications to linear and digital circuits, fundamentals of device design. Students are expected to have completed a course comparable to ECE 3200 before enrolling in this course. Additionally, students are expected to have completed, or be concurrently enrolled in, a course comparable to MATH 3110 or MATH 4340 when enrolling in this course.

ECE 6180 *Power System Analysis* 3 (3) Study of power system planning and operational problems. Topics include load flow, economic dispatch, fault studies, transient stability, and control of problems. System modeling and computer solutions are emphasized through class projects. Students are expected to have completed courses comparable to ECE 3600 and ECE 3800 before enrolling in this course.

ECE 6190 *Electric Machines and Drives* 3 (3) Performance, characteristics, and modeling of AC and DC machines during steady-state and transient conditions. Introduction to power electronics devices and their use in adjustable speed motor drives. Students are expected to have completed courses comparable to ECE 3210 and ECE 3600 and ECE 3800 before enrolling in this course. Additionally, students are expected to have completed, or be concurrently enrolled in, a course comparable to MATH 4340 when enrolling in this course.

ECE 6220 *Electronic System Design I* 3 (2) Emphasizes the application of theory and skills to the design, building, and testing of an electronic system with both analog and digital components. Application varies each semester. Computer software tools are used extensively in the design process. Students are expected to have completed courses comparable to ECE 3210 and ECE 3300 and ECE 3600 and ECE 3710 and ECE 3810 before enrolling in this course. Coreq: ECE 6221.

ECE 6221 *Electronic System Design I Laboratory* 0 (2) Non-credit laboratory to accompany ECE 6220. Coreq: ECE 6220.

ECE 6290 *Organization of Computers* 3 (3) Computer organization and architecture. Topics include a review of logic circuits, bus structures, memory organization, interrupt structures, arithmetic units, input-output structures, state generation, central processor organization, control function implementation, and data communication. Registered Transfer Language (RTL) for description and design of digital systems. Students are expected to have completed a course comparable to ECE 2720 before enrolling in this course.

ECE 6300 *Digital Communications* 3 (3) Introduction to modern digital communication systems, emphasizing modulation and detection, taking into account the effects of noise. Students are expected to have completed courses comparable to ECE 3170 and ECE 3300 before enrolling in this course.

ECE 6320 *Instrumentation* 3 (3) Theory and analysis of transducers and related circuits and instrumentation. Generalized configurations and performance characteristics of instruments are considered. Transducer devices for measuring physical parameters such as motion, force, torque, pressure, flow, and temperature are discussed. Students are expected to have completed a course comparable to ECE 3210 before enrolling in this course. Additionally, students are expected to have completed, or be concurrently enrolled in, a course comparable to MATH 3110 or MATH 4340 when enrolling in this course.
ECE 6350 Grounding and Shielding 3 (3) Introduc-
tion to electromagnetic compatibility concepts and
techniques for students who will be designing or
working with electronic systems when they graduate.
Topics include electromagnetic interference and
noise control, crosstalk and signal integrity, ground-
ning, filtering, shielding, circuit board layout, lighting
and electrostatic discharge protection. Students are
expected to have completed a course comparable to
ECE 3810 before enrolling in this course.

ECE 6360 Microwave Circuits 3 (3) Analysis of
microwave networks comprising transmission
lines, waveguides, passive elements, interconnects,
and active solid state microwave circuits. Use of
modern CAD tools to design RF/Microwave pas-
sive/active networks. Fabrication of typical circuits.
Students are expected to have completed a course
comparable to ECE 3810 before enrolling in this
course. Additionally, students are expected to have
completed, or be concurrently enrolled in a course
comparable to MATH 3110 or MATH 4340 when
enrolling in this course.

ECE 6380 Computer Communications 3 (3) Digital
data transmission techniques, modems and com-
munications channels, communications software
and protocols, multiprocessors and distributed
processing; concurrency and cooperation of dis-
persed processors.

ECE 6390 Fiber Optics 3 (3) Covers the underlying
principles of design for optical fibers in practical
systems. Examines optical fiber as a waveguide
using wave optics and ray optics. Discusses design
criteria for using mono- and multi-mode fibers.
Other topics include fabrication, measurement.
Students are expected to have completed a course
comparable to ECE 3810 before enrolling in this
course. Additionally, students are expected to have
completed, or be concurrently enrolled in, a course
comparable to MATH 4340 when enrolling in this
course.

ECE 6400 Performance Analysis of Local Computer
Networks 3 (3) Introduction to the design and
performance analysis of local computer networks.
Emphasizes performance analysis of representative
multi-access procedures. Three common types of
networks are considered in detail. Students are
expected to have completed courses comparable to
ECE 2720 and ECE 3170 before enrolling in this
course.

ECE 6420 Knowledge Engineering 3 (3) Introduct-
ion to the theoretical and practical aspects of
knowledge engineering or applied artificial intel-
ligence. Topics include symbolic representation
structures and manipulation, unification, produc-
tion systems and structures, rule-based and expert
systems, planning and AI system architectures;
system design in PROLOG and LISP. Project is
required. Students are expected to have completed
courses comparable to ECE 3220 and ECE 3520
before enrolling in this course.

ECE 6460 Antennas and Propagation 3 (3) Study of
the theoretical and practical aspects of antenna
design and utilization, input impedances, structural
considerations, and wave propagation. Students are
expected to have completed courses comparable to
ECE 3300 and ECE 3810, as well as a course
comparable to either MATH 3110 or MATH 4340,
before enrolling in this course.

ECE 6490 Computer Network Security 3 (1) Hands-
on practice in the administration and security of
modern network service emphasizing intrusion
prevention techniques, detection, and recovery.
Prereq: Graduate standing in Computer Engineering
or Electrical Engineering. Coreq: ECE 6491.

ECE 6491 Computer Network Security Laboratory
0 (4) Non-credit laboratory to accompany ECE
6490. Coreq: ECE 6490.

ECE 6550 Robot Manipulators 3 (3) Analysis of
robot manipulator systems with special focus on
interaction of these technologies with society.
Emphasis is on rigid-link robot manipulator
systems. Topics include history of robot technol-
ogy, kinematics, dynamics, control, and operator
interfaces. Case studies reinforce impact of robot
technology on society and vice versa. Students are
expected to have completed courses comparable to
MATH 2060 and MATH 3110 before enrolling in
this course.

ECE 6570 Fundamentals of Wind Power 3 (3)
Introduces wind turbine systems, including wind
ergy potential and application to power genera-
tion. Topics include wind energy principles, wind
site assessment, wind turbine components, power
generation machinery control systems, connection
to the electric grid, and maintenance. May also
be offered as ME 6570. Students are expected to have
completed a course comparable to ECE 2070 or
ECE 3200 before enrolling in this course.

ECE 6590 Integrated Circuit Design 3 (2) Design
concepts and factors influencing the choice of
technology; fundamental MOS device design; sili-
con foundries, custom and semicustom integrated
circuits; computer-aided design software/hardware
trends and future developments; handson use of
CAD tools to design standard library cells; systems
design considerations, testing, and packaging.
Students are expected to have completed a course
comparable to ECE 3210 before enrolling in this
course. Additionally, students are expected to have
completed, or be concurrently enrolled in, a course
comparable to MATH 3110 or MATH 4340 when
enrolling in this course. Coreq: ECE 6591.

ECE 6591 Integrated Circuit Design Laboratory
0 (2) Non-credit laboratory to accompany ECE
6590. Coreq: ECE 6590.

ECE 6610 Fundamentals of Solar Energy 3 (3)
Introduces solar energy conversion systems. Topics
include environmental benefits of solar energy,
solar thermal systems, concentration solar power,
photovoltaic (PV) cell design and manufacturing,
string of PV system, hybrid photovoltaic/thermal
systems, energy storage, and urban/rural applica-
tions. Students are expected to have completed
courses comparable to ECE 3200 before enrolling
in this course.

ECE 6670 Introduction to Digital Signal Processing
3 (3) Introduction to characteristics, design, and ap-
plications of discrete time systems; design of digital
filters; introduction to the Fast Fourier Transform
(FFT); LSI hardware for signal processing applica-
tions. Students are expected to have completed
courses comparable to ECE 3300 before enrolling
in this course.

ECE 6680 Embedded Computing 3 (2) Principles of
using computing in the larger context of a system.
Topics include bus and processor design types (e.g.
microprocessor, microcontroller, DSP), codes, digi-
tal circuit power management, real time sched-
uling, and embedded operating systems. Lab work
consists of projects on embedded hardware (e.g.
PC-104). Students are expected to have completed
courses comparable to ECE 2230 and ECE 3710
before enrolling in this course. Coreq: ECE 6681.

ECE 6681 Embedded Computing Laboratory 0 (2)
Non-credit laboratory to accompany ECE 6680.
Coreq: ECE 6680.

ECE 6730 Introduction to Parallel Systems 3 (3)
Introduces parallel computer architectures and
their programming. Includes an introduction to
MPI and OpenMP and a number of engineering
problems, including numerical simulations. Intro-
duces scalability analysis. Students are expected to
have completed a course comparable to ECE 3220
or ECE 3290 before enrolling in this course.

ECE 6920 Special Problems 1-3 (1-3) Special assign-
ment in electrical or computer engineering. Some
typical assignments include computer programs,
term papers, technical literature searches, hardware
projects, and design project leadership. May be
taken only once for credit.

ECE 6930 Selected Topics 1-3 (1-3) Classroom study
of current and new technical developments in elec-
trical and computer engineering. May be repeated
for a maximum of six credits, but only if different
topics are covered. Prereq: Consent of instructor.

ECE 7010 Master of Engineering Design Project 1-6
(1-6) Practical problems in engineering analysis and
design culminating in the written report required for
the MEEng degree. To be taken Pass/No Pass only.
May be repeated for a maximum of six credits.

ECE 7200 Digital Communication Engineering 1
3 (1-3) Analysis of modulation and detection for digi-
tal communication engineering systems degraded by
noise. Students are expected to have completed
courses comparable to ECE 3170 and ECE 3300
before enrolling in this course. Prereq: Enrollment
in the Electrical Engineering Master of Engineer-
ing program.

ECE 7570 Error Control Block Coding 3 (3) Analysis
and design of error control coding and
decoding for the reliable transmission of digital
data. Students are expected to have completed
courses comparable to ECE 3170 before enrolling
in this course. Prereq: Enrollment in the Electrical
Engineering Master of Engineering program.

ECE 8101 Analysis of Linear Systems 3 (3) Founda-
tions of linear system analysis; matrix algebra, linear
graph theory and operational mathematics applied
to formulation and solution of system equations in
time and frequency domains.

ECE 8020 Electric Motor Control 3 (3) Dynamic
modeling and analysis of electrical machines for
design of AC and DC drive systems; implementa-
tion of such models on a digital computer; voltage-
fed inverters; pulse width modulation and analysis
techniques for inverters; harmonic generation and
reduction. Students are expected to have completed
courses comparable to ECE 4340 before enrolling
in this course.
Courses of Instruction

ECE 8070 Computer Methods for Power Systems Analysis 3 (3) Electric power system operation; development of models of transmission line components and networks; computer methods for solving linear and nonlinear systems of network equations; operating problems in load flow, scheduling and economic dispatch. Students are expected to have completed a course comparable to ECE 4180 before enrolling in this course.

ECE 8110 Integrated Circuit Design 3 (2) Design concepts and factors influencing the choice of technology; fundamental MOS device design; silicon foundries; custom and semicustom integrated circuits; computer-aided design software/hardware trends and future developments; the hands-on use of CAD tools to design MOS standard cells; systems design, testing and packaging. Students are expected to have completed a course comparable to ECE 4590 before enrolling in this course. Coreq: ECE 8111.

ECE 8111 Integrated Circuit Design Laboratory 0 (2) Non-credit laboratory to accompany ECE 8110. Coreq: ECE 8110.

ECE 8160 Electric Power Distribution System Engineering 3 (3) Radial circuit analysis techniques, feeder and transformer modeling, load modeling, loss minimization and voltage control, causes of power quality problems, motor starting analysis, strategies for analyzing impacts of disturbances. Students are expected to have completed a course comparable to ECE 4180 before enrolling in this course.

ECE 8170 Power System Transients 3 (3) Electrical transients in power systems; frequency domain and time domain techniques for power systems transient analysis; capacitor switching, load switching, fault-induced transients, line reclosing and single pole switching. Students are expected to have completed a course comparable to ECE 4180 before enrolling in this course.

ECE 8180 Random Process Applications in Engineering 3 (3) Theory of random processes emphasizing engineering applications; stochastic convergence and limit theorems; martingales; mean-square calculus; Karhunen-Loeve expansions; systems with stochastic inputs; Poisson processes; shot noise; Weiner processes; white noise processes; Markov systems; queuing systems; and estimation theory. Students are expected to have completed courses comparable to ECE 3170 and ECE 3300 before enrolling in this course.

ECE 8190 Detection and Estimation Theory 3 (3) Theory of statistical testing of hypotheses applied to detection and estimation of communication signal parameters; detection of signals with random amplitude, phase and arrival time in noise; detection of single and multiple observation; estimates and their properties; signal resolution. Pr: ECE 6300 or ECE 8180 or ECE 8200.

ECE 8200 Digital Communication Systems 1 3 (3) Modern communications systems emphasizing modulation and methods of taking into account effects of noise on various systems. Students are expected to have completed courses comparable to ECE 3170 and ECE 3300 before enrolling in this course.

ECE 8201 Digital Communication Systems II 3 (3) Continuation for both ECE 6300 and ECE 8200.

ECE 8220 Information Theory 3 (3) Statistical problems encountered in information handling; relations of probability, information and coding theory; unified treatment of set theory, sample space, random variables, information measure and capacity applied to communication. Students are expected to have completed a course comparable to ECE 3170 before enrolling in this course.

ECE 8230 Integrated Circuit Technology 3 (3) Physical and chemical principles underlying the major processing operations used in the fabrication of integrated circuit semiconductor devices, process simulation, diagnostic testing and factors affecting device yield and reliability. Pr: Consent of instructor.

ECE 8240 Power System Protection 3 (3) Coordination of power system protection components including microprocessor based relay-protective protection of power system, power system disturbance identification and system restoration following a major disturbance. Students are expected to have completed a course comparable to ECE 4180 before enrolling in this course; and are expected to have completed or be concurrently enrolled in a course comparable to MATH 4340 when enrolling in this course.

ECE 8250 Solid-State Electronics 3 (3) Modern physics approach to electrons in solids; elementary quantum mechanics; statistics; plasmas; band theory; application of these principles to modern amplifiers; e.g., the travelingwave tube, tunnel diode, masers, and parametric amplifiers.

ECE 8260 Solar Cells 3 (3) Course provides fundamental knowledge about generating solar electricity by the use of solar cells. Special attention is given to demonstrating the potential role of photovoltaic systems as clean and sustainable electricity generation sources for current and future generations of mankind. Students are expected to have completed a course comparable to ECE 4040 and ECE 4060 before enrolling in this course.

ECE 8270 Finite Difference Methods in Electromagnetics 3 (3) Investigates finite-difference methods (FD) as applied to electromagnetics; FD approximations, error, stability and numerical dispersion; solution of Poisson’s, Helmholtz and wave equations; banded matrices, iterative methods and eigensolutions; the finite-difference time-domain method, Yee Lattice, mesh truncation methods, perfectly matched layers, source conditions, near-to-far field transformation, subcellular modeling for fine features and wideband characterization. Students are expected to have completed a course comparable to ECE 4360 or ECE 4460 before enrolling in this course; and are expected to have completed or be concurrently enrolled in a course comparable to ECE 8300 when enrolling in this course.

ECE 8280 Guided Waves, Wave Propagation and Radiation in Stratified Media 3 (3) Covers several important topics of applied electromagnetics, including advanced transmission-line theory for guided electromagnetic waves, analysis of electromagnetic wave propagation in layered media and computation of electromagnetic radiation in stratified regions. Pr: ECE 8290 and ECE 8300.

ECE 8290 Special Functions in Engineering 3 (3) Complex calculus and analytic functions; origin of special functions in engineering; series and integral representations of special functions; properties and applications of gamma, Bessel, Legendre, Chebyshev, etc. functions; computation of special functions; applications in selected engineering problems. Students are expected to have completed courses comparable to ECE 3810 and MATH 4340 before enrolling in this course.

ECE 8300 Electromagnetics 3 (3) Wave equations and waves, electromagnetic potentials, theorems and advanced concepts, guided waves, radiation, boundary value problems and simple Green’s functions. Pr: or concurrent enrollment: ECE 8290.

ECE 8310 Advanced Electromagnetic Theory 3 (3) Advanced boundary-value problems in cylindrical and spherical coordinates, special functions, Sommerfeld integrals, Green’s functions and integral equations. Pr: ECE 8300.

ECE 8340 Asymptotic Methods and Diffraction Theory 3 (3) Canonical diffraction problems for which exact solutions are available; asymptotic reevaluation of these solutions in terms of incident, reflected and diffracted rays leads to Keller’s postulates for an extended theory or geometrical theory of diffraction; application of diffraction from edges and curved surfaces to scattering and antenna problems. Pr: ECE 8300.

ECE 8350 Finite Element Methods in Electromagnetics 3 (3) Finite-element methods (FEM) as applied to electromagnetics; fundamentals of list-linked FEM data structures, sparse matrix solutions, edge-based vector bases, radiation boundary conditions and perfectly absorbing media. Pr: or concurrent enrollment: ECE 8300.

ECE 8390 Integral Equations in Electromagnetics 3 (3) Integral equation formulation in electromagnetics, solution techniques, moment methods and application to practical problems. Pr: ECE 8300 or consent of instructor.

ECE 8400 Physics of Semiconductor Devices 3 (3) Semiconductor device physics emphasized rather than circuits; detailed analysis of the p-n junction, traps, surface states and conduction processes, and devices; analysis and models of Schottky diodes, MIS diodes, MOSFET’s, charge coupled devices and solar cells; charge control concepts, transit time effects, surface-type devices and practical aspects of device processing. Students are expected to have completed courses comparable to ECE 4040 and ECE 4060 before enrolling in this course.

ECE 8420 Computer Architecture 3 (3) Fundamental issues that arise in the composition of logic elements into computer systems; design and analysis of processors, buses, memory hierarchies, communications controllers and associated software. Students are expected to have completed a course comparable to ECE 4290 before enrolling in this course.

ECE 8440 Digital Signal Processing 3 (3) Digital filter design; discrete Hilbert transforms, discrete random signals; effects of finite register length in digital signal processing; homomorphic signal processing; power spectrum estimation; speech processing, radar and other applications. Students are expected to have completed a course comparable to ECE 4670 before enrolling in this course.
ECE 8460 Digital Processing of Speech Signals 3 (3) Application of digital signal processing techniques to problems related to speech synthesis, recognition and communication; digital models and representations of speech wave forms; Fourier analysis; homomorphic processing; linear predictive coding; algorithms for recognizing isolated words and continuous speech; man-machine communications by voice. Students are expected to have completed a course comparable to ECE 4670 before enrolling in this course.

ECE 8470 Digital Image Processing 3 (3) Review of fundamental concepts, issues and algorithms in image processing. Includes image formation, file formats, filters, edge detection, stereo, motion and color. Students are expected to have completed a course comparable to ECE 4670 before enrolling in this course.

ECE 8480 Telecommunication Network Modeling and Analysis 3 (3) Protocols, modeling and analysis of telecommunication networks with emphasis on quantitative performance modeling of networks and systems using packet switching and circuit switching techniques. Preq: Students are expected to have completed a course comparable to CPSC 8250 or ECE 4380 before enrolling in this course.

ECE 8490 Advanced Topics in Computer Communications 3 (3) Performance analysis and design of computer communication networks with emphasis on recent developments; routing flow control, error control, and end-to-end performance analysis, local area, packet radio and long haul store-and-forward networks. Students are expected to have completed a course comparable to ECE 4380 or ECE 4400 before enrolling in this course.

ECE 8500 QoS in Wireless Networks 3 (3) Design principles and core techniques for quality assured communications in Internet and wireless networks. Introduces protocols and mathematical foundations of IntServ, Diffserv and traffic engineering. Covers mobility aware, channel adaptive and cross layer QoS assurance techniques. Students are expected to have completed courses comparable to ECE 6380 and ECE 6400 before enrolling in this course.

ECE 8510 Advanced Topics in Computer Architecture 3 (3) Analysis and design of multiprocessor and modular computer systems; recent developments in integration, fabrication and application of multiprocessor systems. Preq: ECE 8420.

ECE 8540 Analysis of Tracking Systems 3 (3) Topics related to tracking systems and filtering methods used to mitigate noise, including model fitting and the normal equations, nonlinear solutions, Kalman filter, extended Kalman filter, particle filter, unscented transform, recursive Bayesian estimation, and hidden Markov models. Preq: ECE 8010.

ECE 8550 Artificial Intelligence 3 (3) Emulating intelligent behavior by computer; models of cognitive processes; logical foundations; constraint satisfaction problems; natural language understanding; pattern-directed inference and chaining paradigms; goal-directed behavior, planning and search; learning; advanced database structure and inference strategies; examples of LISP, PROLOG, and OPS5. Students are expected to have completed a course comparable to ECE 4420 before enrolling in this course.

ECE 8560 Pattern Recognition 3 (3) Several approaches to general pattern recognition problems with practical computer-oriented applications; feature extraction; classification algorithms; discriminant functions; learning schemes; statistical methods; information theoretic approaches; applications; current developments.

ECE 8570 Coding Theory 3 (3) Principles of algebraic coding and its application to transmission of information over noisy communications channels; introduction to abstract algebra; code performance bounds; code representations; linear codes of the Hamming and Bose-Chaudhuri-Hocquenghem types and burst-error correcting codes; problems of implementation and decoding. Students are expected to have completed a course comparable to ECE 3170 before enrolling in this course.

ECE 8590 Intelligent Robotic Systems 3 (3) Integration and fusion of data from multiple sensors on multiple robots; intelligent decision making on motion planning and execution based on sensed data involving mutual compliance; simultaneous force and position controls using computers. May also be offered as ME 8590. Preq: ECE 8540.

ECE 8600 Advanced Coding Theory 3 (3) Introduction to convolutional codes and trellis-coded modulation. Topics include code generation and representation, distance properties, decoding techniques, performance analysis, multidimensional codes and lattice theory and coding for fading channels; applications to wireline communications and mobile communications. Preq: ECE 6300 or ECE 8200; and ECE 8570.

ECE 8620 Real Time Computer Application in Power Systems 3 (3) Principles of monitoring, control and operation of power systems; load frequency control, on-line load flow, power system state estimation, unit commitment and load forecasting. Students are expected to have completed a course comparable to ECE 4180 before enrolling in this course.

ECE 8630 Power System Dynamics and Stability 3 (3) Modeling of synchronous machines and their control systems; power system stability for small and large disturbances; excitation systems, governor control, power system stabilizers and state variables formulation for power systems dynamic stability studies. Students are expected to have completed courses comparable to ECE 4180 and ECE 4190 before enrolling in this course.

ECE 8680 Architectural Robotics 3 (3) Focuses on understanding, developing and testing robotic systems for the built environment. Collaborative teams of students from Electrical and Computer Engineering and Architecture and their allied disciplines study and develop working robotic prototypes responsive to challenges and opportunities of living in today’s built and natural environments. May also be offered as ARCH 8680. Preq: Consent of instructor.

ECE 8690 Advanced Kinematics in Robotics 3 (3) Complex robotic systems, such as multi-fingered robot hands, dual-armed robots and multi-joint “snake-like” robots; kinematic redundancy, load distribution and dexterous manipulation; effective modeling and solution techniques for these types of underconstrained systems. Students are expected to have completed courses comparable to ECE 4090 and ECE 4350 before enrolling in this course.

ECE 8720 Artificial Neural Networks 3 (3) Design, analysis and application of artificial neural networks, neuron models, network architectures, training (supervised and unsupervised) and hardware implementation; extended studies of selected applications and simulation exercises. Students are expected to have completed a course comparable to MATH 3110 before enrolling in this course.

ECE 8730 Parallel and Distributed Systems 3 (3) Design, analysis and evaluation of algorithms for parallel and distributed computer systems; time complexity, speedup, efficiency and inefficiency; communication costs; numerical algorithms including solving systems of equations (both sparse and dense) as well as symbolic algorithms; substantial parallel programming projects.

ECE 8740 Advanced Nonlinear Control 3 (3) Basics of nonlinear control based on Lyapunov techniques; adaptive control design, robust control design and observer design; understanding and development of Lyapunov control design tools. Preq: ECE 8010.

ECE 8750 Peer to Peer Wireless and Cloud Computing 3 (3) Students learn how to create high-performance, scalable, reliable Peer to Peer (P2P) wireless and cloud computing systems. Introduces an overview of modern distributed models, the design principles, systems architecture, and innovative applications of P2P, wireless and cloud computing.

ECE 8770 Computer Vision 3 (3) Investigation into fundamental concepts, issues and algorithms in computer vision. Includes segmentation, texture, detection, 3-D reconstruction, camera calibration, shape and energy minimization. Preq: ECE 847.

ECE 8910 Master’s Thesis Research 1-12 (1-12) Master’s Thesis Research

ECE 8920 Special Problems in Electrical and Computer Engineering 1-3 (1-3) Term paper, special design, or other problems in electrical and computer engineering approved by the instructor. May not be used for investigation associated with the MS thesis or the engineering report. May be repeated for credit.

ECE 8930 Selected Topics in Electrical and Computer Engineering 1-3 (1-3) Topics not covered in other courses; current literature and results of current research. Topics vary from year to year in keeping with developments in the field. May be repeated for credit.

ECE 9030 Computer Architecture Seminar 1 (1) Recent research publications related to computer architecture including parallel systems, distributed computing, reconfigurable architectures and software development for high performance computing. Students read and discuss one research paper each semester. May be repeated for a maximum of three credits. Preq: Consent of instructor.

ECE 9040 Computer Vision Seminar 1 (1) Review of recent research publications related to computer vision including tracking, correspondence, reconstruction and segmentation. Students read and discuss one research paper per week and present one research paper each semester. May be repeated for a maximum of three credits.
ECON 6050 Introduction to Econometrics 4 (3) Introduction to methods of quantitative analysis of economic data. Reviews basic statistical methods and probability distribution. Topics include data management using professional statistical software applications; multiple regression analysis; hypothesis testing under conditions of multicollinearity, heteroscedasticity, and serial correlation. Preq: ECON 2110 and ECON 2120; and either MATH 1080 or MATH 2070; and STAT 3090 or STAT 3300. Coreq: ECON 6051.

ECON 6051 Introduction to Econometrics Laboratory 0 (3) Non-credit laboratory to accompany ECON 6050. Coreq: ECON 6050.

ECON 6060 Advanced Econometrics 3 (3) Reviews statistical inference using multiple regression (OLS) analysis and model specification. Topics include multicollinearity, heteroscedasticity, and serial correlation; two-stage least squares and instrumental variables models; simultaneous equations models; limited dependent variable models using maximum likelihood estimation and time-series analysis; and presentation of results in technical writing. Preq: ECON 4050 or consent of instructor.

ECON 6100 Economic Development 3 (3) Consideration and analysis of economic and related problems of underdeveloped countries. Attention is given to national and international programs designed to accelerate solution of these problems. Preq: ECON 3140 or consent of instructor.

ECON 6110 Economics of Education 3 (3) Analysis of economic issues related to education. The decision to invest in education, elementary and secondary school markets and reform, the market for college education, teacher labor markets, and education's effects on economic growth and income distribution. Preq: ECON 3140 or consent of instructor.

ECON 6120 International Microeconomics 3 (3) Analysis of the essential aspects of international economic linkages. Discusses gains and redistributive effects of trade and the barriers to trade within the context of a variety of economic models. Also discusses the history of trade policy and the political economy of its determination. Preq: ECON 3140 or consent of instructor.

ECON 6130 International Macroeconomics 3 (3) Examination of macroeconomic linkages between an individual country and the rest of the world and how these linkages are affected by the choice of exchange rate regimes. Topics include the relations between domestic and foreign interest rates and exchange rates and the ability to pursue independent monetary policies. Preq: ECON 3150.

ECON 6220 Monetary Economics 3 (3) Intensive study of the role of monetary factors in economic change. Modern monetary theories and their empirical relevance for policy are developed against a background of monetary history and institutions. Preq: ECON 3140 and ECON 3150 or consent of instructor.

ECON 6230 Microeconomics of Health 3 (3) Applies microeconomic theory to examine the demand for health services and medical care, the market for medical insurance, the behavior of physicians and hospitals, and the role of government in health-care provision and regulation. Preq: ECON 3140.

ECON 6240 Organization of Industries 3 (3) Empirical, historical, and theoretical analyses of market structure and concentration in American industry: the effects of oligopoly, monopoly, and cartelization upon price, output, and other policies of the firm; antitrust and other public policies and problems are studied. Preq: ECON 3140 or consent of instructor.

ECON 6250 Antitrust Economics 3 (3) Analysis of the economic and legal issues created by the exercise of market power. The motivation and execution of government policy towards mergers, predatory conduct, and various restraints of trade are intensively examined. Preq: ECON 3090 or ECON 3140 or consent of instructor.

ECON 6260 Seminar in Sports Economics 3 (3) Economic analysis of sports teams, leagues, and institutions. Topics include antitrust issues, public funding of sports venues, labor relations, wagering markets, athlete compensation, and application of economic principles to sports settings. Empirical research project is cornerstone of course. Preq: ECON 3140 and ECON 4050; or consent of instructor.

ECON 6270 Development of the American Economy 3 (3) Explores several topics relevant to understanding the American experience. Considers the institutions and developments critical to America's ascendancy from a small country to a dominant global economic power. Investigates immigration, innovation, education, finance, and the changing role of race and gender in the economy. Preq: ECON 3140 and ECON 3150.

ECON 6280 Cost-Benefit Analysis 3 (3) Develops techniques for the appraisal of public expenditure programs with particular emphasis on investment in infrastructure. Topics include choice of an appropriate discount rate and the calculation of social costs and benefits in the presence of market distortions. Preq: ECON 3140 or consent of instructor.

ECON 6290 Economics of Energy Markets 3 (3) This course examines the economics of energy markets and energy policy. The unique features and characteristics of these important and interrelated markets are explored, and participants gain practical experience in connecting economic concepts to recent energy-related events and energy policy issues. Preq: ECON 3140.

ECON 6300 Topics in Mathematical Economics 3 (3) This course develops the mathematical tools underlying economic analysis and prepares students for doing advanced theoretical work in economics. The topics covered in this course provide excellent preparation for advanced economics courses, and lay the foundation for doing quantitative analysis associated with both career work and graduate study in economics. Preq: ECON 3140; and either MATH 1080 or MATH 2070.

ECON 6400 Game Theory 3 (3) Introduction to the formal analysis of strategic interaction among rational, self-interested rivals. Basic theoretical aspects of games are discussed and applied to such topics as bargaining, voting, auctions, and oligopoly. Preq: ECON 3140 and MATH 1060; or ECON 4300; or consent of instructor.

ECON 6550 Applied Microeconomic Research 3 (3) Students conduct research in applied microeconomics. Topics vary according to student and professor interests. Students read papers in the literature, formulate their own economic hypotheses, and collect and analyze data to test those hypotheses. May be repeated for a maximum of nine credits, but only if different topics are covered. Preq: ECON 3140; and one of ECON 4050 or ECON 6050; or consent of instructor.

ECON 6570 Natural Resource Use, Technology, and Policy 3 (3) Focuses on economic analyses of actual, efficient, and sustainable uses of natural resources, impacts of technologies that affect these uses, and policies that affect development and use of such technologies. Resource-technology-policy combinations may vary, but an example is crude oil, hybrid automotive engines, and fuel economy standards. May also be offered as APEC 6570. Preq: MATH 1020 or MATH 1060; and ECON 3570 or CRD 3570 or ECON 3140.

ECON 7510 Selected Topics for Teachers 3 (3) Current economic policy issues such as inflation, regulation, protectionism and energy policy. Emphasis is on the presentation of these topics to secondary school students. Topics vary from year to year. May be repeated for credit. Preq: ECON 2000 and ECON 2110.

ECON 8000 History of Economic Thought 3 (3) Development of economic thought from early Greek to Keynesian economics; writings of major economists such as Smith, Ricardo, Marx, Marshall and Keynes; development of major economic theories. May also be offered as APEC 8000.

ECON 8010 Microeconomic Theory 3 (3) Microeconomic theory and its use to analyze and predict the behavior of industries, firms and consumers under various market conditions. Offered fall semester only. May also be offered as APEC 8010.

ECON 8020 Advanced Economic Concepts and Applications 3 (3) Rigorous development of price theory under alternative product and resource market structures. May also be offered as APEC 8020. Preq: Consent of instructor.
ECON 8040 Applied Mathematical Economics 3 (3) Discusses mathematical tools needed in economic analysis; matrix algebra, differentiation, unconstrained and constrained optimization, integration and linear programming. Offered fall semester only. May also be offered as APEC 8040.

ECON 8050 Macroeconomic Theory 3 (3) Macroeconomic theory involving static and dynamic models and their use in analysis of economic problems and policies. Offered spring semester only.

ECON 8060 Econometrics 1 3 (3) Application of econometric techniques and stochastic models to economic problems. Considers distribution theory, simple and multiple regression modeling, hypothesis testing and other issues in regression analysis. May also be offered as APEC 8060.

ECON 8070 Econometrics II 3 (3) Economic models expressed as systems of equations; problems of identification, parameter estimation, measurement errors and statistical inference; techniques of simulation, forecasting, model validation and interpretation. Offered spring semester only.

ECON 8080 Econometrics III 3 (3) Continuation of ECON 8070. Covers current economic models and estimation procedures. Offered spring semester only. Offered spring semester only, May also be offered as APEC 8080. Prq: ECON 8070.

ECON 8090 Advanced Natural Resource Economics 3 (3) Applications of economic theory to problems of natural resource management, epistemological considerations, rent theory, public and private investment criteria, benefit-cost analysis and general equilibrium management models. Offered spring semester only. May also be offered as APEC 8090. Prq: ECON 8040.

ECON 8100 Natural Resources Management and Policy 3 (3) Economic, institutional and legal aspects of control and management of natural resources; concepts of economic science applied to public policy questions related to land and water resources. Specialized background in economics is not necessary. Offered fall semester only. May also be offered as APEC 8100. Prq: ECON 8140.

ECON 8110 Economics of Environmental Quality 3 (3) Pricing and distribution emphasizing effects upon economic welfare; goods allocated by government purchase for joint consumption and those distributed by rationing; alternate plans for allocating public goods. Offered fall semester of even-numbered years only. May also be offered as APEC 8110. Prq: ECON 8140.

ECON 8150 Economic History of the United States 3 (3) Introduces approach of modern economic history, which emphasizes the use of modern economic theory and statistical methods to answer questions of long-standing interest to economists and historians. Covers all major periods of U.S. history from the colonial era through the emergence of the modern welfare state. Prq: ECON 8010 and ECON 8050.

ECON 8160 Labor Economics 3 (3) Wage and employment theory; labor markets; labor history; current problems in labor and manpower economics. May also be offered as APEC 8160.

ECON 8170 Advanced Production Economics 3 (3) Discusses production economics theory in a quantitative framework; technical and economic factor-product, factor-factor, and product-product relationships in single- and multi-product firms under conditions of perfect and imperfect competition in both factor and product markets. Offered spring semester only. May also be offered as APEC 8170. Prq: APEC 4020; and APEC 3080 or ECON 4050.

ECON 8200 Public Finance 3 (3) Impact of government on resource allocation, income distribution and stability; role of regulation; principles of taxation. May also be offered as APEC 8200.

ECON 8210 Public Choice 3 (3) Economic theory to analyze collective decisions. Topics include the pure theory of collective choice and applied analyses of democratic governments and their policy processes.

ECON 8220 Public Policy Economics 3 (3) Covers contemporary public policy, including price and resource policy, affecting rural areas. Discusses public participation, or the lack thereof, related to programs designed to implement public policy. Offered spring semester only. May also be offered as APEC 8220. Prq: ECON 3140.

ECON 8230 Microeconomics for Public Policy 3 (3) Economic aspects of public policy making; individual behavior as governed by the market and other incentive mechanisms. Equips students with methodological tools for evaluating public policies.

ECON 8240 Organization of Industry 3 (3) The structure of markets and firms; forces that determine the size of firms and the boundaries of markets; the behavior of firms, both singly and in concert, to exploit market positions. May also be offered as APEC 8240.

ECON 8250 Antitrust Economics 3 (3) Theoretical analysis of monopoly, monopolizing practices and the exercise of market power. Study of government policy towards mergers, predation and restraints of trade.

ECON 8260 Economic Theory of Government Regulation 3 (3) The scope of governmental regulation in the economy of the United States, its evolution and development; the application of the tools of economic analysis to the issues of regulated enterprise. May also be offered as APEC 8260. Prq: ECON 3140.

ECON 8270 Economics of Property Rights 3 (3) Analyzes the evolution and impact of various property rights institutions on individual behavior and the subsequent use of resources. Particular attention is paid to the importance of property rights structures in the organization of business and in managerial decision making.

ECON 8280 Applied Demand Analysis 3 (3) Analysis of demand by individual households and consumers in aggregate. Modern approaches to estimation of demand systems and valuation methods. May also be offered as APEC 8280. Prq: ECON 3140; and APEC 3080 or ECON 4050.

ECON 8310 Economic Development 3 (3) Economic analysis of development of urban areas within the system of cities; central place theory and general equilibrium models of interregional economic activity emphasizing central place systems, spatial interaction and stochastic processes; internal development of the city focusing on housing and land use patterns, transportation and urban form.

ECON 8320 Community and Regional Economics 3 (3) Covers economic theory and research methods needed to understand happenings in the regional and community economy and how local and non-local decisions influence local economic change. Offered fall semester only. May also be offered as APEC 8320. Prq: APEC 4120 or APEC 6120 or CRD 4120 or CRD 6120.

ECON 8360 Research in Economics of Education 3 (3) Theoretical and econometric analysis of education including such topics as human capital theory, pricing and competition in higher education, public financing and provision of education, cost/benefit analyses of education reforms such as accountability, school finance equalization and school choice. Includes discussion and research on current topics in the economics of education. Prq: APEC 8060 or ECON 8060; or consent of instructor.

ECON 8400 International Trade Theory 3 (3) Theory of free trade from Ricardo to the present; international trade and tariff theory. May also be offered as APEC 8400. Prq: ECON 3140; and either APEC 8020 or ECON 8020; or consent of instructor.

ECON 8410 International Finance 3 (3) Financial economics of decision making in a multinational environment featuring autonomous governments and multiple currencies. Typical topics include the macroeconomic problems of unemployment and inflation in an international economy, management of exchange rate risk, credit risk, political risk and taxation. May also be offered as APEC 8410. Prq: ECON 3150.

ECON 8450 Advanced Game Theory 3 (3) Introduces central concepts in game theory, emphasizing economic problems involving strategic behavior by consumers, firms and governments. Covers static and dynamic games, with both complete and incomplete information. Specific topics may include oligopoly, bargaining, auction theory, mechanism design, repeated games and information transmission.

ECON 8550 Financial Economics 3 (3) Study of modern theory of corporate finance. Includes basic theories of efficient markets, portfolio selection, capital asset pricing, option pricing and agency costs. May also be offered as APEC 8550.

ECON 8880 Directed Reading in Economics 1-3 (1-3) Directed reading and research in the student's field of interest. May be repeated for a maximum of three credits.

ECON 8910 Master's Thesis Research 1-12 (1-12) Master's Thesis Research
Courses of Instruction

ECON 8980 Dynamic Macroeconomics 1 (1) Advanced macroeconomics beyond material covered in ECON 8050. This course covers advanced dynamic macroeconomics at a level required for conducting research in the field. Focus is on formulating and solving dynamic models of consumption, investment, economic growth, asset pricing, and unemployment. All first-year PhD students are required to take both ECON 8050 and ECON 8980.

ECON 8990 Selected Topics in Economics 1-3 (1-3) Selected topics under the guidance of a professor. May be repeated for a maximum of six credits.

ECON 9000 Selected Topics in Economics 3 (3) Current topics in economic theory and empirical research. May be repeated for credit, but only if different topics are covered.

ECON 9010 Price Theory 3 (3) Neoclassical paradigm of market price and quantity; rigorous consideration of consumer behavior, the theory of the firm and market equilibrium, production and resource demands and the supply of resources. May also be offered as APEC 9010. Prereq: APEC 8010 or ECON 8010.

ECON 9050 Advanced Macroeconomic Issues 3 (3) Current unsettled issues in macroeconomic analysis. Topics include disequilibrium macro models, macro models of open economies, rational expectations and its critics, government stabilization policies and the controversy surrounding the concept of Ricardian equivalence. Prereq: ECON 8050.

ECON 9060 Seminar in Area Economic Development 3 (3) Consideration of recent research developments in economic development. Includes a review of research publications, journal articles and other literature. Objectives, analytical techniques and procedures are used in area or regional development efforts. Offered spring semester only. May also be offered as APEC 9060. Prereq: APEC 8060 or ECON 8060.


ECON 9150 General Equilibrium and Economic Growth 3 (3) Risk sharing and efficient allocations are presented. Basic aggregation theory is covered producing the representative agent model. The neoclassical growth model with and without technological progress is presented, followed by the endogenous growth model. The modifications to this model produce multiple development regimes, convergence, biconvergence and switching phenomena. Prereq: ECON 805.

ECON 9160 Advanced Economic Growth 3 (3) Alternative models of endogenous growth are developed, including the public education models of growth, endogenous technology-R&D models, international trade and diffusion models, public policies and institutions, geography and growth, and finance and growth. Particular focus is on the empirical applications of growth models.

ECON 9170 Advanced Seminar in Labor Economics 3 (3) Continuation of ECON 8160, bridging the gap between theory and modern empirical research in labor economics. Emphasizes reading recent empirical research papers to understand the techniques of modern research in labor economics. Prereq: APEC 8160 or ECON 8160. May also be offered as APEC 9170.

ECON 9200 Empirical Public Economics 3 (3) Studies the effects of taxation on household and firm behavior, public goods, income transfer and welfare policies. Considers fiscal federalism, public policy and economic growth. Includes selected topics on effects of legislation and institutions on economic outcome. Prereq: APEC 8010 or ECON 8010; and ECON 8070; and APEC 8200 or ECON 8220.

ECON 9240 Advanced Industrial Organizations 3 (3) Coverage of advanced concepts and methods involving strategic interaction among firms. Topics may include pricing, capacity choice, advertising, collusion and industry dynamics. Prereq: APEC 8240 or ECON 8240; or consent of instructor.

ECON 9400 Empirical International Economics 3 (3) Investigates empirical applications of international issues. Typical topics include the theoretical and empirical international issues, including the Heckscher-Ohlin model, the gravity model of trade, models of exchange rate determination and dynamic stochastic general equilibrium models. Prereq: ECON 8400 or ECON 8410.

ECON 9500 Monetary Economics 3 (3) Economic analysis of money in our economy and effects of monetary policy on prices, interest rates, output and employment. May also be offered as APEC 9500.

ECON 9810 Applications of Economic Analysis 1 (1) Presentations of economic research by guest lecturers, principally department faculty members. Presentations include description of one or more research projects typically taken from a common agenda. Discussion of methodology, data and data collection. Course is for first-year PhD students. To be taken Pass/No Pass only. May be repeated for a maximum of four credits.

ECON 9820 Workshop in Applied Economics 3 (3) Forum for presentation and critical evaluation of ongoing research by candidates for the PhD degree in Applied Economics. May be repeated for a maximum of nine credits. Prereq: Consent of instructor.

ECON 9910 Doctoral Dissertation Research 1-12 (1-12) Doctoral Dissertation Research. May also be offered as APEC 9910.

EDUCA TION

ED 6410 Middle School Curriculum 3 (3) Concepts and methods for teaching middle school students. Discusses nature of middle school students, teacher characteristics, curricular and co-curricular programs, organization, and teaching.

ED 7000 Supervising the Student Teacher in the Public School 2-3 (2-3) Knowledge and skills desirable for supervisors of student teachers; use of observation instruments for recording objective data and evaluating teaching performance. To be taken Pass/No Pass only. Prereq: Professional teaching certificate, at least one year of teaching experience, recommendation from employing school district, or consent of instructor.

ED 7350 Teacher Professional Developments Selected Topics 1-3 (1-3) Selected topics determined by professional-development needs for teachers. Does not count toward a master’s degree; for professional development credit only. May be repeated, but only if different topics are covered.

ED 8370 Independent Study in Education 1-3 (1-3) Master-level study of selected topics under the direction of a faculty member chosen by the student. Student and faculty member develop a course of study different from any existing courses and designed for the individual student. May be repeated for a maximum of 24 credits, but only if different topics are covered.

ED 8380 Selected Topics in Education 1-3 (1-3) Specific master’s-level topics not found in other courses are selected for an in-depth study. May be repeated for a maximum of 24 credits, but only if different topics are covered.

ED 8390 Introduction to Linguistics 3 (3) Introduction to linguistics, including the subfields of syntax, morphology, phonology, semantics, pragmatics and sociolinguistics. Also includes the study of writing systems and applications to literacy, language acquisition, and language contact and change. Prereq: Education field of study or consent of instructor.

ED 8450 Integrating Arts into the Curriculum 3 (3) Series of workshops introducing the integration of drama, music, dance, visual arts and creative writing with academic subjects in the classroom. Includes review of research on the impact of arts education on student achievement, engagement and school culture.

ED 8510 International Education in Primary and Secondary School Settings 3 (3) Investigates educational processes in international settings, including an examination of prevalent learning theories, curricula, assessment, classroom norms, and their connections to social, cultural and geopolitical contexts.

ED 8540 International Perspectives on Poverty and the Schools P-12 3 (3) Explores the global impact of poverty on schools and students, reviews the international research on poverty and schools, identifies effective instructional and curricular strategies for P-12 students living in poverty, and analyzes international policies that address the needs of these students.

ED 8600 Classroom Action Research 3 (3) Develops skills for doing research in a K-12 setting on instructional methodology and/or curriculum. Study of research literature, research methods and IRB procedures. Includes classroom action research project. Students enrolling in this course must hold current teaching certification. Prereq: Admission to MEd degree program and EDF 8770 and EDF 8880; or consent of instructor.

ED 8670 Practicum in the Instruction of ESOL to Elementary and Secondary Learners 1-3 (3-9) Supervised observation and teaching experiences in teaching English to Speakers of Other Languages (ESOL) in cooperation with selected elementary and/or secondary schools. May be repeated for a maximum of three credits.
ED 8890 Research in Education 3 (3) Includes problem selection. Investigates types of educational research and techniques employed. Includes the use of ERIC system and computer program packages. Requires interpretation of research findings. May also be offered as AGED 8890.

ED 9010 Selected Topics Doctoral Study 1-3 (1-3)
Doctoral-level education topics not covered in other courses are selected for in-depth study and research. May be repeated for a maximum of 24 credits, but only if different topics are covered.

ED 9020 Independent Doctoral Study 1-3 (1-3)
Study of selected topics in education under the direction of a faculty member chosen by the student. Student and faculty member develop a course of study different from any existing courses and designed for the individual student. May be repeated for a maximum of 24 credits, but only if different topics are covered.

ED 9030 Introductory Doctoral Seminar I 1 (1)
Familiarizes new doctoral students with the academic culture of doctoral studies and, specifically, the Curriculum and Instruction doctoral program at Clemson. This introductory seminar emphasizes the processes of scholarship, including academic research and writing.

ED 9040 Introductory Doctoral Seminar II 1 (1)
Familiarizes new doctoral students with the academic culture of doctoral studies and, specifically, the Curriculum and Instruction doctoral program at Clemson. This introductory seminar emphasizes the roles and responsibilities of teacher educators.

ED 9380 Grant Development in Education-Related Fields 3 (3) Addresses the process for writing and submitting grant proposals, including training grants, demonstration projects, research grants and curriculum development projects.

ED 9420 Studies of Curriculum and Instruction in Mathematics Education 3 (3) Addresses philosophical, theoretical, and empirical issues related to curriculum, instruction and assessment in mathematics education. Curricular issues relevant to this class span pre-K through grade 12 and include the emergence of national, state and common core standards. Prq: Admission into the Curriculum and Instruction doctoral program; and consent of instructor.

ED 9470 Current Scholarship in Mathematics Education 3 (3) Enhances appreciation for and understanding of research methods and findings in mathematics education. Includes an analysis of research methodology and techniques in mathematics education, the history of research in mathematics education, and various theories of mathematics learning. Prq: Admission into the Curriculum and Instruction doctoral program; and consent of instructor.


ED 9550 Theoretical Bases of Instruction 3 (3) Seminar in the application of learning theory to instructional practice emphasizing instructional strategies in the classroom.

ED 9600 History and Philosophy of African American Education 3 (3) Examination of the historical and contemporary philosophies, practices and pedagogies for Black education from the early nineteenth century through the present. The course emphasizes the educational literature in the areas of culturally responsive pedagogy, African-centered pedagogy and curriculum, multicultural curriculum and critical race theory.

ED 9800 Internship in Curriculum and Instruction 1-6 (1-6) Practical experiences linking the student’s program of study to his/her field of professional service. To be taken Pass/No Pass only. May also be offered as EDF 9800 or EDSP 9800. Prq: Consent of advisor.

ED 9910 Doctoral Dissertation Research 1-18 (1-18) Doctoral Dissertation Research. May also be offered as EDF 9910 or EDSP 9910.

ED 9940 Directed Research 1-4 (1-4) Research in a line of inquiry in education under the direction of faculty. May be taken with different faculty members and may be repeated for a maximum of 18 hours. To be taken Pass/No Pass only. May also be offered as EDF 9940 or EDSP 9940. Prq: EDF 8770 or EDF 8080; or consent of instructor.

EDUCATIONAL COUNSELING

EDC 8010 Foundations of School Counseling 3 (3) Theory and practice of school counseling: principles and policies underlying programs. Prq: Consent of instructor.

EDC 8030 Student Development Services in Higher Education 3 (3) Student personnel services offered by institutions of higher education. Prq: Consent of instructor.

EDC 8040 Theories of Student Development in Higher Education 3 (3) Addresses student development and human development theories of college student identity development. The course examines psychosocial, cognitive, environmental and typological theories with an emphasis on utilizing these theories in working with college students. Prq: Consent of instructor.

EDC 8050 Clinical Mental Health Counseling 3 (3) History and description of various counseling services provided in agency settings; the types of client populations served and existing legislative acts mandating these services.

EDC 8060 Student Affairs Issues 3 (3) Introduction to the current issues in the student personnel profession and future challenges facing student affairs departments. Prq: EDC 8030 and EDC 8040; or consent of instructor.

EDC 8070 Counseling Children and Adolescents 3 (3) Theory and techniques in the area of counseling youth in educational institutions and other settings; common challenges faced by children and adolescents, developmental considerations, and evidence-based interventions. Prq: EDF 8010 and EDC 8100; or consent of instructor.

EDC 8080 Legal and Ethical Issues in Student Affairs Practice and Counselor Education 3 (3) Study of current legal and ethical issues confronting counselor educators and administrators working in student affairs practice and student affairs counseling. Examines a representative sample of key concepts, federal and state court cases and explores the application of legal and ethical issues to student affairs practice and counseling.

EDC 8090 Higher Education Administration 3 (3) Knowledge, skills and processes essential to effectively administer a program or service in higher education. Examines relationships between environmental factors and strategies for planning and managing student affairs programs and services. Prq: Consent of instructor.

EDC 8100 Theories and Techniques of Counseling 3 (3) Counseling theories and techniques. Prq: Consent of instructor.

EDC 8110 Multicultural Counseling 3 (3) Responsibility of counselors to all people regardless of race, sex, gender, socioeconomic status, subculture, etc.; content and theory related to counseling multicultural individuals/groups.

EDC 8120 Career Counseling 3 (3) Gathering, interpreting and utilizing educational, social and occupational information; techniques used in placement, survey and follow-up. Prq: EDC 8100.

EDC 8130 Appraisal Procedures 3 (2) Experience in gathering, interpreting and utilizing data related to the individual; especially significant to counselors. Prq: Consent of instructor. Coreq: EDC 8131.

EDC 8131 Appraisal Procedures Laboratory 0 (1) Noncredit laboratory to accompany EDC 8130. Coreq: EDC 8130.

EDC 8140 Development of Counseling Skills 3 (3) On-campus experience to help counselors develop communication skills through role-playing activities, audio and videotaping, interviewing, lecture and discussion. Prq or concurrent enrollment: EDC 8100.

EDC 8150 Group Counseling 3 (3) Experience as a member of a group to aid the student in understanding group dynamics and the role of a group member as a participant and facilitator; emphasis is on small group participation, communication skills and self-understanding. Prq: EDC 8100 and EDC 8140.

EDC 8160 Introduction to Couples and Family Counseling 3 (3) Major models and techniques of marriage and family counseling; history, research, legal, ethical and other professional issues; concepts related to family life cycle, healthy family functioning, divorce, ethnicity, problem conceptualization and nontraditional structures. Prq: EDC 8100.

EDC 8170 Crisis Intervention Counseling 3 (3) Examines diverse crisis situations and the assessment and treatment strategies used by counselors to assist individuals, groups and organizations to manage and resolve crises. Prq: EDC 8100 or consent of instructor.

EDC 8180 Psychopathology for Counselors 3 (3) Conceptual models employed in classifying and describing various mental disturbances as well as approaches used to alleviate these disturbances. Prq: EDC 8100 and enrollment in Educational Counseling master's program and consent of instructor.
EDC 8100 The Contemporary College Student
3 (3) Analytical approach to the unique character of the contemporary college student, the effects of change on that character and the role of college in enhancing student development in that context. Preq: EDL 8550 or consent of instructor.

EDC 8210 Counseling Psychodiagnosis 3 (3) Comprehensive overview of the Diagnostic and Statistical Manual of Mental Disorders; multiaxial assessment and diagnosis of mental disorders, including coding and reporting procedures. Preq: EDC 8100 and EDC 8180 and enrollment in the Counselor Education master’s program; or consent of instructor.

EDC 8220 Addictions Counseling 3 (3) Comprehensive overview of the phenomenon of chemical dependence and addiction; current methods of identification and intervention; awareness of how addictions affect individuals, families, schools and communities. Preq: Consent of instructor.

EDC 8230 Advanced Counseling Techniques and Strategies 3 (3) Development of in-depth counseling skills; techniques for working with a wide variety of populations and/or problems. Students are expected to have completed 30 hours in a master’s program in Counseling, or to be certified as a school counselor to enroll in this course. Preq: EDC 8140 and EDC 8150.

EDC 8240 Ethical Issues in Counseling 3 (3) Explores the ethical standards and dilemmas facing today’s counseling professionals, including foundations of ethical principles and ethical decision-making. Students explore ethical issues that cover traditional topics, such as confidentiality, dual relationships, and record keeping; as well as contemporary issues, such as multicultural competence and online counseling, that are prevalent in most counseling settings. Preq: EDC 8100 or consent of instructor.

EDC 8300 School Counseling Practicum 3 (1) Supervised field experience in counseling and other services in a school setting. To be taken Pass/No Pass only. Preq: EDC 8100 and EDC 8110 and EDC 8410. Preq or concurrent enrollment: EDC 8070 and EDC 8110. Coreq: EDC 8301.

EDC 8301 School Counseling Practicum Laboratory 0 (6) Non-credit laboratory to accompany EDC 8300. Coreq: EDC 8300.

EDC 8340 Student Affairs Practicum 3 (1) Supervised field experience in counseling and other student services in a postsecondary school setting. To be taken Pass/No Pass only. Preq: EDC 8340; or consent of instructor (100 clock hours). Coreq: EDC 8341.

EDC 8341 Student Affairs Practicum Laboratory 0 (6) Non-credit laboratory to accompany EDC 8340. Coreq: EDC 8340.

EDC 8360 Clinical Mental Health Practicum 3 (1) Supervised field experiences in counseling and other services in a community-agency setting. To be taken Pass/No Pass only. Preq: Consent of instructor. Preq or concurrent enrollment: EDC 8050 and EDC 8140 and EDC 8150.

EDC 8361 Clinical Mental Health Practicum Laboratory 0 (6) Non-credit laboratory to accompany EDC 8360. Coreq: EDC 8360.

EDC 8400 Independent Study in Counseling 1-3 (1-3) Individualized, in-depth study of a particular topic not offered in other courses. Reading, research and independent study are supervised by a faculty member. May be repeated for a maximum of six credits. Preq: Consent of instructor.

EDC 8410 School Counseling Internship 3-6 (3-6) In a supervised field experience, students apply knowledge in individual and group counseling, classroom guidance and consultation to assist students in school settings. May be repeated for a maximum of 12 credits. To be taken Pass/No Pass only. Preq: EDC 8300. Preq or concurrent enrollment: EDC 8120 and EDC 8130. Coreq: EDC 8411.

EDC 8411 School Counseling Internship Laboratory 0 (99) Non-credit laboratory to accompany EDC 8410. Coreq: EDC 8410.

EDC 8440 Student Affairs Internship 3-6 (3-6) Application of previous knowledge to professional and postsecondary settings in a supervised field experience in counseling/student services. May be repeated for a maximum of six credits. To be taken Pass/No Pass only. Preq: EDC 8340 and consent of instructor. Coreq: EDC 8441.

EDC 8441 Student Affairs Internship Laboratory 0 (99) Non-credit laboratory to accompany EDC 8440. Coreq: EDC 8440.

EDC 8460 Clinical Mental Health Counseling Internship 3-6 (3-6) Students apply previous knowledge of counseling theory and techniques in a supervised field experience in professional mental health counseling settings. May be repeated for a maximum of 12 credits. Preq: EDC 8050 and EDC 8100 and EDC 8110 and EDC 8410 and EDC 8150 and EDC 8180 and EDC 8210 and EDC 8360 and consent of instructor. Preq or concurrent enrollment: EDC 8230.

EDC 8461 Clinical Mental Health Counseling Internship Laboratory 0 (99) Non-credit laboratory to accompany EDC 8460. Coreq: EDC 8460.

EDC 8510 Leadership in School Counseling 3 (3) Leadership, management and evaluation of school counseling programs. Preq or concurrent enrollment: EDC 8440.

EDC 8850 Selected Topics in Counseling 1-3, 3 (1-3) Developing trends in counseling not covered in other courses. May be repeated, but only if different topics are covered.

EDC 9150 Internship in Counseling Setting 3 (7) Postmaster’s supervised internship in counseling. Provides experience in counseling as well as coordination of services for a diverse client population. Students participate in direct services with clients in an approved agency. May be repeated for a maximum of six credits. Students must have earned a Master’s degree in Counseling or related field approved by program coordinator to enroll in this course. Preq: Consent of instructor.

EDC 9200 Counselor Supervision 3 (3) Overview of conceptual and empirical literature on counselor supervision that includes models, approaches, techniques, relationships/process issues, legal concerns and ethical considerations. Students develop supervision skills through readings, seminar discussions and supervision of master’s level students. Students must have earned a Master’s degree in Counseling or related field approved by program coordinator to enroll in this course. Preq: Consent of instructor.

EDC 8000 Parent Education in Early Childhood Multicultural Settings 3 (3) Focuses on a multicultural perspective on parent involvement in early childhood education settings. Theory and applications of parent involvement in multicultural environments are studied with an emphasis on activities that set the stage for science and math concept development and on uses of technology with young children.

EDC 8100 Advanced Early Childhood Education Foundations and Methods 3 (3) In-depth study of developmentally appropriate and effective instructional methods in early childhood classrooms and the history of early childhood education as a professional field.

EDC 8200 Advanced Early Childhood Education Curriculum 3 (3) In-depth study of curriculum development and current approaches in the field of early childhood education. Students explore the research literature on effective curriculum in early childhood education at both the national and international levels. Preq: Consent of instructor.

EDC 8400 Theories of Early Childhood Education 3 (3) Examines the theoretical, philosophical and research foundations of early childhood education with emphasis on how these foundations interact with science, math and technology concept development in young children. Students develop skills in critical inquiry as they explore specific topics related to early child care and education.

EDC 8500 Creative and Cognitive Development in Early Childhood: Creating Connections to Math and Science 3 (3) Examines the theoretical, philosophical and cognitive foundations of creative thought during the early childhood years. Students develop skills in critical inquiry as they explore the connections between creativity and math/science education during the early childhood years.

EDC 8800 Current Issues in Early Childhood 3 (3) Focuses on factors that impact early childhood policy, identification of current problems/issues and development of research-based advocacy strategies.

EDC 8850 Thesis Hours in Early Childhood Education 3 (3) Students work with thesis advisor and committee to complete thesis requirements; thesis must address a STEM discipline. Required of students enrolled in thesis track in Early Childhood Education. May be repeated for a maximum of six credits. Preq: 18 credit hours including EDF 8770 and EDF 8790 and consent of thesis advisor.

EDC 8900 Assessment and Program Planning in Early Childhood 3 (3) Study of instructional planning and assessment for young children in all content areas including math, science and technology. Also explores multiple assessment and screening strategies for infants, toddlers and preschool children with typical and atypical development; includes quantitative and qualitative assessment methods for program planning.

EDC 8950 Math, Science and Technology Inquiry in Early Childhood 3 (3) Emphasizes theory to practice and exploration of the processes of inquiry in mathematics, science and technology for early childhood education.
EDEC 8960 Early Childhood Math and Science Curricula 3 (3) Provides a vertical articulation of math and science curricula for the early childhood years through an in-depth analysis of national standards for content and pedagogy. Students experience the progression of math and science understanding in the early years.

ELEMENTARY EDUCATION

EDEL 7600 Curriculum Development in the Elementary School 3 (3) Analysis of trends and practices relative to elementary curriculum planning. Designed to develop an understanding of the essential elements of curriculum decisions followed by the process of improving the curriculum. Prq: EDF 7010 and EDF 7020; or consent of instructor.

EDEL 8040 Advanced Methods of Teaching in the Elementary School 3 (3) Principles and practices involved in promoting effective learning in elementary schools; analysis and evaluation of educational models and research. Prq: EDEL 7600 or consent of instructor.

EDEL 8260 Elementary School Science Theory to Practice 3 (3) In-depth study of current research and trends in science theory, teaching strategies and curriculum development from birth to grade six. Prq: Admission to MEd program in Early Childhood or Elementary Education; or consent of instructor.

EDEL 8310 Elementary School Social Studies Theory to Practice 3 (3) In-depth study of current research and trends in Social Studies theory, teaching strategies and curriculum development from kindergarten to grade six. Prq: Admission to Masters level study in Elementary Education; or consent of instructor.

EDEL 8900 Education Research Project 3 (2) Students select, with approval of professor, and conduct research on an education issue of suitable scope. Oral, written and visual presentation of the research project is required. Students must enroll during final semester. Prq: Consent of instructor. Coreq: EDEL 8901.

EDEL 8901 Education Research Project Laboratory 0 (3) Non-credit laboratory to accompany EDEL 8900. Coreq: EDEL 8900.

EDEL 8920 Elementary School Mathematics Theory to Practice 3 (3) In-depth study of current research and trends in mathematics theory, teaching methods and curriculum development from birth to grade six. Prq: Admission to MEd program in Early Childhood or Elementary Education; or consent of instructor. Coreq: EDEL 8921.

EDEL 8921 Elementary School Mathematics Theory to Practice Laboratory 0 (0) Non-credit laboratory to accompany EDEL 8920. Coreq: EDEL 8920.

EDEL 9370 Designing Elementary Curriculum 3 (3) Theoretical issues and guidelines for educators engaged in the curriculum development process at the elementary level. Prq: Admission to the PhD program in Curriculum and Instruction and ED 9540 and ED 9550 and ED 9560.

EDEL 9380 Teacher as Researcher 3 (3) Various methodologies of field-based research. Students complete a literature review and design a field-based research project. Prq: Admission to the PhD program in Curriculum and Instruction and ED 8780 and ED 8790 and EXST 8010 and one of the following: EDSC 8460 or EDSC 8470 or EDSC 8480 or EDSC 8490 or READ 9440.

EDUCATIONAL FOUNDATIONS

EDF 6800 Foundations of Digital Media and Learning 3 (2) Critical use of digital media for leadership and learning within societal and educational contexts. Course focuses on learner impact while exploring, developing, and evaluating technology-enhanced applications. Further develops competencies with new media literacies and addresses societal, cultural, ethical, and participatory issues and uses of digital media. Coreq: EDF 6801.

EDF 6801 Foundations of Digital Media and Learning Laboratory 0 (2) Non-credit laboratory to accompany EDF 6800. Coreq: EDF 6800.

EDF 6820 Advanced Educational Applications of Microcomputers 3 (2) Provides students with the knowledge and skills needed to apply microcomputer technology to the utilization and generation of educational software in accordance with sound educational principles. Prq: AGED 4800 or EDF 4800. Coreq: 6821.

EDF 6821 Advanced Educational Applications of Microcomputers Laboratory 0 (2) Non-credit laboratory to accompany EDF 6820. Coreq: EDF 6820.

EDF 6800 Classroom Management 3 (3) Aids students in developing strategies and plans to manage a classroom effectively. Topics include both time and behavioral management. Students learn how to prevent problems as well as address problems once they have occurred. Includes Honors sections. Prq: Graduate standing.

EDF 6970 Instructional Media in the Classroom 3 (3) Integrated approach to the use of audiovisual media stressing systematic planning, selection, utilization, and evaluation as well as production of materials and equipment operation. Prq: 2.0 minimum grade-point average.

EDF 8000 Philosophy, Schooling and Educational Policy 3 (3) Development of contemporary educational theory and its impact on current schooling practices and educational policy development. May also be offered as EDL 8000.

EDF 8010 Human Growth and Development 3 (3) Theory and research in human development and its impact on the teaching/learning process.

EDF 8020 Advanced Educational Psychology 3 (3) Educational applications of research and theory on objectives, motivation, class climate, class management and learning theory.

EDF 8030 Early Adolescent Growth and Development 3 (3) Theory and research in early adolescent growth and development and the teaching/learning process for middle-grades youth. Undergraduate students may request consent of instructor.

EDF 8080 Educational Tests and Measurements 3 (3) Construction, use and interpretation of subjective and standard tests; measurement applications.

EDF 8660 Integrating Service Learning into Curriculum 3 (2) Opportunities for certified teachers to build competence in service learning through personal participation in service and in reflection. Students develop a plan to integrate service learning activities into the curriculum of their school and/or district. Designed for 12-25 elementary, middle school, high school and adult education teachers. Students must hold teaching certification in order to enroll in this course. Coreq: EDF 8661.

EDF 8661 Service Learning Lab 0 (3) Non-credit laboratory to accompany EDF 8660. Coreq: EDF 8660.

EDF 8710 Cultural Diversity in Education 3 (3) Sociological and anthropological examination of contemporary P-12 educational policy issues.

EDF 8770 Experimental and Nonexperimental Research Methods in Education I 3 (3) Types of educational research and uses; logical bases of quantitative and qualitative analysis techniques; basic research issues important in education; educational research design and procedures; introduction to measurement and evaluation; applications to special problems in classroom settings and program development; and evaluation in curriculum, administration and educational support services.

EDF 8800 Integration of Digital Media for Middle School Teachers 3 (2) Students learn how digital media can support learning and instruction within various content areas for middle school students. Through the exploration and evaluation of existing and emerging technologies, students develop competencies related to digital literacies, the design of digital learning environments, and professional growth. Prq: Admission to the MAT in Middle Level Education program; or consent of instructor. Coreq: EDF 8801.

EDF 8801 Integration of Digital Media for Middle School Teachers Laboratory 0 (2) Non-credit laboratory to accompany EDF 8800. Coreq: EDF 8800.

EDF 9050 Critical Look at Social Media, Games and Emerging Technologies 3 (3) Designed for students to better understand or expand their knowledge of social media, games and emerging technologies, and their implications for learning.

EDF 9080 Advanced Educational Tests and Measurement 3 (3) Theoretical and quantitative aspects of modern and classical test theory from the practitioner's perspective; solving contemporary problems involving intra-student and class level comparisons of student progress; the subsequent impact of assessment on classroom high-stakes accountability decisions. Prq: EDF 8080 and EDF 8770.

EDF 9910 Theoretical Foundations of Games for Learning 3 (3) This course is designed for participants to consider concepts, methods and models connecting games-based research to practices in formal and informal educational contexts. Students explore social and behavioral science theories supporting principles of game play and design for learning while playing, deconstructing and prototyping simple games. Prq: Graduate standing.
EDF 9200 Philosophy of Educational Research 3 (3) Course introduces doctoral students to the different philosophies of educational research and critical scholarship. Different epistemological stances and their application to educational research are examined. Students learn to define and discuss various epistemological and ontological perspectives and how they relate to educational research. Preq: Admission to a doctoral program or consent of instructor.

EDF 9270 Quantitative Research Designs and Statistics for Educational Contexts 4 (3) Overview of quantitative research designs and bivariate and univariate statistics for single- and two-group studies frequently used in educational research. Students learn about the nature of quantitative research designs, how to design a study, and how quantitative designs relate to probability theory. Preq: Admission to a doctoral program or consent of instructor. Coreq: EDF 9271.

EDF 9271 Quantitative Research Designs and Statistics for Educational Contexts Laboratory 0 (2) Non-credit laboratory to accompany EDF 9270. Coreq: EDF 9270.

EDF 9700 Identity, Schooling and Democratic Education 3 (3) Examines current theories of education that address the relationships between race, ethnicity, gender, social class and democratic education in American public schools.

EDF 9710 Case Study and Ethnographic Research Methods and Design 3 (3) Examines case study and ethnographic research methods and design. Preq: EDF 9770 and EDF 9790; or consent of committee.

EDF 9720 Phenomenology and Grounded Theory Research Methods and Design 3 (3) Examines phenomenology and grounded theory research methods and design. Preq: EDF 9770 and EDF 9790.

EDF 9730 Narrative and Historical Research Methods and Design 3 (3) Examines narrative and historical research methods and design. Preq: EDF 9770 and EDF 9790.

EDF 9740 Emerging Qualitative Research Methods and Design 3 (3) Examines emerging and lesser-known qualitative research methods and designs, such as self-study, portraiture, arts-based research, photo-voice, rhizomatic analysis and critical policy analysis. Preq: EDF 9770 and EDF 9790.

EDF 9750 Mixed Methods Research 3 (3) Examines methods and design for mixed methods methodology. Preq: EDF 9770 and EDF 9790.

EDF 9760 History of American Education 3 (3) Historical development of educational purpose and the social and cultural forces which shaped that development.

EDF 9770 Multiple Regression/General Linear Model in Educational Research 3 (3) Intermediate inferential statistical methods course for educational research. Emphasis is on understanding the theory and application of univariate statistics and developing the ability to conduct independent empirical research in education. Preq: EDF 9270, EDF 9780 Multivariate Educational Research 4 (3) Provides students with an understanding of the logic, concepts, methods, applications and limitations of the common types of multivariate statistical analysis used in educational research. Emphasis is given to the application of these analyses in educational research. Computer applications of the procedures are integrated into the course. Preq: EDF 9770. Coreq: EDF 9781.

EDF 9781 Multivariate Educational Research Laboratory 0 (2) Non-credit laboratory to accompany EDF 9780. Coreq: EDF 9780.

EDF 9790 Qualitative Research in Education 3 (3) Application of qualitative studies to educational questions; nature of qualitative research; rationale and applications of qualitative research methods; integration of qualitative and quantitative research methods in educational research. Preq: EDF 8770.

EDF 9800 Internship in Curriculum and Instruction 1-6 (1-6) Practical experiences linking the student’s program of study to his/her field of professional service. To be taken Pass/No Pass only. May also be offered as ED 9800 or EDSP 9800. Preq: Consent of advisor.

EDF 9910 Doctoral Dissertation Research 1-18 (1-18) Doctoral Dissertation Research. May also be offered as ED 9910 or EDSP 9910.

EDF 9940 Directed Research 1-4 (1-4) Research in a line of inquiry in education under the direction of faculty. May be taken with different faculty members and may be repeated for a maximum of 18 hours. To be taken Pass/No Pass only. May also be offered as ED 9940 or EDSP 9940. Preq: EDF 8770 or EDF 8080 or consent of instructor.

EDUCATIONAL LEADERSHIP

EDL 7000 Public School Administration 3 (3) Theoretical bases of school administration; organizational principles, patterns and practices in public schools; decision making; administration of programs and services. Preq: Three graduate education courses or consent of instructor.

EDL 7050 The Principalship 3 (3) Roles and responsibilities of the principalship including the organization and administration of schools.

EDL 7100 Organizational Theory for School Administrators 3 (3) Theory of management, communication, human relations, social systems, motivation, contingency, decision making and change. Preq: EDL 7000.

EDL 7150 School and Community Relationships 3 (3) Interdependence of school and community, identifying and defining societal expectations of schools and effect of these expectations on educational policy; impact of social, political, economic and demographic change on educational policy.

EDL 7200 School Personnel Administration 3 (3) School personnel selection, practices and problems. Preq: EDL 7000 and EDL 7050.

EDL 7250 Legal Phases of School Administration 3 (3) Legal principles involved in school administration and in court actions. Preq: EDL 7100.

EDL 7300 Techniques of Supervision—The Public Schools 3 (3) Improving, coordinating and evaluating instruction; modern trends of supervisory practices. Preq: EDL 7100.

EDL 7350 Educational Evaluation 3 (3) Evaluation theory and design applied to classroom instruction and to evaluation procedures applicable to school center and district programs and projects. Preq: EDL 7100.

EDL 7400 Curriculum Planning and Improvement for School Administrators 3 (3) Role of leadership in curriculum planning and improvement: curriculum evaluation and development, change, programmatic requirements, cocurriculum, organization, scheduling, planning, management and technology. Preq: EDL 7100.

EDL 7450 School Finance 3 (3) School finance relative to programs, revenues and experience. Preq: EDL 7350.

EDL 7500 Elementary Principal and Supervisor Field Experience I 3 (3) First practicum in a series of two with an experienced elementary/middle (pre-K-8) school principal or supervisor. EDL 7500 and 7510 must be taken in a sequence in a single academic year. Preq: EDL 7050. Coreq: EDL 7501.

EDL 7501 Elementary Principal and Supervisor Field Experience I Laboratory 0 (4) Non-credit laboratory to accompany EDL 7500. Coreq: EDL 7500.

EDL 7510 Elementary Principal and Supervisor Field Experience II 3 (1) Second practicum in a series of two with an experienced elementary/middle (pre-K-8) school principal or supervisor. EDL 7500 and 7510 must be taken in a sequence in a single academic year. Preq: EDL 7500. Coreq: EDL 7501.

EDL 7511 Elementary Principal and Supervisor Field Experience II Laboratory 0 (4) Non-credit laboratory to accompany EDL 7510. Coreq: EDL 7510.

EDL 7550 Secondary Principal and Supervisor Field Experience I 3 (1) First practicum in a series of two with an experienced secondary (grades 7-12) principal or supervisor. EDL 7550 and 7560 must be taken in a sequence in a single academic year. Preq: EDL 7050. Coreq: EDL 7551.

EDL 7551 Secondary Principal and Supervisor Field Experience I Laboratory 0 (4) Non-credit laboratory to accompany EDL 7550. Coreq: EDL 7550.

EDL 7560 Secondary Principal and Supervisor Field Experience II 3 (1) Second practicum in a series of two with an experienced middle/high school (grades 7-12) principal or supervisor. EDL 7550 and 7560 must be taken in a sequence in a single academic year. Preq: EDL 7550. Coreq: EDL 7561.

EDL 7561 Secondary Principal and Supervisor Field Experience II Laboratory 0 (4) Non-credit laboratory to accompany EDL 7560. Coreq: EDL 7561.

EDL 7650 Assessment in Higher Education 3 (3) Outcomes assessment and institutional effectiveness movement including assessment techniques, instrument selection, analysis of assessment data and reporting of assessment findings. Preq: Consent of instructor.
EDL 7950 School Leadership Information Systems 3 (2) Use of computers and related technologies for decision making by public school leaders; logistics of information management, sources of information, communication with technology and integration of technology into the leadership function. Coreq: EDL 7951.

EDL 7951 School Leadership Information Systems Laboratory 0 (2) Non-credit laboratory to accompany EDL 7950. Coreq: EDL 7950.

EDL 8000 Philosophy, Schooling and Educational Policy 3 (3) Development of contemporary educational theory and its impact on current schooling practices and educational policy development. May also be offered as EDF 8000.

EDL 8050 Advanced Educational Leadership: Theory and Practice 3 (3) Principles and theories of leadership as practiced in the institutional setting. Coreq: EDL 8150 and EDF 7300.

EDL 8100 Introductory to School Building Planning 3 (2) Planning of educational facilities from conception of need through utilization of facility. Prereq: EDL 7000. Coreq: EDL 8101.

EDL 8101 Introduction to School Building Planning Laboratory 0 (2) Non-credit laboratory to accompany EDL 8100. Coreq: EDL 8100.

EDL 8150 The Superintendentcy 3 (3) Current, in-depth study of the superintendentcy including relationships with school boards, faculty, staff and community. For practicing and aspiring educational administrators. Prereq: Admission to the Educational Specialist program or the Educational Leadership doctoral program.

EDL 8200 Politics of Education 3 (3) Politics of education in the United States including complex interrelationships among administrators, special interest groups, politicians and knowledge brokers.

EDL 8300 Business Management in Education 3 (2) Fiscal management of individual schools and districts including budgeting, purchasing and accounting for funds. Prereq: EDL 7250 and EDL 7450. Coreq: EDL 8301.

EDL 8301 Business Management in Education Laboratory 0 (3) Non-credit laboratory to accompany EDL 8300. Coreq: EDL 8300.

EDL 8390 Research Methods in Educational Leadership 3 (3) Development of design, method and procedures for conducting the educational specialist project. Course culminates in the completion and presentation of the project prospectus for approval by the instructor and the student’s major advisor. Prereq: EDF 8000 or EDL 8000; and EDL 8050 and EDL 8200 and consent of instructor.

EDL 8400 Field Problems in School Administration and Supervision of Instruction 3 (2) Application of research techniques and practices in solution of field problems in school administration and supervision. Prereq: EDF 8770 and EDL 7000. Coreq: EDL 8401.

EDL 8401 Field Problems in School Administration and Supervision of Instruction Laboratory 0 (3) Non-credit laboratory to accompany EDL 8400. Coreq: EDL 8400.

EDL 8500 Practicum in School System Leadership I 3 (1) First in a two-semester practicum with an experienced school-system-level administrator or supervisor. Prereq: EDF 8000 or EDL 8000; and EDL 8050 and EDF 8150; or consent of instructor. Coreq: EDL 8501.

EDL 8501 Practicum in School System Leadership II Laboratory 0 (4) Non-credit laboratory to accompany EDL 8500. Coreq: EDL 8500.

EDL 8510 Practicum in School System Leadership II 3 (1) Second in a two-semester practicum with an experienced school-system-level administrator or supervisor. Prereq: EDL 8500.

EDL 8511 Practicum in School System Leadership II Laboratory 0 (4) Non-credit laboratory to accompany EDL 8510. Coreq: EDL 8510.

EDL 8550 Applied Research and Evaluation in Higher Education 3 (3) Basic issues of measurement emphasizing questionnaire development, scales and measures commonly used in higher education research, assessment and program evaluation.

EDL 8580 Selected Topics in Educational Administration 1-3 (1-3) Current literature and results of current research. Topics vary from year to year. May be repeated for a maximum of six credits.

EDL 8590 Advanced Field Designs for Educational Personnel 3 (2) Presents state-of-the-art field designs and multivariate statistics for education personnel; and provides hands-on experience with advanced statistical procedures using PASW and AMOS. Addresses demands by publicists and policy makers, and is particularly valuable for PhD students in education pursuing research in curriculum, policy, diversity and leadership. Prereq: EDL 7890 or STAT 8010. Coreq: EDL 8591.

EDL 8591 Advanced Field Designs for Educational Personnel Laboratory 0 (1) Non-credit laboratory to accompany EDL 8590. Coreq: EDL 8591.

EDL 9000 Principles of Educational Leadership 3 (3) Advanced leadership theory; the nature of leadership, major theories of leadership and their application in educational organizations. Prereq: Admission to PhD program in Educational Leadership.

EDL 9050 Theory and Practice in Educational Leadership 3 (3) Advanced organizational and leadership theory; major theories of organization and their applications in understanding the roles of governmental agencies in society. Prereq: Admission to PhD program in Educational Leadership.

EDL 9100 Introductory Doctoral Seminar 3 (3) Educational leadership for beginning doctoral students providing an introduction to the conceptual and theoretical frameworks of educational leadership for both public school and higher education administration. Prereq: Consent of instructor.

EDL 9101 Systematic Inquiry in Educational Leadership 3 (3) Introduces entry level doctoral students to multiple approaches in inquiry practices for the field of educational leadership. Prereq: Admission to doctoral program in Educational Leadership and consent of instructor.

EDL 9150 Educational Planning 3 (3) Systems approach to planning and management; the measurement and interpretation of performance results.

EDL 9250 Instructional Leadership 3 (3) Students examine concepts associated with instructional leadership as such concepts pertain to building-level and district-level leaders.

EDL 9290 The Academic Profession 3 (3) Students experience a structured, historicized and scholarly grounded approach to learning about the academic profession. Readings, discussion, analytical writing, and practical exercises focus on central features and challenges relevant to the academic profession.

EDL 9500 Educational Policy Studies 3 (3) Critical analysis of the sources and nature of educational policy and how policy is developed, administered and assessed for public schools. Prereq: Admission to PhD program in Educational Leadership.

EDL 9550 The Two-Year College 3 (3) Historical developments, functions, organization and administration of the two-year college. Prereq: Admission to PhD program in Educational Leadership or consent of instructor. May also be offered as EDL 9550.

EDL 9600 Legal Principles in the Administration of Institutions of Higher Education 3 (3) General principles of higher education law from the points of view of statute and common law practice. Prereq: Admission to doctoral studies or consent of instructor.

EDL 9620 Governance in Higher Education 3 (3) Exposes students to literature on the organization and governance of higher education institutions. Helps future leaders of higher education understand the distinctive organizational and behavioral features of postsecondary institutions and gives them the knowledge base to make better decisions for their institutions. Prereq: Admission to PhD program in Educational Leadership or consent of instructor.

EDL 9650 Higher Education Finance 3 (3) Higher education finance relative to sources of revenue, expenditures and planning.

EDL 9700 Foundations of Higher Education 3 (3) Survey of American higher education including its historical, political, philosophical and social aspects. Prereq: Admission to PhD program in Educational Leadership.

EDL 9720 Ethics in Educational Leadership 3 (3) The ethical issues involved in administering educational institutions; moral leadership, ethical work environments and decision-making models.

EDL 9750 College Teaching 3 (3) Comprehensive preparation for teaching at the college level: course design and development around student outcomes/objectives; teaching strategies that motivate today’s diverse students and promote active, multimodal, collaborative and experiential learning; assessment of student learning and teaching effectiveness; institutional issues; and job search preparation. Prereq: Consent of instructor.

EDL 9760 External Effectiveness in Higher Education 3 (3) Optimum structures and strategies for fund raising, public relations, constituent relations, governmental affairs and governing boards necessary for a college or university to communicate effectively with its constituents.
EDL 9720 Diversity Issues in Higher Education 3 (3) Students read research and analyze information highlighting the complex nature of diversity issues in postsecondary environments. Students also examine the history of student diversity in higher education and explore the impact of multicultural higher educational environments on students, faculty and postsecondary institutions. Prereq: Admission to PhD program in Educational Leadership or consent of instructor.

EDL 9860 Current Issues in Educational Leadership 1-3 (1-3) Topics and issues as determined by the needs of the students and the instructor. Prereq: Consent of instructor.

EDL 9850 Internship in Educational Leadership I 3 (1) First in a two-semester internship to provide experience in leadership role under the guidance of an experienced field mentor at the student's chosen level of specialization in educational leadership (public schools or institutions of higher education). Prereq: EDL 9000 and EDL 9050 and EDL 9100; or consent of advisor. Coreq: EDL 9851.

EDL 9851 Internship in Educational Leadership I Laboratory 0 (4) Non-credit laboratory to accompany EDL 9850. Coreq: EDL 9850.

EDL 9860 Internship in Educational Leadership II 3 (1) Second in a two-semester internship to provide experience in leadership role under the guidance of an experienced field mentor at the student's chosen level of specialization in educational leadership (public schools or institutions of higher education). Prereq: EDL 9850. Coreq: EDL 9861.

EDL 9861 Internship in Educational Leadership II Laboratory 0 (4) Non-credit laboratory to accompany EDL 9860. Coreq: EDL 9860.

EDL 9880 Directed Research 3 (3) First in a sequence of three required post-candidacy courses in which students refine the conceptual basis for their research questions in directed study with faculty. Prereq: Admission to doctoral candidacy or consent of instructor.

EDL 9890 Advanced Doctoral Seminar I 3 (3) Explores educational leadership topics. Cumulates in the selection of a topic for presentation and approval and the development of Chapter I of a dissertation. Prereq: EDL 9000 and EDL 9050 and EDL 9100. Consent of instructor.

EDL 9900 Advanced Doctoral Seminar II 3 (3) Seminar for advanced students focusing on the preparation of dissertation Chapters I-III.


LITERACY

EDLT 8100 Foundations of Reading and Writing 3 (3) Examines the theoretical and evidence-based foundations of reading and writing processes and instruction, the historical progression of reading instruction, and the role of professional learning, leadership and judgment. Prereq: An undergraduate-level reading or literacy course approved by the instructor or consent of instructor.

EDLT 8120 Assessment Strategies in Reading and Writing 3 (2) Examines a variety of literacy assessment tools and use of assessment results for planning and evaluating effective reading and writing instruction. Students select, administer, score, interpret and report literacy assessment results to a variety of audiences. Prereq: EDLT 8100. Coreq: EDLT 8112.

EDLT 8121 Assessment Strategies in Reading and Writing Laboratory 0 (3) Non-credit laboratory to accompany EDLT 8120. Coreq: EDLT 8120.

EDLT 8130 Instructional Strategies for Literacy in Grades K-12 3 (3) Provides K-12 teachers an overview of instructional strategies for reading and writing, including the theoretical and research underpinnings. Emphasis is placed on all aspects of the reading and writing processes, assessment and instruction for diverse populations. Prereq: EDLT 8100 and EDLT 8110 and EDLT 8120.

EDLT 8140 Reading and Writing Instruction and Assessment for Culturally and Linguistically Diverse Students 3 (3) Examines cross-cultural theoretical dimensions, principles and research related to second language acquisition and provides a knowledge base for teaching the reading and writing processes to English language learners (ELLs). Instructional models, strategies and tools supporting ELLs and their learning needs are presented.

EDLT 8150 Guided Reading and Guided Writing Scaffolded Instruction for Classrooms and Small-Group Intervention 3 (2) Teachers use scaffolded instructional approaches such as interactive read-alouds, guided reading, shared reading, shared writing and interactive writing effectively. Prereq: EDLT 8100 and EDLT 8110 and EDLT 8120 and EDLT 8130 and EDLT 8140. Coreq: EDLT 8151.

EDLT 8151 Guided Reading and Guided Writing Scaffolded Instruction for Classrooms and Small-Group Intervention Laboratory 0 (3) Non-credit laboratory to accompany EDLT 8150. Coreq: EDLT 8150.

EDLT 8160 Practicum in Differentiated Instruction for Learners with Literacy Difficulties 3 (2) Supervised practicum emphasizing diagnostic and intervention work with learners who have literacy difficulties. Prereq: EDLT 8100 and EDLT 8110 and EDLT 8120 and EDLT 8130 and EDLT 8140 and EDLT 8150. Coreq: EDLT 8161.

EDLT 8161 Practicum in Differentiated Instruction for Learners with Literacy Difficulties Laboratory 0 (2) Non-credit laboratory to accompany EDLT 8160. Coreq: EDLT 8160.

EDLT 8170 Content Area Reading and Writing 3 (3) Provides theories and research related to the specialized reading, writing, discourse and thinking valued in content areas, by experts within each school discipline. Teacher practitioners are afforded opportunities to utilize a disciplinary-specific instructional framework to design and scaffold literacy for students in grades 4-12. Prereq: EDLT 8100 and EDLT 8110 and EDLT 8120 and EDLT 8130 and EDLT 8140 and EDLT 8150 and EDLT 8160.

EDLT 8180 Organization, Administration and Supervision in Literacy 3 (3) Focuses on planning, organizing, implementing, supervising and administering school-wide, comprehensive literacy programs. Emphasis is given to development of school-wide literacy program evaluation, accountability, improvement and support. Prereq: EDLT 8100 and EDLT 8110 and EDLT 8120 and EDLT 8130 and EDLT 8140 and EDLT 8150 and EDLT 8160 and EDLT 8170.

EDLT 8190 Coaching for Literacy Education 3 (3) The first of three courses in which the student develops expertise as a literacy specialist and coach. The course provides theoretical rationales for literacy leadership, comprehensive literacy frameworks and coaching. Focus is on the roles and responsibilities of a literacy coach. Participants develop knowledge of lesson demonstration, conducting and supporting team meetings, professional learning communities, and peer-coaching. Prereq: EDLT 8100 and EDLT 8120 and EDLT 8160 and EDLT 8170 and EDLT 8180 and EDLT 8162.

EDLT 8220 Principles and Strategies for Teaching English Speakers of Other Languages 3 (3) Helps participants develop culturally and linguistically responsive classrooms with instructional strategies for teaching the language acquisition process within the context of academics supportive of English language learners (ELLs) and their learning needs. Prereq: Graduate standing in Education or consent of instructor.

EDLT 8600 Reading Instruction in the Elementary School 3 (3) Knowledge and skills necessary for teaching reading to varied types of elementary school learners. Prereq: Consent of instructor.

EDLT 8620 Clinical Research in Reading 3 (3) Reading research and literature; original investigation in such problems as development of reading skills and attitudes, clinical procedures and techniques is required. Prereq: EDLT 8610.

EDLT 8670 Middle School Reading 3 (3) Techniques, materials and theories for teaching reading to middle school students emphasizing correlating reading skills into the content area. Prereq: Education major or consent of instructor.

EDLT 8680 Using Literature and Technology for Reading Instruction 3 (3) Provides early childhood, elementary and middle school teachers with theory and knowledge needed to utilize technological and library resources and make appropriate literature selections for the teaching of reading.

EDLT 8690 Integrated Approach to Reading and Writing Instruction 3 (3) Understanding of the reading/writing processes for early childhood and elementary teachers; investigation of the whole language approach in the classroom. Prereq: EDLT 8610.

EDLT 8700 Early Literacy Strategic Reading and Writing Instruction 3 (3) Use of the theoretical base of the Reading Recovery program to modify instructional practices to include generalizable instructional procedures. Prereq: EDLT 8660.

EDLT 8710 Literacy Across the Curriculum 3 (3) Use of the theoretical base of the Reading Recovery program to modify instructional practices to include reading and writing activities in all aspects of K-5 curriculum. Prereq: EDLT 8660 and EDLT 8700.
EDLT 8800 Reading Recovery Teacher I 3 (3) First in a two-semester, two-course sequence designed to prepare teachers to implement and teach a Reading Recovery Program. Issues related to reading theory and process, instructional processes, program implementation and evaluation. Prq: Consent of instructor. Coreq: EDLT 8820.

EDLT 8810 Reading Recovery Teacher II 3 (3) Second in a two-course sequence designed to prepare teachers to implement and teach in a Reading Recovery Program. Issues related to reading theory and process, instructional process, program implementation and evaluation. Prq: Admission into the Clemson Reading Recovery Program and EDLT 8820. Coreq: EDLT 8830.

EDLT 8820 Reading Recovery Teacher Practicum I 3 (9) Teaching experience allowing teachers to develop and practice responsibilities of implementing and teaching first grade children in a Reading Recovery program. Participants implement content studied in EDLT 8800. Prq: Consent of instructor. Coreq: EDLT 8800.

EDLT 8830 Reading Recovery Teacher Practicum II 3 (9) Teaching experience and practice in implementing and teaching in a Reading Recovery Program. Participants implement content studied in EDLT 8810. Prq: Admission into the Clemson University Reading Recovery Program and EDLT 8800 and EDLT 8820. Coreq: EDLT 8810.

EDLT 8840 Reading Recovery Clinical I 3 (3) First in a two-course sequence aimed at providing leadership experiences in implementing a Reading Recovery Program in an elementary school setting. Prq: Admission into the Clemson University Reading Recovery Teacher Leader program. Coreq: EDLT 8860 and EDLT 9370.

EDLT 8850 Reading Recovery Clinical II 3 (3) Second in a two-course sequence to provide leadership experiences in implementing a Reading Recovery Program in an elementary school setting. Prq: Admission into the Clemson University Reading Recovery Teacher Leader program. Coreq: EDLT 8870 and EDLT 9380.

EDLT 8860 Reading Recovery Teacher Leader Practicum I 3 (9) First in a two-course sequence designed to prepare Reading Recovery Teacher Leaders to implement a school-based program, supervise teachers and carry out responsibilities related to maintaining a Reading Recovery site. Prq: Admission into the Clemson University Reading Recovery Teacher Leader program. Coreq: EDLT 8840 and EDLT 9370.

EDLT 8870 Reading Recovery Teacher Leader Practicum II 3 (9) Second in a two-course sequence designed to prepare Reading Recovery Teacher Leaders to implement a school-based program, supervise teachers and carry out responsibilities related to maintaining a Reading Recovery site. Prq: Admission into the Clemson University Reading Recovery Teacher Leader program. Coreq: EDLT 8850 and EDLT 9380.

EDLT 9000 Sociocultural Theories of Learning 3 (3) Examines views of learning that emphasize social and cultural ways of knowing, and the de-emphasize purely individualistic theories of learning. Rooted in anthropology, social psychology and sociology, the readings for this class infuse educational theories with ideas and methods from a variety of disciplines.

EDLT 9130 Critical Issues in Literacy, Language and Culture 3 (3) Critical issues related to literacy, language and culture are examined. Through an investigation of research and policy literature, students develop an understanding of the trends in literacy, language and culture and the critical issues emerging in the field. Prq: Admission to the PhD program in Literacy, Language and Culture or consent of instructor.

EDLT 9140 Language Development, Diversity and Discourse 3 (3) Students are introduced to the study of language with implications for teaching and learning. Primary topic areas include language development, language diversity and discourse. Prq: Admission to the PhD program in Literacy, Language and Culture or consent of instructor.

EDLT 9170 Disciplinary Literacies 3 (3) Course serves to deepen students’ understanding of theory and research surrounding literacies within secondary school disciples. Students are familiarized with historical conceptions of subject matter and related research, and conceptualize subject matter literacies within disciplines in order to envision and research literacy pedagogies. Prq: Enrollment in a doctoral program or consent of instructor.

EDLT 9200 Language Policy in Educational Contexts 3 (3) Students interested in educational policy are provided with an understanding of the landscape of language policy in the United States. Students examine historical discourses shaping the evolution of language policy in order to understand the material, historical and social forces that have contributed to current policies.

EDLT 9210 Home, Family and Community Literacy 3 (3) Explores home, family and community as sites of literacy learning and practice. Students examine sociocultural theories of literacy learning in home, family and community settings, incorporating both seminal and emergent research. Prq: Admission to the doctoral program in Literacy, Language and Culture or consent of instructor.

EDLT 9220 Research in Early Literacy Development 3 (3) Explores theoretical foundations and research in early reading and writing development. Students explore seminal and current research along with implications for instruction.

EDLT 9370 Reading Recovery Theory I 3 (3) First of a two-course sequence designed to examine theoretical principles of the reading process as applied in the Reading Recovery Program. Issues related to program implementation and systematic program changes. Prq: Consent of instructor. Coreq: EDLT 8840 and 8860.

EDLT 9380 Reading Recovery Theory II 3 (3) Second of a two-course sequence designed to examine theoretical principles of the reading process as applied in the Reading Recovery Program. Issues related to program implementation and systematic program changes. Prq: Consent of instructor. Coreq: EDLT 8850 and 8870.

EDLT 9390 Theoretical Models of Reading and Writing 3 (3) Examines the cognitive processes and theories underlying reading and writing processes and principles that inform literacy instruction. Prq: EDLT 8620 or EDLT 8610 or consent of instructor.

EDLT 9400 Advanced Diagnosis and Remediation in Reading 3 (2) Advanced diagnosis and remediation in reading; review of diagnostic instruments and instructional materials. Prq: EDLT 8600 or EDLT 8610; and EDLT 8650; or consent of instructor. Coreq: EDLT 9401.

EDLT 9401 Advanced Diagnosis and Remediation in Reading Laboratory 0 (3) Non-credit laboratory to accompany EDLT 9400. Coreq: EDLT 9400.

EDLT 9410 Advanced Practicum in Reading 3 (2) Diagnosis and remediation testing; remediation. Extensive case studies with recommendation for the classroom teacher are required. Prq: EDLT 9400 and consent of instructor. Coreq: EDLT 9411.

EDLT 9411 Advanced Practicum in Reading Laboratory 0 (3) Non-credit laboratory to accompany EDLT 9410. Coreq: EDLT 9410.

EDLT 9420 Teaching Reading Through a Literature Emphasis 3 (3) Strategies for integrating literature into the traditional reading program. Students are expected to have completed an introductory reading class.

EDLT 9430 The Reading-Writing Connection: An Integrated Approach 3 (3) Theoretical bases and practical techniques for teaching reading and writing in an integrated manner; reading and writing as processes; basic skills instruction in a coordinated program; multiple subject areas; use of student interest and ability. Students are expected to have completed a basic reading methods course.

EDLT 9440 Reading Research Review and Critique of the Literature 3 (3) Historical and contemporary research in reading and related literacy fields. Prq: Admission to the PhD program in Curriculum and Instruction.

EDLT 9450 Special Problems in Reading Education 3 (1) Individual study of a specific topic in reading. Students may choose from a large diversity of topics. Prq: EDLT 8600 or EDLT 8610; EDLT 8620 and EDLT 8650 and EDF 8080; or consent of instructor. Coreq: EDLT 9451.

EDLT 9451 Special Problems in Reading Education Laboratory 0 (4) Non-credit laboratory to accompany EDLT 9450. Coreq: EDLT 9450.

MIDDLE LEVEL EDUCATION

EDML 8020 Early Adolescent Psychology and Philosophy 3 (3) Educational applications of research and theory on objectives, motivation, class climate, learning theory, and philosophical issues as they affect early adolescents. Prq: Admission to the MAT in Middle Level Education program; or consent of instructor.

EDML 8030 The Early Adolescent Learner 3 (3) Students study the theories and research in the study of early adolescence. Course also examines how these theories and research apply to teaching, learning and cultural influences on middle grades youth. Prq: Admission to the MAT in Middle Level Education program; or consent of instructor.
EDML 8080 Middle School Assessment for Teachers 3 (3) Focuses on middle school student assessment by examining and discussing a variety of ways to assess student achievement. Includes formative and summative assessments, as well as studying reliability and validity measures for assessments. Prereq: Admission to the MAT in Middle Level Education program; or consent of instructor.

EDML 8110 Middle Grades Language Arts Methods/Practicum 3 (2) Development of instructional practices appropriate for middle grades language arts teachers; familiarization with curriculum materials. Includes field work in local schools. Prereq: Admission to MAT Middle-Level Education program. Coreq: EDML 8111.

EDML 8111 Middle Grades Language Arts Methods/Practicum Laboratory 0 (4) Non-credit laboratory to accompany EDML 8110. Coreq: EDML 8110.

EDML 8120 Middle Grades Social Studies Methods/Practicum 3 (2) Development of instructional practices appropriate for middle grades social studies teachers; familiarization with curriculum materials. Includes field work in local schools. Prereq: Admission to MAT Middle-Level Education program. Coreq: EDML 8121.

EDML 8121 Middle Grades Social Studies Methods/Practicum Laboratory 0 (4) Non-credit laboratory to accompany EDML 8120. Coreq: EDML 8120.

EDML 8130 Middle Grades Math Methods/Practicum 3 (2) Development of instructional practices appropriate for middle grades mathematics teachers; familiarization with curriculum materials. Includes field work in local schools. Prereq: Admission to MAT Middle-Level Education program. Coreq: EDML 8131.

EDML 8131 Middle Grades Math Methods/Practicum Laboratory 0 (4) Non-credit laboratory to accompany EDML 8130. Coreq: EDML 8130.

EDML 8140 Middle Grades Science Methods/Practicum 3 (2) Development of instructional practices appropriate for middle grades science teachers; familiarization with curriculum materials. Includes field work in local schools. Prereq: Admission to MAT Middle-Level Education program. Coreq: EDML 8141.

EDML 8141 Middle Grades Science Methods/Practicum Laboratory 0 (4) Non-credit laboratory to accompany EDML 8140. Coreq: EDML 8140.

EDML 8210 Middle Grades Language Arts Methods/Student Teaching 3 (2) Continued development of instructional practices appropriate for middle grades language arts teachers; familiarization with additional curriculum materials. Includes field work in local schools. Prereq: Admission to MAT Middle-Level Education program. Coreq: EDML 8211.

EDML 8211 Middle Grades Language Arts Methods/Student Teaching Laboratory 0 (4) Non-credit laboratory to accompany EDML 8210. Coreq: EDML 8210.

EDML 8220 Middle Grades Social Studies Methods/Student Teaching 3 (2) Continued development of instructional practices appropriate for middle grades social studies teachers; familiarization with additional curriculum materials. Includes field work in local schools. Prereq: Admission to MAT Middle-Level Education program. Coreq: EDML 8221.

EDML 8221 Middle Grades Social Studies Methods/Student Teaching Laboratory 0 (4) Non-credit laboratory to accompany EDML 8221. Coreq: EDML 8221.

EDML 8230 Middle Grades Math Methods/Student Teaching 3 (2) Continued development of instructional practices appropriate for middle grades math teachers; familiarization with additional curriculum materials. Includes field work in local schools. Prereq: Admission to MAT Middle-Level Education program. Coreq: EDML 8231.

EDML 8231 Middle Grades Math Methods/Student Teaching Laboratory 0 (4) Non-credit laboratory to accompany EDML 8230. Coreq: EDML 8230.

EDML 8240 Middle Grades Science Methods/Student Teaching 3 (2) Continued development of instructional practices appropriate for middle grades science teachers; familiarization with additional curriculum materials. Includes field work in local schools. Prereq: Admission to MAT Middle-Level Education program. Coreq: EDML 8241.

EDML 8241 Middle Grades Science Methods/Student Teaching Laboratory 0 (4) Non-credit laboratory to accompany EDML 8240. Coreq: EDML 8240.

EDML 8320 South Carolina History for Teachers 3 (3) Survey of key issues/themes in South Carolina history with an emphasis on South Carolina academic standards for 8th grade social studies. Special attention is given to the adaptation of elements of historical inquiry to the classroom. Prereq: Admission to the MAT in Middle Level Education program; or consent of instructor.

EDML 8340 Environmental Sciences for Middle School Teachers 3 (2) Course addresses the science standards of middle school ecological science and scientific inquiry. Course content focuses on plant and animal organisms, including micro (cell components, structure and function) and macro (food chains, ecosystems, and environment) systems. Prereq: Admission to the MAT in Middle Level Education program; or consent of instructor. Coreq: EDML 8341.

EDML 8341 Environmental Sciences for Middle School Teachers Laboratory 0 (6) Non-credit laboratory to accompany EDML 8340. Coreq: EDML 8340.

EDML 8410 Advanced Middle School Curriculum and Instruction 3 (3) Concepts and methods for teaching middle school students. Discusses the nature of middle school students, teacher characteristics, curricular and co-curricular programs, organization and teaching. Prereq: Acceptance to the MAT Middle-Level Program.

EDML 9000 Review of Research in Middle Grades Teaching 3 (3) Examination of literature in both the research and curriculum in middle level education. Includes a review of the theories that guide middle school education and the research conducted on this specific group. Prereq: Admission to the MAT in Middle Level Education program; or consent of instructor.
EDSC 8430 Advanced Studies in the Teaching of Secondary School Science 3 (3) Methods of science teaching theory and practice as shown by current research literature. Emphasis is on laboratory, inquiry and other student-centered teaching strategies. Techniques in science curriculum development. Issues in science teaching. Science teaching leadership skills. Students must have earned a master’s degree to enroll in this course or obtain consent of the instructor. Prq: EDSC 4270 or consent of instructor.

EDSC 8440 Advanced Studies in the Teaching of Secondary School Social Studies 3 (3) Social studies teaching strategies derived from major theories of learning and contemporary research; curricular issues in social studies education. Students must have earned a master’s degree to enroll in this course or obtain consent of the instructor. Prq: EDSC 4280 or consent of instructor.

EDSC 8460 Current Literature in English Education 3 (3) Research literature in English education; examination of literature in research methods and curriculum in English teaching. Students are expected to have completed a methods course in English education before enrolling in this course.

EDSC 8470 Current Literature in Mathematics Teaching 3 (3) Examination of literature in both the research and curriculum in mathematics education. Students are expected to have completed a graduate teaching methods course or obtained consent of instructor before enrolling in this course.

EDSC 8480 Current Literature in Science Teaching 3 (3) Recent literature in science education; examination of literature in both the research and curriculum in secondary science teaching. Students are expected to have completed a graduate teaching methods course or obtained consent of instructor before enrolling in this course.

EDSC 8490 Current Literature in Social Studies Teaching 3 (3) Examines recent literature in social studies education, in both curriculum and instruction. Students are expected to have completed a graduate teaching methods course or obtained consent of instructor before enrolling in this course.

EDSC 8610 Teaching Methods and Strategies for Secondary Science 3 (3) Students develop instructional practices and materials appropriate for secondary mathematics and become familiar with curriculum standards and materials. Includes field experiences in local schools. Emphasis is on inquiry and other student-centered teaching strategies, laboratory management, techniques in science curriculum development, and science teaching leadership skills. Prq: Consent of instructor. Conq: EDSC 8611.

EDSC 8611 Teaching Methods and Strategies for Secondary Science Laboratory 0 (1) Non-credit laboratory to accompany EDSC 8610. Conq: EDSC 8610.


EDSC 8621 Teaching Methods and Strategies for Secondary Mathematics Laboratory 0 (1) Non-credit laboratory to accompany EDSC 8620. Conq: EDSC 8620.

EDSC 8910 Directed Internship 9 (27) Application of effective teaching techniques and organization of instructional settings for high school students.

EDSC 8920 Capstone Seminar 3 (3) Seminar designed to synthesize skills and instructional techniques developed during coursework and classroom experiences. Analyses of classroom instruction and assessment are facilitated through reflective teaching practices. Class discussions, small group activities, and action research are used to explore topics relevant to internship experiences.

SPECIAL EDUCATION

EDSP 8100 Characteristics of Individuals with Learning Disabilities 3 (3) Addresses definitions, identification procedures, cognitive abilities, social functioning, academic skills, and functional performance of individuals with learning disabilities across the lifespan. Prq: Consent of instructor.

EDSP 8110 Educational Procedures for Individuals with Learning Disabilities 3 (3) Provides knowledge of educational evaluation and instructional procedures to improve outcomes for individuals with learning disabilities. Prq: EDSP 8100 or consent of instructor.

EDSP 8120 Practicum in Learning Disabilities 3 (1) Practical experience in teaching students with learning disabilities under the supervision of college faculty and local mentor teachers. Prq: EDSP 8100 or consent of instructor. Conq: EDSP 8121.

EDSP 8121 Practicum in Learning Disabilities Laboratory 0 (6) Non-credit laboratory to accompany EDSP 8120. Conq: EDSP 8121.

EDSP 8130 Characteristics of Individuals with Emotional and Behavioral Disorders 3 (3) Addresses the characteristics of individuals with emotional and behavioral disorders. Consideration is given to historical and legal aspects, definitions, comprehensive assessment and the impact of school, home, culture and society. Research findings in the field of emotional and behavioral disorders are emphasized. Prq: Consent of instructor.

EDSP 8140 Procedures for Individuals with Emotional and Behavioral Disorders 3 (3) Procedures for teaching students with emotional and behavioral disorders, including curriculum and instructional modifications, program planning, facility adaptation, behavior controls, communication with mental health specialists, and transition to general education settings. Prq: EDSP 8130 or consent of instructor.

EDSP 8150 Practicum in Emotional and Behavioral Disorders Laboratory 0 (6) Non-credit laboratory to accompany EDSP 8150. Conq: EDSP 8150.

EDSP 8160 Characteristics of Individuals with Intellectual Disabilities and Autism 3 (3) In-depth study of the etiology, assessment procedures, and learning and behavioral characteristics of individuals with intellectual disabilities and autism across the lifespan. Prq: Consent of instructor.

EDSP 8170 Educational Procedures for Individuals with Intellectual Disabilities and Autism 3 (3) Identification, selection, and preparation of functional curriculum materials and pedagogy for teaching students with intellectual disabilities and autism. A multidisciplinary, student-centered approach to program planning provides the framework. Prq: EDSP 8160 or consent of instructor.

EDSP 8180 Practicum in Intellectual Disabilities and Autism 3 (1) Addresses content knowledge, performance skills and professional values for successful teaching of students with intellectual disabilities and autism. Focuses on teacher-directed instruction and the use of critical instructional factors, the use of recommended practices for students with disabilities, and the measurement and analysis of student performance data. Prq: EDSP 8160 or consent of instructor. Conq: EDSP 8181.

EDSP 8181 Practicum in Intellectual Disabilities and Autism Laboratory 0 (6) Non-credit laboratory to accompany EDSP 8180. Conq: EDSP 8180.

EDSP 8200 Language Arts Instruction for Individuals with Disabilities 3 (3) Research-based methods for instructing individuals with disabilities. Includes principles of effective language arts instruction in reading, writing, speaking and listening skills. Prq: Consent of instructor.

EDSP 8210 Educational Assessment of Individuals with Disabilities 3 (3) Introduction to the assessment process in special education by addressing procedural safeguards; data collection via informal and standardized procedures; issues in assessment, psychometric properties of standardized tests; and administration, scoring and interpretation of selected instruments. Prq: Consent of instructor.

EDSP 8220 Teaching Mathematics to Individuals with Disabilities 3 (3) Procedures for teaching mathematics to individuals with disabilities using direct instruction as an approach to assessment, instructional planning and evaluation. Research in mathematics instruction for individuals with disabilities and mathematics program. Prq: Consent of instructor.

EDSP 8230 Teaching Individuals with Disabilities in Integrated Settings 3 (3) Strategies for teaching individuals with disabilities in integrated settings; appropriate instruction, accommodations, natural supports, collaboration and consultation.

EDSP 8380 Selected Topics in Special Education 1-3 (1-3) Specific master’s level special education topics not found in other courses are selected for in-depth study. May be repeated for a maximum of 24 credits, but only if different topics are covered. Prq: Consent of instructor.

EDSP 8390 Independent Study in Special Education 1-3 (1-3) Master’s level study of selected topics in special education under the direction of a faculty member. May be repeated for a maximum of 24 credits, but only if different topics are covered. Prq: Consent of instructor.
EDSP 8400 Transition Education and Services for Individuals with Disabilities 3 (3) Postsecondary options for individuals with disabilities; educational programs and services which support their transition from school to life. Prereq: Consent of instructor.

EDSP 8410 Instructional Strategies for Individuals with Disabilities in Secondary School Settings 3 (3) Instructional procedures for teaching individuals with disabilities in middle and high schools. Research-validated practices in learning strategies, content-area instruction, functional skills and community-based instruction. Prereq: Consent of instructor.

EDSP 8530 Legal and Policy Issues in Special Education 3 (3) The impact of legislation-IDEA, Section 504 and litigation on special education; six major principles of special education law; interpretation of court cases; residential placements; discipline; extended school year services; compensatory education; inclusion; strategies to minimize litigation and trends in special education.

EDSP 8540 Applied Behavior Analysis 3 (3) Class members accurately recognize, observe, record and chart inappropriate behaviors; develop behavioral plans based on functional assessment data; determine behavioral objectives; apply behavior analysis principles; and foster student self-management skills.

EDSP 8550 Intensive Academic Interventions for Individuals with Disabilities 3 (3) Provides content knowledge and skills in addressing intensive academic interventions for students with disabilities. Emphasis is placed on research-based practices in assessment and identification of academic difficulties and research-based interventions to address the significant academic needs of students with disabilities. Prereq: Admission to a graduate program in education or consent of instructor.

EDSP 8560 Intensive Behavioral Interventions for Individuals with Disabilities 3 (3) Provides content knowledge and skills in addressing intensive behavioral needs of students with disabilities within school settings and across a range of grade levels. Emphasis is placed on research-based practices in assessment, behavioral progress monitoring, and intervention within individualized data-based intervention. Prereq: Admission to a graduate program in education or consent of instructor.


EDSP 8770 Introduction to Exceptionalities 3 (3) Introduction to characteristics of exceptional learners and their education. Emphasis is placed on educational, psychological, sociological and medical aspects of disabilities with linkages to effective assessment and instructional practice. Prereq: Admission to a graduate program in education or consent of instructor.

EDSP 8800 Methods for Conducting Research with Individuals with Disabilities for Beginning Researchers 3 (3) Introduces students to the process of how to critique, design and conduct research with individuals with disabilities, as well as their families and educational providers. Students explore the unique characteristics and contexts of disability research and how this uniqueness impacts which, and how, research is conducted. Prereq: Admission to a graduate program or consent of instructor.

EDSP 9300 Critical Issues and Trends in Special Education 3 (3) Helps students develop an understanding of the role of convergent research evidence in addressing critical issues in special education practices and policies. Focuses on foundational issues of special education, intervention issues and personnel preparation issues. Prereq: Doctoral level standing.

EDSP 9310 Advanced Research in Learning Disabilities 3 (3) Investigates history, theory, research and practice pertaining to selected issues in methods and curriculum within the field of learning disabilities. Employs research-based interventions in the preparation, selection and adaptation of instruction for students with learning disabilities. Prereq: Doctoral level standing.

EDSP 9320 Advanced Research in Emotional/Behavioral Disorders 3 (3) History, theory, research and practice pertaining to selected issues in the fields of emotional/behavioral disorders. Influence of various theoretical approaches in the field. Research-based interventions and curriculum development. Prereq: Doctoral level standing.

EDSP 9330 Advanced Research in Mental Retardation 3 (3) History, theory, research and practice pertaining to selected issues in the field of mental retardation; historical treatment; theoretical approaches; research-based interventions; community-based and lifespan curriculum development for individuals with mental retardation. Prereq: Doctoral level standing.

EDSP 9340 Evidence-Based Research in Instructional Design and Delivery 3 (3) Emphasizes the research foundations of special education and the importance of evidence-based instructional design and delivery frameworks that impact important outcomes for students with disabilities. Prereq: Doctoral level standing.

EDSP 9350 Preparing Highly Qualified Special Educators Research in Teacher Education 3 (3) Prepares doctoral students for the role of teacher educator. Topics include current issues in teacher education and special education including effective teaching practices in general and special education. Current findings in teacher education and special education research and development and conduct of research are emphasized. Prereq: Doctoral level standing.

EDSP 9360 Single-Subject Research Design 3 (3) Provides doctoral students with practical information regarding the conduct, theory and practice of single-subject research methods. Emphasizes skills in design, implementation and analysis of single-subject research. Prereq: Doctoral level standing.

EDSP 9370 Research in High Incidence Disabilities 3 (3) Emphasizes research related to characteristics and identification of individuals with high incidence disabilities, as well as evidence-based instructional and behavioral interventions. Prereq: Doctoral level standing.

EDSP 9390 Professional Writing in Special Education 3 (3) Provides orientation and training to doctoral students in professional writing in the field of special education. Emphasis is placed on critical thinking, practice writing and peer assessment. The course culminates with students compiling a portfolio of writings in various formats.

EDSP 9400 Accountability and Assessment for Diverse Populations in High Needs Schools 3 (3) Examines the use of assessment for gauging student progress over time, strengthening instructional programs, and making high-stakes decisions. Theory and practice, as well as current issues and trends related to assessment in special education, are explored, particularly in connection with recent legislation and use of assessment data for educational accountability.

EDSP 9530 Legal Trends in Special Education 3 (3) Critical examination of legislative mandates in special education. Areas of study include the Individuals with Disabilities Education Act, Section 504, the Americans with Disabilities Act, and the Elementary and Secondary Education Act. Pertinent landmark and current litigation is also examined.

EDSP 9800 Internship in Curriculum and Instruction 1-6 (1-6) Practical experiences linking the student’s program of study to his/her field of professional service. To be taken Pass/No Pass only. May also be offered as ED 9800 or EDF 9800. Prereq: Consent of advisor.

EDSP 9910 Doctoral Dissertation Research 1-18 (1-18) Doctoral Dissertation Research. May also be offered as ED 9910 or EDF 9910.

EDSP 9940 Directed Research 1-4 (1-4) Research in a line of inquiry in education under the direction of faculty. May be taken with different faculty members and may be repeated for a maximum of 18 hours. To be taken Pass/No Pass only. May also be offered as ED 9940 or EDF 9940. Prereq: EDF 8770 or EDF 8080 or consent of instructor.

ENVIRONMENTAL ENGINEERING AND SCIENCE

EES 6010 Environmental Engineering 3 (3) Introduction to the field of environmental engineering. Topics include environmental phenomena, impact of pollutants in the aquatic environment, solid-waste management, air pollution control, radiological health, and simple water and wastewater treatment systems.

EES 6020 Water and Waste Treatment Systems 3 (3) Study of fundamental principles, rational design considerations, and operational procedures of the unit operations and processes employed in water and waste treatment. Both physicochemical and biological treatment techniques are discussed. Introduces the integration of unit operations and processes into water and waste treatment systems.
EES 6100 Environmental Radiation Protection I
3 (3) Fundamental principles of radiological health and radiation safety. Topics include radiation fundamentals, basic concepts of environmental radiation protection, internal and external dosimetry, environmental dose calculations and radiation protection standards.

EES 6110 Ionizing Radiation Detection and Measurement 3 (2) Laboratory exercises in ionizing radiation detection and measurements. Topics include nuclear electronics; counting statistics; radiation interactions; basic gas, scintillation, and semiconductor detectors; gamma-ray spectroscopy; health physics survey instrumentation; and thermoluminescent dosimetry. Preq: EES 4100 or EES 6100. Coreq: EES 6111.

EES 6111 Ionizing Radiation Detection and Measurement Laboratory 0 (3) Non-credit laboratory to accompany EES 6110. Coreq: EES 6110.

EES 6300 Air Pollution Engineering 3 (3) Introductory course in air pollution and its control. Topics include air pollutants and effects, sources, dispersion models, engineering controls, and air-quality legislation.

EES 6370 Biodegradation and Bioremediation 3 (3) Basic principles of biodegradation for major classes of organic and inorganic contaminants, including halogenated aliphatic and aromatic compounds, fuel hydrocarbons, pesticides and nitrated energetic compounds, metals, and radionuclides. The basic science of microbiology and chemistry, and how these are used to develop bioremediation strategies and technologies, are discussed. Preq: EES 8510.

EES 6510 Newman Seminar and Lecture Series in Natural Resources Engineering I (2) Topics dealing with development and protection of land, air, water, and related resources are covered by seminar with instructor and invited lecturers. Current environmental and/or resource conservation issues are addressed. May also be offered as BE 6510 or FOR 6510.

EES 6800 Environmental Risk Assessment 3 (3) Quantitative estimation of human health risk posed by the release of a contaminant to the environment. Topics include methods for analyzing emission rate, environmental transport, exposure, and health effects; methods of uncertainty analysis; and the role of risk assessment in environmental regulation and environmental decision making.

EES 6840 Municipal Solid Waste Management 3 (3) Introduction to the problems, regulations, collection, handling, recycling, and disposal of municipal solid wastes in the urban and rural sectors. Emphasizes an integrated waste-management system with resource recovery, composting, incineration, landfill disposals, and their costs. May also be offered as BE 6840.

EES 6850 Hazardous Waste Management 3 (3) Introduction to the problems, regulations, treatment, and ultimate disposal of hazardous and toxic materials. Spill cleanup, groundwater transport, land disposal, incineration, and treatment technologies are discussed.

EES 6860 Environmental Sustainability 3 (3) Topics include sustainable engineering and industrial ecology with emphasis on pollution prevention methods using source reduction, recycling assessments, treatment to reduce disposal, lifecycle assessment and design for the environment. Emphasizes case studies.

EES 6900 Special Projects 1-3 (1-3) Studies or laboratory investigations on special topics in the environmental engineering and science field. Arranged on a project basis with a maximum of individual student effort and a minimum of staff guidance. May also be offered with a maximum of three credits. Preq: Consent of instructor.

EES 8020 Environmental Engineering Principles 3 (3) Fundamental principles required for simulation and modeling of environmental engineering phenomena; mass transfer, reactor kinetics, simulation techniques and applications to various natural and engineered systems. Offered fall semester only.

EES 8030 Physicochemical Operations in Water and Wastewater Treatment Systems 3 (3) Principles of physicochemical operations used in wastewater treatment including sedimentation, filtration, mixing, gas transfer, adsorption, ion exchange, coagulation, precipitation, disinfection and oxidation. Offered spring semester only. Preq: EES 8020 and EES 8430.

EES 8040 Biochemical Operations in Wastewater Treatment Systems 3 (3) Principles of biochemical operations used in wastewater treatment; modeling of ideal biochemical reactors and design criteria for aerated lagoons, activated sludge, trickling filters, rotating biological contactors, nitrification, denitrification and digestion. Offered spring semester only. Preq: EES 8020 and EES 8510.

EES 8050 Laboratory in Water and Wastewater Treatment Operations 3 (6) Laboratory exercises in selected water and wastewater treatment operations including sedimentation, filtration, adsorption, coagulation, softening, aeration, activated sludge, aerobic digestion and anaerobic digestion. Offered spring semester only. Preq or concurrent enrollment: EES 8030 or EES 8040.

EES 8060 Process and Facility Design for Environmental Control Systems 2-4 (2-4) Integration of unit operations into complex systems for treatment of industrial/domestic water and wastewater, contaminated groundwater or air, landfill leachate and toxic liquid wastes. Student teams design an integrated system for either water/wastewater or a hazardous/toxic waste. Offered fall semester only. Preq: EES 8030 or EES 8040.

EES 8080 Groundwater Modeling 3 (3) Mathematical and computer modeling of groundwater flow and nonreactive solute transport through geological formations; conceptual flow-models for geologic systems; formulation of governing mass and energy conservation equations; application of analytical, numerical and stochastic models to real-world problems. May also be offered as GEOl 8080.

EES 8090 Subsurface Remediation Modeling 3 (3) Lectures and computer exercises involving subsurface remediation methods including groundwater extraction, soil vapor extraction, stream flooding and a variety of other techniques; modeling flow of multiphase and multicomponent mixtures in porous medium. May also be offered as GEOI 8090.

EES 8100 Analytical Methods for Hydrogeology 3 (3) Analytical mathematical methods for modeling subsurface fluid flow and transport processes including saturated water flow, unsaturated zone flow, chemical transport and heat transfer, emphasizing the derivation and solution of governing equations for modeling subsurface flow and transport. May also be offered as GEOI 8100.

EES 8120 Environmental Nuclear Engineering 3 (3) Environmental aspects of nuclear technology emphasizing nuclear reactors and the nuclear fuel cycle; environmental transport of radioactive materials; radioactive effluents from nuclear power plants; nuclear power plant safety; environmental aspects of fuel cycle activities; waste management. Offered fall semester only. Preq: EES 6100.

EES 8130 Environmental Radiation Protection Laboratory 3 (1) Continuation of EES 6110; advanced experiments in radiation detection, radiation protection, health physics and environmental monitoring. Offered fall semester only. Preq: EES 4110 or EES 6110. Coreq: EES 8131.

EES 8131 Environmental Radiation Protection Laboratory 0 (6) Non-credit laboratory to accompany EES 8130. Coreq: EES 8130.

EES 8140 Applied Numerical Methods in Process Simulation 3 (3) Numerical solution techniques as applied to process control systems; finite difference techniques for partial differential equations stressing applied numerical methods rather than theoretical numerical analysis. Standard methods for ordinary differential equations are reviewed. May also be offered as CHE 8140. Preq: Consent of instructor.

EES 8160 Technical Nuclear Forensics 3 (3) Technical nuclear forensics is a discipline that involves the collection, analysis and evaluation of samples from pre-detonation or post-detonation of a nuclear weapon. These radiological and nuclear materials, as well as devices, debris and immediate effects created by a nuclear detonation are of interest. Preq: EES 6100.

EES 8170 Applied Process Simulation 3 (2) Introduction to techniques for simulating processes related to fluid flow through porous media, conduits or tanks, transport of heat and mass, chemical reactions, deformation of solids, and coupling of multiple processes. Applications are taken from natural and engineered systems. Preq: BE 6120 or EES 8020 or GEOl 6150 or consent of instructor. Coreq: EES 8171.

EES 8171 Applied Process Simulation Laboratory 0 (1) Non-credit laboratory to accompany EES 8170. Coreq: EES 8170.

EES 8200 Environmental Systems Analysis 3 (3) Analysis of a systems view of environmental problems, with particular emphasis on conflicting objectives such as economic and environmental concerns. Example problems span traditional environmental engineering processes, natural resources, proactive environmental management and sustainability.

EES 8320 Air Pollution Meteorology 3 (3) Applications of meteorology to air pollution; micro-meteorology; air pollution processes, plume rise modeling, atmospheric diffusion; deposition and washout of pollutants; air chemistry; applications of diffusion modeling to air quality planning. Preq: Consent of instructor.
EES 8330 Air Pollution Control Systems 3 (3) Principles and design of air pollution control equipment including mechanical collectors, electrostatic precipitators, baghouse filters, wet scrubbers, adsorbers and incinerators. Offered spring semester only. Preq: EES 4300 or EES 6300.

EES 8340 Particles in the Atmosphere 3 (3) Chemical and physical behavior of atmospheric particles and their interaction with other particles, gases and light; generation, measurement methods and control strategies of atmospheric particles. Students are expected to have completed coursework in differential equations prior to enrolling in this course. Preq: EES 4300 or EES 6300.

EES 8370 Biodegradation and Bioremediation 3 (3) Basic principles of biodegradation for major classes of organic contaminants including halogenated aliphatics and aromatics, fuel hydrocarbons, pesticides and nitrated energetic compounds; biotransformations of metals; biodegradation principles applied to the development of bioremediation technologies including intrinsic, in situ and on-site engineered approaches. Preq: EES 8510.

EES 8420 Actinide Chemistry 3 (3) Chemical and physical aspects of actinide metals and compounds (including properties, structure and bonding, reactions, kinetics, thermodynamics), coordination and solution chemistry, behavior and speciation in the environment, separation and purification, chemistry of the nuclear fuel cycle and waste treatment and related topics; fundamental concepts, history and recent developments. Preq: Consent of instructor. May also be offered as CH 8420.

EES 8430 Environmental Chemistry 3 (3) Principles of chemical kinetics and thermodynamics applied to fundamental understanding of aqueous environmental samples including natural waters, wastewaters and treated waters; factors controlling chemical concentrations, acid-base equilibria, solubility equilibria, complex formation, electrochemistry, adsorption phenomena. Offered fall semester only. Students are expected to have completed two semesters of general chemistry before enrolling in this course.

EES 8440 Environmental Chemistry Laboratory I 3 (2) Laboratory experience in basic analytical methods used in water quality studies; experimental design, sampling, wet-chemical analytical techniques, data collection and analysis, data interpretation and data quality techniques. Offered fall semester only. Students are expected to have completed two semesters of coursework in general chemistry before enrolling in this course. Coreq: EES 8441.

EES 8441 Environmental Chemistry Laboratory I Laboratory 0 (3) Non-credit laboratory to accompany EES 8440. Coreq: EES 8440.

EES 8450 Environmental Organic Chemistry 3 (3) Application of parameters that describe the equilibrium distribution and exchange rates for environmentally significant organic compounds to the modeling of processes in engineered and natural systems, including environmental parameter estimation techniques, structure-activity relationships and integration of environmental processes to model contaminant distribution and residence time in environmental systems. Offered spring semester only. Students are expected to have completed two semesters of coursework in general chemistry before enrolling in this course.

EES 8460 Inorganic Environmental Geochemistry 3 (3) Study and application of chemical principles to understand and model the behavior of metals and other important inorganic species in natural and engineered environmental systems. Real world problems are addressed using case studies and student-selected projects. Preq: EES 8430 or consent of instructor.

EES 8470 Advanced Environmental Chemistry 3 (3) Advanced principles and methods in environmental chemistry with applications to both natural and treatment systems; current investigative and study techniques; nature, fluxes and controlling processes of chemical species and radionuclides in environmental systems. Preq: EES 8430.

EES 8490 Environmental Chemistry Laboratory II 3 (1) Theory and applications of instrumental methods of analysis as applied to measurements for environmental control; spectroscopy and spectro-photometric techniques; electrochemical analyses; chromatographic methods of analysis; light scattering and electrophoretic measurements. Offered fall semester only. Coreq: EES 8491.

EES 8491 Environmental Chemistry Laboratory II Laboratory 0 (6) Non-credit laboratory to accompany EES 8490. Coreq: EES 8490.

EES 8500 Stream and Estuarine Analysis 3 (3) Physical, chemical and biological processes and relationships which exist in streams and estuaries; estuarine environment; free-flowing streams; mechanisms describing transport of conservative and nonconservative materials through estuarine systems; the estuary as a resource and techniques for its management. Offered fall semester only.

EES 8510 Biological Principles of Environmental Engineering 3 (3) Basic principles of biology and biochemical processes applied to problems of environmental control and wastewater treatment; kinetic and energetic aspects. Offered fall semester only.

EES 8520 Subsurface and Wetland Hydraulics 3 (3) Hydraulics of subsurface water including hydraulic head and gradient concepts, Darcy's Law, saturated/unsaturated flow, flow in aquifers and aquitards, flow to wells and interactions with surface water in wetlands including discharge and development of seepage faces. Mathematics is at the level of elementary ordinary and partial differential equations. Preq: EES 8020. Students who have not completed EES 8020, but who have completed coursework in differential equations and fluid mechanics, may request a registration override from the instructor.

EES 8550 Surface and Subsurface Transport 3 (3) Quantitative analysis of reactive transport and biodegradation in ground water and surface water; applications of the advection-dispersion equation with reaction terms including classical chemical reactions, radioactive decay and reactions mediated by microbes. Students are expected to have completed coursework in differential equations and fluid mechanics before enrolling in this course.

EES 8560 Pollution of the Aquatic Environment 3 (3) Effects of domestic and industrial water pollution on the physical, chemical and biological characteristics of natural waters; associated environmental determinants of human disease, toxicity and epidemiology of chronic disease. Offered fall semester only.

EES 8610 Environmental Engineering and Science Seminar 1 (1) Current advances and research developments in various areas of environmental engineering and science. Off-campus speakers, students and faculty participate. To be taken Pass/No Pass only.

EES 8800 Environmental Risk Assessment 3 (3) Methodology of quantitative risk assessment including identification and quantification of the source term, calculation of environmental transport and estimation of health effects. Applications involve various classes of contaminants in atmospheric and aquatic environmental pathways. Offered spring semester only.

EES 8810 Special Problems 1-4 (1-4) Problems selected to meet interests and experiences of student and instructor.

EES 8830 Selected Topics in Environmental Engineering 1-4 (1-4) Topics in environmental engineering not covered in other courses. Topics vary to keep pace with current developments. May be taken concurrently with EES 8840, which (if offered) would be a different topic.

EES 8840 Selected Topics in Environmental Engineering 1-4 (1-4) Topics in environmental engineering not covered in other courses. Topics vary to keep pace with current developments. May be taken concurrently with EES 8830, which (if offered) would be a different topic.

EES 9010 Master's Thesis Research 1-12 (1-12) Master’s Thesis Research

EES 9610 Environmental Engineering and Science Doctoral Student Seminar 1 (1) Current advances and research developments in various areas of environmental engineering and science. Doctoral students are required to enroll each semester that the course is offered and present one seminar per year. To be taken Pass/No Pass only.

EES9910 Doctoral Dissertation Research 1-12 (1-12) Doctoral Dissertation Research

EXECUTIVE LEADERSHIP AND ENTREPRENEURSHIP

ELE 6000 Technology Entrepreneurship 3 (3) Introduction to technology entrepreneurship emphasizing ideation, opportunity assessment, market and technology forecasting, intellectual property protection, financial modeling and business valuation, project management, and cross-functional team building. Preq: Junior standing in the College of Engineering and Science.

ELE 8000 Special Topics in Technology Entrepreneurship 1-6 (1-6) Comprehensive study of a topic of current interest in technology entrepreneurship. May be repeated for a maximum of six credits, but only if different topics are covered. Preq: ELE 4000.

ENGLISH

ENGL 6000 The English Language 3 (3) Studies in English usage and historical development of the language. Preq: ENGL 3100 or consent of instructor.

ENGL 6010 Grammar Survey 3 (3) Survey of modern grammars with a focus on exploring the impact structural grammar has had on traditional grammar. Recommended for English teachers. Preq: ENGL 3100 or consent of instructor.
ENGL 6070 The Medieval Period 3 (3) Selected works of Old and Middle English literature, exclusive of Chaucer. Preq: ENGL 3100 or consent of instructor.

ENGL 6080 Chaucer 3 (3) Selected readings in Middle English from The Canterbury Tales and other works by Chaucer. Preq: ENGL 3100 or consent of instructor.

ENGL 6100 Drama of English Renaissance 3 (3) Selected readings in non-Shakespearian dramatic literature of the 16th and 17th centuries. Preq: ENGL 3100 or consent of instructor.

ENGL 6110 Shakespeare 3 (3) Study of selected tragedies, comedies, and history plays of Shakespeare. Required of all English majors. Preq or concurrent enrollment: ENGL 3100 or consent of instructor.

ENGL 6140 Milton 3 (3) Development of Milton’s art and thought from the minor poems and selected prose through Paradise Lost, Paradise Regained, and Samson Agonistes, set against the background of the late Renaissance. Preq: ENGL 3100 or consent of instructor.

ENGL 6150 The Restoration and Eighteenth Century 3 (3) Readings in Dryden, Swift, Pope, and Dr. Johnson. Preq: ENGL 3100 or consent of instructor.

ENGL 6160 The Romantic Period 3 (3) Readings from the poetry and critical prose of Blake, Wordsworth, Coleridge, Byron, Shelley, Keats, and other representative figures. Preq: ENGL 3100 or consent of instructor.

ENGL 6170 The Victorian Period 3 (3) Reading from the poetry and nonfiction prose of selected Victorian authors, including works of Carlyle, Tennyson, Browning, Arnold, and other representative figures. Preq: ENGL 3100 or consent of instructor.

ENGL 6180 The English Novel 3 (3) Study of the English novel from its 18th century beginnings through the Victorian Period. Preq: ENGL 3100 or consent of instructor.

ENGL 6190 Postcolonial and World Literatures 3 (3) Selected readings in post-colonial literature and theory, focusing on issues of nationalism, migration, resistance, race, language, and master narratives. Preq: ENGL 3100 or consent of instructor.

ENGL 6200 Amer Lit to 1799 3 (3) Focused study of authors, movements, themes, critical approaches and genres in literature of colonial and early national America from early European explorations of the continent to 1799. Preq: ENGL 3100 or consent of instructor.

ENGL 6210 American Literature from 1800 to 1899 3 (3) Focused study of authors, movements, themes, critical approaches and genres in poetry and prose of major American authors and literary movements from the nineteenth century. Preq: ENGL 3100 or consent of instructor.

ENGL 6250 The American Novel 3 (3) Survey of the most significant forms and themes of the American novel from its beginnings to 1900. Preq: ENGL 3100 or consent of instructor.

ENGL 6260 Southern Literature 3 (3) Intellectual and literary achievement of the South from 1607 to the present, with emphasis on the writers of the 19th century. Preq: ENGL 3100 or consent of instructor.

ENGL 6280 Contemporary Literature 3 (3) Focuses on American, British, and other fiction, poetry, and drama from Post-World War II to the present. Preq: ENGL 3100 or consent of instructor.

ENGL 6290 Dramatic Literature I 3 (3) Selected reading in the dramatic literature from the classical era of Greece and Rome to the Renaissance. May also be offered as THEA 6290. Preq: ENGL 3100 or consent of instructor.

ENGL 6300 Dramatic Literature II 3 (3) Principles and progress of drama from the Restoration to the present; analysis of representative plays; critical reports; discussion of trends in dramatic literature. May also be offered as THEA 6300. Preq: ENGL 3100 or consent of instructor.

ENGL 6310 Modern Poetry 3 (3) The modern tradition in English and American poetry from Yeats to the present; relevant critical essays. Preq: ENGL 3100 or consent of instructor.

ENGL 6320 Modern Fiction 3 (3) American and British novels and short stories of the 20th century. Preq: ENGL 3100 or consent of instructor.

ENGL 6330 The Anglo-Irish Literary Tradition 3 (3) Exploration of the unique literary heritage and achievement of English-language Irish writers in the 19th and 20th centuries. Major figures of the Irish tradition: W. B. Yeats, James Joyce, Samuel Beckett, and other writers; consideration of the specifically Irish aspects of their works. Preq: ENGL 3100 or consent of instructor.

ENGL 6340 Environmental Literature 3 (3) Survey of literature that examines the relationship between human beings and the natural world, including analysis of environmental themes in myths and legends and in selected poetry and prose of 19th- and 20th-century England and America. Preq: ENGL 3100 or consent of instructor.

ENGL 6350 Literary Criticism 3 (3) Major critical approaches to literature. Preq: ENGL 3100 or consent of instructor.

ENGL 6360 Feminist Literary Criticism 3 (3) Introduces the germinal works of feminist literary theory and criticism. Outlines the development of modern literary criticism by studying feminist versions of the major critical methodologies. May also be offered as WS 6360. Preq: ENGL 3100 or consent of instructor.

ENGL 6370 Directed Studies 1-3 (1-3) Class and tutorial work for students with special interests or projects in American, British, or European literature outside the scope of existing courses. Applications must be approved during the registration period of the semester preceding the one in which directed studies will occur. May be repeated by arrangement with the department. Preq: ENGL 3100 or consent of instructor.

ENGL 6400 Literary Theory 3 (3) Examination of how approaches such as Marxism, Psychoanalysis, Feminism, Deconstruction, New Historicism, Post-Colonialism, Cultural Studies, and Queer Theory answer the question, “What is literature?” Preq: ENGL 3100 or consent of instructor.

ENGL 6410 Literary Editing 3 (3) Examination of how the theories and practices of editing construct texts, stressing the problems and objectives of editing and providing practical experience with literary editing. Preq: ENGL 2120 or ENGL 2140 or ENGL 2150.

ENGL 6420 Cultural Studies 3 (3) Investigation of the similarities and connections between a wide variety of cultural products, events, and practices - from fast food to opera to online shopping - using theories ranging from Marxism to hybridity. Preq: ENGL 3100 or consent of instructor.

ENGL 6440 Renaissance Literature 3 (3) Selected readings in non-Shakespearian British literature from 1500–1660. Includes drama, poetry, and prose. Preq: ENGL 3100 or consent of instructor.

ENGL 6450 Fiction Workshop 3 (3) Workshop in the creative writing of prose fiction. May be repeated once for credit. Preq: ENGL 3450 or consent of instructor.

ENGL 6460 Poetry Workshop 3 (3) Workshop in the creative writing of poetry. May be repeated once for credit. Preq: ENGL 3460 or consent of instructor.

ENGL 6470 Playwriting Workshop 3 (3) Workshop in the creative writing of plays. May be repeated once. May also be offered as THEA 6470. Preq: ENGL 3470 or THEA 3470.

ENGL 6480 Screenwriting Workshop 3 (3) Workshop in the creative writing of screenplays. May be repeated once for credit. Preq: ENGL 3480 or consent of instructor.

ENGL 6490 Creative Non-Fiction 3 (3) Advanced workshop in writing non-fiction prose for magazine and free-lance markets. Preq: ENGL 3450 or 3460 or consent of instructor.

ENGL 6500 Film Genres 3 (2) Advanced study of films that have similar subjects, themes, and techniques, including such genres as the Western, horror, gangster, science fiction, musical, and/or screwball comedy. Also considers nontraditional genres, screen irony, genre theory, and historical evolution of genres. Topics vary. Preq: ENGL 3570 or consent of instructor. Coreq: ENGL 6501.

ENGL 6501 Film Genres Laboratory 0 (3) Non-credit laboratory to accompany ENGL 6500. Coreq: ENGL 6500.

ENGL 6510 Film Theory and Criticism 3 (2) Advanced study into the theory of film/video making emphasizing understanding a variety of critical methods to approach a film. Examines the history of film theory and defines the many schools of film criticism, including realism, formalism, feminism, semiotics, Marxism, and expressionism. May also be offered as COMM 6510. Preq: ENGL 3570 or consent of instructor. Coreq: ENGL 6511.

ENGL 6511 Film Theory and Criticism Laboratory 0 (3) Non-credit laboratory to accompany ENGL 6510. May also be offered as COMM 6511. Coreq: ENGL 6510.

ENGL 6520 Great Directors 3 (2) Intensive study of one to three film directors emphasizing understanding the entire canon of each director. Students study similarities in techniques, shifts in thematic emphasis, and critical methodologies for approaching the works of each director. Topics vary. Preq: ENGL 3570 or consent of instructor. Coreq: ENGL 6521.

ENGL 6521 Great Directors Laboratory 0 (3) Non-credit laboratory to accompany ENGL 6520. Coreq: ENGL 6520.
### ENGL 6530 Sexuality and the Cinema 3 (2)
- Examination of male/female sexual roles and their evolution in American genre films, avant-garde cinema, and international films. Includes the study of movies in relation to cultural values and social stereotypes, introduction to feminist film theory, and consideration of film pornography. 
Preq: ENGL 3570 or consent of instructor. Coreq: ENGL 6531.

### ENGL 6531 Sexuality and the Cinema Laboratory 0 (3)
Noncredit laboratory to accompany ENGL 6530. Coreq: ENGL 6530.

### ENGL 6550 American Humor 3 (3)
Native American humor of the 19th and 20th centuries. Preq: ENGL 3100 or consent of instructor.

### ENGL 6560 Literature and Arts of the Holocaust 3 (3)
Addresses the Holocaust through literature, art, architecture, music, and film. Beginning with historical, political, and economic forces that contributed to the Holocaust, course then focuses on highly diverse creative responses to this event - responses that often reflect the difficulties and politics of these commemorative gestures. May also be offered as HUM 6560. Preq: ENGL 3100 or consent of instructor.

### ENGL 6590 Special Topics in Language, Criticism, Theory 3 (3)
Advanced studies in topics not central to other English courses, such as certain authors, works, genres, themes, or areas of knowledge and culture. Specific topics are announced when offered. May be repeated once for credit with department chair's consent. Preq: ENGL 3100 or consent of instructor.

### ENGL 6600 Issues in Writing Technologies 3 (3)
Examination of writing technologies from different historical periods. Investigates how writing is understood, circulated, legislated, and protected in terms of its production technology. Preq: ENGL 3100; and, ENGL 2020 or ENGL 2130 or ENGL 2140 or ENGL 2150; or consent of instructor.

### ENGL 6630 Topics in Literature to 1699 3 (3)
Selected readings in literature from antiquity through the 17th century for focused study of authors, movements, themes, critical approaches, and genres. Topics vary and are constructed by individual faculty. May be repeated for a maximum of six credits, but only if different topics are covered. Preq: ENGL 3100 or consent of instructor.

### ENGL 6640 Topics in Literature from 1700 to 1899 3 (3)
Selected readings in 18th- and 19th-century literature for focused study of authors, movements, themes, critical approaches, and genres. Special topics vary and are constructed by individual faculty. May be repeated for a maximum of six credits, but only if different topics are covered. Preq: ENGL 3100 or consent of instructor.

### ENGL 6650 Topics in Literature from 1900 3 (3)
Selected readings in 20th- and 21st-century literature for focused study of authors, movements, themes, critical approaches, and genres. Topics vary and are constructed by individual faculty. May be repeated for a maximum of six credits, but only if different topics are covered. Preq: ENGL 3100 or consent of instructor.

### ENGL 6670 Writing for Electronic Media 3 (3)
Workshop in new forms of writing and hypertextual design for interactive electronic media, including social networks, online and video communities. May be repeated once for credit at the undergraduate level. Preq: ENGL 3100 or consent of instructor.

### ENGL 6780 Digital Literacy 3 (3)
Examines how technology has expanded ideas of literacies and texts. Includes reading, studying and analyzing print and digital texts to determine how digital techniques change patterns of reading and how readers make sense of electronic texts. Preq: ENGL 3100 or consent of instructor.

### ENGL 6820 African American Literature to 1920 3 (3)
Critical examination of the development of the African American literary tradition from the Colonial Period to the Harlem Renaissance. Considers the historical and cultural contexts of a variety of texts, themes and theories. Preq: ENGL 3100 or consent of instructor.

### ENGL 6830 African American Literature from 1920 to the Present 3 (3)
Critical examination of the development of the African American literary tradition from the Harlem Renaissance to the present. Considers historical and cultural contexts of a variety of texts, themes, theories and literary movements. Preq: ENGL 3100 or consent of instructor.

### ENGL 6850 Composition and Language Studies for Teachers 3 (3)
Examines the principles and practices of composing and teaching composition. Includes a historical study of English language with attention to phonology, morphology, syntax, semantics, and practical aspects of language grammar. Serves as a practicum in composing and assessing processes, collaborative learning, writers purposes, audience expectations, and language conventions. May also be offered as EDSC 6850. Preq: ENGL 3100 or consent of instructor.

### ENGL 6870 Topics in Book History 3 (3)
Examines the material and theoretical constructions of the book. Covers both historical and contemporary dimensions of dissemination, reception, artistry, and influence of books. Preq: ENGL 1030 or consent of instructor.

### ENGL 6880 Genre and Activity Theory 3 (3)
Examination of the forms that texts take, of the print and digital media in which they are composed, and of the ways they circulate among experts, in the public, and around the world.

### ENGL 6890 Special Topics in Writing and Publication Studies 3 (3)
Selected readings from topics in writing and publication studies, emphasizing areas such as major theories, practices, research, and critical approaches. May be repeated for a maximum of six credits, but only if different topics are covered. Preq: ENGL 3100 or consent of instructor.

### ENGL 6900 Advanced Technical and Business Writing 3 (3)
Advanced work in writing proposals, manuals, reports and publishable articles. Client-based and collaborative writing. Preq: ENGL 3040 or 3140 or consent of instructor.

### ENGL 6910 Classical Rhetoric 3 (3)
Traces the development of rhetoric from Protagoras through Isocrates, Plato, Aristotle, Cicero and Quintillian and considers questions essential to understanding persuasive theory and practices. May also be offered as COMM 6910. Preq: ENGL 3100 or consent of instructor.

### ENGL 6920 Modern Rhetoric 3 (3)
Examines the new rhetorics of the 20th century, which are grounded in classical rhetoric but include findings from biology, psychology, linguistics and anthropology, among other disciplines. May also be offered as COMM 6920. Preq: ENGL 3100 or consent of instructor.

### ENGL 6940 Writing About Science 3 (3)
Advanced work in scientific writing and editing for peer and lay audiences. Preq: ENGL 3100 or consent of instructor.

### ENGL 6950 Technical Editing 3 (3)
Practical experience in editing and preparing technical manuscripts for publication. General introduction to the functions of the technical editor. Preq: ENGL 3140 or consent of instructor.

### ENGL 6980 Writing Center Theory and Practice 3 (3)
Preparation for students to work in the Clemson University Writing Center. Required of all undergraduate Writing Fellows. Preq: Sophomore standing and consent of instructor. Coreq: ENGL 6981.

### ENGL 6981 Writing Center Theory and Practice Laboratory 0 (1)
Non-credit laboratory to accompany ENGL 6980. Coreq: ENGL 6980.

### ENGL 7000 Children's Literature for Teachers 3 (3)
Literature for preschool through junior high. Preq: ENGL 3100, or consent of instructor.

### ENGL 8000 Introduction to Research 1 (1)
Literary history and research; use of libraries and bibliographical tools; exposition of scholarship. Required of all candidates for the Master of Arts degree and Master of Education degree with a concentration in Secondary Education-English.

### ENGL 8010 Topics in Composition 3 (3)
Principal theories and practices in modern grammar, stylistics and semantics related to teaching composition.

### ENGL 8020 Topics in Literary Genres 3 (3)
Principal literary genres. May be repeated for a maximum of nine credits.

### ENGL 8030 Topics in Rhetorical Theory 3 (3)
Major rhetorical theories, figures and historical movements.

### ENGL 8040 Fundamentals of Health Communication 3 (3)
Fundamentals of health communication and the Health Communication Certificate; two theoretical bases underlying this interdisciplinary program in health communication, one based on social science theory and one based on humanities, i.e. rhetorical theory; history of both theoretical bases. Preq: Undergraduate students may request consent of Health Communication Coordinator to enroll in this course.

### ENGL 8050 Topics in Medieval Literature 3 (3)
Principal works in verse and prose from c. 1100-1500. May be repeated for a maximum of nine credits.

### ENGL 8060 Medical Rhetoric and Writing 3 (3)
Issues in medical writing and health communication, including grant writing and writing for visual and electronic media; general and specific forms and documents for professional writers in health professions. Preq: Undergraduate students may request consent from Health Communication Coordinator.
ENGL 8070 Health Communication Campaign Planning and Evaluation 3 (3) Application of theories, practices and tools developed in ENGL 8040 and 8060 to planning, implementing and evaluating a public health campaign that targets a particular health practice. May also be offered as COMM 8070. Preq: ENGL 8040 and ENGL 8060 or consent of Health Communication Certificate Coordinator.

ENGL 8080 Topics in Renaissance and Restoration Literature 3 (3) Principal works in verse and prose from c. 1500-1700. May be repeated for a maximum of nine credits.

ENGL 8090 Communication, Culture and the Social Net 3 (3) Seminar explores communication and cultural practices that are evolving around social media. May also be offered as COMM 8090.

ENGL 8100 Literary Criticism and Theory 3 (3) Introduces significant methods, approaches and theorists in the current practice of literary and cultural criticism. Establishes a basic familiarity with the vocabulary and techniques of major critical movements and offers a foundation for specialized study.

ENGL 8110 Topics in Neoclassic and Romantic Literature 3 (3) Principal works in verse and prose from c. 1700-1832. May be repeated for a maximum of nine credits.

ENGL 8140 Topics in Victorian and Modern British Literature 3 (3) Principal works in verse and prose from c. 1832 to present. May be repeated for a maximum of nine credits.

ENGL 8200 Topics in American Literature to 1865 3 (3) Significant authors; works in poetry and prose; literary-intellectual movements such as Puritanism, the Enlightenment, Romanticism and Transcendentalism from c. 1607-1865. May be repeated for a maximum of nine credits.

ENGL 8230 Topics in American Literature Since 1865 3 (3) Significant authors; works in poetry and prose; literary-intellectual movements such as realism, naturalism, modernism and postmodernism from 1865 to the present. May be repeated for a maximum of nine credits.

ENGL 8310 Special Topics 3 (3) Topics not covered in other courses. May be repeated for a maximum of nine credits.

ENGL 8320 Topics in Scientific, Technical and Business Writing 3 (3) Covers topics not covered in other professional communication seminars.

ENGL 8330 Rhetoric of Science 3 (3) Rhetorical approaches to understanding science and scientific rhetorics.

ENGL 8340 Usability Testing Methodologies in Professional Communication 3 (3) Research methodologies used in testing the usability of professional communication.

ENGL 8350 Topics in Literary Criticism 3 (3) Principal statements of literary critics from the classical era to the present.

ENGL 8360 Digital Publishing Technologies: Theories in Practice 3 (3) User-centered design theories applied to multimedia interfaces and online documents for professional communicators.

ENGL 8380 Global Professional Communication 3 (3) Implications of professional communication in an international context; theories, methods and practices of global professional communication.

ENGL 8390 Writing Proposals and Grant Applications 3 (3) Practice in reading requests for oral and digital proposals, analyzing rhetorical contexts and theories of proposals, and writing proposals and grant applications; and making oral and digital presentations of proposals.

ENGL 8400 Selected Topics 3 (3) Independent/directed study; tutorial work in linguistics, professional communication, or American, British or European literature not offered in other courses. May also be offered as AAH 8400 or COMM 8400. Preq: Consent of director of MA in English or MA in Professional Communication program.

ENGL 8500 Research Methods in Professional Communication 3 (3) Covers various research methods with emphasis on humanistic and empirical inquiry. Readings and research examine how professional communication creates new knowledge and affects the daily lives of others. May also be offered as COMM 8500.

ENGL 8510 Seminar in Professional Writing 3 (3) Advanced seminar in the principles and practice of writing and editing documents for government, industry and the sciences. Students produce projects suitable for publication or presentation; professional development for technical communicators.

ENGL 8520 Rhetoric and Professional Communication 3 (3) Theories of effective communication, classical to contemporary, that inform decision-making strategies in professional communication.

ENGL 8530 Visual Communication 3 (3) Understanding the language of images used in textual and extratextual communication; theories of perception, methods of visual persuasion, gender analysis, and cognitive and aesthetic philosophies of visual rhetoric; technologies of visual communication; and technologies of visual production.

ENGL 8540 Teaching Professional Writing 3 (3) Examines theories and practices of teaching written, graphic and oral communication. Students prepare course descriptions, rationales and syllabi for teaching various forms of business, scientific and technical writing.

ENGL 8560 Theories and Practices of Workplace Communication 3 (3) Workplace cultures and their theoretical and practical applications for professional communication.

ENGL 8570 Digital Rhetorics Across Media and Information Technologies 3 (3) Application of emerging rhetorics of visuals, animations, audio, video, and interfaces to professional communication technologies through hands-on experience with technologies widely used in academic and industry settings. Work with extant and emerging information technologies building digital audio projects, digital video movies, Web publications, and social media.


ENGL 8720 Print and Digital Portfolios 3 (3) Focuses on theories, development, construction and assessment of print and digital portfolios in educational contexts including the classroom, school reform and other large-scale efforts, programmatic assessments and personal/professional development. Special attention is given to ways the medium shapes reflection, presentation, connections and artifacts within the portfolio.

ENGL 8850 Composition Theory 3 (3) Teaching college-level courses, stressing contemporary composition theory, research and practice. Required of all MA in English and MAFC Teaching Assistants.

ENGL 8860 Composition Practicum 1 (1) Students continue training for teaching ENGL 1030. Accelerated Composition. Specific attention is given to translating theoretical concepts into creating assignments, designing curriculum and grading. Course is to be taken only fall semester of student’s teaching assistantship year. No credit towards a degree will be awarded. Students must be enrolled in a graduate teaching assistantship to enroll in this course. Preq: ENGL 8850.

ENGL 8870 Writing Center Theory and Practice 1 (1) Prepares graduate students in English and Professional Communication Programs to work with students in the Writing Center. Undergraduate students may request consent of instructor to enroll in this course.

ENGL 8910 Master’s Thesis Research 1-12 (1-12) Master’s Thesis Research

ENGL 8920 Master’s Project 3 (3) Required for non-thesis option in the Professional Communication MA program. Students create a communication deliverable for the professional world, keep a journal as a record of the project, and write a scholarly paper. Students present projects to their advisor.

ENVIRONMENTAL AND NATURAL RESOURCES

ENR 6130 Restoration Ecology 3 (3) Applies ecological principles to the restoration of disturbed terrestrial, wetland, and aquatic ecosystems. Includes the restoration of soils and waterways, of flora and fauna, and of natural ecological processes such as plant succession and nutrient cycling. May also be offered as BIOL 6130. Preq: BIOL 3130 or BIOL 4410 or WFB 3130.

ENR 6160 Forest Policy and Administration 3 (3) Introduction to the development, principles, and legal provisions of forest policy in the United States and an examination of administrative and executive management in forestry. May also be offered as FOR 6160.

ENR 6290 Environmental Law and Policy 3 (3) Develops an understanding of the three branches of government that affect and dictate use and protection of natural resources. Attention is given to major federal environmental statutes. Includes examination of how policy is developed, implemented, and evaluated in the public and private sectors. Preq: Junior standing.
ENR 6340 Geographic Information Systems for Landscape Planning 3 (2) Develops competence in geographic information systems (GIS) technology and its application to various spatial analysis problems in landscape planning. Topics include data development and management, spatial analysis techniques, critical review of GIS applications, needs analysis and institutional context. GIS hardware and software, hands-on application. Credit may be received for only one of ENR 4340 or FOR 4340. May also be offered as FOR 6340. Coreq: ENR 6341.

ENR 6341 Geographic Information Systems for Landscape Planning Laboratory 0 (3) Non-credit laboratory to accompany ENR 6340. May also be offered as FOR 6341. Coreq: ENR 6340.

ENT 6500 Conservation Issues 3 (3) Interactive study and discussion of issues related to the conservation of natural resources, emphasizing current issues in the conservation of biodiversity, identification of conflicting issues between consumptive and nonconsumptive resource management, and development of viable solutions for conservation of natural resources. Prereq: BIOL 3130 or WFB 3130.

ENVIRONMENTAL SCIENCE AND POLICY

ENSP 6720 Environmental Planning and Control 2 (2) Application of planning and control to effective environmental quality improvement. Considers water supply and treatment, wastewater treatment and disposal, solid waste disposal, air pollution abatement, and land use and zoning from the standpoint of control. Not intended for graduate students in engineering. Prereq: Consent of instructor.

ENTOMOLOGY

ENT 6000 Insect Morphology 4 (3) Study of insect structure in relation to function and of the variation of form in insects. May also be offered as BIOL 6000. Prereq: ENT 3010. Coreq: ENT 6001.

ENT 6001 Insect Morphology Laboratory 0 (3) Non-credit laboratory to accompany ENT 6000. May also be offered as BIOL 6001. Coreq: ENT 6000.

ENT 6040 Urban Entomology 3 (3) Study of pests common to the urban environment with emphasis on arthropod pest biology, pest importance, and management strategies. Students learn both theoretical and practical aspects of urban pest management. Prereq: BIOL 1030 and BIOL 1040; or BIOL 1100 and BIOL 1110; or ENT 3010.

ENT 6060 Diseases and Insects of Turfgrasses 2 (2) Host-parasite relationships, symptomatology, diagnosis, economics, and control of infectious diseases of turfgrasses and life histories, diagnosis, and control of important insect pests of turfgrasses. May also be offered as PLPA 6060. Prereq: ENT 3010 and PLPA 3100.

ENT 6070 Applied Agricultural Entomology 3 (2) Topics include recognition, biology, damage, and control of economically important insects and mites found on major Southeastern field, fruit, nut, and vegetable crops. Principles and practices of crop protection, including pesticide application, economic basis for decision making, and development of scouting programs are introduced. Prereq: ENT 3010. Coreq: ENT 6071.

ENT 6071 Applied Agricultural Entomology Laboratory 0 (3) Non-credit laboratory to accompany ENT 6070. Coreq: ENT 6070.

ENT 6080 Diseases and Insects of Turfgrasses Laboratory 1 (3) Laboratory to complement PLPA 4060 or ENT 4060 to learn symptomatology, diagnosis, and control of infectious diseases of turfgrasses and diagnosis of damage caused by important insect pests of turfgrasses. May also be offered as PLPA 6080. Prereq: PLPA 4060 or ENT 4060.

ENT 6090 Urban Entomology Laboratory 1 (3) Identification of household and structural pests common to the urban environment. Students also gain hands-on experience in termite and general pest control. Prereq: BIOL 1030 and BIOL 1040; or BIOL 1100 and BIOL 1110; or ENT 3010. Prereq or concurrent enrollment: ENT 4040.

ENT 6150 Insect Taxonomy 3 (1) Identification of the principal families of the major orders of adult insects. Laboratory work consists of intensive practice of such identification. Lecture material deals with theoretical discussion of taxonomic features observed in the laboratory. May also be offered as BIOL 6150. Prereq: BIOL 4000 or ENT 4000. Coreq: ENT 6151.

ENT 6151 Insect Taxonomy Laboratory 0 (6) Non-credit laboratory to accompany ENT 6150. May also be offered as BIOL 6151. Coreq: ENT 6150.

ENT 6360 Insect Behavior 3 (2) Fundamentals of insect behavior in an evolutionary and ecological perspective. Laboratory emphasizes generation and testing of hypotheses and observation, description, and quantification of insect behavior. May also be offered as BIOL 6360. Prereq: ENT 3010. Coreq: ENT 6361.

ENT 6361 Insect Behavior Laboratory 0 (3) Non-credit laboratory to accompany ENT 6360. May also be offered as BIOL 6361. Coreq: ENT 6360.

ENT 6690 Aquatic Insects 3 (1) Identification, life history, habitats, and interrelationships of aquatic insects; techniques of qualitative field collecting; important literature and research workers. Prereq: ENT 3010. Coreq: ENT 6691. May also be offered as BIOL 6690 or WFB 6690.

ENT 6691 Aquatic Insects Laboratory 0 (6) Non-credit laboratory to accompany ENT 6690. May also be offered as BIOL 6691 or WFB 6691. Coreq: ENT 6690.

ENT 6950 Insect Biotechnology 3 (3) Considers many unique genetic features exhibited by insects and describes the applications of biotechnology to enhance useful products from insects and to affect the control of destructive insects. May also be offered as GEN 6950. Prereq: ENT 3010 and GEN 3020.

ENT 7000 Entomology for Teachers 3 (2) General entomology course for secondary school science teachers with emphasis on collecting and identifying the more common insects; insect morphology, physiology, metamorphosis and methods available for control of destructive species. Not open to Entomology majors pursuing the MS or PhD degrees. Offered spring semester only. Prereq: Consent of instructor. Coreq: ENT 7001.

ENT 7001 Entomology for Teachers Laboratory 0 (2) Non-credit laboratory to accompany ENT 7000. Coreq: ENT 7000.

ENT 8080 Taxonomy of Immature Insects 3 (1) Identification of immature insects emphasizing the Holometabola. Identified collection is required. Offered fall semester of odd-numbered years only. Coreq: ENT 8081.

ENT 8081 Taxonomy of Immature Insects Laboratory 0 (6) Non-credit laboratory to accompany ENT 8080. Coreq: ENT 8080.

ENT 8090 Seminar in Entomology 1 (1) Current literature and research in entomology. Class attendance is mandatory. May be repeated for credit. To be taken Pass/No Pass only.

ENT 8100 Selected Topics 1-3 (1-3) Current areas of entomological research and pest management. May be repeated for credit. Prereq: Consent of instructor.

ENT 8530 Applied Systematics 3 (2) Application of evolutionary principles to resolution of contemporary zoological problems; legal issues and technical skills for efficient operation of international zoological information storage and retrieval system. Offered spring semester of even-numbered years only. Coreq: ENT 8531.

ENT 8531 Applied Systematics Laboratory 0 (3) Non-credit laboratory to accompany ENT 8530. Coreq: ENT 8530.

ENT 8630 Special Problems in Entomology 1-3 (1-3) Entomological research not related to thesis. Prereq: Consent of instructor.

ENT 8700 Insect Physiology and Molecular Biology 4 (3) Advanced instruction on the structure and function of insect physiological processes at the molecular, cellular and tissue levels; physiological and molecular mechanisms underlying the various internal systems of insects. Laboratory emphasizes hands-on experimentation and the scientific writing technique to report experimental findings. Prereq: BIOL 1110 or CH 2230 or ENT 3010 or ENT 4950. Coreq: ENT 8701.

ENT 8701 Insect Physiology and Molecular Biology Laboratory 0 (3) Non-credit laboratory to accompany ENT 8700. Coreq: ENT 8700.

ENT 8910 Master’s Thesis Research 1-12 (1-12) Master’s Thesis Research

ENT 9910 Doctoral Dissertation Research 1-12 (1-12) Doctoral Dissertation Research
ENGINEERING AND SCIENCE EDUCATION

ESED 8000 Seminar in Engineering and Science Education 1 (1) Brings contemporary issues in engineering and science education research into the classroom. Experts from academia, industry and the corporate world give presentations on various issues, including recruitment of minorities, retention issues, technology integration into engineering curricula, distance learning, engineering content into K-12 curriculum, learning theories and education policy issues.

ESED 8200 Teaching Undergraduate Engineering 3 (3) Designed for engineering graduate students seeking a career in academic. Includes both discussion and practice of effective teaching techniques, assessments and technologies, as well as an overview of current engineering education research.

ESED 8210 Teaching Undergraduate Science 3 (3) Graduate students in the sciences who are interested in an academic career learn to improve their teaching by incorporating results of modern science education research, including effective teaching techniques, assessment issues and the use of technology. Students are expected to be enrolled in a science, technology, engineering or mathematics graduate program when enrolling in this course.

ESED 8250 Engineering and Science Student Strategies 3 (3) Elucidates relationships between students’ prior knowledge, problem solving skills and cognitive processes in undergraduate engineering and science courses. Focuses on steps involved in problem solving, how misconceptions are manifested in students’ work and how instruction can be structured to address those misconceptions.

ESED 8500 Special Topics in Engineering and Science Education 1-4 (1-4) Advanced topics intended to develop in-depth areas of particular student interest. May be repeated for a maximum of 15 credits. Prerq: Consent of instructor.

ESED 8610 Practicum in Engineering and Science Education 1-3 (1-3) Practicum that includes teaching or mentoring undergraduates in Engineering and Science (General Engineering or student’s home department). Counts towards a Certificate in Engineering and Science Education. May be repeated for a maximum of three credits.

ESED 8700 Theories of Engineering and Science Learning 3 (3) Provides graduate student in engineering and the sciences a foundation in theories of learning with a particular focus on their application to the teaching and learning of science, technology, engineering or mathematics. Prerq: Enrollment in a science, technology, engineering or mathematics graduate program.

ESED 8710 Engineering and Science Education Research Methods 3 (3) Introduces methods and tools available for conducting pedagogically sound engineering and science education research. Quantitative, qualitative and mixed methods are discussed and practiced.

ESED 8750 Current Issues in STEM Education Research 3 (3) Designed for doctoral students interested in STEM education research. Covers research issues of current relevance to a breadth of STEM education fields. Students have the opportunity to investigate a current topic of their choosing. Prerq: Enrollment in a PhD program.

ESED 8880 Preparing for the Professoriate 3 (3) Prepares students for obtaining a faculty position and achieving tenure in science and engineering disciplines. Students develop a professional portfolio, prepare for the application/interview process and write a mini-proposal. Prerq: Enrollment in a doctorate program in the College of Engineering and Science.

ESED 9910 Dissertation Research and Writing 1-12 (1-12) Designed for students who are conducting research and/or writing their dissertation under the supervision of a faculty member in the Engineering and Science Education program. Credit is to be arranged. Prerq: Enrollment in a doctorate program in the College of Engineering and Science.

ENVIRONMENTAL TOXICOLOGY

ENTOX 6000 Wildlife Toxicology 3 (3) Assessment of impacts of toxic substances on reproduction, health, and well-being of wildlife species; acute and chronic effects of agricultural chemicals, pesticides, hazardous waste, industrial waste, and oil releases are discussed. Prerq: [BCMH 3010 or BCMH 3050; or both CH 2230 and CH 2270] and [BIOL 1040 and BIOL 1060; or BIOL 1110] and WFB 3500.

ENTOX 6210 Chemical Sources and Fate in Environmental Systems 3 (3) Discusses chemical cycles in the environment on global and microcosm scales. Examines the dependence of fate processes on physical and chemical properties and environmental conditions. Addresses breakdown, movement, and transport of selected toxicants to illustrate the mechanisms that govern chemical fate. Prerq: CH 2230 and CH 2270 and CH 3130.

ENTOX 6300 Toxicology 3 (3) Basic principles of toxicology, including quantitation of toxicity, toxicokinetics, biochemical action of poisons, and environmental toxicology, are studied. Acute and chronic effects of various classes of poisons (e.g., pesticides, drugs, metals, and industrial pollutants) are discussed in relation to typical routes of exposure and regulatory testing methods.

ENTOX 6370 Ecotoxicology 3 (3) Study of the effects of stressors on the ecosystem. Explores the integrative relationships that comprise the field of ecotoxicology in a hierarchical format that focuses on the various levels of ecological organization. Prerq: ETOX 4300.

ENTOX 6850 Environmental Soil Chemistry 3 (3) Study of soil chemical processes (sorption, desorption, ion exchange, precipitation, dissolution, and redox reactions) of nutrients and inorganic and organic contaminants in soils and organic matter. Chemical complex equilibria and adsorption phenomena at the solid (soil, sediment, and mineral) water interface are emphasized. Prerq: CH 1020 or PES 2020. May also be offered as GEOL 6850 or PES 6850.

ENTOX 8110 Immunotoxicology 3 (3) Study of how environmental contaminants, drugs and natural biotoxins affect the immune system of man and animals; cellular and molecular mechanisms of action by immunotoxic agents may also be offered as BIOL 8110. Prerq: AVS 8250 and ETOX 6300 and consent of instructor.

ENTOX 8220 Analytical Toxicology Laboratory 3 (1) Laboratory instrumentation, procedures and experimental methods used for identification and quantitation of toxic substances and their transformation products in environmental and biological samples. Application of these procedures in the isolation, detection and quantitation of toxicants in authentic samples. Students are expected to have completed coursework in organic and analytical chemistry or to have received consent of instructor before enrolling in this course. It is recommended that students also complete coursework in instrumental analysis before enrolling in this course. Coreq: ETOX 8221.

ENTOX 8221 Analytical Toxicology Laboratory 0 (6) Non-credit laboratory to accompany ETOX 8220. Coreq: ETOX 8220.

ENTOX 8300 Mechanistic Toxicology 3 (3) Detailed biochemical toxicology: control, regulation and activity of metabolic enzymes; molecular and cellular mechanisms of toxic action; proposed mechanisms for initiation and development of cancer; mode of action and kinetics of cholinesterase inhibitors; structure/activity relationships of ion channel blockers; biochemical and molecular biomarkers. May also be offered as BIOL 8300. Prerq: ENT 4300 or ETOX 4300.

ENTOX 8310 Biomarkers in Toxicology 3 (1) Methodology used in biomarker identification and evaluation of the effects of toxic substances on living systems using biomarkers in sentinel organisms and surrogate biomarkers. Students are expected to have completed coursework in organic chemistry and coursework and lab work in biochemistry before enrolling in this course. May also be offered as BIOL 8310. Prerq: ENT 4300 or ETOX 4000; or consent of instructor. Coreq: ETOX 8311.

ENTOX 8311 Biomarkers in Toxicology Laboratory 0 (6) Non-credit laboratory to accompany ETOX 8310. May also be offered as BIOL 8311. Coreq: ETOX 8310.

ENTOX 8410 Procedures and Techniques in Ecological Risk Assessment 2 (1) Evaluation and application of the procedures and techniques used in ecological risk assessments, including laboratory and field methods, to determine, measure and evaluate the risks to aquatic, terrestrial and avian species; impacts to biota within, and resulting from, chemical waste disposal facilities and hazardous waste sites. Prerq: CH 2230 and CH 2240 and CH 3130; and either EXST 8040 or EXST 8050; and either ENT 6300 or ETOX 6300; or consent of instructor. Coreq: ETOX 8411.

ENTOX 8411 Procedures and Techniques in Ecological Risk Assessment Laboratory 0 (3) Non-credit laboratory to accompany ETOX 8410. Coreq: ETOX 8410.
ETOX 8520 Ecological Models 3 (2) Systems analysis applied to ecology; construction of models which predict ecological consequences of stresses to the environment; frequency response analysis, energy models, information flow, and transfer functions for population interactions. Students are expected to have completed a course in ecology and in computer programming or to have obtained consent of instructor before enrolling in this course. Coreq: ETOX 8521.

ETOX 8521 Ecological Models Laboratory 0 (2) Non-credit laboratory to accompany ETOX 8520. Coreq: ETOX 8520.

ETOX 8540 Aquatic Toxicology 3 (3) Combines concepts of solution chemistry with toxicology to establish stress-response relationships for aquatic organisms at various trophic levels. Bioavailability is a unifying concept and concepts of contaminant exposure and organism response are set in an ecological risk assessment framework. May also be offered as BIOL 8540.

ETOX 8550 Sediment Toxicology and Chemistry 3 (3) Focuses on the chemistry and toxicology of contaminants in freshwater sediments. Sediment geochemistry, ecology, toxicity bioassay methodology and sediment sampling are discussed in a course framework that deals directly with contaminant bioavailability questions. Prereq: ETOX 8540 or consent of instructor.

ETOX 8600 Graduate Seminar 1 (1) Recent research in environmental toxicology; presentation, review and discussion of current issues by graduate students in an area of specialization selected by the instructor. May be repeated four times for credit. To be taken Pass/No Pass only.

ETOX 8610 Departmental Seminar 1 (1) Presents current research by Department of Environmental Toxicology faculty, staff, finishing graduate students and invited speakers. Improves students’ skills in evaluation of research plans and oral presentations and increases their awareness of literature resources and employment opportunities in the field. To be taken Pass/No Pass only. May be repeated an unlimited number of times for credit.

ETOX 8630 Selected Topics 1-4 (1-4) Topics in environmental toxicology not covered in other courses. Topics vary with current developments in the discipline. May be repeated, but only if different topics are covered. Prereq: Consent of instructor.

FCS 8100 Master’s Thesis Research 1-12 (1-12) Master’s Thesis Research

FCS 9910 Doctoral Dissertation Research 1-12 (1-12) Doctoral Dissertation Research

**FAMILY AND COMMUNITY STUDIES**

FCS 8110 Human Development and Family Life in Cultural Context 3 (3) Examines cultural context in human development and family life; the impacts of culture on physical, cognitive and social development; the influences of different environmental experiences on individual and family functioning; practical applications of a cross-cultural human and family development perspective; and the state of human development around the world. Prereq: FCS 8100.

FCS 8120 Democracy and the Growth of Civil Society 3 (3) Study of democracy as a political system and a way of life. Examines the nature of civil society and its relation to the development and sustainability of democratic values and institutions and the cultural, economic and political correlates of civic participation at various points in the lifespan. Prereq: FCS 8100 or consent of instructor.

FCS 8130 Research Methods in International Family and Community Studies I 3 (3) Survey of the processes and techniques of social research, with an emphasis on quantitative and mixed designs. Topics include the nature of inquiry and research fundamentals; measurement; sampling; methods of data collection; and research design. Particular attention is given to issues in conducting research in international settings.

FCS 8200 International Human Rights Law 3 (3) Examines international human rights law, the origins of international human rights, the emergence of international human rights law, issues related to the implementation, the position of the U.S. regarding ratification of human rights treaties, processes for monitoring and implementing human rights and treatment of human rights in the courts.

FCS 8270 Public Personnel Administration 3 (3) Organization, techniques and theories of personnel management; interpersonal relations in organizations; personnel change and development; changing conditions in the public service; educational specializations, unions, collective bargaining, etc.; ethics for the public service. May also be offered as PADM 8270.

FCS 8290 Public Financial Management 3 (3) Organization and techniques of governmental financial management; budgetary theories; intergovernmental financial relations. May also be offered as PADM 8290.

FCS 8300 Community Development: Principles and Practices 3 (3) Comparative theory and practice of community development, community building and community transformations that support child, youth and family well-being. Includes U.S. community development examples with selected examples from other nations.

FCS 8310 Community Transformation 3 (3) Advanced course on community transformation theories, methodologies and practice. Discusses and illustrates major paradigm shifts within the last three decades in the way community development is thought about and done. Case studies on community transformation from selected nations are utilized. Prereq: FCS 8300 or consent of instructor.

FCS 8320 Policies and Programs in Human Services 3 (3) Philosophy, theories and principles for organizing human services in and across selected nations, emphasizing strategies for and barriers to the development of collaborations among and between governmental and nongovernmental organizations. Discusses community-level child and family support, poverty alleviation, health care, early childhood education and care and old-age assistance. Prereq: FCS 8300 or consent of instructor.

FCS 8330 Humanitarian Assistance 3 (3) Introduction to humanitarian assistance. Topics include historical background, determinants, legal issues, and health and social service delivery to current and past refugee and internally-displaced people, and ethno-political conflicts and terrorism as major sources of humanitarian crises. Prereq: FCS 8300 or consent of instructor.

FCS 8340 Research Methods in International Family and Community Studies II 3 (3) Through a combination of lecture and discussion, this course covers topics in multivariate research design, emphasizing the elements of research critical to selecting an appropriate design. The course reviews the principal research designs. Special attention is given to community-based and field research, as well as research in international settings. Prereq: FCS 8310.

FCS 8350 Institutions in Community Life 3 (3) Interdisciplinary review of core community institutions and their impact on families and communities. Focuses on four institutions: education, religion, health and government. Each institution is examined both individually and from a systems perspective for its relationship with other institutions and with families and communities.

FCS 8360 Area Studies 3 (3) Expands students’ knowledge of the nature of family and community life in various regions of the world (e.g., Eastern Europe; Middle East; Latin America; the Caribbean). Topics include political, social and economic trends; social and political transformation; cross cultural issues; globalization; human rights; and civil society. May be repeated for a maximum of six credits.

FCS 8400 Topics in Societal and International Research 1-3 (1-3) Covers selected topics in research design and data analysis with attention to community-based and field research, and research in international settings. Prereq: Consent of instructor.

FCS 8510 International Law and Policy on Children’s Issues 3 (3) Comparative analysis of law and policy on children’s issues. Attention is given to relevant international instruments, particularly the Convention on the Rights of the Child and to related concepts in the law and policy of various nations, including the United States. Prereq: FCS 8200.

FCS 8520 Right to Health 3 (3) Examination of the relationship between health and human rights emphasizing the application of a rights-based approach to health-related interests of children, families and communities. Topics include discussion of the content and contours of a right to health and of emerging trends in health and human rights. Prereq: FCS 8200 or consent of instructor.

FCS 8620 Administrative Leadership 3 (3) Foundations of leadership in public organizations; personal and organizational values underlying decision processes in the public service. May also be offered as PADM 8620.
FOOD SCIENCE

FDSC 6010 Food Chemistry I 3 (3) Basic composition, structure, and properties of food and the chemistry of changes occurring during processing utilization. Preq: BCHM 3050 or consent of instructor.

FDSC 6020 Food Chemistry II 3 (3) Application of theory and procedures for quantitative and qualitative analysis of food ingredients and food products. Methods for protein, moisture, lipid, carbohydrate, ash, fiber, rancidity, color, and vitamin analyses and tests for functional properties of ingredients are examined. Preq: BCHM 3050 or consent of instructor.

FDSC 6030 Food Chemistry and Analysis 2 (1) Principles of analytical procedures and techniques used to quantitatively and qualitatively determine chemical composition of foods, and elucidate the physio-chemical properties of food materials. Laboratories provide experience in critical thinking, performing food analysis, and analyzing data. Preq: BCHM 3050 and BIOL 4340 and FDSC 2140; or consent of instructor. Conreq: FDSC 6031.

FDSC 6031 Food Chemistry and Analysis Laboratory 0 (3) Non-credit laboratory to accompany FDSC 6030. Conreq: FDSC 6030.

FDSC 6040 Food Preservation and Processing 3 (3) Principles of food preservation applied to flow processes, ingredient functions, and importance of composition and physical characteristics of foods related to their processing; product recalls and product development concepts. Preq: BCHM 3050; and one of FDSC 2140 or FDSC 3010; and one of PHYS 1220 or PHYS 2000 or PHYS 2070; or consent of instructor.

FDSC 6060 Food Preservation and Processing Laboratory I I I (3) Laboratory exercises on preservation methods, equipment utilized, and processes followed in food manufacture. Preq: FDSC 4040.

FDSC 6070 Quantity Food Production 2 (1) Principles of the production of food in quantity for use in food service systems. Emphasizes functions of components of foods and of ingredients in food, and focuses on the quality of the final product, on safe production of food, and on proper use of equipment. Conreq: FDSC 6071.

FDSC 6071 Quantity Food Production Laboratory 0 (3) Non-credit laboratory to accompany FDSC 6070. Conreq: FDSC 6070.

FDSC 6080 Food Process Engineering 4 (3) Study of basic engineering principles and their application in food processing operations. Emphasizes the relation between engineering principles and fundamentals of food processing. Preq: CH 1020 and FDSC 2140; and one of MATH 1020 or MATH 1060; and one of PHYS 1220 or PHYS 2000 or PHYS 2070. Conreq: FDSC 6081.

FDSC 6081 Food Process Engineering Laboratory 0 (3) Non-credit laboratory to accompany FDSC 6080. Conreq: FDSC 6080.

FDSC 6090 Tqm for Food & Pkng 3 (3) Introduction to the principles of modern quality management emphasizing quality standards and issues and the practices necessary for food processing and packaging companies to survive in a customer-driven marketplace.

FDSC 6100 Food Product Development 4 (3) A strategic and systems approach to integrated product development practices for developing new food products within a team setting. Focuses on the Stage-Gate process for moving from product idea to launch and application of sensory analysis techniques. Conreq: FDSC 6101.

FDSC 6101 Food Product Development Laboratory 0 (3) Non-credit laboratory to accompany FDSC 6100. Conreq: FDSC 6100.


FDSC 6301 Dairy Processing and Sanitation Laboratory 0 (3) Non-credit laboratory to accompany FDSC 6300. Conreq: FDSC 6300.

FDSC 8020 Nutraceuticals and Functional Food 2 (2) Identifies sources, formulations, functional properties, and processing regulations for nutraceuticals and functional foods, and review the chemistry or separation and identification of bioactive ingredients. Preq: FDSC 6010 and FDSC 6020; or consent of instructor.

FDSC 8100 Chemical and Biochemical Aspects of Foods 4 (4) Chemical, biochemical and functional properties of food components and their interactions in food emulsions, foams, colloids, and gel and solution states; the influence of processing on isolation, utilization and production of the constituents using techniques based on constituent properties. Preq: BCHM 6230 and FDSC 4010; or consent of instructor.

FDSC 8110 Physical and Thermophysical Properties of Foods 3 (3) Principles involved in relating physical and thermophysical properties to food quality. Includes standard methods and instruments to determine texture and the relationship of physical properties to sensory evaluation; interrelationships of chemical structure and physical properties in food processing operations. Preq: FDSC 8100 or consent of instructor.

FDSC 8120 Microbiological Aspects of Food Systems 3 (3) Function and characteristics of microorganisms in the utilization and manufacture of food products; food fermentations, microbially induced chemical and physical changes, environmental aspects, and production of food ingredients and resources. Preq: MICR 4070 or consent of instructor.

FDSC 8150 Food Service Systems Management 4 (3) Management of the procurement, distribution and service of food that meets nutrition guidelines, cost parameters and consumer acceptance criteria; supervision of customer satisfaction systems, marketing functions and human resource systems. Conreq: FDSC 8151.

FDSC 8151 Food Service Systems Management Laboratory 0 (3) Non-credit laboratory to accompany FDSC 8150. Conreq: FDSC 8150.

FDSC 8200 Selected Topics in Food Science 1-3 (1-3) Special topics in food science not covered in other courses. May be repeated for a maximum of nine credits.

FDSC 8210 Selected Topics 1-4 (1-4) Independent research investigation in food science areas not conducted in other courses. May be repeated for a maximum of 12 credits. Preq: Consent of instructor.

FDSC 8510 Food Science Seminar 1 (1) Current research and related developments in food science reviewed by faculty, students and invited lecturers. May be repeated for a maximum of two credits, but only if different topics are covered.

FDSC 8550 Practicum Teaching Experience 1 (1) Students integrate and apply knowledge and skills in assisting a faculty member in the teaching of an undergraduate lecture or laboratory course in food, nutrition and/or packaging science. To be taken Pass/No Pass. May be repeated for a maximum of two credits.

FDSC 8910 Master’s Thesis Research 1-12 (1-12) Master’s Thesis Research

FOOD TECHNOLOGY

FDTH 8510 Food Technology Seminar 1 (1) Current and ongoing research and developments in food technology reviewed by faculty, students and invited lecturers. Preq: Enrollment in the Food Technology PhD program or consent of instructor.

FDTH 9910 Doctoral Dissertation Research 1-12 (1-12) Doctoral Dissertation Research
FINANCE
FIN 6020 Corporate Valuation 3 (3) Study of the decision process and analytical techniques used in evaluating corporate investment and financing decisions. Topics include capital budgeting, capital structure and bankruptcy, valuation, corporate governance, executive compensation, mergers and acquisitions, and restructuring. Preq: FIN 3120 with a C or better.

FIN 6060 Analysis and Use of Derivatives 3 (3) Consideration of the option pricing theory and strategy techniques most commonly used in the market for options. Also considers an overview of the futures markets. Special emphasis is given to interest-rate futures, stock-index futures, and foreign-exchange futures. Preq: FIN 3050 with a C or better.

FIN 6150 Real Estate Investment 3 (3) Focuses on the structure and analysis of real estate investment emphasizing financial theory and analysis technique. Case study and project-oriented homework assignments facilitate the understanding of real estate investments. Preq: FIN 3070 with a C or better.

FIN 6160 Real Estate Valuation 3 (3) Advanced course in commercial real estate valuation. Topics include income capitalization, cash equivalency, highest and best use analysis, the cost approach, the direct sales comparison approach, and DCF analysis. Preq: FIN 3070 with a C or better.

FIN 6170 Real Estate Finance 3 (3) Advanced course applying financial analysis and theory to real estate. Emphasizes mortgage credit analysis and current financial techniques for residential and commercial properties. Topics include financial institutions, syndications, and construction financing. Preq: FIN 3070 with a C or better.

FIN 8320 International Financial Management 3 (3) Factors that influence the financial management of multinational corporations. Topics include international parity conditions, currency exposure management, capital budgeting of international projects and political risks. May also be offered as MBA 8320. Preq: MBA 8070 or MBA 8570; or consent of instructor.

FIN 8360 Real Estate Principles 3 (3) Advanced survey course to acquaint students with the theories, practices and principles of real estate. Topics include urban economics, real estate law, brokerage, real estate valuation, financial institutions, tax issues, investment analysis, and development. May also be offered as MBA 8360. Preq: MBA 8070 or MBA 8190; or consent of instructor.

FORESTRY AND NATURAL RESOURCES
FNR 7300 Master Naturalist for Teachers 3 (2) Teachers learn about the natural history and natural resources of South Carolina, including geology, biology, ecology and human impacts. Additionally, this online course with associated field trips may be used to help teachers as part of obtaining certification through the South Carolina Master Naturalist program. Coreq: FNR 7301.

FNR 7301 Master Naturalist for Teachers Laboratory 0 (0) Noncredit laboratory to accompany FNR 7300. Coreq: FNR 7300.

FNR 8080 Graduate Seminar 1 (1) Covers research methods, current literature, scientific communications and scientific presentations in forestry, forest resources and wildlife fisheries science. To be taken Pass/No Pass only. May be repeated for a maximum of two credits.

FORESTRY
FOR 6000 Public Relations in Natural Resources 3 (3) Identifying relevant policies, their characteristics and acceptance to natural resource management, and techniques of maintaining appropriate public relations. Preq: Senior standing.

FOR 6080 Wood and Paper Products 3 (3) Study of wood structures and identification; physical and mechanical properties of wood products; standard testing procedures; manufacture of lumber, plywood, oriented strand board; drying, preservation, grading, and use of wood products. Also discusses common grades of paper and paperboard; fiber sources; pulping and paper-making equipment and processes; chemical recovery process; and environmental issues. Preq: Junior standing.

FOR 6100 Harvesting Processes 4 (3) Study of forest harvesting processes with detailed analysis of production, cost, environmental impacts, safety, transportation, and business considerations. Preq: Senior standing. Coreq: FOR 6101.

FOR 6101 Harvesting Processes Laboratory 0 (3) Noncredit laboratory to accompany FOR 6100. Coreq: FOR 6100.


FOR 6131 Integrated Forest Pest Management Laboratory 0 (3) Noncredit laboratory to accompany FOR 6130. Coreq: FOR 6130.

FOR 6150 Forest Wildlife Management 3 (2) Principles, practices, and problems of wildlife management emphasizing upland forest game species. Habitat manipulation through use of appropriate silvicultural practices in association with other techniques is evaluated. Preq: FOR 4600. Coreq: FOR 6151.

FOR 6151 Forest Wildlife Management Laboratory 0 (3) Noncredit laboratory to accompany FOR 6150. Coreq: FOR 6150.

FOR 6160 Forest Policy and Administration 3 (3) Introduction to the development, principles, and legal provisions of forest policy in the United States and an examination of administrative and executive management in forestry. May also be offered as ENR 6160.

FOR 6170 Forest Resource Management and Regulation 3 (3) Fundamental principles and analytical techniques in planning, management, and optimization of forest operations. Preq: FOR 3020 and FOR 3080 and FOR 4180 and FOR 4650.

FOR 6180 Forest Resource Valuation 3 (3) Analysis of capital investment tools and their application to decision making among forestry investment alternatives; valuation of land, timber, and other resources associated with forestry, including the impact of inflation and taxes. Preq: FOR 3040.

FOR 6230 Current Issues in Natural Resources 2 (2) Lectures in various fields of forestry delivered by selected faculty from forest industries, consultants, agencies, associations, and other forestry operations. Will not be taught when enrollment is less than 15. To be taken Pass/No Pass only. Preq: Junior standing.

FOR 6270 Urban Tree Care 3 (3) Principles, practices, and problems of protecting and maintaining trees in urban and recreational areas. Examines environmental and biological factors affecting trees in high-rise areas, their management and cultural requirements, and the practices necessary for their protection and care as valuable assets in the landscape. May also be offered as HORT 6270. Preq: Consent of instructor.

FOR 6310 Recreation Resource Planning in Forest Management 2 (1) Analysis of forest recreation as a component of multiple-use forest management; techniques of planning; physical and biological effects on forest environments; and forest site, user, and facility management. Coreq: FOR 6311.

FOR 6311 Recreation Resource Planning in Forest Management Laboratory 0 (3) Noncredit laboratory to accompany FOR 6310. Coreq: FOR 6310.

FOR 6330 GPS Applications 3 (2) Develops competence in global positioning system (GPS) technology, including theory, methods, and application to natural resources mapping. Topics include basic concepts of GPS; projection systems; types of data; mission planning; and data capture, correction, and export to geographical information systems (GIS). Preq: Senior standing. Coreq: FOR 6331.

FOR 6331 GPS Applications Laboratory 0 (3) Noncredit laboratory to accompany FOR 6330. Coreq: FOR 6330.

FOR 6340 Geographic Information Systems for Landscape Planning 3 (2) Develops competence in geographic information systems (GIS) technology and its application to various spatial analysis problems in landscape planning. Topics include data development and management, spatial analysis techniques, critical review of GIS applications, needs analysis and institutional context. GIS hardware and software, hands-on application. Credit may be received for only one of ENR 4340 or FOR 4340. May also be offered as ENR 6340. Coreq: FOR 6341.

FOR 6341 Geographic Information Systems for Landscape Planning Laboratory 0 (3) Noncredit laboratory to accompany FOR 6340. May also be offered as ENR 6341 Coreq: FOR 6340.

FOR 6410 Properties of Wood Products 3 (3) Basic properties of wood, including the hygroscopic, thermal, electrical, mechanical, and chemical properties; standard testing procedures for wood. Preq: Junior standing.
FOR 6420 Manufacture of Wood Products 3 (3) Study of the manufacture of lumber, plywood, poles, piles; drying, preservation, grading, and uses of wood products. Considers the manufacture of particleboard, flakeboard, oriented-strand board, fiberboard, and paper products. Includes physical, mechanical, and chemical properties and their applications. Preq: Consent of instructor.

FOR 6440 Forest Products Marketing and International Trade 3 (3) Study of marketing and international trade practices currently employed by the forest products industry and the application of basic marketing principles and global trade concepts in the industry's current and future environment. Preq: FOR 4420.

FOR 6500 Woody Plant Stress Physiology 3 (3) Structure, function, and physiology of tree shoot and crown growth, wood formation, diameter growth, root growth, and reproduction, especially as related to stress factors. Preq: BIOL 4010 or FOR 4600.

FOR 6510 Newman Seminar and Lecture Series in Natural Resources Engineering 1 (2) Topics dealing with development and protection of land, air, water, and related resources are covered by seminar with instructor and invited lecturers. Current environmental and/or resource conservation issues are addressed. May also be offered as BE 6510 or EES 6510.

FOR 6650 Silviculture 4 (3) Discussion of the theory and practice of manipulating forests to meet the needs and values of landowners and society in accordance with biological, ecological, and economic principles. Preq: FOR 2060 and FOR 2510 and FOR 2520 and FOR 2530 and FOR 2540. Coreq: FOR 6651.

FOR 6651 Silviculture Laboratory 0 (3) Non-credit laboratory to accompany FOR 6650. Coreq: FOR 6650.

FOR 7070 Special Problems in Forestry 1-3 (1-3) Directed individual study of a special problem in an applied field of forestry. Written report of study results is required.

FOR 8050 Forest Landscape Ecosystems 4 (3) Three basic landscape components of soils, landform and vegetation; their interrelationships in forest ecosystems; factors and processes of soils as interacting components with landform and vegetation. Offered fall semester of odd-numbered years only. Coreq: FOR 8051.

FOR 8051 Forest Landscape Ecosystems Laboratory 0 (3) Non-credit laboratory to accompany FOR 8050. Coreq: FOR 8050.

FOR 8070 Special Problems in Forestry 1-12 (1-12) Special problems in forestry research methods that do not directly pertain to the candidate's thesis.

FOR 8110 Forest Wetland Ecology and Management 2 (2) Assessment of ecological processes and how they influence forest wetland productivity, management and regulation. Offered spring semester only. Preq: Consent of instructor.

FOR 8120 Fire Ecology and Management 3 (3) Historical presence of fire in various regions of North America and its effects on forests; analysis of current fire management strategies with emphasis on usage of prescribed fire as an ecosystem management tool. Coreq: FOR 8121.

FOR 8121 Fire Ecology and Management Laboratory 0 (3) Non-credit laboratory to accompany FOR 8120. Coreq: FOR 8120.

FOR 8140 Advanced Forest Resource Management and Planning 3 (3) Current forest resource management and planning topics; operational emphasis on application of various quantitative tools to solve economic and management problems; advanced topics in forest regulation, forest valuation, mathematical programming and harvest scheduling, simulation, multiple-use alternatives and selected areas. Offered spring semester of odd-numbered years only. Preq: FOR 4170.

FOR 8150 Systems Processes in Natural Resources 3 (2) Use of system thinking and system analysis to define the issues, model, simulate and evaluate alternatives for forest landscape problems and opportunities. Coreq: FOR 8151.

FOR 8151 Systems Processes in Natural Resources Laboratory 0 (3) Non-credit laboratory to accompany FOR 8150. Coreq: FOR 8150.

FOR 8160 Remote Sensing and GIS in Natural Resources 3 (2) Practical application of computer mapping, spatial analysis and natural resource inventory using remote sensing and geographical information systems. Offered spring semester of odd-numbered years only. Preq: ENR 4340 or FOR 4340. Coreq: FOR 8161.

FOR 8161 Remote Sensing and GIS in Natural Resources Laboratory 0 (3) Non-credit laboratory to accompany FOR 8160. Coreq: FOR 8160.

FOR 8450 Biodiversity in Managed Forests 3 (2) Theory and practice of maintaining biodiversity are fundamental to successful management of forests. Conservation of biodiversity is viewed from the macro (landscape) and micro (stand) levels. Socioeconomic and policy as well as ecological perspectives are considered in design of appropriate management practices. Preq: FOR 4150 or FOR 4600. Coreq: FOR 8451.

FOR 8451 Biodiversity in Managed Forests Laboratory 0 (3) Non-credit laboratory to accompany FOR 8450. Coreq: FOR 8450.


FOR 8930 Selected Topics in Forest Resources 1-4 (1-4) Specialized topics not covered in other courses which explore current areas of research and management in forest and natural resources in a format of lecture, lab, or both. May be repeated for a maximum of eight credits, but only if different topics are covered.

FOR 8931 Selected Topics in Forest Resources Laboratory 0 (1-12) Non-credit laboratory to accompany FOR 8930.

FOR 9910 Doctoral Dissertation Research 1-12 (1-12) Doctoral Dissertation Research

FRENCH
FR 6990 Selected Topics in French Literature 3 (3) Selected topics that have characterized French literature, language, and culture. May be repeated for a maximum of six credits. Preq: Consent of department chair.

GRAPHIC COMMUNICATIONS
GC 6060 Package and Specialty Printing 4 (2) In depth study of the problems and processes for printing and converting in package label and specialty printing industries. Flexographic prepyation, printing, die making, diecutting, screen printing, container printing, pad printing and bar code production are covered. New developments and trends are discussed. Laboratory in techniques includes printing and converting. Preq: GC 3400; or consent of instructor. Coreq: GC 6061.

GC 6061 Package and Specialty Printing Laboratory 0 (6) Non-credit laboratory to accompany GC 6060. Coreq: GC 6060.

GC 6070 Advanced Flexographic Methods 4 (2) In-depth study of the methods used in flexographic printing and converting of porous and nonporous substrates. Theory and laboratory applications include setting standards for process color, preparation of plate systems, ink mixing and color matching, testing of films and foils, analysis of recent developments, and prediction of future markets. Preq: GC 6060 or consent of instructor. Coreq: GC 6071.

GC 6071 Advanced Flexographic Methods Laboratory 0 (6) Non-credit laboratory to accompany GC 6070. Coreq: GC 6070.

GC 6400 Commercial Printing 4 (2) Advances skills learned in previous graphic communications courses and applies the knowledge to large format presses. Students work from the design conception through stage all aspects of preparation, production, and finishing. Emphasizes understanding and incorporating emerging technologies into the production workflow. Preq: GC 3400 or consent of instructor. Coreq: GC 6401.

GC 6401 Commercial Printing Laboratory 0 (6) Non-credit laboratory to accompany GC 6400. Coreq: GC 6400.

GC 6440 Current Developments and Trends in Graphic Communications 4 (2) Advanced course for Graphic Communications majors. Emphasizes the theory and technical developments that affect process and equipment selection. Topics include color theory and application, electronic color scanning, electronic prepress and communications, gravure color quality control and analysis. Preq: GC 4060 and GC 4400. Coreq: GC 6441.

GC 6441 Current Developments and Trends in Graphic Communications Laboratory 0 (6) Non-credit laboratory to accompany GC 6440. Coreq: GC 6440.
GC 6450 Advanced Screen Printing Methods 3 (2) In-depth study of the systems and materials used with the screen printing process. Emphasizes techniques of control and procedures for establishing screen printing methods and standards. Preq: GC 2070 or consent of instructor. Coreq: GC 6451.

GC 8111 Advanced Screen Printing Methods Laboratory 0 (3) Non-credit laboratory to accompany GC 6450. Coreq: GC 6450.

GC 6460 Ink and Substrates 3 (2) Covers components, manufacturing, process use as well as end use of ink and substrates used in lithography, flexography, gravure, and screen printing. Examines the interrelationship between inks, substrates, and the printing process. Through controlled testing and examination, optimum conditions for improved printability are determined. Preq: GC 6060 or GC 6400; or consent of instructor. Coreq: GC 6461.

GC 6461 Ink and Substrates Laboratory 0 (3) Non-credit laboratory to accompany GC 6460. Coreq: GC 6460.

GC 6480 Planning and Controlling Printing Processes 3 (2) Studies of systems for setting printing production standards, estimating, scheduling, job planning, and the selection of new hardware and technologies. Preq: GC 3500 and GC 4060 and GC 4400 and GC 4500; or consent of instructor. Coreq: GC 6481.

GC 6481 Planning and Controlling Printing Processes Laboratory 0 (3) Non-credit laboratory to accompany GC 6480. Coreq: GC 6480.

GC 6900 Graphic Communications Selected Topics 1-3 (1-3) Subjects not covered in other graphic communications courses; organized according to industry trends and student needs. May be repeated for a maximum of 18 credits, but only if different topics are covered. Preq: Consent of instructor.

GC 8010 Process Control in Color Reproduction 3 (2) Techniques and rationale for procedures used in reproducing color originals for printed media. Topics include color systems, measurement, reproduction characteristics, proofing systems, process evaluation/analysis for offset, gravure, flexography and screen printing processes. Preq: GC 6440. Coreq: GC 8011.

GC 8011 Process Control in Color Reproduction Laboratory 0 (3) Non-credit laboratory to accompany GC 8010. Coreq: GC 8010.

GC 8110 Printing Industry Operations 3 (3) Concepts and principles of operations and applications of technology and trends within the printing, publishing, packaging and allied industries. Twelve plant visits supplement study of the organization, management, marketing, economics, production, environmental issues and products of modern graphic communications firms. Coreq: GC 8111.

GC 8111 Printing Industry Operations Laboratory 0 (3) Non-credit laboratory to accompany GC 8110. Coreq: GC 8110.

GC 8310 Color Science Applied to Graphic Communications 3 (2) Color reproduction applications found in both photomechanical and digital workflows for print production; foundation in color science principles, measurement and integration relative to the printing, publishing and packaging industry; color systems development, application and integration. Preq: Consent of instructor. Coreq: GC 8311.

GC 8311 Color Science Applied to Graphic Communications Laboratory 0 (3) Non-credit laboratory to accompany GC 8310. Coreq: GC 8310.

GC 8500 Graphic Communications Internship I 2 (1-2) Full-time employment for hands-on experience in manufacturing, marketing, or managing within the graphic communications industry. For Graphic Communications graduates students only. May be repeated for a maximum of two credits. Preq: Consent of instructor.

GC 8910 Master’s Thesis Research I 1-6 (1-6) Student participation in a research project. Basic skills in a selected research methodology are developed. Preq: GC 8940.

GC 8940 Graphic Communications Graduate Seminar 1 (1) Discussions on relevant topics and guidance to prepare research proposals in the graphic communications field. May be repeated for a maximum of two credits, but only if different topics are covered. Preq: Consent of instructor.

GC 8970 Graphic Communications Research Problems I 3 (3) In-depth investigation of phenomena relative to the printing, publishing, packaging, or allied industries. Preq: GC 8940 and acceptance of a written proposal and approval of advisor.

GC 8980 Graphic Communications Research Problems II 3 (3) Continuation of GC 8970. In-depth investigation of phenomena relative to the printing, publishing, packaging, or allied industries. Preq: GC 8940 and GC 8970 and acceptance of a written proposal and approval of advisor.

GENETICS

GEN 6050 Molecular Genetics of Eukaryotes 3 (3) Molecular genetic analyses of eukaryotes in relation to mutations and repair, complex phenotypes, biochemical pathways, short- and long-term regulation of gene expression, and evolution. May also be offered as BIOL 6050. Preq: Consent of instructor.

GEN 6100 Population and Quantitative Genetics 3 (3) Classical and computational genetic topics, including Mendelian vs. non-Mendelian inheritance, genetic variation, evolutionary, conservation, coalescent theory, molecular evolution, quantitative trait locus, and association mapping in the framework of population and quantitative genetics. Preq: Consent of instructor.

GEN 6110 Population and Quantitative Genetics Laboratory 2 (4) Crosses are performed using eukaryotic organisms with appropriate markers, and molecular markers are amplified, sequenced, and analyzed. Collected data are used to test hypotheses regarding possible modes of inheritance and for patterns of molecular evolution. Population and molecular evolutionary genetics concepts are also examined. Preq: Consent of instructor.

GEN 6200 Molecular Genetics and Gene Regulation 3 (3) Molecular genetics, including replication, transcription and translation, gene expression, recombinant DNA technology, developmental, human, cancer, and behavioral genetics. Preq: Consent of instructor.

GEN 6400 Bioinformatics 3 (3) Theory and application of computational technology to analysis of the genome, transcriptome, and proteome. May also be offered as BCHM 6400. Preq: Consent of instructor.

GEN 6500 Comparative Genetics 3 (3) Outlines the genome structure, function, and evolution based on available complete genome sequences. Topics include the evolution of multigene families, origin of eukaryotic organelles, molecular phylogeny, gene duplication, domain shuffling, transposition, and horizontal gene transfer. Preq: Consent of instructor.

GEN 6700 Human Genetics 3 (3) Basic principles of inheritance; population, molecular and biochemical genetics; cytogenetics; immunogenetics; complex traits; cancer genetics; treatment of genetic disorders; genetic screening and counseling; and the Human Genome Project. Preq: Consent of instructor.

GEN 6950 Insect Biotechnology 3 (3) Considers many unique genetic features exhibited by insects and describes the applications of biotechnology to enhance useful products from insects and to affect the control of destructive insects. May also be offered as ENT 6950. Preq: ENT 3010 and GEN 3020.

GEN 7300 Genetics Topics for Teachers 3 (2) Lectures and laboratories focus on genetics and biotechnology. Restricted to elementary and secondary teachers. May be repeated for a maximum of six credits, but only if different topics are covered. Preq: Consent of instructor. Coreq: GEN 7301.

GEN 7302 Genetics Topics for Teachers Laboratory 0 (3) Non-credit laboratory to accompany GEN 7300. Coreq: GEN 7300.

GEN 8010 Cytogenetics 3 (2) Classical and contemporary problems of chromosome structure, behavior and transmission; recombination; interspecific hybridization; euchromatin and heterochromatin; polyplody; mutable genetic systems; structural and numerical aberrations of chromosomes and their effects upon breeding systems of plants and animals. Offered spring semester of alternate years only. Preq: GEN 3020. Coreq: GEN 8011.

GEN 8011 Cytogenetics Laboratory 0 (3) Non-credit laboratory to accompany GEN 8010. Coreq: GEN 8010.

GEN 8030 Quantitative Genetics 3 (3) Quantitative genetics concepts, line crosses and inbreeding, detecting major genes, mapping quantitative trait loci, estimation of genetic variation and heritability. Offered spring semester only. Preq: GEN 8140 or consent of instructor. (EXST 8010 is recommended.)

GEN 8050 Issues in Research 3 (3) Scientific writing, oral presentations and critical evaluation of them; legal and ethical issues associated with modern biochemical research. Science job hunting, time management and creativity for professional scientists are treated. May also be offered as BCHM 8050. Preq: Enrollment in the Genetics program.

GEN 8060 Special Problems in Genetics 1-3 (0-3-9) Research not related to a thesis.

GEN 8100 Principles of Molecular Biology 3 (3) Introduction to the principles and techniques used to analyze prokaryotic and eukaryotic gene and genome structure, regulation of transcription initiation, regulation of protein synthesis and protein function. May also be offered as BCHM 8100. Preq: Enrollment in the Genetics program.
GEN 8120 Physiological Genetics 3 (3) Advanced topics in the molecular aspects of physiological genetics including genes and metabolism, genes and signal transduction, oncogenes and growth, chromosomal aberrations, immunogenetics and others. Preq: A semester of biochemistry and introductory genetics.

GEN 8140 Advanced Genetics 3 (3) Topics include organization of DNA in prokaryotes and eukaryotes, mutation, extranuclear inheritance, recombination, control of gene activity, systems of mating, genes and development, genetics of behavior, population genetics, genetics and disease. Preq: Consent of instructor.

GEN 8150 Developmental Genetics 3 (3) Current research in developmental genetics including model systems, homeotic genes of Drosophila, primary induction, adhesion, molecules and cancer, axis formation, global pattern mutants in plants, homeobox genes in plants, and photo regulation. Preq: GEN 8140 or consent of instructor.

GEN 8200 Genomics and Proteomics 3 (3) Genomes, transcriptomes and proteomes of a variety of organisms are studied along with the technology used to obtain them. Bioinformatics tools and access to this information are developed, and the significance of this information for the life sciences is made clear. May also be offered as BCHM 8200. Preq: BCHM 8140 or GEN 8140.

GEN 8250 Seminar I I (1) Special topics and original research in genetics reviewed by students, faculty and invited lecturers. May be repeated for credit. May also be offered as BCHM 8250. Preq: Enrollment in the Genetics program.

GEN 8300 Molecular Evolution and Population Genetics 3 (3) Topics include statistical methodology in the study of population genetics, probability as applied to genetic systems, gene and zygotic frequencies, derivation of genetics expectation, forces that change gene frequency, inbreeding, estimation, and testing of genetic parameters. Preq: GEN 8140 or consent of instructor. (EXST 8010 is recommended.)

GEN 8510 Seminar II 1 (1) Investigation of current topics in biochemistry. May be repeated for a maximum of ten credits. To be taken Pass/No Pass only. May also be offered as BCHM 8510. Preq: Enrollment in the Genetics Program.

GEN 8990 Special Topics in Genetics 1-3 (1-3) Group discussion of recent developments in genetic research. May be repeated for a maximum of six credit hours. Preq: Consent of instructor.

GEN 8990 Master’s Thesis Research 1-12 (1-12) Master’s Thesis Research

GEN 9990 Doctoral Dissertation Research 1-12 (1-12) Doctoral Dissertation Research

GEOGRAPHY

GEOG 6010 Studies in Geography 3 (3) Intensive study of the geography of a selected world region, such as North America, Europe, or the Middle East, or the geography of a topic, such as the geography of oil or the geography of underdevelopment. May be repeated once for credit with departmental consent. Preq: GEOG 1010 or GEOG 1030 or consent of instructor.

GEOG 6100 Geography of the American South 3 (3) Study of the geography of the American South in its changing complexities across almost 4000 years of development. Preq: GEOG 1010 or GEOG 1030 or consent of instructor.

GEOG 6200 Historical Geography of the United States 3 (3) Survey that places the spatial concepts of geography into a time sequence with special emphasis upon the United States. Preq: GEOG 1010 or GEOG 1030 or consent of instructor.

GEOG 6300 World Geography of Parks and Equivalent Reserves 3 (3) Major international patterns in the provision and use of urban and rural parks and recreation are examined. May also be offered as PRTM 6300.

GEOG 6400 Geography of Historic Preservation 3 (3) Aspects of historic preservation emphasizing sites and structures in their geographical, historical, and socioeconomic contexts. Examples are drawn from American architectural styles and settlement forms. Preq: GEOG 1010 or GEOG 1030 or consent of instructor.

GEOG 7100 Teaching Geography 3 (3) Investigates world regions as a set of problems posed to teachers of geography; comparative analysis of basic geographic concepts. Oriented to public school teachers of geography.

GEOLOGY

GEOL 6030 Invertebrate Paleontology 3 (2) Study of life of past geologic ages as shown by fossilized remains of ancient animals, with emphasis on the invertebrates. Conreq: GEOG 6031.

GEOL 6031 Invertebrate Paleontology Laboratory 0 (3) Non-credit laboratory to accompany GEO 6030. Conreq: GEO 6031.

GEOL 6050 Surficial Geology 4 (3) Study of surface features of the earth and the processes that produce them. Analysis of landforms including their form, nature, origin, development, and rates and patterns of change. Laboratory studies emphasize terrain analysis and the mechanics of surficial geological processes. Preq: GEOG 1020 and GEOG 3000; or consent of instructor. Conreq: GEOG 6051.

GEO 6051 Surficial Geology Laboratory 0 (3) Non-credit laboratory to accompany GEO 6050. Conreq: GEO 6050.

GEO 6090 Environmental and Exploration Geophysics 4 (3) Students develop an understanding of the principles and methods used to acquire, analyze, and interpret geophysical data. Emphasis on seismic/radar, gravimetric, and electromagnetic methods. Applications to hydrogeology, environmental engineering and science, soil science, contaminant transport and remediation, near surface geology, geotechnical problems, oil and gas exploration, and carbon sequestration. Conreq: GEO 6091.

GEO 6091 Environmental and Exploration Geophysics Laboratory 0 (3) Non-credit laboratory to accompany GEO 6090. Conreq: GEO 6090.

GEO 6130 Stratigraphy 3 (2) Analysis of stratified rocks as the repository of earth history and the conceptual framework used to synthesize the world geologic record as a coherent whole. Emphasizes not only traditional lithostratigraphy but also modern seismic stratigraphy, biostratigraphy, magnetostratigraphy, and current stratigraphic issues. Conreq: GEOG 6131.

GEO 6131 Stratigraphy Laboratory 0 (2) Non-credit laboratory to accompany GEO 6130. Conreq: GEO 6130.


GEO 6151 Analysis of Geological Processes Laboratory 0 (3) Non-credit laboratory to accompany GEO 6150. Conreq: GEO 6150.

GEO 6210 GIS Applications in Geology 3 (1) Introduction to geographic information systems with applications to current geological and hydrological problems. Topics include the use of global positioning systems, spatial analysis, and image analysis. Hands-on training with geographic information systems software and techniques is covered in lab. Preq: At least Junior standing. Conreq: GEO 6211.

GEO 6211 GIS Applications in Geology Laboratory 0 (4) Non-credit laboratory to accompany GEO 6210. Conreq: GEO 6210.

GEO 6510 Selected Topics in Hydrogeology 1-3 (1-3) Selected topics in hydrogeology emphasizing new developments in the field. May be repeated for a maximum of six credits, but only if different topics are covered. Conreq: GEO 6511.

GEO 6511 Selected Topics in Hydrogeology Laboratory 0 (1-3) Non-credit laboratory to accompany GEO 6510. Conreq: GEO 6510.

GEO 6590 Biogeochemistry 3 (3) Examines how biology directs mass and energy transfer between the lithosphere, biosphere, hydrosphere, and atmosphere. Scale of examination ranges from molecular to global. Topics include element cycling, mineral-water interface are emphasized. Preq: GEOG 6510 or PES 6850. Conreq: GEO 6590.

GEO 6590 Biogeochemistry Laboratory 0 (3) Non-credit laboratory to accompany GEO 6590. Conreq: GEO 6590.

GEO 6780 Groundwater and Contaminant Transport 3 (3) Basic principles of groundwater hydrology and transport of contaminants in groundwater systems; groundwater system characteristics; steady and transient flow; well hydraulics, design, and testing; contaminant sources, movement and transformations. Preq: Junior standing in the College of Engineering and Science and GEOG 1010; or consent of instructor. May also be offered as ETOX 6850 or PES 6850.
Courses of Instruction

**GEOL 7900 Selected Topics in Earth Sciences 1-6** (1-6) One or more earth science topics. Lecture and laboratory emphasize the incorporation of new or updated subject matter into classroom instruction. Restricted to elementary and secondary school teachers. May be repeated for credit, but only if different topics are covered.

**GEOL 8030 Geostatistics 3 (3)** Numerical and statistical treatment of geological data emphasizing the analysis of spatially and temporally distributed variables and unique aspects of geological variables; methods of sampling geological data, quantitative procedures for reducing the dimensionality of geological data sets, and techniques for presentation and interpretation of results. Students are expected to have completed an introductory statistics course and two semesters of calculus before enrolling in this course.

**GEOL 8060 Aquifer Characterization 3 (3)** Characterization of aquifers from the microscopic scale to the regional scale; geological origin of aquifers and modifications by diagenetic and deformational processes; application of subsurface geological techniques to data acquisition and interpretation; prediction of fluid occurrence and flow by integrating results of subsurface analysis.

**GEOL 8080 Groundwater Modeling 3 (3)** Mathematical and computer modeling of groundwater flow and nonreactive solute transport through geological formations; conceptual flow-models for geologic systems; formulation of governing mass and energy conservation equations; application of analytical, numerical and stochastic models to real-world problems. May also be offered as EES 8080.

**GEOL 8090 Subsurface Remediation Modeling 3 (3)** Lectures and computer exercises involving subsurface remediation methods including groundwater extraction, soil vapor extraction, steam flooding and a variety of other techniques; modeling flow of multiphase and multicomponent mixtures in porous medium.

**GEOL 8100 Analytical Methods for Hydrogeology 3 (3)** Analytical mathematical methods for modeling subsurface fluid flow and transport processes including saturated water flow, unsaturated zone gas flow, chemical transport and heat transfer, emphasizing the derivation and solution of governing equations for modeling subsurface flow and transport. May also be offered as GEOL 8100.

**GEOL 8140 Environmental Sedimentology 3 (3)** Environmental-based applications of sedimentology to developing an understanding of heterogeneity and scale, fluid flow and saturation, sediment-fluid interactions, and modeling approaches; field and laboratory methods; case studies; implications to environmental sustainability.

**GEOL 8160 Aquifer Systems 3 (3)** Hydrogeologic characteristics of selected major aquifer systems in the U.S. and elsewhere; conceptual models for the controls of recharge, discharge and flow through aquifers in different geologic settings; development of numeric models to simulate natural and stressed aquifers.

**GEOL 8180 Hydrogeology of Fractured Aquifers 3 (3)** Processes and characteristics of fluid flow through naturally and artificially fractured subsurface formations; principles of flow in dual porosity materials, characterizing fractures and fractured aquifers, mechanics of fracture formation, methods of inducing fractures from wells; case studies and applications.

**GEOL 8500 Selected Topics in Environmental Geology 1-4** (1-3) Selected topics in environmental geology emphasizing the subsurface contamination. May be repeated for a maximum of six credits, but only if different topics are covered. Coreq: GEOL 8501.

**GEOL 8501 Selected Topics in Environmental Geology Laboratory 0 (1-3)** Non-credit laboratory to accompany GEOL 8500. Coreq: GEOL 8500.

**GEOL 8510 Geology Seminar 1 (1)** Students review current topics in geology and make oral presentations. To be taken Pass/No Pass only. May be taken twice for credit.

**GEOL 8750 Hydrogeology Summer Field Camp 6** (4) Groundwater geology field techniques including examination of surface exposures, analysis of cores and geophysical well logs, subsurface mapping, aquifer performance test and groundwater remediation. Coreq: GEOL 8751.

**GEOL 8751 Hydrogeology Summer Field Camp Laboratory 0** (6) Non-credit laboratory to accompany GEOL 8750. Coreq: GEOL 8750.

**GEOL 8910 Master’s Thesis Research 1-12** (1-12) Master’s Thesis Research

**GERMAN**

**GER 6980 Independent Study 3** (1-3) Supervised study of selected topics in German literature, language, or culture. May be repeated for a maximum of six credits. Preq: Consent of department chair.

**GRADUATE STUDIES**

**GS 7990 Comprehensive Studies 1-15** (1-15) Independent studies in preparation for comprehensive examinations; credit hours to be determined by the department or program chair. To be taken Pass/No Pass only.

**GS 8000 Research Proposal Development Seminar 1 (1)** Principles and techniques for the preparation of research proposals. Does not count toward a graduate degree. To be taken Pass/No Pass only. Preq: Second year or graduate standing in current major.

**HUMAN-CENTERED COMPUTING**

**HCC 8310 Fundamentals of Human-Centered Computing 3** (3) Fundamental concepts in human-centered computing, including human subjects, interface design, usability evaluation methods, software programming, information technology tools, ethics, policy, and current problems of interest to human-centered computing.

**HCC 8330 Research Methods for Human-Centered Computing 3** (3) Research methods supporting scholarly research and publication in human-centered computing. Topics include scientific methods, identification and creation of research problems, archive searches, design of experimental and nonexperimental research, interdisciplinary approaches, technical writing and ethics.

**HCC 8880 Directed Projects in Human-Centered Computing 1-6** (1-6) Directed individual project supervised by department faculty. May be repeated for a maximum of 18 credits. To be taken Pass/No Pass only.

**HCC 9910 Doctoral Dissertation Research 1-12** (1-12) May be repeated for a maximum of 99 credits. To be taken Pass/No Pass only.

**HEALTH CARE GENETICS**

**HCG 9010 Advances in Human Genetics 3** (3) Overview of the disciplines and content areas related to advances in human genetics/genomics. Topics include aspects of biochemical, molecular, population genetics and cytogenetics as they relate to genomic health care. Bioinformatics is addressed, incorporating the use of genetic databases for research and clinical settings. Preq: Consent of instructor.

**HCG 9030 Interdisciplinary Research 1** (1) Examination of interdisciplinary research in the life sciences as a means of integrating information, data, techniques, tools, perspectives, concepts and/or theories from two or more disciplines or bodies of specialized knowledge to advance knowledge development or solve problems. Preq: Consent of instructor.

**HCG 9050 Genomics, Ethics and Health Policy 3** (3) Designed for health-care professionals. Analyzes relationships among political climate, policy design and government action as related to ethical, legal and social issues surrounding availability of genetic information. Examines an ethical perspective and outcomes on health policies relating to genomic issues as well as contemplated actions based on new medical techniques. Preq: Consent of instructor.

**HCG 9070 Applied Health Genetics 3** (3) The principles of genetics are being utilized to individualize healthcare with new resources available to professionals for research and education. This course focuses on applying principles and issues in the areas of translation research, intervention and policy to establish a working knowledge of healthcare genetics. Preq: Doctoral standing or consent of instructor.
HEHD 6000 Introduction to Leadership Theories and Concepts Laboratory (1) Non-credit laboratory to accompany HEHD 6000. Coreq: HEHD 6000.

HEHD 6100 Leadership Behavior and Civic Engagement (3) Students couple concepts of social justice and civic engagement with theoretical foundations from HEHD 4000 to complete a comprehensive theory-to-practice project. Introduces students to a comprehensive leadership skill set to become active change agents for the common good. Coreq: HEHD 4000.

HEHD 6101 Leadership Behavior and Civic Engagement Laboratory (1) Non-credit laboratory to accompany HEHD 6100. Coreq: HEHD 6100.

HEHD 6200 Leadership Application and Experience (3) Immerse students in a practical leadership experience utilizing knowledge and skills gained in HEHD 4000 and 4100. Students identify an issue or problem and practice leadership by developing and implementing a community project. Challenges students to commit themselves to longterm engagement as agents of change. Coreq: HEHD 4100.

HEHD 6201 Leadership Application and Experience Laboratory (3) Non-credit laboratory to accompany HEHD 6200. Coreq: HEHD 6200.

HEHD 8000 Theories of Youth Development: An Applied Perspective (3) Examines theories of positive youth development with an emphasis on how to apply them to "real world" issues facing young people. Students explore existing models, read theoretical and applied literature and examine current social changes that impact positive youth development.

HEHD 8010 Child and Adolescent Development (3) Focuses on child and adolescent development emphasizing a strength-based approach. Students develop an understanding of early childhood and adolescent growth and development from a social, cultural and psychological perspective.

HEHD 8020 Youth Development Programming in a Contemporary Society (3) Focuses on programs and administrative policies and procedures that govern youth development programs at the local, state and national levels. Models programs emphasizing "best practices" are studied. A cross-sectional approach is used to examine assets and protective factors in the contexts of family, school and community.

HEHD 8030 Creative and Ethical Leadership in a Changing Society (3) Focuses on the development of leadership skills and group dynamics in program development and supervision of staff and volunteers. Students engage in listening, empowerment and process skills utilizing the latest approaches in the field of communications. Professional ethics related to human service professionals are integrated.

HEHD 8040 Assessment and Evaluation of Youth Programs (3) Focuses on developing knowledge of rationale, procedures and tools for conducting intake, needs and environmental assessments of youth, families and communities. Effective skills for mastering comprehensive program evaluation strategies are taught. Students explore statistical packages specifically appropriate for evaluation of youth programs.

HEHD 8050 Youth Development in the Context of Family (3) Focuses on youth development in the context of family development and interpersonal relationships. Students gain knowledge and skills in development issues and family functioning. Students become aware of and respect diverse family structures, parental involvement and the influence of culture and ethnicity on family dynamics.

HEHD 8060 Youth Development in the Context of a Global and Diverse Society (3) Focuses on specific circumstances and issues related to youth in at-risk environments. Students learn methods, strategies and techniques to address diversity issues (e.g. racial, ethnic, gender, disability, sexual preference). Issues of poverty, mass culture, physical environment, etc. are examined globally.

HEHD 8070 Internship in Youth Development (3) Practical experience in youth-serving agencies/or organizations. Students are required to complete a minimum of 1500 hours of experiential education in a supervised setting. Upon approval, exceptions are given to students with experience working in youth-related fields. To be taken Pass/No Pass only. Coreq: Consent of program coordinator.

HEHD 8080 Management of Staff and Volunteers (3) Examines approaches and strategies for successful management and development of staff and volunteers in youth-serving organizations, including effective organizational systems and working with boards and advisory committees. Covers business and organizational principles and practices for success as well as challenges of recruiting, supervising and retaining staff and volunteers. Coreq: Admission to MS in Youth Development Leadership Program or consent of instructor.

HEHD 8880 Special Topics in Youth Development Leadership (3) Provides opportunities to students in youth development to explore topical areas of the discipline not currently covered in required courses, but which are receiving greater attention in the field. Examples may include youth and technology, volunteerism, sports, school-community partnerships, education and employment.

HEHD 8900 The Profession of Youth Development Leadership (3) Students create and submit a digital portfolio as evidence of academic and experiential mastery of the ten core competencies of youth development leadership. Competencies include growth and development, youth programs, observation and assessment, family, school, and community relationships, safety and wellness, and youth engagement.

HEHD 8910 Master's Project I (3) Students are assisted in the preparation and completion of a graduate-level evaluative research project. Students share research project ideas with classmates and work to complete specific assignments, such as hypothesis development, literature review and research methodology proposed to prepare for data collection, analysis and final project presentation. Coreq: STAT 8010 and HEHD 8000 and HEHD 8040.

HEHD 8920 Master's Project II (3) Students conduct evaluative research projects to include writing an article for submission to a professional journal. Students present articles to instructor for review. To be taken Pass/No Pass only. Coreq: Consent of program coordinator.

HIST 6000 Studies in United States History (3) Topics and problems in the history of the United States from the Colonial era to the present. May be repeated once for credit with departmental consent.

HIST 6150 Introductory to Digital History (3) Introduces students to the philosophy and practice of the emerging field of History and New Media with a particular focus on how public historians can use technology to enhance their archival/museum/center's visibility with the general public. Coreq: Any 3000-level history course.
HIST 6170 History and Tourism 3 (3) Introduces students to important scholarship in the heritage tourism field. Examines the origins and objectives of heritage tourism, and case studies of how professionals employ heritage tourism. Preq: Any 3000-level history course.

HIST 6180 Oral History and Local History 3 (3) Introduces students to the most recent work in oral history and methodology with a focus on the history of the Upstate and Appalachia from the colonial era to the present. Students engage in their own local oral history project and produce a research paper based on their findings. Preq: Any 3000-level history course.

HIST 6200 History and Film 3 (2) Analyzes the role of the cinema in the construction and dissemination of history. May be repeated once for credit with departmental consent. Coreq: HIST 6201.

HIST 6201 History and Film Laboratory 0 (3) Non-credit laboratory to accompany HIST 6200. Coreq: HIST 6200.

HIST 6240 Topics in History of Medicine and Health 3 (3) Selected topics in the development of medicine and health care including public attitudes towards health and medicine.

HIST 6360 The Vietnam Wars 3 (3) Wars in Vietnam are seen in two phases. The First Indochina War, 1946-54, is covered briefly. Main body of the course covers the Second Indochina War, which began as a guerrilla conflict in 1959-60 and ended as a mostly conventional war in the Communist victory of 1975.

HIST 6380 Problems in African Historiography and Methodology 3 (3) Concentrates on major issues in the field of African history with an additional focus on methodological concerns. May be repeated once for credit with departmental consent.

HIST 6400 Studies in Latin American History 3 (3) Consideration of selected and varied topics in Latin American history through readings, discussions, and individual or group projects. Special attention is given to the use of an inquiry or problem-solving method of historical analysis and to the cultivation of a comparative perspective. May be repeated once for credit with departmental consent.

HIST 6500 Studies in Ancient History 3 (3) Selected topics in ancient history ranging from pre-Biblical times to the fall of the Roman Empire. May be repeated once for credit with departmental consent.

HIST 6510 Alexander the Great 3 (3) Focuses on the career of Alexander the Great and deals with the history and archaeology of ancient Macedonia.

HIST 6520 History of Early Christianity 3 (3) Study of the history, social and doctrinal, of early Christianity up to 600 A.D. May also be offered as REL 6520.

HIST 6600 Studies in British History 3 (3) Examination of selected themes, topics, or periods in British history from Anglo-Saxon times to the present. May be repeated once for credit with departmental consent.

HIST 6700 Studies in Early European History 3 (3) Study of selected topics or themes in European history from the fall of the Roman Empire to the age of industrialization. May be repeated once for credit with departmental consent.

HIST 6710 Studies in Modern European History 3 (3) Study of selected topics or problems in European history from the end of the Old Regime to the present. May be repeated once for credit with departmental consent.

HIST 6720 Medieval Conquests and Crusades 3 (3) Focuses on medieval conquests with particular emphasis on the era of the crusades. Investigates the origins and historical significance of the crusades from both Christian and Muslim perspectives, and examines crusader societies at home and abroad. Explores other medieval colonization movements and religious justifications for warfare outside the Holy Land.

HIST 6870 World War II and the World 3 (3) World War II was a cataclysm of the twentieth century that touched every part of the globe and ushered in the atomic age. This course examines the war from its origins in the aftermath of World War I to the war crimes trials and the dawn of the Cold War.

HIST 6910 Studies in the History of Science and Technology 3 (3) Selected topics in the development of science and technology emphasizing their social, political, and economic effects. May be repeated once for credit with departmental consent.

HIST 6920 Studies in Diplomatic History 3 (3) Selected topics and problems in international conflict and conflict resolution among nations. Concentration is usually in 20th century history. May be repeated once for credit with departmental consent.

HIST 6930 Studies in Social History 3 (3) Studies in the ways people have earned their livings and lived their lives, individually and as communities, in the confines of different societies. May be repeated once for credit with departmental consent.

HIST 6940 Studies in Comparative History 3 (3) Selected topics in comparative history, contrasting and comparing similar historic developments in different nations, geographic areas, or civilizations. May be repeated once for credit with departmental consent.

HIST 6950 Studies in the History of Ideas 3 (3) Selected topics and themes in the development of ideas that have had an impact on the behavior of individuals and civilizations. May be repeated once for credit with departmental consent.

HIST 6960 Studies in Legal History 3 (3) Study of selected problems in the development of law and the system of criminal and civil justice. May be repeated once for credit with departmental consent.

HIST 7100 United States Since 1865 3 (3) Problems in U.S. history since 1865 with attention given to bibliography and teaching methods. Primarily for Master of Education candidates, but open to all graduate students. May be repeated with consent of graduate program director.

HIST 7750 Europe Since the 18th Century 3 (3) Problems in European history since 1700 with attention given to bibliography and teaching methods. Primarily for Master of Education candidates, but open to all graduate students. May be repeated with consent of graduate program director.

HIST 8000 Seminar in United States History 3 (3) Training in historical research and writing. May be repeated for credit with consent of graduate program director.

HIST 8100 Culture and Society 3 (3) Training in historical research and writing with a focus on the social and cultural underpinnings of U.S. history. May be repeated for credit as topics change with consent of graduate program director.

HIST 8200 American Historiography 3 (3) Graduate seminar designed to familiarize students with the major overarching themes, scholarly interpretations and issues of American history that historians have presented over the last century.

HIST 8300 Seminar in Asian History 3 (3) Training in historical research and writing with focus on Asian history. May be repeated for credit with consent of graduate program director.

HIST 8400 Seminar in Latin American History 3 (3) Training in historical research and writing with focus on Latin American history. May be repeated for credit with consent of graduate program director.

HIST 8600 Seminar in British History 3 (3) Training in historical research and writing with focus on British history. May be repeated for credit with consent of graduate program director.

HIST 8700 Seminar in European History 3 (3) Training in historical research and writing with focus on European history. May be repeated for credit with consent of graduate program director.

HIST 8720 Issues and Methods in European and Non-Western History 3 (3) Seminar discussion of contemporary approaches to European and non-Western history: exploration of theoretical and empirical debates.

HIST 8800 Special Topics in History 3 (3) Training in historical research and writing. May be repeated for credit with consent of graduate program director.

HIST 8810 Historiography 3 (3) Seminar discussion of contemporary approaches and methodologies used by historians; exploration of current debates over major issues confronting the discipline of history.

HIST 8850 Independent Study 3 (3) Critical study of a historical topic, selected according to needs of the student and with approval of graduate program director. May be repeated for credit with consent of graduate program director.

HIST 8870 Archival Management: An Introduction 3 (3) Introduction to basic concepts of archival theory and management.

HIST 8900 Research Workshop 3 (3) Workshop to help students develop research and writing skills as preparation for work on the master’s thesis. Workshop participants produce an original, professional-level research paper, as well as a thesis prospectus.

HIST 8910 Master’s Thesis Research 1-12 (1-12) Master’s Thesis Research

HIST 8930 Practicum in Archival Management 3 (9) Hands-on experience in the operations of an archival program, including acquisitions, arrangements, descriptions, conservation and reference service. Preq: HIST 8870 or consent of instructor.

HIST 8940 Practicum in Historical Editing 3 (3) Practicum for applying methodologies learned in introductory editing course to a specific body of original sources such as family correspondence, diaries, or journals in order to become a historical editor.
HEALTH

HLTH 6000 Selected Topics in Health 1-6 (3-18)
Topics in health selected to meet special and individualized interests of students. May be repeated for a maximum of nine credits, but only if different topics are covered. Prereq: Junior standing and consent of instructor.

HLTH 6100 Maternal and Child Health 3 (3)
Focuses on key issues concerning the health status and needs of mothers and children. Topics include primary health care, measurement and indicators of health status, health of minorities, role of families, and major programmatic interventions towards the health needs of these two groups.

HLTH 6150 Public Health Issues in Obesity and Eating Disorders 3 (3) In-depth review of prevalence, risk factors, consequences, and treatments of obesity and other eating disorders. Focuses on the public health importance of cultural norms, prevention, and early intervention related to obesity and eating disorders. Prereq: Junior standing in Health Science or consent of instructor.

HLTH 6200 Health Science Internship 1-9 (1-9)
Under supervision in an approved agency, students have an opportunity for on-the-job experiences. Students are placed in an agency and develop personal/professional goals and objectives appropriate to the setting, population, and health issues. Students create a comprehensive exit portfolio in a digital format. May be repeated for a maximum of six credits. Prereq: HLTH 4190 and a minimum grade-point average of 2.0 and Junior standing in Health Science and consent of instructor.

HLTH 6300 Health Promotion of the Aged 3 (3)
Focuses on analysis and evaluation of health issues and health problems of the aged. Emphasizes concepts of positive health behaviors. Health majors are given enrollment priority. Prereq: HLTH 2980.

HLTH 6500 Applied Health Strategies 3 (3) Students plan, implement, and evaluate strategies to promote health through individual behavior changes. Both healthful and unhealthful behaviors are included. Examples include smoking cessation, weight management, and stress management. Prereq: Health Science major.

HLTH 6980 Improving Population Health 3 (3)
Critical examination of current and emerging issues in improving public health practice and population health. Covers examples in empirical and applied research, revealing future trends in population health. Health Science majors and minors will be given enrollment priority. Prereq: HLTH 2400 and HLTH 2980 and HLTH 3800, or consent of instructor.

HLTH 8020 Health Economics 3 (3) Provides in-depth exposure to economic concepts and theory as applied to the health services sector. Topics include healthcare demand and supply analysis, consumer behavior, production and costs, perfect competition vs. healthcare competition, price discrimination and regulation. Students are expected to have completed an undergraduate course in principles of economics before enrolling in this course.

HLTH 8030 Theories and Determinants of Health 3 (3) An ecological perspective of biological, behavioral and social health determinants and how theory is used to explain relationships between determinants of health and to describe behavior change processes. Emphasizes theories of individual behavior, community and group models of behavior change, and the use of theory in practice, research and evaluation.

HLTH 8090 Epidemiological Research 3 (3) Basic concepts of epidemiology with emphasis on applied aspects rather than theoretical. Examples are drawn from clinical practice. Use of relevant PC-based computer packages is required. Prereq: MATH 4050 or STAT 8010, or consent of instructor.

HLTH 8100 Health Policy 3 (3) Provides experience in analysis of decisions in health-care management policy, problems, resources and alternative courses of action for health service organizations. Students participate in analysis of organization objectives and means for achieving health service goals. Prereq: HLTH 8070 or FIN 8070 or MBA 8070; and MBA 8030 and MBA 8060 and MBA 8080; and MBA 8090 or MGT 8090.

HLTH 8110 Health Care Delivery Systems 3 (3) Examines health delivery system and their functions with a focus on the United States. Economic theory is used to examine a number of critically important issues, including the organizational structure of health care payment systems, access, and quality of care in the United States.

HLTH 8210 Health Research I: Design and Measurement 3 (3) Addresses issues in research design, measurement, project planning, data collection and data management for health research. Topics include experimental and quasi-experimental design, measurement theory applied to key health concepts, survey methodology, observational research and research ethics.

HLTH 8220 Health Research II: Qualitative and Mixed Methods 3 (3) Qualitative research methods and mixed methods in health research, including identification and creation of research problems, the development of designs, actual data collection in healthcare settings, and analysis procedures to address those problems. Includes qualitative-interpretive methods of accessing and analyzing healthcare data, including participant observation/ethnography, case studies and grounded theory. Course addresses the methodological grounding for these methods, some of the methods themselves (through field exercises), and research designs. Prereq: HLTH 8210.

HLTH 8290 Epidemiology II: Applied Epidemiology 3 (3) Instruction in basic and advanced epidemiological principles, concepts and methods in population health with an emphasis on the practical application of epidemiological methods in health and clinical settings using case studies and practice-related exercises in health research and evaluation. Prereq: HLTH 8190.

HLTH 8310 Quantitative Analysis in Health Research 3 (3) Course focuses on the application of statistical methods to health research questions using health survey data. Course material is built on knowledge gained from previous courses in research design methods and statistics. Students gain hands-on experience in investigating health research questions and analyzing complex health data sets. Prereq: MATH 2060 and MATH 4030, or consent of instructor.

HLTH 8320 Quantitative Analysis in Health Research II 3 (3) Covers common statistical and econometric methods used in population health research. Extended from the topics covered in Quantitative Analysis in Health Research I, students gain additional hands-on experience in applying advanced analytical techniques and tools to investigate health research questions using complex health data sets. Prereq: HLTH 8310.

HLTH 8410 Foundations of Evaluation in Health 3 (3) Foundational course on historical and theoretical aspects of evaluation as applied to population health, medicine and healthcare. Paradigms and philosophies associated with methods, use, values and social justice branches are emphasized. Other topics include evaluation terminology and standards, theory-driven evaluation, planning models, planning and evaluation cycle, engaging stakeholders, and presenting findings.

HLTH 8420 Applied Evaluation Methods in Health 3 (3) Continuation of HLTH 8410. Practical aspects of planning, designing and managing evaluations in population health, medicine and healthcare settings. Topics include scope, selecting an appropriate design, threats to validity, common and emerging methods of formative and summative evaluation, staffing and management, collecting and analyzing data, and writing evaluation reports. Prereq: HLTH 8410.

HLTH 8890 Seminar in Applied Health Research and Evaluation 1 (1) Students present, critically discuss and examine issues related to their research with other students, faculty and visitors in a formal setting, approximating professional meetings. Students develop communication skills, professional leadership skills and professional conduct expected of a graduate student in applied health research and evaluation. May be repeated for a maximum of six credits. Prereq: HLTH 8220.

HLTH 9910 Doctoral Dissertation Research in Applied Health Research and Evaluation 1-12 (1-12) Students identify dissertation research topic, develop a proposal, execute research and finalize their dissertation report. May be repeated for a maximum of credits.

HORTICULTURE

HORT 6040 Plant Propagation 3 (3) Practices of plant propagation from seeds, bulbs, divisions, layers, cuttings, grafting, and plant tissue culture are introduced. Physiological principles of pollination and seed biology, plant growth, regulators, source sink relations, life cycles and developmental phase transitions explain the practices. Environmental and economic contexts frame the preferred practices.
Hort 6050 Plant Propagation Techniques Laboratory 1 (3) Techniques of plant propagation are covered. Sexual methods covered include germination, scarification, and stratification. Asexual methods covered include grafting, budding, cuttings, layering, tissue culture divisions, and separations. Local nurseries are visited. Prereq or concurrent enrollment: HORT 6040.

Hort 6120 Advanced Turfgrass Management 3 (2) Advanced principles and practices associated with turfgrass management for golf courses, sports fields, sod production, and commercial lawn care. Topics include turfgrass physiology, plant growth and development, construction, turfgrass nutrition, irrigation, drainage, pesticide use and fate, and development of effective management systems. Prereq: CSEN 2020 or HORT 2120. Coreq: HORT 6121.

Hort 6121 Advanced Turfgrass Management Laboratory 0 (3) Non-credit laboratory to accompany HORT 6120. Coreq: HORT 6120.

Hort 6200 Applied Turfgrass Physiology 3 (3) Advanced course in turfgrass science and management. Provides the current status and development of turfgrass stress physiology and research. Main topics include temperature, drought, traffic, edaphic stresses, new developments in the turf industry, and environmental stewardship. Prereq: HORT 2120 and HORT 2130.

Hort 6270 Urban Tree Care 3 (3) Principles, practices, and problems of protecting and maintaining trees in urban and recreational areas. Examines environmental and biological factors affecting trees in high-use areas, their management and cultural requirements, and the practices necessary for their protection and care as valuable assets in the landscape. May also be offered as FOR 6270. Prereq: Consent of instructor.

Hort 6330 Landscape and Turf Weed Management 3 (2) Weed management strategies that include cultural, biological, and chemical methods are studied for landscape and turfgrass areas. Problem-solving skills and herbicide characteristics are emphasized. Coreq: HORT 6331. May also be offered as PES 6330.

Hort 6331 Landscape and Turf Weed Management Laboratory 0 (2) Non-credit laboratory to accompany HORT 6330. Coreq: HORT 6330. May also be offered as PES 6331.

Hort 6550 Just Fruits 3 (3) Students explore the origins, biology, culture, and production of major temperate zone fruit-apples, berries, and cherries to pawpaws, peaches, and pomegranates, the familiar to the forbidden. They discover principles, practices, and technologies employed to grow, protect, and harvest the fruits that feed us from commercial orchards, organic farms, and backyards. Prereq: HORT 1010.

Hort 6560 Organic Vegetable Production Laboratory 0 (6) Non-credit laboratory to accompany HORT 6560. Coreq: HORT 6560.

Hort 6610 Advanced Landscape Garden Design 4 (3) Garden design for urban or other highly visible locations. A specific specialty garden with environmental education potential will be designed. Planned plans include detailed planting, installation and maintenance, and communication. Emphasis is on establishing healthy plant communities, habitat linkages, and healthy water and soil. Prereq: HORT 3080 and HORT 3090. Coreq: HORT 6611.

Hort 6611 Advanced Landscape Garden Design Laboratory 0 (3) Non-credit laboratory to accompany HORT 6610. Coreq: HORT 6610.

Hort 6650 Plant Molecular Biology 3 (3) Study of fundamental plant processes at both the cellular and molecular levels. Topics include genome structure and organization (both nuclear and organelar); regulation of gene expression and its role in cellular and whole-plant processes; transposable genetic elements; applications for biotechnology. Prereq: Junior standing; and GEN 3020; and either BIOL 3040 or BIOL 3050.

Hort 6710 Advanced Internship 1-6 (1-6) Prereq: planned work experience under competent supervision in approved agency dealing with horticultural endeavors. Gives advanced students on-the-job learning opportunities to apply acquired knowledge and skills. Monthly reports and final departmental seminar required. Undergraduates may accumulate a maximum of six credits for participation in HORT 2710 and/or 4710. Prereq: Junior standing.

Hort 6720 Landscapes + Health 3 (3) Explores the role of landscapes in human health and wellness. Historical healing places and contemporary urban environments are examined for evidence of psychological and physiological impacts. Readings include interdisciplinary research. Prereq: Senior standing.

Hort 8020 Historic Preservation Research Seminar 3 (3) Advanced research in preparation for thesis project with particular attention to the role of proposals and methodology in independent research. Prereq: HP 8080 or HSPV 808; and enrollment in MS in Historic Preservation program.

Hort 8030 Building Technology and Pathology 3 (3) An advanced lecture course that focuses on the physical properties of modern building materials, mechanisms of failure, and alternatives for conservation interventions. Prereq: HP 8070 or HSPV 807; and HP 8190 or HSPV 819; and enrollment in MS in Historic Preservation program.

Hort 8040 Management and Administration of Historic Preservation 3 (3) Principles of management of non-profit cultural resources organizations with particular stress on non-profit theory, fundraising and development, strategic planning, lobbying, human resources, and communications. Professional projects in this course are created from current preservation and planning issues. Prereq: HP 8080 or HSPV 808; and enrollment in MS in Historic Preservation program.

Hort 8050 Preservation Studio 6 (18) A studio course developing preservation projects. Course content stresses documentation, critical evaluation and application of design and preservation strategies to cases in Charleston and its environs. Main street designs, cultural landscape interventions, design theory and skills, and measured drawings are implemented and addressed. Prereq: HP 8190 or HSPV 819; and enrollment in MS in Historic Preservation program.

Hort 8070 American Architecture 3 (3) A survey of American buildings from the sixteenth century to the modern era with particular attention to the social, intellectual, technological, and economic forces that shaped America’s cityscapes, small towns and countryside. Prereq: Enrollment in MS in Historic Preservation program.

Hort 8080 History and Theory of Historic Preservation 3 (3) Survey history of preservation that explores a variety of theoretical issues that impact the discipline. Provides a basis for critical evaluation of historic preservation. Discusses architectural and planning theories that drive preservation policy and application. Prereq: Enrollment in MS in Historic Preservation program.

Hort 8090 Historical Research Methods 3 (3) Advanced instruction in historical research methods in private archival manuscript sources and public records with application to recovery and writing the history of buildings and landscapes. Students acquire research, writing and presentation skills. Prereq: Enrollment in MS in Historic Preservation program.
HP 8100 Conservation Science Laboratory 6 (18)
Conservation of historic materials on site and in the lab. Detailed analysis of architectural building materials using hands-on experiences, lectures, readings and laboratory exercises necessary to understand the performance and physical properties of historic building materials and abilities to identify mechanisms of deterioration and formulate appropriate conservation interventions. Prereq: HP 8190 or HSPV 819; and enrollment in MS in Historic Preservation program.

HP 8110 Advanced Conservation Science Laboratory 3 (Advanced practice in conservation through a specific site or conservation issue. Prereq: HP 8100 or HSPV 810; and enrollment in MS in Historic Preservation program.

HP 8190 Investigation, Documentation and Conservation 6 (6) The integration of multiple preservation skills by creating a professionally presented documentation and analysis project. It prepares students to read and record the material fabric of historic buildings and landscapes, and provides a platform for field experience in architectural descriptions, photography, measured drawings and landscapes. Prereq: Enrollment in MS in Historic Preservation program.

HP 8210 Historic Preservation and Public Memory 3 (A seminar that explores the creation of American public memory through commemorations, festivals, museum exhibits, historic sites, monuments, and other historic preservation activities. Prereq: HP 8080 or HSPV 808; and enrollment in MS in Historic Preservation program.

HP 8220 Vernacular Places and Spaces 3 (An intensive survey of the study of commonplace buildings and landscapes in North America. Prereq: HP 8070 or HSPV 807; and enrollment in MS in Historic Preservation program.

HP 8230 Historic American Interiors 3 (Survey of the American domestic interior from the seventeenth to the twentieth century with emphasis on the social, cultural, economic, and technological currents that influenced the furnishing of American dwelling places. In addition to investigating period forms and materials, it explores the interpretation of primary sources and historical finishes. Prereq: HP 8080 or HSPV 808; and enrollment in MS in Historic Preservation program.

HP 8250 Sustainability and Historic Preservation 3 (A seminar course analyzing the sustainability movement as intricately tied to historic preservation. History is examined through the evolution of policy and building science. Coursework investigates foundational theories from the sustainability field and emphasizes the multi-faceted movement’s existing and potential for interface with the discipline of preservation. Prereq: HP 8080 or HSPV 808; and enrollment in MS in Historic Preservation program.

HP 8260 Historic Structures Report 3 (This project-based course takes students through the process of generating a historic structures report. The course builds on student skill sets introduced in earlier coursework. Students undertake research, documentation and architectural investigation to comprehensively document and analyze a case-study building in Charleston or its environs. Prereq: HP 8190 or HSPV 819; and enrollment in MS in Historic Preservation program.

HP 8270 Adaptive Use 3 (This project-based course revolves around the production of an adaptive use planning scheme. Students develop creative, logical processes to propose a reuse scheme consistent with real-world constraints. Prereq: HP 8190 or HSPV 819; and enrollment in MS in Historic Preservation program.

HP 8280 Case Studies in Preservation Engineering 3 (Introduction to structural engineering, loads on structures, and structural elements in buildings. Examines behavior and deterioration of primary structural materials in historic structures. Students visit real-world examples of major engineering issues in existing structures to determine how conclusions are reached and how recommendations are made concerning structure. Prereq: HP 8190 or HSPV 819; and enrollment in MS in Historic Preservation program.

HP 8330 Cultural and Historic Landscape Preservation 3 (Overview of cultural historic landscape preservation principles and practices. Includes inventory and analysis of historic resources from a cultural landscape perspective. Qualities of integrity are studied in correspondence to location, design, setting, materials, workmanship, and feeling and association. Prereq: HP 8190 or HSPV 819; and enrollment in MS in Historic Preservation program.

HP 8450 Historic Preservation Internship 3 (Internship typically completed during the summer, through which students explore a historic preservation project in a professional work environment. Prereq. Enrollment in MS in Historic Preservation program.

HP 8910 Thesis in Historic Preservation 1-9 (1-9) Completion of thesis proposed in the third semester under the guidance of a thesis director and committee. To be taken Pass/No Pass only. May be repeated for a maximum of nine credits. Prereq: HP 8020 or HSPV 802; and enrollment in MS in Historic Preservation program.

HP 8920 Special Topics in Historic Preservation 3 (This seminar is dedicated to intensive exploration of timely topics in historic preservation. May be repeated for a maximum of six credits. Prereq: HP 8080 or HSPV 808; and enrollment in the MS in Historic Preservation program.

HP 8930 Independent Study in Historic Preservation 1-3 (1-3) Pursuit of an independent research project under the direction of graduate faculty. May be repeated for a maximum of six credits. Prereq: HP 8090 or HSPV 809; and HP 8190 or HSPV 819.

HUMAN RESOURCE DEVELOPMENT


HRD 8250 Organizational Performance Improvement 3 (3) Provides concepts and skills employed by managers and change agents to promote and sustain productive organizations. Students learn how to perform behavior analysis and management, how to determine criteria for performance appraisals and how to establish leadership in the workplace. Prereq: HRD 8200 and HRD 8300.

HRD 8300 Concepts of Human Resource Development 3 (3) Theory and practice of contemporary applications of human resource development (HRD) programs; training and development functions; strategies for designing and developing programs; and application of methods, techniques and resources in the context of changing needs, technologies, demographics and economic circumstances that create the need for different skills and knowledge in the work force. Prereq: Consent of instructor.

HRD 8450 Needs Assessment for Education and Industry 3 (3) Theory and practice of needs assessment activities in human resource development (HRD) programs; importance of the process to the identification of content/curricula topics and the overall training environment; specific methodologies used in the needs assessment process; supportive components of various program planning systems. Prereq: HRD 8300 or consent of instructor.

HRD 8470 Instructional Systems Design 3 (3) Theory and practice of instructional systems development activities in human resource development (HRD) programs; identification, selection and organization of subject matter appropriate for competency-based training (CBT) programs; occupational analysis techniques; rationale statements, goals and objectives; related instructional materials; participant evaluation; and instructional scheduling. Prereq: HRD 8450 or consent of instructor.

HRD 8490 Evaluation of Training and Development/HRD Programs 3 (3) Theory and practice of evaluation processes related to training and development in human resource development programs; developing a results-oriented approach based on specific criteria or standards; designing instruments; determining program costs; and collecting, analyzing and interpreting data to ascertain return on investment. Prereq: AGED 8890 or ED 8890; and HRD 8470 and HRD 8600; or consent of instructor.

HRD 8600 Instructional Materials Development 3 (3) Development and application of instructional materials and laboratory activities for training programs in education and industry; reinforcement of instructional training concepts and materials development procedures that are applied across human resource development (HRD) programs. Prereq: HRD 8450.

HRD 8700 Consulting for Education and Industry 3 (3) Theory and practice of external and internal consulting practices in human resource development programs; dynamics of a professional helping relationship; methods and techniques for initiating and terminating consulting relationships; diagnosing client situations; identification, selection and implementation of alternative problem solutions; evaluation of professional consulting relationships. Prereq: HRD 8300 or consent of instructor.
Courses of Instruction

HRD 8800 Research Concepts and Skills 3 (3) Introductory course in research to familiarize human performance improvement professionals with the nature of research and reporting processes and to help develop the necessary criteria to become critical, analytical consumers of published research. Preq: HRD 8200 and HRD 8300.

HRD 8820 Knowledge Management for Improved Performance 3 (3) Introduction to knowledge management to familiarize students with organizational competencies required to adapt and prosper in a chaotic, global environment. Focuses on contemporary theory, research, and application of knowledge management as a strategy for improving personal and organizational performance. Preq: HRD 8800.

HRD 8900 Instrumentation for Human Performance Improvement 3 (3) Introduction to commercially available instruments used to assess and evaluate human performance in the workplace. Students develop critical judgment skills to determine the adequacy and use of instruments in modern organizations. Preq: HRD 8800.

HRD 8970 Applied Research and Development 3 (3) Study of a specific topic under the direction of a faculty member. Students identify a special problem related to the human resource development profession based on their personal interests, experiences, needs and goals. Preq: Submission of a written proposal and prior approval of advisor and satisfactory completion of 12 hours of graduate HRD courses; and AGED 8890 or ED 8890.

HISTORIC PRESERVATION
(College of Charleston)

HSPV 620 Preservation Law and Economics (CofC) 3 (3) Advanced discussion of the legal framework of historic preservation with particular attention to cultural resources statutes and local laws, as well as policy mechanisms and review of pertinent economic policies. Preq: HP 8080 or HSPV 808; and enrollment in MS in Historic Preservation program; or consent of instructor.

HSPV 802 Historic Preservation Research Seminar (CofC) 3 (3) Advanced research in preparation for thesis project with particular attention to the role of proposals and methodology in independent research. Preq: HP 8090 or HSPV 809; and enrollment in MS in Historic Preservation program.

HSPV 803 Building Technology and Pathology (CofC) 3 (3) An advanced lecture course that focuses on the physical properties of modern building materials, mechanisms of failure, and alternatives for conservation interventions. Preq: HP 8070 or HSPV 807; and HP 8190 or HSPV 819; and enrollment in MS in Historic Preservation program.

HSPV 804 Management and Administration of Historic Preservation (CofC) 3 (3) Principles of management of non-profit cultural resources organizations with particular stress on non-profit theory, fundraising and development, strategic planning, lobbying, human resources, and communications. Professional projects in this course are created from current preservation and planning issues. Preq: HP 8080 or HSPV 808; and enrollment in MS in Historic Preservation program.

HSPV 805 Preservation Studio (CofC) 6 (18) A studio course developing preservation projects. Course content stresses documentation, critical evaluation and application of design and preservation strategies to cases in Charleston and its environs. Main street designs, cultural landscape interventions, design theory and skills, and measured drawings are implemented and addressed. Preq: HP 8190 or HSPV 819; and enrollment in MS in Historic Preservation program.

HSPV 807 American Architecture (CofC) 3 (3) A survey of American buildings from the sixteenth century to the modern era with particular attention to the social, intellectual, technological, and economic forces that shaped America’s cityscapes, small towns and countryside. Preq: Enrollment in MS in Historic Preservation program.

HSPV 808 History and Theory of Historic Preservation (CoC) 3 (3) Survey history of preservation that explores a variety of theoretical issues that impact the discipline. Provides a basis for critical evaluation of historic preservation. Discusses architectural and planning theories that drive preservation policy and application. Preq: Enrollment in the MS in Historic Preservation program.

HSPV 809 Historical Research Methods (CofC) 3 (3) Advanced instruction in historical research methods in private archival manuscript sources and public records with application to recovering and writing the history of buildings and landscapes. Students acquire research, writing and presentation skills. Preq: Enrollment in the MS in Historic Preservation program.

HSPV 810 Conservation Science Laboratory (CofC) 6 (18) Conservation of historic materials on site and in the lab. Detailed analysis of architectural building materials using hands-on experiences, lectures, readings and laboratory exercises necessary to understand the performance and physical properties of historic building materials and abilities to identify mechanisms of deterioration and formulate appropriate conservation interventions. Preq: HP 8190 or HSPV 819; and enrollment in MS in Historic Preservation program.

HSPV 811 Advanced Conservation Science Laboratory (CofC) 3 (3) Advanced practicum in conservation through a specific site or conservation issue. Preq: HP 8100 or HSPV 810; and enrollment in MS in Historic Preservation program.

HSPV 819 Investigation, Documentation and Conservation (CofC) 6 (6) The integration of multiple preservation skills by creating a professionally presented documentation and analysis project. It prepares students to read and record the material fabric of historic buildings and landscapes, and provides a platform for field experience in architectural descriptions, photography, measured drawings and landscapes. Preq: Enrollment in MS in Historic Preservation program.

HSPV 821 Historic Preservation and Public Memory (CofC) 3 (3) A seminar that explores the creation of American public memory through commemorations, festivals, museum exhibits, historic sites, monuments, and other historic preservation activities. Preq: HP 8080 or HSPV 808; and enrollment in MS in Historic Preservation program.

HSPV 822 Vernacular Places and Spaces (CofC) 3 (3) An intensive survey of the study of commonplace buildings and landscapes in North America. Preq: HP 8070 or HSPV 807; and enrollment in MS in Historic Preservation program.

HSPV 823 Historic American Interiors (CofC) 3 (3) Survey of the American domestic interior from the seventeenth to the twentieth century with emphasis on the social, cultural, economic, and technological currents that influenced the furnishing of American dwellings. In addition to investigating period forms and materials, it explores the interpretation or primary sources and historical finishes. Preq: HP 8080 or HSPV 808; and enrollment in MS in Historic Preservation program.

HSPV 825 Sustainability and Historic Preservation (CofC) 3 (3) A seminar course analyzing the sustainability movement as intricately tied to historic preservation. History is examined through the evolution of policy and building science. Coursework investigates foundational theories from the sustainability field and emphasizes the multi-faceted movement’s existing and potential for interface with the discipline of preservation. Preq: HP 8080 or HSPV 808; and enrollment in MS in Historic Preservation program.

HSPV 826 Historic Structures Report (CofC) 3 (3) This project-based course takes students through the process of generating a historic structures report. The course builds on student skill sets introduced in earlier coursework. Students undertake research, documentation and architectural investigation to comprehensively document and analyze a case-study building in Charleston or its environs. Preq: HP 8190 or HSPV 819; and enrollment in MS in Historic Preservation program.

HSPV 828 Case Studies in Preservation Engineering (CofC) 3 (3) Introduction to structural engineering, loads on structures, and structural elements in buildings. Examines behavior and deterioration of primary structural materials in historic structures. Students visit real-world examples of major engineering issues in existing structures to determine how conclusions are reached and how recommendations are made concerning structure. Preq: HP 8190 or HSPV 819; and enrollment in MS Historic Preservation program.

HSPV 833 Cultural and Historic Landscape Preservation (CofC) 3 (3) Overview of cultural landscape preservation principles and practices. Includes inventory and analysis of historic resources from a cultural landscape perspective. Qualities of integrity are studied in correspondence to location, design, setting, materials, workmanship, and feeling and association. Preq: HP 8190 or HSPV 819; and enrollment in MS in Historic Preservation program.
HSPV 845 Historic Preservation Internship (CoC) 3 (3) Internship typically completed during the summer, through which students explore a historic preservation project in a professional work environment. Preq: Enrollment in MS in Historic Preservation program.

HSPV 891 Thesis in Historic Preservation (CoC) 1-9 (1-9) Completion of thesis proposed in the third semester under the guidance of a thesis director and committee. To be taken Pass/No Pass only. May be repeated for a maximum of nine credits. Preq: HP 8020 or HSPV 802; and enrollment in MS in Historic Preservation program.

HSPV 892 Special Topics in Historic Preservation (CoC) 3 (3) This seminar is dedicated to intensive exploration of timely topics in historic preservation. May be repeated for a maximum of six credits. Preq: HP 8080 or HSPV 808; and enrollment in the MS in Historic Preservation program.

HSPV 893 Independent Study in Historic Preservation (CoC) 1-3 (1-3) Pursuit of an independent research project under the direction of graduate faculty. May be repeated for a maximum of six credits. Preq: HP 8090 or HSPV 809; and HP 8190 or HSPV 819.

HUMANITIES

HUM 6560 Literature and Arts of the Holocaust (CoC) 3 (3) Addresses the Holocaust through literature, art, architecture, music, and film. Beginning with historical, political, and economic forces that contributed to the Holocaust, course then focuses on highly diverse creative responses to this event - responses that often reflect the difficulties and politics of these commemorative gestures. May also be offered as ENGL 6560. Preq: ENGL 3100 or consent of instructor.

INDUSTRIAL ENGINEERING

IE 6000 Honors Thesis I-6 (1-6) Individual or joint research project performed with a faculty mentor or committee of faculty. May be repeated for a maximum of six credits. Preq: IE 2680 and consent of mentor.

IE 6300 Human Factors Engineering in Healthcare 3 (3) Focuses on how industrial engineers help improve the quality and safety of patient care. Students learn how healthcare is different from traditional industrial engineering sectors. A substantial part of the course is focused on learning how to apply industrial engineering tools, specifically those grounded in human factors, to healthcare problems. Preq: IE 6880 or IE 8000 or PSYC 8350.

IE 6400 Decision Support Systems in Industrial Engineering 3 (2) Study of decision support systems for production and service systems based on operations research models. Includes use of spreadsheets, databases, and integrated software development environments to implement decision support systems. Coreq: IE 6401.

IE 6401 Decision Support Systems in Industrial Engineering Laboratory 0 (3) Non-credit laboratory to accompany IE 6400. Coreq: IE 6400.

IE 6520 Reliability Engineering 3 (3) Probabilistic approach to assessing system reliability. Methods for analyzing serial, parallel, and complex systems. Reliability life testing and its acceleration are covered. Essential elements of maintainability are identified and related to system availability. Preq: IE 8090; or (MATH 6000 or MATH 8000) and (MATH 6050 or MATH 8050).

IE 6560 Supply Chain Design and Control 3 (3) Industrial engineering aspects of supply chains, including design and control of material and information systems. Preq: IE 8040 or consent of instructor.

IE 6570 Transportation and Logistics Engineering 3 (3) Introduces transportation and logistic systems analysis from both analytical and practical perspectives. Covers methods for identifying level-of-service metrics and measuring system performance. Discusses key aspects of modeling, simulation, and other techniques for economic and quantitative analysis of transportation and logistics planning issues.

IE 6600 Quality Improvement Methods 3 (3) Study of modern quality improvement techniques presented in an integrated, comprehensive context.

IE 6610 Quality Engineering 3 (3) Design aspects of quality and the engineer's role in problems of quality in production systems. Preq: IE 3610.

IE 6620 Six Sigma Quality 3 (3) Study of DMAIC (Define, Measure, Analyze, Improve, and Control) elements of Six Sigma, project management, process analysis, quality function deployment, hypothesis testing, gage R&R, data analysis, multivari-analysis, design of experiments, statistical process control, and process capability analysis. Preq: STAT 8010 or IE 8090 or MATH 6030 or MATH 8040 or MATH 8050.

IE 6630 Quality in the Capital Projects Industry 3 (3) Covers topics in quality and lean principles relevant to the capital projects industry. Provides a broad overview on quality concepts and philosophies, quality management and inspection tools applicable to capital projects, Six Sigma Approach, lean concepts and value stream mapping.

IE 6650 Facilities Planning and Design 3 (3) Study of the principles and techniques of facility planning and design. Discusses economic selection of materials handling equipment and integration of this equipment into the layout plan to provide effective product flow in production, distribution, and service contexts. Includes quantitative techniques for evaluation of facility design. Preq: IE 8000 and IE 8030 and IE 8090.

IE 6680 Systems Modeling 4 (4) The purpose, theory, and techniques of modeling systems with dynamic events. Students learn a powerful analytical process to use in the analysis and improvement of systems in several industries, including transportation, logistics, manufacturing and service systems. Incorporates professional simulation software as a tool in evaluating the system performance. Preq: IE 8030 or (MATH 6400 and MATH 6420) or (MATH 8030 and MATH 8100); and (IE 8090 or MATH 6030 and MATH 8040). Coreq: IE 6821.

IE 6685 Survey of Optimization Methods and Applications 3 (3) Survey of deterministic and stochastic optimization methods, theory and algorithms. Modeling, analysis and applications of optimization to modern industrial engineering problems. Preq: IE 8030; or MATH 8030 and MATH 8100; or MATH 6400 and MATH 6410.

IE 6670 Industrial Safety 3 (3) Recognition and prevention of hazards; recognition and control of hazardous materials; developing and managing a safety program; designing inherently safe equipment and workplaces.

IE 6680 Human Factors Engineering 3 (3) Introduction to human performance and limitations in the design of effective and efficient systems. Covers issues related to changes in technology, impact of design on society, ethical issues in design of systems, and the cost benefits from designing systems and environments that often challenge perceived notions of benefits.

IE 6690 Industrial Ergonomics and Automation 3 (2) Physical ergonomics and ergonomics in industrial settings, including work physiology, the physical environment, automated systems, and hybrid work systems. Preq: IE 8000. Coreq: 6891.

IE 6691 Industrial Ergonomics and Automation Laboratory 0 (3) Non-credit laboratory to accompany IE 6690. Coreq: IE 6690.

IE 6910 Selected Topics in Industrial Engineering 1-3 (1-3) Comprehensive study of any timely or special topic in industrial engineering not included in other courses. May be repeated for a maximum of six credits.

IE 8000 Human Factors Engineering 3 (3) Fundamentals of design for human use; human performance; applications of abilities and limitations to the design of tools, machines, facilities, tasks and environments for efficient, safe and comfortable human use.

IE 8010 Design and Analysis of Human-Machine Systems 3 (3) Methodologies used in the design and evaluation of human-machine systems including function and task analysis; questionnaires and interviews; scenarios, mock-ups and prototypes; participative design, empirical testing and iterative design; models of human-system interaction; analysis and classification of human error; and design of job performance and training aids. Preq: Admission to one of the following programs: MS or PhD in industrial engineering, MS in applied psychology, PhD in human factors psychology, MS or PhD in computer science or human centered computing, or MS or PhD in mechanical engineering.

IE 8020 Design of Human-Computer Systems 3 (3) Issues in designing, implementing, maintaining and refining the user interface of interactive computer systems including interface design theories, models, principles and guidelines; interaction styles; input and output devices; system messages; screen design, manuals, on-line help and tutorials; and iterative design, testing and evaluation. Preq: IE 8010 or consent of instructor.

IE 8030 Engineering Optimization and Applications 3 (3) Introduction to optimization through the study of problems related to the planning, design and control of production/manufacturing systems; classical nonlinear optimization and algorithmic procedures, primal and dual problems with postoptimality analysis, Markov chains.
Courses of Instruction

IE 8040 Manufacturing Systems Planning and Design 3 (3) Concepts and principles associated with the design of manufacturing systems with a focus on modeling and integration methodologies; group technology, process planning, manufacturing modeling and design for manufacturing. Prereq: Consent of instructor.

IE 8050 Foundations in Quality Engineering 3 (3) Fundamental tools of quality engineering and their application to real situations; advanced statistical process control, design of experiments, Taguchi techniques and Shainin methodologies. Prereq: Consent of instructor.

IE 8090 Model Systems Under Risk 3 (3) Application of probabilistic methods to engineering problem solving and decision making. Cases are presented illustrating use of Markov chains, queuing processes and other stochastic models in practice.

IE 8110 Human Factors in Quality Control 3 (3) Aspects of use of the human as a detector of product quality, serving as the basis for a taxonomy of human tasks in inspection; incorporates models of visual search and human decision making within the quality control framework. Prereq: Consent of instructor.

IE 8120 Work Science and Design 3 (3) Design methods for work and work systems; scientific and engineering basis of work and its analysis. Prereq: Consent of instructor.

IE 8150 Research Methods in Ergonomics 3 (3) Contexts and processes for research in ergonomics with emphasis on engineering problems; scientific and engineering methods; measurement; visual and physical tasks; simulation, laboratory and archival studies. Prereq: MATH 8840 or consent of instructor.

IE 8500 Introduction to Capital Projects Supply Chain 3 (3) Introduces the phases of capital projects; design and control of the capital projects supply chain; challenges associated with each of the primary supply chain entities (owners, contractors and suppliers).

IE 8510 Data Collection, Analysis and Interpretation 3 (3) Collection and presentation of data for decision making in industry focusing on design and control of industrial processes. Includes application of inferential statistics to data from industrial engineering situations. Prereq: IE 8500 or consent of instructor.

IE 8520 Modeling and Decision Making 3 (3) Students formulate and resolve models of industrial engineering systems focusing on decision making. Prereq: IE 8510 or consent of instructor.

IE 8530 Foundations of Quality 3 (3) Discusses quality control and quality assurance techniques including control charting and supplier surveillance. Special attention is devoted to nontraditional applications such as those used in nonmanufacturing supply chain. Prereq: IE 8510 or consent of instructor.

IE 8540 Fundamentals of Supply Chain and Logistics 3 (3) Students apply model building and analytical techniques to design, optimize and control the supply chain and other logistics systems. Prereq: IE 8510 or consent of instructor.

IE 8550 Capital Projects Supply Chain 3 (3) Application of quantitative and qualitative tools and techniques to the design, control, management and optimization of the capital projects supply chain. Prereq: MGT 8560 or consent of instructor.

IE 8570 Industrial Safety and Risk Management 3 (3) Discusses safety and risk management issues in industrial engineering systems including hazard information systems, process safety, export control and federal and international safety regulation requirements. Prereq: IE 8500 or consent of instructor.

IE 8580 Case Studies in Capital Projects Supply Chain 3 (3) Analysis of case studies in the capital projects supply chain. Prereq: IE 8520 or IE 8530 or IE 8540 or IE 8550 or IE 8570; or consent of instructor.

IE 8590 Capstone Design Project 3 (3) Capstone experience in the design, control, management and optimization of capital projects supply chains. Prereq: IE 8580 or consent of instructor.

IE 8600 Dynamic Programming 3 (3) Theory and methodology of dynamic programming; Bellman's principle of optimality; Mitten's sufficiency conditions; recursive optimization of serial and nonserial multistage systems; optimization of discrete and continuous systems through decomposition; special aspects of problem formulation. Prereq: IE 8030.

IE 8650 Facility Planning and Design 3 (3) Planning and design of industrial facilities emphasizing automated production facilities; quantitative approaches to equipment design and evaluation of performance. Prereq: IE 8030.

IE 8800 Advanced Methods of Operations Research 3 (3) Methods and applications of advanced operations research techniques; discrete optimization, integer and mixed integer programming, Boolean minimization, network optimization, permutation methods on implicit enumeration. Prereq: IE 8030 or consent of instructor.

IE 8810 Metaheuristics 3 (3) Survey of selected metaheuristic techniques. Topics may include genetic algorithms and other evolutionary algorithms, tabu search and simulated annealing. Students implement multiple metaheuristics from problems throughout the semester in a high-level language.

IE 8840 Advanced Engineering Economic Analysis 3 (3) Engineering economic analysis for engineering research, development and construction projects emphasizing detailed treatment of tax effects, methods for determining discount rates, proper use of economic criteria in various decision environments (certainty vs. uncertainty, single vs. multiple project selections, etc.). Prereq: Consent of instructor.

IE 8860 Operations Research in Production Control 3 (3) Latest techniques in scientific inventory management, scheduling and forecasting; operations research; statistics; computer methods; case studies. Prereq: IE 8030.

IE 8870 Modeling Logistics and Behavior Using Simulation 3 (3) Covers design and development of discrete event, system dynamics and agent-based models to explain behavior or improve performance. Environments addressed include process flow, social and behavioral systems. Advanced topics of study may include input and output analysis. Modeling concepts are motivated with real-world examples from representative fields. Prereq: IE 4820 or IE 6820 or consent of instructor.

IE 8880 Advanced Probabilistic Methods 3 (3) Advanced treatment of stochastic optimization, potentially including single and multiple channel queues, Markov programming and stochastic optimal control. Prereq: Consent of instructor.

IE 8900 Special Problems in Industrial Engineering 1-3 (1-3) Principles and methods of industrial engineering applied to analysis of a current interest problem. May be repeated for a maximum of six credits. To be taken Pass/No Pass only. Prereq: Consent of instructor.

IE 8910 Master's Thesis Research 1-12 (1-12) Master’s Thesis Research. Prereq: Consent of instructor.

IE 8920 Master's Design Project 3 (1) Design project in industrial systems; integration of industrial engineering principles and methodologies; resolution of contemporary systems design problems. Project requires research, development, implementation planning, reporting and project assessment. Prereq: Consent of instructor.

IE 8930 Selected Topics in Industrial Engineering 1-3 (1-3) Selected topics in industrial engineering emphasizing new developments in systems science, systems analysis and operations research. May be repeated for credit.


INTEGRATED PEST MANAGEMENT

IPM 6010 Principles of Integrated Pest Management 3 (3) Origins, theory, and practice of integrated pest management. Relationships among crop protection practices and protection practices are explored. Economics of various control strategies are considered. Integrated pest management field projects are studied. Conventional and integrated pest management approaches are compared. Multidisciplinary plant problem analysis is introduced. Prereq: CSEN 4070 or ENT 3010 or PLPA 3100.

IPM 8000 Special Problems in Plant Health 1-3 (1-3) Directed individual study of a special problem in plant health. Emphasis is on organizing, conducting and reporting on independent investigation. Prereq: Consent of instructor.

LANGUAGE

LANG 6000 Phonetics 3 (3) Study of basic phonetic concepts used in the study of sounds in language.

LANDSCAPE ARCHITECTURE

LARC 6050 Urban Genesis and Form 3 (3) Exploration of urban forms and developments within their historical context through off-campus, on-site lectures and exposure to historic cities and sites. Students visit historic and contemporary cities and analyze those places through readings and direct observations. Offered in the summer only. Prereq: LARC 2520 or consent of instructor.

LARC 6230 Environmental Issues in Landscape Architecture 3 (3) Overview of environmental and ecological issues and their relationship to landscape architecture practice and design. Prereq: LARC 4520 or consent of instructor.

LARC 6330 Historic Preservation in Landscape Architecture 3 (3) Study of historic landscape preservation in a number of contexts, including gardens, vernacular landscapes, parks, cemeteries, and battlefields. Prereq: LARC 4520 or consent of instructor.
LARC 6430 Community Issues in Landscape Architecture 3 (3) In-depth study of issues relevant to community design. Overview of physical design and related social issues. Preq: LARC 4520 or consent of instructor.

LARC 6530 Key Issues in Landscape Architecture 3 (3) Overview of research in landscape architecture and study of relevant research methods. Students write proposals for their own projects positioned within the larger context of research in the profession. Preq: Junior standing.

LARC 8010 Landscape Architecture Orientation I 6 (3) Focused study of design, design theory and design communication. Assigned readings, lectures and discussions link those topics to graduate-level explorations of design intervention in the cultural and natural landscape. Preq: Students in First Professional MLA program or consent of instructor. Coreq: LARC 8011.

LARC 8011 Landscape Architecture Orientation I Laboratory 0 (9) Non-credit laboratory to accompany LARC 8010. Coreq: LARC 8010.

LARC 8020 Landscape Architecture Orientation II 6 (3) Second-semester course of focused study in design, design theory and design communication. Assigned readings, lectures and discussions link those explorations to graduate-level study in nature, culture and design. Explorations begun in LARC 8010 are taken to greater depth and complexity. Preq: Students in First Professional MLA program or consent of instructor. Coreq: LARC 8021.

LARC 8021 Landscape Architecture Orientation II Laboratory 0 (9) Non-credit laboratory to accompany LARC 8020. Coreq: LARC 8020.

LARC 8130 Advanced Regional Design 6 (3) Advanced study and analysis of natural and cultural landscapes at the regional scale with an emphasis on South Carolina. Includes an exploration of landscape ecology as an informant to design and application geographic information systems. Each student also engages in independent research. Preq: Students in Second Professional MLA or MArch program or consent of instructor. Coreq: LARC 8131.

LARC 8131 Advanced Regional Design Laboratory 0 (9) Non-credit laboratory to accompany LARC 8130. Coreq: LARC 8130.

LARC 8210 Research Methods 3 (3) Foundations and procedures of landscape architectural research design and methods. Explores alternate research methodologies and the theory of knowledge regarding foundations, scope and validity. Preq: LARC 6530.

LARC 8230 Advanced Community Design Studio 6 (3) Studio focused on the study of communities. Students engage in a series of design explorations culminating in a mixed-use parcel on a large tract. Includes intensive study of growth and change in the contemporary landscape. New development in southeastern U.S. serves as a laboratory. Preq: LARC 6530 or consent of instructor. Coreq: LARC 8231.

LARC 8231 Advanced Community Design Studio Laboratory 0 (9) Non-credit laboratory to accompany LARC 8230. Coreq: LARC 8230.

LARC 8300 Graduate Seminar I 3 (3) Seminar including reading, writing and discussion on environmental and social/cultural issues in landscape architecture. Course is grounded in an exploration of the history of landscape architectural theory. Preq: LARC 8020 or consent of instructor.

LARC 8400 Graduate Seminar II 3 (3) Graduate seminar in one of the areas of departmental focus: growth and change, health and design, or restoration. Preq: LARC 8300 or consent of instructor.

LARC 8430 Interdisciplinary Design and Research 6 (3) Students participate in an interdisciplinary project linked to one of the focus areas in the department: health and design, restoration (environmental or cultural/historical), growth and change. Each student identifies a personal research project related to the larger team project. Preq: LARC 6530 or consent of instructor. Coreq: LARC 8431.

LARC 8431 Interdisciplinary Design and Research Laboratory 0 (9) Non-credit laboratory to accompany LARC 8430. Coreq: LARC 8430.

LARC 8500 Graduate Colloquium 3 (3) Series of lectures and presentations by graduating students, faculty members and guest designers and scholars. Students offer reviews and critiques of the various presentations. Preq: LARC 8400 or consent of instructor.

LARC 8520 Advanced Urban Design 6 (1) Advanced landscape architectural design in the urban context. Students study urban issues and offer design and sustainable management solutions for urban areas. Includes readings and theory component as well as an opportunity to collaborate with architecture students. Preq: Second Professional Degree Graduate status in Landscape Architecture. Coreq: LARC 8521.

LARC 8521 Advanced Urban Design Laboratory 0 (10) Non-credit laboratory to accompany LARC 8520. Coreq: LARC 8520.

LARC 8530 Advanced Interdisciplinary Design and Research 6 (3) Continuation of LARC 8430 with an advanced interdisciplinary project linked to one of the focus areas in the department: health and design, restoration (environmental or cultural/historical), and growth and change. Each student identifies a personal research project related to the larger team project. Preq: LARC 8430 or consent of instructor. Coreq: LARC 8531.

LARC 8531 Advanced Interdisciplinary Design and Research Laboratory 0 (9) Non-credit laboratory to accompany LARC 8530. Coreq: LARC 8530.

LARC 8900 Directed Studies 1-6 (1-6) Special topics and independent research in landscape architecture with faculty guidance. May be repeated for a maximum of six credits. Preq: Consent of advisor.

LARC 8910 Thesis Project 6 (16) Complex and sophisticated independent project in landscape architectural research and/or advanced design. Preq: LARC 8430 or consent of instructor.

LAW 6050 Construction Law 3 (3) Provides a practical knowledge of legal principles applied to the construction process and legal problems likely to be encountered by practicing construction professionals. Topics include construction contracting, liability, claims and warranties, documentation, and responsibility and authority of contracting parties. Preq: LAW 3220 or LAW 3330.

LAW 6200 International Business Law 3 (3) Intensive examination of the historical background of modern public and private international law; selected issues of public international law–human rights, law of war, United Nations’ system, and international litigation; selected issues of private international law–international sales, international trade, and formation and operation of multinational businesses. Preq: LAW 3220 or consent of instructor.

LAW 8480 Law for Real Estate Professionals 3 (3) Provides the real estate professional with the fundamentals of law as it applies in the real estate arena. Explores the various legal forms of ownership, the form and process of real estate transactions, and governmental regulation of land use. Undergraduate students may obtain consent of instructor to enroll in this course.

LAW 8500 Law for Professional Accountants 3 (3) Preparation for professional exams and responsibilities in managerial positions. Topics include professional and legal responsibilities of accountants, business organizations, commercial law, government regulation of business and property. Case studies, problems and student papers are utilized. Preq: Enrollment in the MPacc program.

MATH 6000 Theory of Probability 3 (3) Principal topics include combinatorial theory, probability axioms, random variables, expected values; special discrete and continuous distributions, jointly distributed random variables, correlation, conditional expectation, law of large numbers, central limit theorem. Students are expected to have completed a Multivariable Calculus course before enrolling in this course.

MATH 6020 Statistics for Science and Engineering II 3 (3) Principal topics include simple linear regression, multiple regression and correlation analysis, one-way analysis of variance, multiple comparison, multifactor analysis of variance, experimental design. Computation and interpretation of results are facilitated through use of statistical computer packages. Preq: MATH 3020.

MATH 6030 Introduction to Statistical Theory 3 (3) Principal topics include sampling distributions, point and interval estimation, maximum likelihood estimators, method of moments, least squares estimators, tests of hypotheses, likelihood ratio methods, regression and correlation analysis, introduction to analysis of variance. Students are expected to have completed a Theory of Probability course before enrolling in this course.
Courses of Instruction

MATH 6060 Sampling Theory and Methods
3 (3) Probability-based treatment of sampling methodology. Theory and application of estimation techniques are treated using simple and stratified random sampling, cluster sampling, and systematic sampling. Students are expected to have completed a Statistical Methods course and a Theory of Probability course before enrolling in this course.

MATH 6070 Regression and Time-Series Analysis
3 (3) Theory and application of the regression and time series. Approaches to empirical model building and data analysis are treated. Computation and interpretation of results are facilitated through the use of interactive statistical packages. Students are expected to have completed a Linear Algebra course, a Theory of Probability course, and a Statistics course before enrolling in this course.

MATH 6080 Exploration and Analysis of Secondary Mathematics
3 (3) In-depth exploration and analysis of important underlying ideas in the secondary mathematics curriculum. An emphasis is placed on reasoning and proof as students investigate topics in algebra, geometry, probability, statistics and calculus. Students are expected to have completed a Multivariable Calculus course before enrolling in this course.

MATH 6110 Introduction to Combinatorics
3 (3) Introductory course in combinatorial analysis. Topics include enumeration, graph theory, posets, and extremal combinatorics. Students are expected to have completed a Linear Algebra course and either a Discrete Mathematics course or a Introduction to Proofs course before enrolling in this course.

MATH 6120 Introduction to Modern Algebra
3 (3) Introduction to the concepts of algebra. Topics include the number system and the elementary theory of groups, rings, and fields. Students are expected to have completed a Linear Algebra course before enrolling in this course.

MATH 6190 Discrete Mathematical Structures I
3 (3) Applies theoretical concepts of sets, functions, binary relations, graphs, Boolean algebra, propositional logic, semigroups, groups, homomorphisms, and permutation groups to computer characteristics and design, words over a finite alphabet and concatenation, binary group codes, and other communication or computer problems. Students are expected to have completed a Linear Algebra course before enrolling in this course.

MATH 6340 Advanced Engineering Mathematics
3 (3) Fourier series, Laplace and Fourier transform, and numerical methods for solving initial value and boundary-value problems in partial differential equations are developed. Applications to diffusion wave and Dirichelet problems are given. Matrix methods and special functions are utilized. Students are expected to have completed a Differential Equations course before enrolling in this course.

MATH 6350 Complex Variables
3 (3) Elementary functions; differentiation and integration of analytic functions; Taylor and Laurent series; contour integration and residue theory; conformal mapping; Schwartz-Christoffel transformation. Students are expected to have completed a Multivariable Calculus course before enrolling in this course.

MATH 6400 Linear Programming
3 (3) Introduction to linear programming covering the simplex algorithm, duality, sensitivity analysis, network models, formulation of models, and the use of simplex codes to solve, interpret, and analyze problems. Students are expected to have completed a Multivariable Calculus course and a Linear Algebra course before enrolling in this course.

MATH 6410 Introduction to Stochastic Models
3 (3) An introductory treatment of stochastic processes, finite-state Markov chains, queueing, dynamic programming, Markov decision processes, reliability, decision analysis, and simulation. Both theory and applications are stressed. Students are expected to have completed a Theory of Probability course before enrolling in this course.

MATH 6420 Advanced Mathematical Programming
3 (3) Theory, methodology, and applications of integer and nonlinear programming. Topics include model development, computer solutions, branch and bound, unconstrained and constrained optimization algorithms, complexity and convergence analysis. Case studies are included. Students are expected to have completed an Introduction to Stochastic Models course or a Mathematical Programming course before enrolling in this course.

MATH 6530 Advanced Calculus I
3 (3) Limits, continuity, and differentiation of functions of one and several variables, the Riemann integral, and vector analysis. Students are expected to have completed a Multivariable Calculus course before enrolling in this course.

MATH 6540 Advanced Calculus II
3 (3) Continuation of MATH 6530. Transformations, multiple integrals, line and surface integrals, infinite sequences and series, and improper integrals. Students are expected to have completed an Advanced Calculus course before enrolling in this course.

MATH 6550 Topics in Geometry
3 (3) Covers a variety of geometries, such as Euclidean, hyperbolic, projective, and spherical. The intrinsic properties of these spaces, such as their geodesics and isometries, are studied. Other topics include differential geometry of curves and surfaces, Gaussian curvature, and the celebrated Gauss-Bonnet theorem linking geometry with topology.

MATH 6560 Topology
3 (3) Introduction to point-set topology. Topics include metric spaces, topological spaces, Hausdorff spaces, homeomorphisms, continuity, product and quotient spaces, compactness, and connectedness. Additional topics, such as homotopy equivalence of paths, the fundamental group, and basic knot theory, are introduced as time permits.

MATH 6600 Introduction to Numerical Analysis
3 (3) Introduction to the problems of numerical analysis emphasizing computational procedures and application. Topics include sources of error and conditioning, matrix methods, systems of linear equations, nonlinear equations, interpolation and approximation by splines, polynomials, and trigonometric functions. Students are expected to have completed a Multivariable Calculus course and a Mathematical Computing course before enrolling in this course.

MATH 6630 Mathematical Analysis
3 (3) Basic properties of the real number system, sequences and limits; continuous functions, uniform continuity and convergence. Integration, differentiation, functions of several real variables, implicit function theory. Students are expected to have completed a Multivariable Calculus course before enrolling in this course.

MATH 7060 Probability and Statistics for Middle Grade Teachers
3 (3) Topics include organizing, classifying and summarizing data; univariate and bivariate graphical techniques; measures of center and dispersion; correlation and simple regression; elementary probability theory, counting and simulations; binomial and normal distributions. A graphing calculator is used. Prq: Enrollment in Middle-Level Education graduate program.

MATH 7090 Geometry for Middle Grades
3 (3) Hands-on approach to constructions with straight-edge and compass; polygons including tessellations and polyhedra; symmetry and transformational geometry; coordinate geometry measurement with dimensional analysis; perspective drawing and related topics; history of geometry; reasoning and informal proof with congruence; and computer software, calculator use and Internet. Prq: Enrollment in Middle-Level Education graduate program.

MATH 7130 Algebra for Middle Grades
3 (3) Study of elementary algebra, solution of equations, and inequalities; properties and applications of linear, quadratic, polynomial and exponential functions and models; graphical analysis and curve-fitting of real-world data; systems of equations and basic matrix operations. A graphing calculator is used. Prq: Enrollment in Middle-Level Education graduate program.

MATH 7140 Foundations of Mathematics for Middle Grades
3 (3) Topics include logic, set theory, numeration systems; arithmetic operations and their properties on the integer, rational and real number systems; decimals, ratio, proportion, percent, exponents and roots. Includes an introduction to algebra and counting, permutations and combinations. Prq: Enrollment in Middle-Level Education graduate program.

MATH 7380 Modern Geometry for Secondary Teachers
3 (3) Concepts of Euclidean geometry reviewed and extended by means of coordinates, vectors, matrices; conic sections. Prq: Enrollment in Secondary Education graduate program.

MATH 7400 Linear Programming for Secondary Teachers
3 (3) Development of mathematical theory of simplex algorithm; survey of mathematical background; matrix algebra, systems of linear equations and vector spaces; problem formulation is emphasized. Prq: Enrollment in Secondary Education graduate program.

MATH 7490 Discrete Mathematics for Secondary Teachers
3 (3) Discrete mathematics emphasizing applications to computer science; propositions and logic; Boolean Algebra and switching circuits; recursion and induction; relations and partially ordered sets, graphs and trees.
MATH 7500 Modern Algebra for Secondary Teachers 3 (3) Introduction to the fundamental concepts and historical development of abstract algebra. Topics include integers, binary operations, functions, equivalence, relations, permutations, groups, polynomials, commutative rings, integral domains, and fields. Students are expected to have completed a linear algebra course or a graduate-level matrix algebra for secondary teachers course before enrolling in this course. Prereq: enrollment in the Secondary Education graduate program.

MATH 7530 Matrix Algebra for Secondary Teachers 3 (3) Matrices and systems of equations; determinants; vector spaces and linear transformations; eigenvalues. Prereq: Enrollment in Secondary Education graduate program.

MATH 7550 Combinatorial Analysis for Secondary Teachers 3 (3) Permutations; combinations; generating functions; recurrence relations; principle of inclusion-exclusion; partitions; Latin squares; block designs; finite geometries; graphs; codes; Polya’s theorem; recreational mathematics. Prereq: Enrollment in Secondary Education graduate program.

MATH 7560 Applied Modern and Linear Algebra for Secondary Teachers 3 (3) Various applied problems whose solutions rely on techniques and results of linear and modern algebra. Problems are selected from such areas as economics, forest management, genetics, population growth, transportation networks, cryptography, satellite communications, electronic switching circuits, chemistry, physics, sociology and others. Students are expected to have completed a graduate-level matrix algebra for secondary teachers course before enrolling in this course.

MATH 7580 Number Theory for Secondary Teachers 3 (3) Topics include properties of integers, divisors and prime numbers; fundamental properties of congruence; polynomials and primitive roots; quadratic residues. Prereq: Enrollment in Secondary Education graduate program.

MATH 7750 AP Statistics Institute III 3 (3) Topics include probability, conditional probability, descriptive statistics, random variables, probability functions, binomial distribution, normal distribution, sampling, estimation, decision making. Prereq: Enrollment in Secondary Education graduate program.

MATH 7770 AP Calculus Institute III 3 (3) Elementary functions, differential calculus and integral calculus; enrichment material and a theoretical perspective of calculus. Restricted to teachers who hold a current teaching certificate in secondary mathematics. Completion of this course satisfies the special certification requirements for AB-calculus teachers in South Carolina.

MATH 7800 Probability Theory for Secondary Teachers 3 (3) Calculus-based introduction to basic ideas in probability theory. Topics include basic counting techniques, fundamental axioms of probability, conditional probability, discrete and continuous distributions, and sampling distributions. Emphasizes real-world applications and the use of simulations to illustrate concepts. Students are expected to have completed a science and engineering single variable calculus II course before enrolling in this course. Prereq: Enrollment in Secondary Education graduate program.

MATH 7850 Data Analysis for Secondary Teachers 3 (3) Topics include data types, basic sampling and experimental designs, one- and two-sample confidence intervals and hypothesis tests, analysis of variance, model building with simple and multiple linear regression, and contingency tables. Includes a brief review of probability. Student groups propose and implement a real-world research project. Students are expected to have completed a course in introductory statistics, introductory probability, or graduate probability theory for secondary teachers course before enrolling in this course. Prereq: Enrollment in Secondary Education graduate program.

MATH 7910 Selected Topics in Mathematics Education 1-3 (1-3) Mathematical problems in elementary or secondary school curricula. May be repeated for credit, but only if different topics are covered. Prereq: Enrollment in Secondary Education graduate program.

MATH 8000 Probability 3 (3) Study of basic probability theory with emphasis on results and techniques useful in operations research and statistics. Topics include axiomatic probability, advanced combinatorial probability, conditional informative expectation, functions of random variables, moment generating functions, distribution theory and limit theorems. Offered fall semester only. Students are expected to have completed a course in multivariable calculus before enrolling in this course.

MATH 8010 General Linear Hypothesis I 3 (3) Topics include least-square estimates; Gauss-Markov theorem; confidence ellipsoids, and confidence intervals for estimable functions; tests of hypotheses; one-, two- and higher-way layouts; analysis of variance for other models. Offered fall semester only. Students are expected to have completed a course in linear algebra and a course in mathematics statistics before enrolling in this course.

MATH 8020 General Linear Hypothesis II 3 (3) Continuation of MATH 8010. Offered spring semester only. Students are expected to have completed a graduate-level course in linear models before enrolling in this course.

MATH 8030 Stochastic Processes 3 (3) Theory and analysis of time series, recurrent events, Markov chains, random walks, renewal theory, application to communication theory and operations research. Students are expected to have completed a course in multivariable calculus and a course in introductory probability theory before enrolling in this course.

MATH 8040 Statistical Inference 3 (3) Sampling distributions; maximum likelihood estimation and likelihood ratio tests; asymptotic confidence intervals for Binomial, Poisson and Exponential parameters; two-sample methods; nonparametric tests; ANOVA; regression; model building. Offered fall semester only. Students are expected to have completed a course in multivariable calculus and a course in introductory probability before enrolling in this course.

MATH 8050 Data Analysis 3 (3) Methodology in analysis of statistical data emphasizing applications to real problems using computer-oriented techniques: computer plots, transformations, criteria for selecting variables, error analysis, multiple and stepwise regression, analysis of residuals, model building in time series and ANOVA problems, jackknife and random subsampling, multidimensional scaling, clustering. Students are expected to have completed a course in introductory statistics and a course in introductory probability before enrolling in this course.

MATH 8060 Nonparametric Statistics 3 (3) Order statistics; tolerance limits; rank-order statistics; Kolmogorov-Smirnov one-sample statistics; Chi-square goodness-of-fit test; two-sample problem; linear rank statistics; asymptotic relative efficiency. Offered spring semester only. Students are expected to have completed a course in statistical inference before enrolling in this course.

MATH 8070 Applied Multivariate Analysis 3 (3) Applied multivariate analysis: computer plots of multivariate observations; multidimensional scaling; multivariate tests of means, covariances and equality of distributions; univariate and multivariate regressions and their comparisons; MANOVA; principal components analysis; factor analysis; analytic rotations; canonical correlations. Offered fall semester only. Students are expected to have completed a course in linear algebra and a course in statistical inference before enrolling in this course.

MATH 8080 Reliability and Life Testing 3 (3) Probability models and statistical methods relevant to parametric and nonparametric analysis of reliability and life testing data. Offered spring semester only. Students are expected to have completed a course in statistical inference before enrolling in this course.

MATH 8090 Time Series Analysis, Forecasting and Control 3 (3) Modeling and forecasting random processes; autocorrelation functions and spectral densities; model identification, estimation and diagnostic checking; transfer function models; feedforward and feedback control schemes. Offered spring semester only. Students are expected to have completed a course in multivariable calculus and a course in introductory probability before enrolling in this course.

MATH 8100 Mathematical Programming 3 (3) Formulation and solution of linear programming models; mathematical development of the simplex method; revised simplex method; duality; sensitivity analysis; parametric programming; implementation and software packages. Students are expected to have completed a course in linear algebra before enrolling in this course.

MATH 8110 Nonlinear Programming 3 (3) Theoretical development of nonlinear optimization with applications, classical optimization, convex and concave functions, separable programming, quadratic programming and gradient methods. Offered spring semester only. Students are expected to have completed a course in linear programming and a course in advanced calculus before enrolling in this course.
MATH 8120 Discrete Optimization 3 (3) Principal methods used in integer programming and discrete optimization; branch and bound, implicit enumeration, cutting planes, group knapsack, Lagrangian relaxation, surrogate constraints, heuristics (performance analysis), separation/branching strategies, and polynomial time algorithms for specific problems on special structures. Offered fall semester only. Students are expected to have completed a graduate-level course in linear programming before enrolling in this course.

MATH 8130 Advanced Linear Programming 3 (3) Development of linear programming theory using inequality systems, convex cones, polyhedra and duality; solution algorithms, and computational considerations for large scale and special structured problems using techniques of upper bounded variables, decomposition, partitioning and column generation; game theory; nonlinear representations and other methods such as ellipsoid and Karmarkar. Offered spring semester only. Students are expected to have completed a graduate-level course in linear programming before enrolling in this course.

MATH 8140 Network Flow Programming 3 (3) Max-flow/min-cut theorem, combinatorial applications, minimum cost flow problems (transportation, shortest path, transshipment), solution algorithms (including the out-of-kilter), and implementation and computational considerations. Offered fall semester only. Students are expected to have completed a graduate-level course in linear programming before enrolling in this course.

MATH 8160 Network Algorithms and Data Structures 3 (3) Design, analysis and implementation of algorithms and data structures associated with the solution of problems formulated as networks and graphs; applications to graph theory, combinatorial optimization and network programming. Offered spring semester only. Students are expected to have completed a course in each of the following before enrolling in this course: linear programming, graduate mathematical programming, graph theory, undergraduate algorithms and data structures.

MATH 8170 Stochastic Models in Operations Research I 3 (3) Stochastic control; structure of sequential decision processes; stochastic inventory models; recursive computation of optimal policies; discrete parameter finite Markov decision processes; various optimality criteria; computation by policy improvement and other methods; existence of optimal stationary policies; stopping rule problems; examples from financial management, maintenance and reliability, search, queuing and shortest path. Offered spring semester only. Students are expected to have completed a graduate-level course in stochastic processes before enrolling in this course.

MATH 8180 Stochastic Models in Operations Research II 3 (3) Introduction to queuing theory: Markovian queues, repairman problems, queues with an embedded Markov structure, the queue GI/G/1, queues with a large number of servers, decision making in queues; introduction to reliability theory; failure distributions; stochastic models for complex systems; maintenance and replacement policies; reliability properties of multicomponent structures. Offered fall semester only. Students are expected to have completed a graduate-level course in stochastic models in operations research before enrolling in this course.

MATH 8190 Multicriteria Optimization 3 (3) Theory and methodology of optimization problems with vector-valued objective functions; preference orders and domination structures; generating efficient solutions; solving multicriteria decision-making problems; noninteractive and interactive methods with applications. Offered fall semester only. Students are expected to have completed a graduate-level course in mathematical programming before enrolling in this course.

MATH 8200 Complementarity Models 3 (3) Theory, algorithms and applications of linear and nonlinear complementarity; classes of matrices and functions and corresponding algorithms; applications to economics, mechanics and networks; generalizations to fixed-point problems and nonlinear systems of equations. Offered spring semester only. Students are expected to have completed a graduate-level course in mathematical programming before enrolling in this course.

MATH 8210 Linear Analysis 3 (3) Normed spaces; Hilbert spaces, Banach spaces, linear functionals, linear operators, orthogonal systems. Offered spring semester and summer session only. Students are expected to have either completed an undergraduate-level course in advanced calculus II or to have completed both an undergraduate-level advanced calculus I course and a graduate-level matrix analysis course before enrolling in this course.

MATH 8220 Measure and Integration 3 (3) Riesz and algebras of sets, inner and outer measures; measurability and additivity, examples on the line and in space, Lebesgue integration, types of convergence, Lebesgue spaces; integration and differentiation, product measure, Fubini theorem. Offered fall semester only. Students are expected to have completed an undergraduate-level course in advanced calculus II before enrolling in this course.

MATH 8230 Complex Analysis 3 (3) Topological concepts; complex integration; local and global properties of analytic functions; power series; representation theorems; calculus of residues. Designed for nonengineering majors.

MATH 8250 Introduction to Dynamical Systems Theory 3 (3) Techniques of analysis of dynamical systems; sensitivity analysis, linear systems, stability and control; theory of differential and difference equations. Offered fall semester only. Students are expected to have either completed undergraduate-level courses in both advanced calculus II and linear algebra, or to have completed both an undergraduate-level advanced calculus I course and a graduate-level matrix analysis course before enrolling in this course.

MATH 8260 Partial Differential Equations 3 (3) First-order equations: elliptic, hyperbolic and parabolic. Second-order equations: existence and uniqueness results, maximum principles, finite difference and Hilbert Space methods. Offered fall semester only. Students are expected to have completed a graduate-level course in linear analysis before enrolling in this course.

MATH 8270 Dynamical System Neural Networks 3 (3) Modeling problems in the context of dynamical systems theory; useful methods from Lyapunov stability, local linearization, qualitative analysis using graph theory and numerical approximations; several dynamical systems neural networks including binary code recognizers and binary matrix choosers. Students are expected to have completed a course in multivariable calculus and a course in linear algebra before enrolling in this course.

MATH 8310 Fourier Series 3 (3) Fourier series with applications to solution of boundary value problems in partial differential equations of physics and engineering. Introduction to Bessel functions and Legendre polynomials.

MATH 8370 Calculus of Variations and Optimal Control 3 (3) Fundamental theorem of the calculus of variations; variable end points; the parametric problem; the isoperimetric problem; constraint inequalities; introduction to the theory of optimal control; connections with the calculus of variations; geometric concepts. Students are expected to have completed an undergraduate-level course in advanced calculus I before enrolling in this course.

MATH 8410 Applied Mathematics I 3 (3) Derivation of equations from conservation laws, dimensional analysis, scaling and simplification; methods such as steepest descent, stationary phase, perturbation series, boundary layer theory, WKB theory, multiscale analysis, and ray theory applied to problems in diffusion processes, wave propagation, fluid dynamics and mechanics. Offered fall semester only. Students are expected to have completed an undergraduate-level course in both ordinary differential equations and in advanced calculus I before enrolling in this course.

MATH 8500 Computational Algebraic Geometry 3 (3) Covers algebraic geometry and commutative algebra via Grobner bases. Includes ideals and varieties (affine and projective), Grobner bases, elimination theory, dimensions, solving polynomial systems via eigenvalues and eigenvectors. Selected applications may include coding theory, computer vision, geometric theorem proving, integer programming, or statistics. Students are expected to have completed an undergraduate-level course in both linear algebra and in modern algebra before enrolling in this course.

MATH 8510 Abstract Algebra I 3 (3) Basic algebraic structures: groups, rings and fields; permutation groups, Sylow theorems, finite abelian groups, polynomial domains, factorization theory and elementary field theory. Offered spring semester only.

MATH 8520 Abstract Algebra II 3 (3) Continuation of MATH 8510 including selected topics from ring theory and field theory. Offered fall semester only.
MATH 8530 Matrix Analysis 3 (3) Topics in matrix analysis that support an applied curriculum: similarity and eigenvalues; Hermitian and normal matrices; canonical forms; norms; eigenvalue localization; singular value decompositions; definite matrices. Students are expected to have completed either an undergraduate-level course in both linear algebra and advanced calculus, or to have completed an undergraduate-level course in mathematical analysis before enrolling in this course.

MATH 8540 Theory of Graphs 3 (3) Connectedness; path problems; trees; matching theorems; directed graphs; fundamental numbers of the theory of graphs; graphs and groups. Offered spring semester only.

MATH 8550 Combinatorial Analysis 3 (3) Combinations; permutations; permutations with restricted position; Polya's theorem; principle of inclusion and exclusion; partitions; recurrence relations; generating functions; Mobius inversion; enumeration techniques; Ramsey numbers; finite projective and affine geometries; Latin rectangles; orthogonal arrays; block designs; error detecting and error correcting codes. Offered fall semester only. Students are expected to have completed an undergraduate-level course in linear algebra before enrolling in this course.

MATH 8560 Theory of Error-Correcting Codes 3 (3) Topics include code constructions such as Hamming, cyclic, BCH, Reed-Solomon, Goppa, algebraic geometry, finite geometry, low-density parity check, convolutional and polynomial codes; code parameters and bounds; and decoding algorithms. Students are expected to have completed a graduate-level course in matrix analysis before enrolling in this course.

MATH 8570 Cryptography 3 (3) Classical and modern cryptography and their uses in modern communication systems are covered. Topics include entropy, Shannon's perfect secrecy theorem, Advanced Encryption Standard (AES), integer factorization, RSA cryptosystem, discrete logarithm problem, Diffie-Hellman key exchange, digital signatures, elliptic curve cryptosystems, hash functions and identification schemes. Students are expected to have completed undergraduate-level courses in linear algebra, theory of probability, and modern algebra; or a graduate-level course in abstract algebra before enrolling in this course.

MATH 8580 Number Theory 3 (3) Covers topics and techniques from modern number theory including unique factorization, elementary estimates on the distribution of prime numbers, congruences, Chinese remainder theorem, primitive roots, $n$th power residues modulo an integer, quadratic residues, quadratic reciprocity, quadratic characters, Gauss sums and finite fields. Students are expected to have completed a graduate-level course in computer programming language, ordinary differential equations, and linear algebra before enrolling in this course.

MATH 8610 Advanced Numerical Analysis 3 (3) Consideration of topics in numerical linear algebra: eigenvalue problems, the singular value decomposition, iterative algorithms for solving linear systems, sensitivity of linear systems, and optimization algorithms. Students are expected to have completed undergraduate-level courses in linear algebra and numerical analysis; or a graduate-level course in scientific computing before enrolling in this course.

MATH 8630 Digital Models 1 3 (3) Experimental mathematics; pseudostochastic processes; analytical and algebraic formulations of time-independent simulation; continuous-time simulation and discrete-time simulation; digital optimization; Fibonacci search; ravine search; gradient methods; current research in digital analysis. Offered fall semester only. Students are expected to have digital computer experience before enrolling in this course. Students are expected to have completed undergraduate-level courses in linear algebra, advanced calculus, and computer programming language before enrolling in this course.

MATH 8650 Data Structures 3 (3) Representation and transformation of information; formal description of processes and data structures; tree and list structures; pushdown stacks; string and formula manipulation; hashing techniques; interrelation between data structure and program structure; storage allocation methods. Offered fall semester only. Students are expected to have completed a graduate-level course in linear algebra before enrolling in this course.

MATH 8670 Finite Element Method 3 (3) Discusses the basic theory of the finite element method (FEM) for the numerical approximation of partial differential equations. Topics include Sobolev spaces, interpolation theory, finite element spaces, error estimation, and implementation of FEM in one and higher dimensions. Students are expected to have completed a senior- or graduate-level course in scientific computing and an undergraduate-level course in advanced calculus II; or to have completed an undergraduate-level course in advanced calculus I and a graduate-level course in matrix analysis before enrolling in this course.

MATH 8740 Integration Through Optimization 3 (3) Theory, methodology and applications of decomposition, integration and coordination for largescale or complex optimization problems encountered in engineering design. Topics include conventional and non-conventional engineering optimization algorithms, analysis models and methods, multidisciplinary optimization, analytic target cascading, multicriteria optimization, and multicriteria design. Case studies are included. Students are expected to have completed a graduate-level course in mathematical programming or scientific computing or engineering optimization before enrolling in this course.

MATH 8810 Mathematical Statistics 3 (3) Fundamental concepts of sufficiency, hypothesis testing and estimation; robust estimation; resampling (jackknife, bootstrap, etc.) methods; asymptotic theory; two-stage and sequential sampling problems; ranking and selection procedures. Offered spring semester only. Students are expected to have completed a course in statistical inference before enrolling in this course.

MATH 8840 Statistics for Experimenters 3 (3) Statistical methods for students who are conducting experiments; introduction to descriptive statistics, estimation and hypothesis testing as they relate to design of experiments; higher-order layouts, factorial and fractional factorial designs, and response surface models. Offered fall semester only. Students are expected to have completed a course in multivariable calculus before enrolling in this course.

MATH 8850 Advanced Data Analysis 3 (3) Continuation of MATH 8850 covering alternatives to ordinary least squares, influence and diagnostic considerations, robustness, special statistical computation methods. Offered spring semester only. Students are expected to have completed a graduate-level regression analysis course before enrolling in this course.

MATH 8910 Master's Thesis Research 1-12 (1-12) Students conduct master's thesis research.

MATH 8920 Master's Project Course 1 (1) For students in the nonthesis option of the M.S. degree program in Mathematical Sciences. Successful completion includes a presentation of the master's project to the student's advisory committee and acceptance of the paper by the committee.

MATH 9000 Seminar in Preparing for College Teaching in Mathematical Sciences 3 (3) Elements involved in being a college professor with emphasis on broadening the student's mathematical experiences within a framework of improving classroom performance. Students must complete the departmental PhD qualifying examinations before enrolling in this course.

MATH 9010 Probability Theory I 3 (3) Axiomatic theory of probability; distribution functions; expectation; Cartesian product of infinitely many probability spaces, and the Kolmogorov consistency theorem; models of convergence; weak and strong laws of large numbers. Students are expected to have completed a graduate-level course in measure and integration and in introductory examinations before enrolling in this course.

MATH 9020 Probability Theory II 3 (3) Continuation of MATH 9010; characteristic functions, infinitely divisible distributions, central limit theorems, laws of large numbers, conditioning, and limit properties of sums of dependent random variables, conditioning, martingales. Students are expected to have completed a course in measure-theoretic probability before enrolling in this course.

MATH 9270 Functional Analysis 3 (3) Linear operators on specific spaces, spectral theory, semigroups of operators and the Hille-Yosida theorem, applications of linear spaces and operators, convexity. Students are expected to have completed a graduate-level course in linear analysis before enrolling in this course.

MATH 9500 Commutative Algebra 3 (3) This course covers the fundamentals of commutative algebra and its algebraic geometric aspect, providing background for further study in algebraic geometry and algebraic number theory. Students must have completed at least one semester of graduate abstract algebra to enroll in this course.
MATH 9150 Algebraic Number Theory 3 (3) Covers arithmetic of number fields and number rings. Covers prime decomposition, ideal class groups, unit groups of number fields and distribution of prime ideals in number fields. Provides an overview of completions absolute values and valuation theory. Students are expected to have completed a graduate-level course in abstract algebra before enrolling in this course.

MATH 9520 Analytic Number Theory 3 (3) The theory of Fourier analysis and complex analysis are essential to modern number theory. Course focuses on applications of this theory to number theory, such as the proof of the prime number theorem and the connection of complex L-series to the distribution of primes and to arithmetic geometry. Students are expected to have completed a graduate-level course in abstract algebra before enrolling in this course.

MATH 9540 Advanced Graph Theory 3 (3) Continuation of MATH 9540 including the four-color theorem, domination numbers, Ramsey theory, graph isomorphism, embeddings, algebraic graph theory and tournaments. Research papers are also examined. Offered fall semester only. Students are expected to have completed a graduate-level course in graph theory before enrolling in this course.

MATH 9700 Directed Studies in Mathematical Sciences 1-3 (1-3) Directed individual studies on topics in the mathematical sciences supervised by faculty. May be repeated for a maximum of 12 credits.

MATH 9740 Selected Topics in Mathematical Sciences 1-3 (1-3) Advanced topics in the mathematical sciences from current areas of interest presented in lecture format. May be repeated for a maximum of 24 credits, but only if different topics are covered.

MATH 9810 Selected Topics in Mathematical Statistics and Probability 1-3 (1-3) Advanced topics in mathematical statistics and probability of current interest. May be repeated for credit, but only if different topics are covered.

MATH 9820 Selected Topics in Analysis 1-3 (1-3) Advanced analysis topics from current problems of interest. May be repeated for credit, but only if different topics are covered.

MATH 9830 Selected Topics in Computational Mathematics 1-3 (1-3) Advanced topics in computational mathematics and numerical analysis from current problems of interest. May be repeated for credit, but only if different topics are covered.

MATH 9850 Selected Topics in Algebra and Combinatorics 1-3 (1-3) Advanced topics in algebra and combinatorics from current problems of interest. May be repeated for credit, but only if different topics are covered.

MATH 9860 Selected Topics in Geometry 1-3 (1-3) Advanced topics in geometry from current problems of interest. May be repeated for credit, but only if different topics are covered.

MATH 9880 Selected Topics in Operations Research 1-3 (1-3) Advanced topics in operations research from current problems of interest. May be repeated for credit, but only if different topics are covered.

MATH 9890 Selected Topics in Mathematical Education 1-3 (1-3) Advanced topics in the mathematical sciences from the area of mathematics education. May be repeated for credit, but only if different topics are covered.

MATH 9910 Doctoral Dissertation Research 1-12 (1-12) Students conduct doctoral dissertation research.

MBA 8030 Statistical Analysis of Business Operations 3 (3) Application of modern statistical inference in business operations. Topics include testing statistical hypotheses, consequences of making decisions with incomplete information, univariate and multivariate regression with emphasis on business applications and design of experiments and analysis of variance. Special attention is given to efficient and relevant data collection and interpretation.

MBA 8050 Enterprise, Government and the Public 3 (3) Regulatory environment of business and how it evolves. Through use of economic logic and business cases, students are equipped to understand the all-pervading nature and importance of government regulation in the economy.

MBA 8060 Operations Management 3 (3) How firms create value and how decisions in the areas of capacity, facilities, technology, vertical integration, workforce, quality, production planning/materials control, and organization influence a firm's ability to add value; decisions and analysis tools used for these decisions.

MBA 8070 Financial Management 3 (3) Theory of financial management as it relates to the financial problems faced by business concerns. Concepts developed are used to assess the validity of emerging formalized techniques for improving decision making in the financial area. Topics include financial planning, short- and long-term fund raising, capital budgeting, the administration of working capital, recapitalization, listing of securities and reorganization. Case material and problems are used. Prq: MBA 8190 or consent of instructor.

MBA 8090 Organizational Behavior and Human Resources Management 3 (3) Theories and models of behavior; human resources management concepts and processes as they apply to managing individual and workgroup behavior in organizations. Organizational behavior topics include leadership, motivation and teamwork. Human resource management topics include human resources strategy, selection, performance evaluation, reward systems and employee development. May also be offered as MGT 8090.

MBA 8100 International Business Management 3 (3) Survey and analysis of managerial theory and the practices of international business, including the influence of cultural, economic, political and financial factors affecting the management of the firm. Case studies of companies engaged in international business are discussed.

MBA 8120 Financial Markets and Institutions 3 (3) Topics critical to the proper management of financial institutions including financial regulations, financial security types and their yields, interest rate theories, interest rate risk management, foreign currency risk management, stock index futures and numerous operating functions in banking. Prq: MBA 8070 or consent of instructor.

MBA 8140 Directed Research in Quantitative Analysis 3 (3) Directed Research in Quantitative Analysis

MBA 8150 Directed Research in Qualitative Analysis 3 (3) Directed Research in Qualitative Analysis

MBA 8170 Business Forecasting Techniques and Applications 3 (3) Study of forecasting techniques and their application for developing and assessing forecasts. Topics include economic data sources, multiple regression and time series analysis, and interpretation of forecasts for management and other clients. Prq: MBA 8020 and MBA 8030.

MBA 8190 Introduction to Accounting and Finance 3 (3) Basic concepts of accounting and finance with emphasis on using financial data for decision making; measuring, processing, reporting and analysis of financial information; use of discounted cash flow analysis in evaluation and the measurement of risk and return. Designed for MBA students lacking background in accounting and finance. Prq: Consent of MBA director.

MBA 8200 Globalization and Macro Markets 3 (3) Operation of international markets, factors that determine exchange rates and influence trade, role of government and non-government organizations on economic outcomes, structured financial products to reduce international business risk. Prq: Consent of instructor.

MBA 8260 Business Marketing 3 (3) Strategic marketing as it applies to industrial, organizational and institutional markets; consumer marketing versus business-to-business marketing; current business marketing literature and practices. Prq: Coursework in principles of marketing or equivalent or consent of instructor.

MBA 8280 Services Marketing 3 (3) Nature of services marketing and the special requisites that distinguish successful services marketing from goods marketing. Topics include promoting and making the service tangible, designing optimal service operations, the ideal service worker, pricing of services and critical points of services delivery. Prq: Coursework in principles of marketing or equivalent or consent of instructor.

MBA 8290 Marketing Foundations 2 (2) Principles and concepts involved in planning, pricing, promoting and distributing goods and services. Prq: Consent of MBA director.

MBA 8310 Communications and Sales 2 (2) Students learn the principles of effective business communication, with a focus on delivering presentations and persuasive business pitches. Entrepreneurs will also learn how to adapt a message to a variety of audiences, including investors, employees and customers.

MBA 8320 International Financial Management 3 (3) Factors that influence the financial management of multinational corporations. Topics include international parity conditions, currency exposure management, capital budgeting of international projects and political risks. Prq: MBA 8070 or MBA 870; or consent of instructor.

MBA 8330 Real Estate Investments 3 (3) Study of real estate investment analysis and decision making featuring the use of the discounted cash flow model and other tools to evaluate investment alternatives from the perspective of an equity real estate investor. Emphasizes market analysis, ownership alternatives and financing considerations. Prq: FIN 8360 or MBA 8360.
MBA 8340 Business Plan Capstone 3 (3) Students finalize business plans and deliver presentations to a group of business leaders.

MBA 8350 Investment Management 3 (3) Discusses current techniques and strategies in the analysis of various investment alternatives. Includes portfolio management with an introduction to options and futures markets. Students are expected to have completed coursework in principles of accounting and to have demonstrated proficiency in basic finance before enrolling in this course.

MBA 8360 Real Estate Principles 3 (3) Advanced survey course to acquaint students with the theories, practices and principles of real estate. Topics include urban economics, real estate law, brokerage, real estate valuation, financial institutions, tax issues, investment analysis, and development. May also be offered as FIN 8360. Preq: MBA 8070 or MBA 8190; or consent of instructor.

MBA 8370 Legal Environment of Business 2 (2) Legal and case analysis of court systems and dispute resolution, contracts, business torts, EEOC, Age Discrimination in Employment Act, Americans with Disabilities Act, Employment-at-Will compared to union participation; international legal considerations as these topics relate to business concerns. May not be used for credit toward a graduate degree. Preq: Consent of MBA director.

MBA 8380 Entrepreneurial Accounting 2 (2) Introduction to basic accounting principles. Students learn to analyze financial statements, understand GAAP, and comprehend double-entry bookkeeping from the perspective of a manager of a new business venture.

MBA 8400 Entrepreneurial Law 1 (1) Exposes students to issues ranging from registering a business to protecting intellectual property. Students learn about the fundamental concepts of business law relating to tort law, contract law, liability law and business taxation.

MBA 8450 Technology and Innovation Management 3 (3) Interdisciplinary examination of problems and issues in integrating technology and innovation into processes and products; evaluating tangible and intangible aspects of new technology adoption; management research and development; and functional integration of marketing and operations. May also be offered as MGT 8450.

MBA 8460 Use of Derivatives in Financial Engineering 3 (3) The valuation and use of basic derivative securities such as futures and options; the financial engineering of securities combinations such as swaps, spreads and straddles; applications of derivatives and financial engineering in managing financial risks. Preq: MBA 8070 or MBA 8670; or consent of instructor.

MBA 8470 New Venture Creation 2 (2) Students set up a new venture, build networks and create a business plan while learning how to identify and exploit opportunities.

MBA 8480 Entrepreneurial Marketing and Digital Strategies 3 (3) Students learn basic marketing principles and digital strategies, including Web optimization and social media strategies. Entrepreneurs also learn about electronic commerce and the economics of digital business.

MBA 8490 Entrepreneurial Strategy 3 (3) Employs a case-based approach, focusing on the strategies employed by companies in a variety of industries. By extension, entrepreneurs utilize strategic frameworks to understand the external and internal forces that will impact their own venture.

MBA 8500 Business Communications 1 (1) Techniques, skills and approaches for effective business communications; strengths and weaknesses of various communications forms with concentration on informative and persuasive models. Includes practical experience in written work and presentations, video and verbal feedback, teamwork, problem solving and situational presentations. To be taken Pass/No Pass only. Preq: Consent of MBA director.

MBA 8510 Business Operations and Logistics 1 (1) Students learn the fundamentals of operations strategy to achieve efficient organizational performance and effective use of resources in their new business ventures.

MBA 8520 Social Entrepreneurship 1 (1) Study of sustainability, hybrid entrepreneurship principles and the role of start-up companies as social ventures.

MBA 8540 Managerial Accounting 3 (3) Analysis, interpretation and use of accounting information for planning and control in business and non-business organizations. Includes profit planning, budgeting and standards, product and segment costing and evaluation; and case studies and computer-based assignments. Preq: MBA 8190 or consent of instructor.

MBA 8590 Managerial Decision Modeling 3 (3) Survey of decision modeling techniques useful in managerial decision making, including linear programming, project management, queuing models, transportation problems and Monte Carlo simulation. Preq: Consent of MBA director.

MBA 8600 Advanced Marketing Strategy 3 (3) Advanced marketing theory and critical thinking skills applied to support strategic decision making. Data analysis and advanced marketing models are employed with emphasis on building analytic and assessment skills. Preq: MBA 8290 or consent of instructor.

MBA 8610 Information Systems 3 (3) The critical role of information systems in contemporary business organizations; key information systems and technologies; their impacts both within and across organizational settings. May also be offered as MGT 8610.

MBA 8620 Managerial Economics 3 (3) Use of economic analysis in managerial decision making. Topics include the theory of cost, production, industrial organization, coordination and control of the firm, from theoretical concepts to actual decision making. Preq: Consent of MBA director.

MBA 8630 Advanced Managerial Economics 3 (3) Advanced economic analysis for managerial decision making. Topics include advanced price theory, theory of firm, internal organization of the firm, the economics of strategic behavior in the market and the empirical estimation of demand and cost functions. Preq: MBA 8620 or consent of instructor.

MBA 8700 Strategic Management 3 (3) Investigation of the ongoing process of positioning a firm for competitive advantage in its changing business environment focusing on the role of general managers in formulating and implementing strategies for single and multibusiness firms. Business cases, class discussions and group projects are used to integrate content from previous business courses. Preq: MBA 8070 and MBA 8600.

MBA 8710 Programming and System Development 3 (3) Programming concepts and structures in developing information systems applications. Specific techniques and tools covered are updated to incorporate the newest technologies. Preq: Consent of instructor.

MBA 8720 Entrepreneurial Finance 3 (3) Topics include business valuation, financial forecasting, financing strategies and business harvesting. Includes case studies and computer modeling. Preq: ECON 8550 or MBA 8070.

MBA 8740 Managing Continuous Improvement 3 (3) How to initiate and lead change toward a total quality environment; basic tools of quality management; use of teams to achieve change; quality function deployment; ISO 9000; supplier development; and use of survey methods to track progress of change. May also be offered as MGT 8740. Preq: MGT 8030 or consent of instructor.

MBA 8750 Enterprise Development 3 (3) Studies the entrepreneurial process from conception to birth of new venture emphasizing discovery, search for opportunities and gathering resources to convert opportunities to businesses. Students learn how to evaluate entrepreneurs and their plans by working in teams to write a business plan for a new venture.
Courses of Instruction

MBA 8760 Sustainable Business Practices 3 (3) Examination of emerging field of sustainable business practices and its role in strategy development and implementation. Specific emphasis is on history, science and politics of sustainability, including its effects on production, consumption and environmental impact. Prereq: Consent of instructor.

MBA 8800 MBA Seminar I-3 (1-3) Presents various topics, such as professional development for MBA students, project research methods for graduate research assistants, and other special topics. To be taken Pass/No Pass only. May be repeated for a maximum of four credits. Prereq: Consent of instructor.

MBA 8810 Seminar on Ethics and Leadership I (1) Examines MBA students to various ethical, leadership and personal development venues through a combination of speakers, networking activities, workshops, competitions, personal development exercises and other related activities. May be repeated for a maximum of two credits. To be taken Pass/No Pass only. Prereq: Consent of instructor.

MBA 8880 Internship in Business Administration 2-6 (2-6) Preplanned, preapproved, faculty-supervised internship designed to give students on-the-job learning in support of classroom education. A two-credit hour internship must be no fewer than 400 contact hours (e.g., four weeks, 30 hours per week; or eight weeks, 15 hours per week; or 15 weeks, eight hours per week) with the same internship provider. To be taken Pass/No Pass only. May be repeated for a maximum of six credits. Students must have completed thirty semester hours of graduate credit before enrolling in this course. Prereq: Consent of MBA director.

MBA 8990 Selected Topics in Business Administration 1-6 (1-6) Current topics in business administration as they relate to the manager. Topics may come from a single functional area or may integrate two or more functional areas (accounting, economics, finance, management, or marketing). May be repeated for a maximum of nine credits.

MECHANICAL ENGINEERING

ME 6070 Applied Heat Transfer 3 (3) Application oriented extension of ME 3040, considering topics in transient conduction, flow of fluids, energy exchange by radiation, and mass transfer. Applications in heat-exchanger design with emphasis on economics and variation of operating conditions from the design point. Prereq: ME 3040 or consent of instructor.

ME 6170 Mechatronics System Design 3 (2) Mechatronics integrates control, sensors, actuators, and computers to create a variety of electromechanical products. Includes concepts of design, appropriate dynamic system modeling, analysis, sensors, actuating devices, and real time microprocessor interfacing and control. Laboratory experiments, simulation, and design projects are used to exemplify the course concepts. Prereq: ME 3050 or consent of instructor. Coreq: ME 6171.

ME 6171 Mechatronics System Design Laboratory 0 (3) Non-credit laboratory to accompany ME 6170. Coreq: ME 6170.

ME 6200 Energy Sources and Their Utilization 3 (3) Covers availability and use of energy sources such as fossil fuels, solar (direct and indirect), and nuclear; addresses energy density and constraints to use (technical and economic) for each source. Prereq: ME 3030 and ME 3040, or consent of instructor.

ME 6210 Introduction to Compressible Flow 3 (3) Introductory concepts to compressible flow; methods of treating one-dimensional gas dynamics including flow in nozzles and diffusers, normal shocks, moving and oblique shocks, Prandtl-Meyer Flow, Fanno Flow, Rayleigh Flow, and reaction propulsion systems. Prereq: ME 3030 and ME 3080, or consent of instructor.

ME 6220 Design of Gas Turbines 3 (3) Guiding principles in gas turbine cycles are reviewed. Turbine and compressor design procedures and performance prediction for both axial and radial flow machines are presented. Methods of design of rotary heat-exchangers and retrofiting gas turbine for regenerative operation are presented. Design projects are used to illustrate the procedures. Prereq: ME 3080 or consent of instructor.

ME 6230 Introduction to Aerodynamics 3 (3) Basic theories of aerodynamics are presented for the purpose of accurately predicting the aerodynamic forces and moments which act on a vehicle in flight. Prereq: ME 3080 or consent of instructor.

ME 6260 Nuclear Energy 3 (3) Engineering methods and science principles are considered for the design of components to nuclear power stations. A systems level understanding is emphasized. Includes nuclear fuel cycle and regulatory considerations. Prereq: ME 3030 and ME 3040, or consent of instructor.

ME 6290 Thermal Environmental Control 3 (3) Mechanical vapor compression refrigeration cycles, refrigerants, thermoelectrical cooling systems, cryogenics, thermodynamic properties of air, psychometric charts, heating and cooling coils, solar radiation, heating and cooling loads, insulation systems. Prereq: ME 3030 and ME 3080, or consent of instructor.

ME 6300 Mechanics of Composite Materials 3 (3) Develops fundamental relationships for predicting the mechanical and thermal response of multilayered materials and structures. Develops micro- and macro-mechanical relationships for laminated materials emphasizing continuous filament composites. Discusses the unique nature of composites and the advantages of designing with composites. Prereq: ME 2040 or consent of instructor.

ME 6320 Advanced Strength of Materials 3 (3) Topics in strength of materials not covered in ME 3020. Three-dimensional stress and strain transformations, theories of failure, shear center, unsymmetrical bending, curved beams, and energy methods. Other topics such as stress concentrations and fatigue concepts are treated as time permits. Prereq: ME 2040 or consent of instructor.

ME 6530 Dynamic Performance of Vehicles 3 (3) Introduces techniques for analyzing the dynamic behavior of vehicles. Types of vehicles to be considered are chosen from aircraft, surface ships, automobiles and trucks, railway vehicles, and magnetically levitated vehicles. Prereq: ME 3050 or consent of instructor.

ME 6540 Design of Machine Elements 3 (3) Design of common machine elements including clutches, brakes, bearings, springs, and gears. Optimization techniques and numerical methods are employed as appropriate. Prereq: ME 3060 or consent of instructor.

ME 6550 Design for Manufacturing 3 (3) Concepts of product and process design for automated manufacturing are considered. Topics include product design for automated manufacturing, inspection and assembly, using automation, industrial robotics, knowledge-based systems and concepts of flexible product manufacture. Prereq: ME 3060 and ME 3120 or consent of instructor.

ME 6570 Fundamentals of Wind Power 3 (3) Introduces wind turbine systems, including wind energy potential and application to power generation. Topics include wind energy principles, wind site assessment, wind turbine components, power generation machinery control systems, connection to the electric grid, and maintenance. May also be offered as ECE 6570. Prereq: ECE 2070 or ECE 3200; or consent of instructor.

ME 6710 Computer-Aided Engineering Analysis and Design 2-6 (2-6) Study of topics not found in other courses. May be repeated for a maximum of six credits, but only if different topics are covered. Prereq: Consent of instructor.

ME 6711 Computer-Aided Engineering Analysis and Design Laboratory 0 (3) Non-credit laboratory to accompany ME 6710. Coreq: ME 6710.

ME 6930 Selected Topics in Mechanical Engineering I-6 (1-6) Study of topics not found in other courses. May be repeated for a maximum of six credits, but only if different topics are covered. Prereq: Consent of instructor.

ME 8010 Foundations of Fluid Mechanics 3 (3) Derivations of basic equations for multidimensional flow fields; analytical techniques for solving problems in laminar viscous flow and laminar inviscid flow; theories of similitude. Prereq: Consent of instructor.

ME 8100 Macroscopic Thermodynamics 3 (3) First, second and third laws of thermodynamics with engineering applications; thermodynamic property relations; chemical equilibrium. Prereq: ME 3120.

ME 8110 Gas Dynamics 3 (3) Concepts from thermodynamics, one-dimensional gas dynamics, one-dimensional wave motion, normal and oblique shocks; flow in ducts and wind tunnels; two-dimensional equation of motion; small perturbation theory. Prereq: Students are expected to have completed an undergraduate course in fluid mechanics before enrolling in this course.

ME 8120 Experimental Methods in Thermal Science 3 (2) Theories of measurements, instrumentation and techniques for measuring temperature, pressure and velocity on a practical graduate engineering level; mathematical presentation of data, uncertainty analysis, data acquisition techniques, and theory and state-of-the-art measuring systems. Coreq: ME 8121.
ME 8121 Experimental Methods in Thermal Science Laboratory 0 (2) Non-credit laboratory to accompany ME 8120. Coreq: ME 8120.

ME 8140 Concepts of Turbulent Flow 3 (3) Concepts of fluid turbulence; turbulent transport mechanisms, dynamics of turbulence and experimental techniques pertinent to existing theories; classification of shear flows and their prediction methods. Preq: ME 8010 or consent of instructor.

ME 8150 Statistical Thermodynamics I 3 (3) Fundamental principles of kinetic theory and quantum statistical mechanics; Boltzmann statistics, Fermi-Dirac statistics and Bose-Einstein statistics. Students are expected to have completed a course in thermodynamics or obtained consent of instructor before enrolling in this course. May also be offered as PHYS 8150.

ME 8180 Introduction to Finite Element Analysis 3 (3) Introduction to the finite element method; applications to heat transfer, fluid flow and solids; introduction to transient analysis; analysis strategies using finite elements; introduction to solid modeling, finite element modeling and analysis using commercial codes. Preq: Students are expected to have completed a numerical methods course or obtained consent of instructor before enrolling in this course.

ME 8190 Computational Methods in Thermal Sciences 3 (3) Numerical techniques as applied to the solution of fluid flow and heat transfer problems; use of finite difference methods.

ME 8200 Modern Control Engineering 3 (3) State-space approach to analysis of linear dynamic systems and control design, state-space representation, key topics in linear algebra and vector spaces, principles of controllability, observability, stability and performance specification; trade-offs between state variable and transfer function techniques. Observer designs, pole placement and optimal control theory; LQR and Kalman filtering. Preq: ME 8230 or consent of instructor. Students who have not completed ME 8230 but have completed undergraduate controls course should request a registration override from the instructor.

ME 8210 Advanced Control Engineering 3 (3) Reviews topics from modern control engineering, characteristics of nonlinear systems. Phase Plane and Describing-Function techniques. Lyapunov theory and stability analysis; nonlinear feedback control systems using Lyapunov method. Advanced topics, variable structure system control, adaptive control-system analysis and design, robust adaptive control, optimal control and digital control. Preq: ME 8200 or consent of instructor. Students who have not completed ME 8200 but have completed a graduate-level course in modern control should request a registration override from the instructor.

ME 8230 Control Systems Engineering 3 (3) Physical modeling; mathematical analysis and feedback principles for control of multidisciplinary dynamic systems, including mechanical, electrical, electromechanical, hydraulic and pneumatic systems. Transient response, root locus and frequency response principles applied to control of complex dynamic systems. Sensors, actuators and dynamic plant integration to develop, model, control and analyze dynamics systems. Students are expected to have completed an undergraduate course on system dynamics or obtained consent of instructor before enrolling in this course.

ME 8290 Energy Methods and Variational Principles 3 (3) Application of variational principles in solid mechanics problems; virtual work; Castigliano’s theorems on deflection and rotation; stationary potential energy; energy stability criterion; Hamilton’s principle. Preq: ME 8370 or consent of instructor.

ME 8300 Conduction and Radiation Heat Transfer 3 (3) Fundamental concepts related to conduction and radiation heat transfer; analytical methods for steady and transient conduction heat transfer in one and two physical dimensions; radiation exchange between surfaces with and without radiatively participating media; combined conduction and radiation heat transfer. Preq: ME 3040 or consent of instructor.

ME 8310 Convective Heat Transfer 3 (3) Derivation of continuity, momentum, and energy equations for boundary layer flow; solutions for confined and external flow regimes in laminar and turbulent flow. Preq: ME 3040 and MATH 2080.

ME 8320 Radiative Heat Transfer 3 (3) Radiation properties; enclosure theory; radiation exchange between solid bodies; radiation exchange in the presence of absorbing, transmitting and emitting media; combined radiation, conduction and convection exchange. Preq: ME 3040 or consent of instructor.

ME 8330 Heat Transfer with Change of Phase 3 (3) Nucleate boiling in a pool; film boiling in a pool; forced nucleate boiling; forced film boiling; effect of impurities on boiling phenomena; dropwise condensation; filmwise condensation; effect of noncondensable gases on condensation; boiling and condensing processes in systems. Preq: ME 3040 or consent of instructor.

ME 8340 Principles of Structural Stability 3 (3) Practical criteria for analysis of conservative and nonconservative systems’ stability; methods of adjacent equilibrium, initial imperfections, total potential energy and vibration as applied to practical problems. Preq: ME 8370.

ME 8360 Fracture Mechanics 3 (3) Fundamental elasticity-based course in the development of the basic concepts of engineering fracture mechanics; the Griffith criterion, Barrenblatt and Dugdale models, linear elastic fracture mechanics (L.E.F.M.), plane strain fracture toughness, the crack-tip stress and strain field, and plasticity and the J-integral. Preq: ME 8370.

ME 8370 Theory of Elasticity I 3 (3) Theory of stress and deformation for continuous media; linear stress-strain relations for elastic material; two-dimensional problems including Airy stress function, polynomial solutions, plane stress and plane strain in rectangular and polar coordinates, torsion and bending of prismatic bars and thermal stresses. Preq: ME 3020 and MATH 2080 or consent of instructor.

ME 8380 Theory of Elasticity II 3 (3) Continuation of ME 8370, including topics from either three-dimensional problems associated with an infinite elastic medium, elastic half-space, contact stresses, symmetrically loaded sphere and circular cylinder, or complex variable methods in plane elasticity, stress concentrations problems, singular stresses and fracture, and composite materials. Preq: ME 8370 and PHYS 8120.

ME 8430 Advanced Dynamics 3 (3) Concepts in nonlinear dynamic systems with emphasis to mechanical systems. Classification, stability and bifurcations of equilibrium solutions. Analytical construction, stability and bifurcations of periodic solutions. Floquet theory, Poincare maps. Quasi-periodic solutions, Lyapunov exponents and routes to chaos. Perturbation and asymptotic methods for approximate analytical solutions of weakly nonlinear systems. Preq: ME 8460 or consent of instructor. Students who have not completed ME 8460 but have completed undergraduate courses in dynamics and differential equations should request a registration override from the instructor.

ME 8450 Structural Vibrations 3 (3) Vibrations of lumped-parameters systems; free and forced vibrations of SDOF and MDOF systems, general eigenvalue problem and modal analysis. Variational approach and energy methods. Vibrations of distributed-parameter systems; strings, bars, shafts, beams, membranes and plates. Approximate methods; Rayleigh’s Quotient, Rayleigh-Ritz methods, method of functions expansion, Galerkin’s and assumed mode methods. Preq: ME 8460 or consent of instructor. Students who have not completed ME 8460 but have completed an undergraduate course in vibration or in dynamics and differential equations, should request a registration override from the instructor.

ME 8460 Intermediate Dynamics 3 (3) Kinematics and dynamics of particles, rigid and elastic bodies using vectorial and analytical approaches. Fundamentals of analytical dynamics; holonomic versus nonholonomic constraints, virtual displacements and work, Hamilton’s Principle and Euler-Lagrange’s equations. Rigid-body dynamics; principal axes and Euler angles. Kinematics and dynamics of elastic bodies. Students who have not completed ME 3050 but have completed undergraduate courses in dynamics and differential equations should request a registration override from the instructor.

ME 8520 Advanced Finite Element Analysis 3 (3) Application of variational and weighted residuals methods; nonlinear analysis, steady-state and time-dependent problems; application of commercial finite element codes; advanced computational procedures. Preq: CE 8080 or consent of instructor.

ME 8590 Intelligent Robotic Systems 3 (3) Integration and fusion of data from multiple sensors on multiple robots; intelligent decision making on motion planning and execution based on sensed data involving mutual compliance; simultaneous force and position controls using computers. May also be offered as ECE 8590. Preq: ECE 8540.

ME 8610 Materials Selection in Engineering Design 3 (3) Advanced study of various physical, chemical and mechanical materials properties which govern the selection of materials in engineering design. Case studies of materials selection in design with metals, ceramics, polymers and composites are presented.

ME 8700 Advanced Design Methodologies 3 (3) Nurturing of creativity; decision-making processes for design; in-depth study of the mechanical design process and tools; quality function deployment, concurrent design, systemic design, robust design, design for assembly and axiomatic design.
ME 8710 Engineering Optimization 3 (3) Optimization in the context of engineering design; nonlinear and linear, static and dynamic, constrained and unconstrained formulation and solution of practical problems; structural optimization; multiobjective optimization; genetic algorithms; simulated annealing.

ME 8720 Design Automation for Mechanical Engineers 3 (3) Students are exposed to data structures, search algorithms, geometric algorithms, geometric modeling, and software engineering for mechanical engineers. Students design and implement mechanical CAD software packages. Emphasizes the use of software development tools, algorithm design, and their interfaces in mechanical engineering. Students are expected to have programming experience before enrolling in this course. Those with no programming experience may request consent of instructor.

ME 8730 Research Methods in Collaborative Design 3 (3) Topics include research methods for studying collaborative design, influencing factor of collaboration, computer issues in collaboration, and mechanical engineering as facilitated by collaboration. Technical writing and experimentation are emphasized.

ME 8740 Integration Through Optimization 3 (3) Theory, methodology and applications of decomposition, integration and coordination for large-scale or complex optimization problems encountered in engineering design. Topics include conventional and non-conventional engineering optimization algorithms, analysis models and methods, multi-disciplinary optimization, analytic target cascading, multi-scenario optimization, and multicriteria optimization. Case studies are included. Prereq: MATH 9000 or MATH 9860 or ME 8710.

ME 8910 Master’s Thesis Research 1-12 (1-12) Master’s Thesis Research

ME 8930 Selected Topics in Mechanical Engineering 1-6 (1-6) Topics not covered in other courses. May be repeated for credit.

ME 9300 Advanced Topics in Heat Transfer 1-6 (1-6) Topics not covered in other courses. May be repeated for a maximum of six credits.

ME 9310 Advanced Topics in Fluid Mechanics 3 (3) Topics not covered in other courses. May be repeated for a maximum of six credits.

ME 9320 Advanced Topics in Thermodynamics 3 (3) Topics not covered in other courses. May be repeated for a maximum of six credits.

ME 9910 Doctoral Dissertation Research 1-12 (1-12) Doctoral Dissertation Research

MANAGEMENT

MGT 8030 Operations Management 3 (3) Introduction to a broad range of operations management topics. Serves as a foundation for understanding the importance, relevance and significance of analytical models and tools to be introduced in subsequent courses in the MS in Management program. Topics include operations strategy, process and facility design, planning and control, quality management, and continuous improvement. Offered fall semester only.

MGT 8040 Operations Strategy 3 (3) In-depth study, through case studies and readings, of the role operations systems capabilities play in providing sources of competitive advantage. Topics include industry analysis, technological forecasting, formulation of organization and operations strategies, and development of operations system capabilities. Offered fall semester only. Prereq: MGT 8030 or consent of instructor.

MGT 8060 Industrial Management Internship 0 (0) Faculty-approved internship to give MS in Management students on-the-job learning in support of classroom education. Internships must be at least six, full-time, consecutive weeks with the same internship provider. May be repeated. Prereq: Consent of graduate coordinator.

MGT 8070 Comparative Management Theory 3 (3) Evolution of management theory, up to and including contemporary theories; comprehensive review of the major schools of management thought, with emphasis on the area of organization theory and design.

MGT 8080 Manufacturing Planning and Control Systems 3 (3) Important components of a manufacturing planning and control system emphasizing the integration of planning and control functions in a dynamic manufacturing environment; extensive hands-on work with integrated manufacturing software. Offered spring semester only. Prereq: MGT 8030 or consent of instructor.

MGT 8090 Organizational Behavior and Human Resources Management 3 (3) Theories and models of behavior; human resources management concepts and processes as they apply to managing individual and workgroup behavior in organizations. Organizational behavior topics include leadership, motivation and teamwork. Human resource management topics include human resources strategy, selection, performance evaluation, reward systems and employee development. May also be offered as MBA 8090.

MGT 8120 Supply Chain Management 3 (3) In-depth study, through case studies and readings, of methodologies for designing and managing integrated, international supply chain networks. Topics include supply network design, distribution strategy, strategic alliances, inventory management, coordinated product and network design, and information systems for supply chain. Offered fall semester only. Prereq: Consent of instructor.

MGT 8150 Personnel Management 3 (3) Personnel management activities including recruitment, selection, training and development, performance appraisal, discipline, grievance handling, wage and salary administration, and employee benefit programs.

MGT 8190 Web-Based Information Systems for Supply Chain Management 3 (2) Examines system architectures, technologies, approaches and infrastructure requirements for supply-chain information systems. Students learn to design, develop and implement systems that facilitate collaboration of an enterprise with its buyers and suppliers. Prereqs: MGT 8120 and MGT 8180; or consent of instructor. Coreq: MGT 8191.

MGT 8191 Web-Based Information Systems for Supply Chain Management Laboratory 0 (0) Non-credit laboratory to accompany MGT 8190. Coreq: MGT 8190.

MGT 8200 Service Operations Management 3 (3) Concepts and techniques of service operating system design and management. Topics include characteristics of services, service system performance measurement, queuing and automation, planning and control in different service environments, and international service operations. Prereq: MGT 8030 or consent of instructor.

MGT 8210 Lean Operations 3 (3) Examines uses of the scientific method, the Toyota Production System and the application of the appropriate tools and methods to design both service and production operations. Development of systems that promote lean operations is emphasized. Prereq: MBA 8060 or MBA 8560 or MGT 8030 or consent of instructor.

MGT 8220 International Operations Management 3 (3) Operations management within an international business environment. Topics include the regulatory and cultural environment of international business, international business and operations strategies, global location, global sourcing and logistics decisions, international workforce management, technology transfer and configuration, and coordination of global operations activities. Prereq: MGT 8030 or consent of instructor.

MGT 8230 Management Information Systems Analysis 3 (3) Design, construction and analysis of stochastic simulation models for management decisions; design; input-output; variance reduction; applications; validation; implementation; optimum seeking techniques; designed experiments; effect of model results on managerial policy decisions.

MGT 8240 Service Strategy: Design for Customer Experience 3 (3) Multidisciplinary approach to service design, considering the roles of customers and employees in creating experiences. Includes principles, frameworks and paradigms describing services design and management necessary to achieving a distinctive competitive advantage. Emphasizes development and execution of strategies that link operations and marketing. Prereq: MBA 8560 or consent of instructor.

MGT 8290 Management of E-Commerce 3 (3) Concepts of electronic commerce as facilitated by the Internet and related technologies. Topics include the catalysts for e-commerce (both B2B and B2C), technological challenges, legal and regulatory framework, behavior and educational challenges, and strategies for e-commerce. Prereq: Consent of instructor.

MGT 8330 E-Commerce Project 3 (9) Application of e-commerce knowledge to a significant problem or opportunity. Prereq: Submission of a written proposal and consent of instructor.

MGT 8450 Technology and Innovation Management 3 (3) Interdisciplinary examination of problems and issues in integrating technology and innovation into processes and products; evaluating tangible and intangible aspects of new technology adoption; management research and development; and functional integration of marketing and operations. May also be offered as MBA 8450.
MGT 8500 Business Decision Models 3 (3) Fundamental management science modeling techniques emphasizing problem formulation, computer solution and economic analysis in an operations context; queuing analysis, computer simulation and mathematical programming approaches including linear, goal and integer programming. Application areas encompass production, capacity, and project planning, scheduling, location, layout and logistics. Prereq: Consent of instructor.

MGT 8520 Management Science II 3 (3) Continuation of MGT 8500; dynamic, integer and nonlinear programming emphasizing applications of different types of mathematical programming to business and industrial problems. Prereq: MGT 8500 or consent of instructor.

MGT 8540 Design of Experiments in Business and Management 3 (3) Design and analysis of experiments with a focus on business and industrial applications. Topics range from the analysis of single-factor experimental designs through factorial experiments, multiple comparisons and confounding. Problems arising in the actual industrial environments are used to illustrate the application of the techniques and to introduce the student to major statistical software packages for the analysis of experimental data. Offered fall semester only.

MGT 8560 Business Fundamentals for Supply Chain Management 3 (3) Principles and techniques of leadership, human resources management, financial management, marketing and economic analysis, particularly as they relate to the capital projects supply chain management. Prereq: Enrollment in Master of Engineering Program in Industrial Engineering.

MGT 8610 Information Systems 3 (3) The critical role of information systems in contemporary business organizations; key information systems and technologies; their impacts both within and across organizational settings. May also be offered as MBA 8610.

MGT 8660 System Analysis and Design 3 (2) Software engineering methods and techniques specific to analysis and design of information systems. Topics include concepts and methods for valuation of IT applications, data gathering, and process, data and object-oriented modeling analysis and design. Prereq: MGT 8660.

MGT 8661 System Analysis and Design Laboratory 0 (1) Non-credit laboratory to accompany MGT 8660. Prereq: MGT 8660.

MGT 8690 Project Management 3 (3) In-depth study, through case studies, readings and hands-on experience, of processes and techniques to initiate, plan, execute, control and close-out information technology projects. Topics include project integration, scope, time, cost, quality, human resource, communications, risk and procurement management. Prereq: Consent of instructor.

MGT 8740 Managing Continuous Improvement 3 (3) How to initiate and lead change toward a total quality environment; basic tools of quality management; use of teams to achieve change; quality function deployment; ISO 9000; supplier development; and use of survey methods to track progress of change. May also be offered as MBA 8740. Prereq: MGT 8030 or consent of instructor.

MGT 8850 Industrial Scheduling 3 (3) Theoretical results for single and parallel machine, flow shop, job shop and network scheduling; treatment of mathematical programming applications, scheduling algorithm design and search procedures. Prereq: One of the following: CE 8350 or CPSC 8400 or IE 8030 or MBA 8590 or MGT 8500 or MATH 8120 or MATH 8140; and consent of instructor.

MGT 8880 International Perspectives in Industrial Management 1-6 (1-6) International perspective to industrial management via organized plant visitations to businesses in a foreign country and lectures by, and discussions with, senior operations managers. Cultural visits and lectures are also organized to provide a holistic perspective to cover cultural and economic development of the host country. May be repeated for a maximum of six credits. Prereq: Consent of instructor.

MGT 8910 Master’s Thesis Research 1-12 (1-12) Master’s Thesis Research

MGT 8920 Master’s Project Course 3 (9) Field project, the capstone activity in the program, requiring application of the program body of knowledge to a real-world operations management problem. Formal presentation and written report are required. May be repeated for a maximum of 12 credits. To be taken Pass/No Pass only. Prereq: Consent of instructor.

MGT 8990 Selected Topics in Industrial Management 3 (3) Current topics in industrial management theory and/or practice. Topics vary in keeping with developments in the management profession and interests of faculty. May be repeated for a maximum of nine credits.

MGT 9030 Seminar in Manufacturing Planning and Control Systems 3 (3) Current research issues and developments in manufacturing planning and control systems emphasizing research (philosophical, analytical and empirical) dealing with alternative approaches for planning and control of manufacturing operations. Prereq: MGT 8080 and consent of instructor.

MGT 9040 Seminar in Current Management Topics 3 (3) Topics from current management literature emphasizing research from scholarly journals. Topics vary in keeping with developments in the literature. May be repeated with different faculty for a maximum of six credits. Prereq: MGT 8030 or consent of instructor.

MGT 9050 Research Methods 3 (3) Research methods supporting scholarly research and publication in management. Topics include theory building, hypothesis specification and testing, experimental design, measurement, sampling, research ethics and related issues. Restricted to doctoral students. Prereq: MGT 8540.

MGT 9070 Seminar in the Design of Operations Systems 3 (3) Current management issues and developments in the evaluation, selection, design and installation of systems for manufacturing and service operations; empirical research dealing with the building blocks of operations such as process technology scanning, selection and installation; operations systems location and layout; and management systems selection and installation. Prereq: MGT 8210 and consent of instructor.

MGT 9100 Seminar in Operations Management 1-3 (1-3) New methodological developments, both analytical and philosophical, in operations management; development of theory of management science; converting management theory into practice while considering behavioral and economic aspects of the problem. Prereq: Consent of instructor.

MGT 9160 Directed Readings in Management 1-3 (1-3) Directed reading and research in the student’s area of interest. May be repeated for a maximum of three credits. Prereq: Consent of instructor.

MGT 9180 Seminar in Management Support Systems 3 (3) Contemporary topics in decision-oriented information systems research; structure of the field, research methodologies and research opportunities. Prereq: MGT 8180 or consent of instructor.

MGT 9250 Seminar on Information Systems Foundations 3 (3) Foundations of information systems research including classical framework literature. Research philosophies, key methodologies and relevant theoretical underpinnings are discussed and debated.

MGT 9270 Seminar in Organizational Impacts of Information Systems 3 (3) Current theoretical and empirical research related to the organizational impacts of information systems. Research focuses on strategic and structural impacts of information technologies within and across organizations.

MGT 9910 Doctoral Dissertation Research 1-12 (1-12) Doctoral Dissertation Research

HEALTH ADMINISTRATION

MHA 7170 Selected Topics in Health Administration I-3 (1-3) Variable topics are taught to reflect current state-of-the-art issues. May be repeated for a maximum of six credits, but only if different topics are covered.

MHA 7210 Health Care Delivery Systems 3 (3) Overview of the development of the health services delivery system in the United States.

MHA 7240 Health Care Ethics 3 (3) Examination and analysis of the professional standards, laws and political and economic forces that establish a context for health care ethics.

MHA 7320 Outcomes Assessment and Evaluation in Health Services 3 (3) Introduces the general application of evaluative research in a variety of health care settings, administrative purposes of evaluation of organizational components and/or programs and the design and implementation of evaluative efforts.

MHA 7430 Managing with Health Professionals 3 (3) Devoted to learning about clinical professionals and exploring ways to facilitate effective and efficient team relationships in the management and delivery of health services.

MHA 8530 Seminar in Health Administration and Leadership 2 (2) Integrates knowledge and skills acquired across all courses in the context of strategic management.
COURSES OF INSTRUCTION

MICR 6000 Public Health Microbiology 3 (3) Epidemiology of transmissible diseases including pathogenic characteristics of the infectious organism, modes of transmission, mechanism of infection, diagnostic aids, effective treatments, immunizing procedures, and methods of preventing infection. Prereq: MICR 3050.

MICR 6010 Microbial Diversity and Ecology 3 (3) In-depth survey of microbial morphology, ecology, and diversity. Study of the interaction and adaptation of microbes in a wide range of environmental conditions, including consideration of their metabolism, nutrition, growth and the use of microbiological assays. Prereq: CH 2210 or CH 2230; and CH 2270; and MICR 3050.

MICR 6020 Environmental Microbiology 3 (3) Discussion of microorganisms in air, terrestrial, and aquatic environments and how they are used for environmental restoration activities. Topics include the nature of biofilms, interactions of microbes with inorganic and organic constituents, processes to implement biomediation in surface/subsurface environments, and treatment of solid, liquid, and gaseous waste streams. Prereq: MICR 3050 and MICR 4010; and either CH 2100; or both CH 2230 and CH 2270; or consent of instructor.

MICR 6030 Marine Microbiology 3 (2) Discussion of the microbes that inhabit the marine environment, their peculiar physiological traits, and contributions to the ecology of oceans. Prereq: MICR 3050; and either CH 2100; or both CH 2230 and CH 2270. Coreq: MICR 6031.

MICR 6031 Marine Microbiology Laboratory 0 (3) Non-credit laboratory to accompany MICR 6030. Coreq: MICR 6030.

MICR 6050 Advanced Microbial Ecology of Humans 3 (3) Investigation of the complex ecological relationships between microbes and their human hosts, including investigation of the normal microbial community in various body systems, factors that change the microbiota, and the role of the microbiota in normal development, health and disease of the host. Prereq: MICR 4010.

MICR 6070 Food and Dairy Microbiology 4 (3) Physical-chemical factors limiting survival and growth of microorganisms during processing and manufacturing of food and dairy products. Standard methods for enumerating and identifying indicator bacteria, yeasts, molds, and microbes producing food and food-borne illness. Starter cultures, fungal toxins, microbial cell injury and standards for food and dairy products. Prereq: MICR 3050; and one of BCHM 3050 or CH 2100 or CH 2230. Coreq: MICR 6071.

MICR 6071 Food and Dairy Microbiology Laboratory 0 (3) Non-credit laboratory to accompany MICR 6070. Coreq: MICR 6070.

MICR 6100 Soil Microbiology 3 (3) Role of microorganisms in the decomposition of organic substances, transformation of nitrogen and mineral substances in the soil; interrelationships between higher plants and microorganisms; importance of microorganisms in soil fertility. Prereq: MICR 4010.

MICR 6110 Pathogenic Bacteriology 3 (3) Study of pathogenic bacteria and their virulence mechanisms. Emphasizes host-microbe interactions, responses to infection and treatment, and research strategies for various topics of bacterial pathogenesis. Prereq: MICR 3050 and MICR 4120 and MICR 4140.

MICR 6120 Bacterial Physiology 3 (3) Consideration of the cytology, physiology, metabolism, and genetics of bacteria. Includes studies of growth and death, reproduction and mutation, nutrition and metabolic pathways, regulatory mechanisms, and effects of environment. Includes Honors sections. Prereq: CH 2240 and MICR 3050; and either BCHM 3010 or BCHM 3050. MICR 6130 Industrial Microbiology 3 (2) Microbial aspects of large-scale processes for the production of foods, antibiotics, enzymes, fine chemicals, and beverages. Topics include strain selection, culture maintenance, biosynthetic pathways, continuous cultivation and production of single cell protein. Prereq: MICR 3050. Coreq: MICR 6131.

MICR 6131 Industrial Microbiology Laboratory 0 (3) Non-credit laboratory to accompany MICR 6130. Coreq: MICR 6130.

MICR 6140 Basic Immunology 3 (3) Introduction to the immune system of vertebrate animals, with an emphasis on structure, function, regulation, and cellular and molecular mechanisms of immune responses. May also be offered as AVS 6140 or BIOL 6140. Prereq: BIOL 4610 and MICR 3050.

MICR 6150 Microbial Genetics 3 (3) Investigates the molecular basis of microbial lives. Topics include essential genes involved in DNA, RNA and protein metabolism; mutations and genome evolution; global gene regulation; and genetic analysis, using both forward and reverse genetics. Prereq: MICR 4120; and BCHM 3010 or BCHM 3050; and GEN 3000 or GEN 3020. Non-Microbiology majors do not have to have taken MICR 4120, but must request a registration override from the instructor to enroll in this course.

MICR 6160 Introductory Virology 3 (3) Introduction to the field of virology, including animal, bacterial, and plant viruses. Topics include nomenclature and classification, biochemical and biophysical characteristics, mechanisms of replication, chemotherapy, and techniques for isolation, assay, and purification. Prereq: MICR 3050; and either BCHM 3010 or BCHM 3050.

MICR 6170 Cancer and Aging 3 (3) Discusses alterations that occur at molecular, cellular and tissue levels during cell transformation and aging. Topics include the cell division cycle, signal transduction pathways, oncogenes and tumor suppressors, cell death and cell aging. Prereq: MICR 3050 and BIOL 4610; and either BCHM 3010 or 3050.

MICR 6190 Selected Topics in Molecular Medicine 3 (3) Introduction to various areas of molecular medicine. Examines the latest research and developments in molecular medicine. Designed for students interested in medicine and biomedical research. Graduate students may repeat for a maximum of six credits. Prereq: BCHM 3010 or BCHM 3050 or MICR 3050.

MICR 6240 Immunology Laboratory 1 (3) This course is designed to apply the knowledge gained in MICR 6140, Immunology lecture, in an applied setting. The experiments in this beginning immunology laboratory are designed to study both the innate and acquired immune systems. Experimentation into the formation, function and detection of antibodies provides students with skills in basic immunologic techniques. Prereq or concurrent enrollment: MICR 6140.

MICR 6250 Microbial Gen Lab 1 (3) Complements the genetics topics covered in the Microbial Genetics lecture. These topics are important at practical levels for molecular and genetics studies. The laboratory is used to teach basic cloning techniques, the basis of blue/white screening, isolation of mutants, calculation of mutation rate, as well as gene regulation. Prereq or concurrent enrollment: MICR 6150.

MICR 6270 Cancer and Aging Lab 1 (3) The laboratory is used to teach the basic molecular protocols for cancer and aging research, and will help students to understand the mechanisms of cancer and aging discussed in lecture. Prereq or concurrent enrollment: MICR 6170.

MICR 6300 Soil Microbiology Laboratory 1 (3) Examines microbes residing in the soil and their effects on the soil substrate and resident plant communities. Topics include biogeochemistry, microbial isolation, microcosm development, and characterization of soil microbial communities. Prereq or concurrent enrollment: MICR 4100 or consent of instructor.

MICR 6560 Medical and Veterinary Parasitology 3 (3) Introduction to parasitism in the animal kingdom. Emphasizes basic and applied principles related to economically and medically important diseases. Classical and experimental approaches to the study of parasitism are examined in reference to protozoa, helminths, and arthropods. May also be offered as BIOL 6560.

MICR 6570 Medical and Veterinary Parasitology Laboratory 2 (1) Laboratory to reinforce material presented in BIOL 4560. Introduces students to both live and preserved human/animal parasites. Also introduces techniques used in collection, preservation, and examination of animal parasites. Coreq: MICR 6560 and MICR 6571.

MICR 6571 Medical and Veterinary Parasitology Laboratory 0 (2) Non-credit laboratory to accompany MICR 6570. Coreq: MICR 6570.

MICR 8020 Bacteriological Techniques 4 (2) Analytical and experimental procedures used in bacteriology including techniques for studying bacterial cytology, physiology and metabolism; experience in more advanced methods of investigation. Offered fall semester only. Coreq: MICR 8021.

MICR 8021 Bacteriological Techniques Laboratory 0 (6) Non-credit laboratory to accompany MICR 8020. Coreq: MICR 8020.

MICR 8030 Special Problems in Microbiology 1-12 (1-12) Research not related to a thesis.

MICR 8040 Selected Topics in Microbiology 1-3 (1-3) Evaluation of current research literature in various areas of microbiology. Critical evaluation of specific publications in terms of their scientific merit. Required of all Microbiology graduate students. May be repeated for credit.
MICR 8050 Techniques of Clinical Microbiology and Immunobiology 3 (2) Methods for isolating, identifying and culturing different mammalian cell types; techniques used to analyze cell function and viability and for protein and DNA analysis emphasizing application to the diagnosis of disease, determination of prognosis, optimization of treatment and determination of etiology. Preq: AVS 6140 or BIOL 6440 or MICR 6140; and MICR 6150 and BCHM 6230; or consent of instructor. Coreq: MICR 8051.

MICR 8051 Techniques of Clinical Microbiology and Immunobiology Laboratory 0 (3) Non-credit laboratory to accompany MICR 8050. Coreq: MICR 8050.

MICR 8060 Pathogenesis and Infectious Disease 3 (3) Medically important host-parasite relationships at the cellular and subcellular levels with emphasis on bacterial and viral infections in man. Preq: MICR 6110 or consent of instructor.

MICR 8070 Current Topics in Microbiology 1 (1) Students learn and practice skills of literature interpretation, presentation and discussion of articles in relevant and current scientific journals. To be taken Pass/No Pass only. May be repeated for a maximum of eight credits.

MICR 8090 Epidemiological Research 3 (3) Basic concepts of epidemiology with emphasis on applied aspects rather than theoretical. Examples are drawn from clinical practice. Use of relevant PC-based computer packages is required. Preq: AVS 6140 or BIOL 6440 or MICR 6140; and MICR 6150 and BCHM 6230; or consent of instructor.

MICR 8110 Bacterial Cytology and Physiology 4 (4) Structure, chemistry and physiology of the various bacterial cell components. Physiology of bacterial growth and reproduction in batch, continuous and synchronous cultures. Economy of the bacterial cell including endogenous metabolism and maintenance requirements; physiology of bacterial death; regulation of enzyme and nucleic acids synthesis. Offered spring semester of odd-numbered years only. Preq: BCHM 4230 and MATH 2060; or consent of instructor.

MICR 8120 Bacterial Metabolism 3 (3) Various biochemical pathways occurring in bacterial cells; fermentations of carbohydrates and related compounds and of nitrogenous organic compounds; anaerobic and aerobic respiration including electron transport systems and oxidative phosphorylation; bacterial photosynthesis; nitrogen fixation; biosyntheses of amino acids, purines, pyrimidines, lipids, proteins, nucleic acids and polysaccharides. Offered spring semester of even-numbered years only. Preq: BCHM 4230 and MATH 2060; or consent of instructor.

MICR 8150 Advanced Microbial Genetics 3 (3) Current developments in microbial genetics; integration of genetics and biochemistry; analysis of genetic fine structure in microorganisms; nature of bacterial variation and expression of mutations; population dynamics; physicochemical mechanisms of heredity; regulation of gene action in microorganisms; physiology and genetics of virulent and lysogenic bacteriophages. Offered fall semester only. Preq: MICR 4150.

MICR 8250 Global Gene Regulation of Bacterial Stress Response 3 (3) Focuses on global gene regulation in microbial systems and discusses how microorganisms adapt to various environments. Topics include general stress response, heat shock, envelope stress, oxidative and nitrosative stress, metal homeostasis, sporulation and competence regulation, and bacterial cannibalism. Preq: MICR 4150 or 6150; or consent of instructor.

MICR 8910 Master’s Thesis Research 1-12 (1-12) Master’s Thesis Research

MICR 9910 Doctoral Dissertation Research 1-12 (1-12) Doctoral Dissertation Research

MARKETING

MKT 6230 Promotional Strategy 3 (3) Emphasizes promotion as the communication function of marketing. Attention is given to communication theory and promotion’s relation to mass and interpersonal communication. Factors affecting promotional decision-making process are explored, and promotion as a competitive tool is examined. Preq: MKT 3010 or consent of instructor.

MKT 6270 International Marketing 3 (3) Study of marketing from the international point of view. Emphasis is on the necessary modification of marketing thinking and practice for foreign markets due to individual environmental differences. Preq: MKT 3010.

MKT 6280 Services Marketing 3 (3) Exploration and study of the nature of service organizations and the principles that guide the marketing of their products. Emphasis is on a marketing mix that is fundamentally different than that found in traditional goods marketing. Preq: MKT 3010 or consent of instructor.

MKT 6290 Public and Nonprofit Marketing 3 (3) Examines the role and application of marketing in public and nonprofit settings. Focuses on a conceptual understanding of the marketing discipline and marketing processes and shows how basic concepts and principles of marketing are applicable to public and nonprofit organizations. Preq: MKT 3010 or consent of instructor.

MKT 6300 Marketing Product Management 3 (3) Management of the firm’s product or service offerings. Topics include new product screening, evaluation, and development; product line and mix analysis, abandonment decisions, brand manager’s role, new product development department, and others. Emphasis is on decision making. Preq: MKT 3010; or consent of instructor.

MKT 6950 Selected Topics 3 (3) In-depth examination of timely topics in marketing. May be repeated for credit, but only if different topics are covered. Preq: MKT 3010 or consent of instructor.

MKT 8260 Business Marketing 3 (3) Strategic marketing as it applies to industrial, organizational and institutional markets; consumer marketing versus business-to-business marketing; current business marketing literature and practices. Students are expected to have completed a principles of marketing course or to obtain consent of instructor before enrolling in this course.

MKT 8280 Services Marketing 3 (3) Nature of services marketing and the special requisites that distinguish successful services marketing from goods marketing. Topics include promoting and making the service tangible, designing optimal service operations, the ideal service worker, pricing of services and critical points of services delivery. Students are expected to have completed a principles of marketing course or to obtain consent of instructor before enrolling in this course.

MKT 8600 Advanced Marketing Strategy 3 (3) Advanced marketing theory and critical thinking skills applied to services marketing and decision making. Data analysis and advanced marketing models are employed with emphasis on building analytic and assessment skills. Offered spring semester only. Preq: MBA 8580 or MKT 8650 or consent of instructor.

MKT 8610 Marketing Research 3 (3) Marketing theory and critical thinking to support decision making; data analysis and advanced marketing models are employed with emphasis on building assessment skills. Primary topics are gathering primary and secondary data, questionnaire design, sampling, experimental design, data collection and data analysis. Students who are enrolled in the MS in Marketing program, but who have not completed MKT 8600 must request a registration override from the instructor to enroll in this course. Preq: MKT 8600 or consent of instructor.

MKT 8620 Quantitative Methods in Marketing 3 (3) Advanced quantitative analytic methods and their use in translating facts into meaningful information. Provides practical understanding of several advance quantitative data analytic procedures including both predictive and interdependence techniques. Application to case analysis format to broaden analysis skills. Preq: MKT 8610 or consent of instructor.

MKT 8630 Buyer Behavior 3 (3) Buyer decision processes in the purchase and consumption of goods and services by both businesses and consumers. Topics include economic, sociocultural and psychological aspects of buying behavior; decision-making processes and buyer choice; individual and group level influences on consumer behavior; and implications of consumer behavior for marketers. Students who are enrolled in the MS in Marketing program, but who have not completed MKT 8600, must request a registration override from the instructor to enroll in this course. Preq: MKT 8600 or consent of instructor.

MKT 8650 Seminar in Marketing Management 3 (3) Current research and practice in components of marketing management. In-depth discussion of marketing mix variables, segmentation, targeting and positioning, and budget-related issues. Preq: Enrollment in MS in Marketing.

MKT 8660 Selected Topics in Marketing 3 (3) Current topics in marketing theory and research. Topics vary with developments in the marketing profession. May be repeated for a maximum of six credits, but only if different topics are covered. Preq: MKT 8600 or MKT 8650; or consent of instructor.
**MATERIALS SCIENCE AND ENGINEERING**

**MSE 6020 Solid State Materials 3 (3)** Discussion of the properties of solids as related to structure and bonding with emphasis on electronic materials. Band structure theory, electronic, and optical properties are treated. Preq: MSE 3260 and MATH 2080 and PHYS 2210.

**MSE 6130 Noncrystalline Materials 3 (3)** Study of the fundamentals of the noncrystalline state. Includes cooling kinetics and effects on formation, as well as physical properties of noncrystalline substances in metallic, polymeric, and ceramic systems. Preq: MSE 3260; Coreq: MSE 6020; or consent of instructor.

**MSE 6150 Introduction to Polymer Science and Engineering 3 (3)** Chemistry of monomers and polymers and the chemical and physical properties of polymers are discussed emphasizing fiber forming, synthetic polymers. Includes molecular characterization, structure, morphology, and mechanical properties as they relate to the design of polymer systems for end uses in textiles, geotextiles, plastics and fiber-reinforced composite materials. Preq: CH 2240; or both CH 2010 and CH 3300; or consent of instructor.

**MSE 6160 Electrical Properties of Materials 3 (3)** Covers a range of topics dealing with electrical and magnetic materials, including metal and polymer conductors, insulators, ceramic and polymer materials for dielectric applications, and ferroelectric, piezoelectric, pyroelectric, and electrooptic materials. Metal and ceramic magnetic materials are also discussed.

**MSE 6220 Mechanical Behavior of Materials 3 (3)** Covers the microstructural basis of deformation and fracture in ceramic, metallic, and polymeric systems. Preq: CE 2010 and MATH 2080.

**MSE 6240 Optical Materials and Their Applications 3 (3)** Introduces the interaction of materials with light. Specific topics include fundamental optical properties, materials synthesis, optical fiber and planar waveguides, and the componenentry and systems-level aspects of optical communication systems. Preq: MSE 4020 and MSE 4130.

**MSE 6560 Polymer and Fiber Materials II 3 (2)** Chemicals used in the preparation of fabric for dyeing and finishing. Oxidizing and reducing agents and their control and effect on various fibers. Colloidal and surface active properties of various compounds and the fundamental factors influencing these properties. Preq: MSE 4150 or consent of instructor. Coreq: MSE 6561.

**MSE 6561 Polymer and Fiber Science II Laboratory 0 (2)** Non-credit laboratory to accompany MSE 6560. Coreq: MSE 6560.

**MSE 6570 Color Science 3 (3)** Understanding of physical, chemical, and mechanical principles behind the application of colors and finishes to textiles. Requires an appreciation of fiber chemistry and morphology, dye and finish structures and reactivity and mechanical principles behind equipment used to effect transfer of these chemicals onto the textile substrate.

**MSE 6580 Surface Phenomena in Materials Science and Engineering 3 (3)** Introduction to surface phenomena focusing on fiber science. Fundamentals of interfacial phenomena embrace thermodynamics of surfaces, physics of adhesion, wetting, and finishing emphasizing specific features associated with interactions of liquids and chemicals with fibers and fibrous materials. Preq: Junior standing in engineering or science.

**MSE 6620 Properties of Textile Structures 3 (2)** Yarn and fabric properties, their scientific significance and analysis. Dimensional, structural, and mechanical interrelationships are established and evaluated. Coreq: MSE 6621.

**MSE 6621 Properties of Textile Structures Laboratory 0 (2)** Non-credit laboratory to accompany MSE 6620. Coreq: MSE 6620.

**MSE 6640 Nonwoven Structures 3 (2)** Nonwoven fabric structures, their manufacture, properties, and applications. Methods of nonwoven fabric formation, resultant material characteristics and end-use applications are examined. Preq: MSE 2010. Coreq: MSE 6641.

**MSE 6641 Nonwoven Structures Laboratory 0 (2)** Non-credit laboratory to accompany MSE 6640. Coreq: MSE 6640.

**MSE 6900 Selected Topics in Materials Science and Engineering I-3 (1-3)** Study of topics not ordinarily covered in other courses. Taught as the need arises. Typical topics could include current research in a specific area or technological advances. May be repeated for a maximum of six credits, but only if different topics are covered. Preq: Consent of instructor.

**MSE 8000 Seminar in Materials Research 1 (1)** Special topics and original research in materials science, materials engineering, and polymer and fiber chemistry. To be taken Pass/No Pass only.

**MSE 8010 Graduate Student Seminar in Materials Research 1 (1)** Presentation of individual graduate student research topics in materials science and engineering. Preq: MSE 8000.

**MSE 8090 High-Temperature Materials 3 (3)** Properties of oxides, carbides, nitrides, borides and silicides; observation and measurement of high temperatures; measurement of properties at high temperatures.

**MSE 8150 Colloidal and Surface Science 3 (3)** Theory and application of colloidal and surface chemistry to ceramic materials and processes.

**MSE 8160 Constitution and Structure of Glasses 3 (3)** Modern concepts of glass structure and properties.

**MSE 8190 X-Ray Diffractometry 3 (2)** Theory and application of powder X-ray diffractometry to ceramic and materials problems.

**MSE 8200 Deformation Mechanisms in Solids 3 (3)** Dislocation theory of solids; mechanisms of plastic deformation in single crystals and polycrystalline aggregates of metals and nonmetals; ductile and brittle fractures; fatigue, creep and stress-corrosion cracking of metals. Preq: Consent of instructor.

**MSE 8210 Fracture and Fatigue 3 (3)** Investigation into stress-strain-time relations in elasticity, plasticity and rupture showing effects of high- and low-temperature structures. Preq: MSE 8200 or consent of instructor.


**MSE 8221 Scanning Electron Microscopy Laboratory 0 (3)** Non-credit laboratory to accompany MSE 8220. Coreq: MSE 8220.

**MSE 8230 Transmission Electron Microscopy 3 (2)** Advanced course in electron microscopy for materials science incorporating all aspects of transmission techniques: basics, diffraction, imaging and spectrometry. Preq: MSE 8210 and MSE 8220; or consent of instructor. Coreq: MSE 8231.

**MSE 8231 Transmission Electron Microscopy Laboratory 0 (3)** Non-credit laboratory to accompany MSE 8230. Coreq: MSE 8230.

**MSE 8240 Magnetic and Electrical Ceramic Materials 3 (3)** Application of magnetic and electrical theory to ceramic insulators, semiconductors, and ferroelectric and ferromagnetic products.

**MSE 8250 Solid State Materials Science 3 (3)** Bonding and structural of crystalline materials as related to mechanical, thermal and chemical properties of solids.

**MSE 8260 Phase Equilibria in Materials Systems 3 (3)** Advanced treatment of phase equilibria in materials systems, phase diagrams, thermodynamics of defects, surfaces, interfaces and solutions. Preq: MSE 2100 and consent of instructor. Preq or concurrent enrollment: ME 8100.


**MSE 8400 Analytical Methods in Textile and Polymer Science 4 (3)** Use of chemical and physical instrumental methods to characterize polymeric materials in textile and polymer science; basic principles and unique problems encountered when techniques such as IR, NMR, GC, LC, MS, GC/MS and thermal analysis, microscopy and tensile testing are applied to polymeric materials. Offered spring semester only. Preq: Consent of instructor. Coreq: MSE 8401.
**Courses of Instruction**

**MUSIC**

**MUSC 6000 Music in the Elementary Classroom** 3 (3) Familiarizes teachers in the elementary classroom with traditional, Kodaly, Orff, and Kindermusik approaches in correlating music with language arts, mathematics, and social studies.

**MUSC 6990 Independent Studies** 1-3 (1-3) Tutorial work for students with special interests in music study outside the scope of existing courses. May be repeated for a maximum of six credits. Preq: Consent of department chair.

**NURSING**

**NURS 8010 Advanced Family and Community Nursing** 3 (3) Developmental, psychodynamic, social-political and cultural theories and concepts are synthesized and applied to the analysis of health and illness in communities and in families across the life cycle. Roles and functions of advanced practice nurses in promoting community health and family health are examined.

**NURS 8040 Knowledge Development in Advanced Nursing** 2 (2) Nursing theories and theories relevant to nursing practice and research; processes of theoretical thinking and critical thinking applied to health problems and needs of individuals and their families in the community; theoretical and conceptual models of contemporary practice and research.

**NURS 8050 Pharmacotherapeutics for Advanced Nursing** 3 (3) Prescription administration and patient/family education in use of pharmacological agents emphasizing drugs prescribed for common or chronic illnesses; drug selection; adverse drug reactions; age-related differences in utilization; regulations affecting nurses’ prescriptive authority. Preq or concurrent enrollment: NURS 8050 or NURS 8090.

**NURS 8060 Advanced Assessment for Nursing** 3 (2) Comprehensive assessment and diagnosis of health problems and status for individuals of all ages including assessment of families; physical and laboratory/radiologic diagnostic assessments; directed laboratory experiences in advanced assessment of clients of several ages. Coreq: NURS 8061.

**NURS 8061 Advanced Assessment for Nursing Laboratory** 0 (3) Non-credit laboratory to accompany NURS 8060. Coreq: NURS 8060.

**NURS 8070 Nursing Research Design and Methods** 3 (3) Quantitative and qualitative research methodologies useful and appropriate to clinical nursing practice and for the development of nursing knowledge; ethics with human subjects; does not include thesis advisement. Student must select chairperson prior to enrollment. Preq: NURS 8040 and NURS 8080.

**NURS 8080 Nursing Research Statistical Analysis** 2 (2) Encompasses the use of quantitative research methods in nursing science. Topics include descriptive and inferential methodology, epidemiology and appropriate statistic selection. Computer use is integrated to emphasize applications to nursing. Students are expected to have completed an undergraduate statistics course before enrolling in this course.

**NURS 8090 Pathophysiology for Advanced Nursing** 3 (3) Human response to health alterations as they impact nursing knowledge and practice; recognizing the manifestations of health alterations and developing nursing interventions accordingly.

**NURS 8140 Instructional Technologies for Nursing Educators** 3 (3) Provides novice and experienced nurse educators an opportunity to integrate emerging instructional technologies. Covers theories and trends that support the use of technologies for the enhancement of teaching and learning. Emphasizes the integration of education technologies and the evaluation of current technologies to enhance instruction.

**NURS 8180 Developing Family in Primary Care** 2 (2) Theories related to nursing management in the care of women’s health and developing families. Students apply critical thinking to health problems and needs of women and developing families, related nursing issues, and current research. Preq: NURS 8060.

**NURS 8190 Developing Family Nursing** 4 (2) Theories and concepts related to nursing management in the care of developing families; critical thinking applied to health problems and needs of developing families, before, during and immediately following pregnancy; application of related nursing issues and current research; clinical practice with developing families in a variety of settings. Preq: NURS 8101 and NURS 8040 and NURS 8050 and NURS 8060 and NURS 8090. Coreq: NURS 8191.

**NURS 8191 Developing Family Nursing Laboratory** 0 (6) Non-credit laboratory to accompany NURS 8190. Coreq: NURS 8190.

**NURS 8200 Child and Adolescent Nursing** 4 (2) Advanced nursing roles and functions applied to health promotion, health maintenance, health restoration, habilitation and rehabilitation of infants, children and adolescents with existing or potential health problems. Critical thinking is used to assess, diagnose, intervene and promote continuity of care with these child clients or these ages irrespective of setting. Preq: NURS 8101 and NURS 8040 and NURS 8050 and NURS 8060 and NURS 8090; and either NURS 8190 (Maternal/Child CNS students only) or NURS 8210 (Family Practitioner students only). Coreq: NURS 8201.

**NURS 8201 Child and Adolescent Nursing Laboratory** 0 (6) Non-credit laboratory to accompany NURS 8200. Coreq: NURS 8200.

**NURS 8210 Adult Nursing** 4 (2) Roles and functions embodied in advanced practice applied to the health promotion and clinical management of common or chronic health problems of adults within the context of family; clinical practice with adult clients in a variety of settings. Preq: NURS 8210 and NURS 8040 and NURS 8050 and NURS 8060 and NURS 8090. Coreq: NURS 8211.

**NURS 8211 Adult Nursing Laboratory** 0 (6) Non-credit laboratory to accompany NURS 8210. Coreq: NURS 8210.

**NURS 8220 Gerontology Nursing** 4 (2) Roles and functions of advanced practice applied to the preventive, restorative and rehabilitative care of the older adult with existing or potential health problems; clinical practice in a variety of settings. Preq: NURS 8010 and NURS 8040 and NURS 8050 and NURS 8060 and NURS 8090. Coreq: NURS 8221.
Courses of Instruction

NURS 8221 Gerontology Nursing Laboratory 0 (6) Non-credit laboratory to accompany NURS 8220. Coreq: NURS 8220.

NURS 8230 Nurse Practitioner Clinical Practicum 6 (18) Guided practice applying advanced nursing knowledge in family nursing and advanced practice roles (clinical nurse specialist, case manager and/or practitioner); joint preceptor and faculty guidance and supervision in the care of selected populations in a variety of health care settings. Preq: FNP track: NURS 8190 and NURS 8200 and NURS 8210 and NURS 8220; GNP track: NURS 8220 and NURS 8222 and GNP 8790; A/GNP track: NURS 8210 and NURS 8222 and NURS 8820 and NURS 8840.

NURS 8250 Leadership in Health-Care Systems 3 (3) Examines health-care systems and delivery across the continuum. Emphasizes complexity, influence of internal and external environments, assessment of strengths and opportunities, strategic planning, leadership theories and leading change. Explores implications for middle and executive level health-care leaders.

NURS 8260 Quality and Outcomes Management in Health Care 4 (3) Examines the science of systems improvement including the models, methods and tools of process analysis and improvement applied to health care. Emphasis is on designing outcome and evidence-based safe and efficient processes and workflows to achieve customer satisfaction and targeted outcomes. Practicum with quality expert permits guided application of classroom content. Preq: NURS 8250 or consent of instructor. Coreq: NURS 8261.

NURS 8261 Quality and Outcomes Management in Health Care Laboratory 0 (3) Non-credit laboratory to accompany NURS 8260. Coreq: NURS 8260.

NURS 8270 Foundations of Nursing Education 4 (3) Exploration of the foundations of nursing education. Emphasizes curriculum development in nursing for the collegiate or continuing education programs; current issues and research in classroom, laboratory; and continuing education programs. A teaching practicum is required. Preq: Enrolling in Nursing program.

NURS 8280 The Nurse Educator 4 (1) Roles and functions of nurse educators applied to education of nurses and nursing students in collegiate and continuing education nursing education programs; current issues and research in classroom, laboratory; and continuing education programs. A teaching practicum is required. Preq: NURS 8270. Coreq: NURS 8281.

NURS 8281 The Nurse Educator Laboratory 0 (9) Non-credit laboratory to accompany NURS 8280. Coreq: NURS 8280.

NURS 8290 Theories and Models of Clinical Specialization 3 (3) Caregiver, researcher, manager, teacher and consultant roles of the clinical nurse specialist in a variety of settings; theories, models and health care issues underlying the role of clinical nurse specialist. Preq: NURS 8040 and CNS graduate option; or consent of instructor.

NURS 8300 Clinical Specialty Practicum in Nursing 6 (18) Advanced practice in a selected clinical specialty area in nursing that emphasizes application of the clinical specialist role. Preq: NURS 8290 and one of the following: NURS 8190 or NURS 8200 or NURS 8210 or NURS 8220 or NURS 8820 or NURS 8840; or consent of instructor.

NURS 8310 Clinical Research 1-3 (1-3) Critical thinking and methodologies of scientific inquiry applied to clinical issues/problems encountered in advanced nursing. May be repeated for a maximum of three credits. To be taken Pass/No Pass only. Preq: NURS 8040.

NURS 8460 Healthcare Financial Management 3 (3) Analysis of financial theory and practice for healthcare executives. Includes methods of financial reporting and defines accounting practices for decision making and operating activities. Includes processes for measuring and reporting financial information in the management and use of financial information for planning and controlling the health-care business. Students must have completed an undergraduate accounting course before enrolling in this course.

NURS 8470 Internship 4 (1) Guided practice to apply advanced nursing knowledge in nursing administration in the advanced practice role; joint preceptor and faculty guidance and supervision in the administrative management and care with selected populations in a variety of health care settings. Preq: NURS 8250 and NURS 8260 and NURS 8460; or consent of instructor. Coreq: NURS 8471.

NURS 8471 Internship Laboratory 0 (9) Non-credit laboratory to accompany NURS 8460. Coreq: NURS 8470.

NURS 8480 Health Care Policy and Economics 3 (3) Reciprocal relationship between client, community, health care system, sociocultural and economic variables and policy making; analysis and synthesis of these relationships and their impact on the role and responsibility of the advanced practice nurse and nurse administrator.

NURS 8500 Information and Control Systems for Nursing Leadership 3 (3) Computer-based systems of information management and control for nursing environments. Explores data needed for cost-efficient use of nursing resources and effective systems of monitoring, quality assurance, and control; information systems as tools useful to humanistic nursing practice, human resource management and solution of professional and scientific problems.

NURS 8790 Special Topics in Nursing 1-2 (1-12) In-depth seminar on selected topics such as therapeutic communication, legal and ethical issues in nursing, and health care and political process in health. Preq: Consent of instructor.

NURS 8820 Primary Care for Elders 4 (2) Application of the roles and functions of advanced practice in the management of frailty in old age; prevention of early disability and dependence; maintenance of function, independence and self care; cultural, social and ethical issues. Preq: NURS 8010 and NURS 8040 and NURS 8050 and NURS 8060 and NURS 8090. Coreq: NURS 8921.

NURS 8821 Primary Care for Elders Laboratory 0 (6) Non-credit laboratory to accompany NURS 8820. Coreq: NURS 8820.

NURS 8830 Frail Elders in Primary Care 2 (2) Explores the roles and functions of advanced practice nurses in the interdisciplinary care of the frail elderly. Focus is on preventing early disability and dependence, maintaining function, independence, and self care. Cultural, social and ethical issues are also addressed. Preq: NURS 8060.

NURS 8840 Mental Health and Illness of Adults 4 (2) Psychosocial, developmental, spiritual and cultural theories are synthesized and applied to the analysis of mental health and illness in adulthood. Considers roles and functions of advanced practice nurses in promoting the mental health of adults and their families. Clinical practice in the community is incorporated. Preq: NURS 8010 and NURS 8040 and NURS 8050 and NURS 8060 and NURS 8090. Coreq: NURS 8841.

NURS 8841 Mental Health and Illness of Adults Laboratory 0 (6) Non-credit laboratory to accompany NURS 8840. Coreq: NURS 8840.

NURS 8850 Mental Health in Primary Care 2 (2) Psychological, developmental, spiritual and cultural theories are synthesized and applied to the analysis of mental health and illness in adulthood. Roles and functions of advanced practice nurses in promoting the mental health of individuals and their families are examined. Preq: NURS 8060.

NURS 8890 Special Problems in Nursing 1-6 (1-6) Problems selected to meet special and individualized interests of students. Up to six hours of NURS 8890 may be taken as elective credit. Preq: Consent of instructor.

NURS 8910 Master’s Thesis Research 1-12 (1-12) Research activities related to thesis; minimum of six hours required.

NUTR 6010 Fundamentals of Nutrition 3 (3) Biochemical and physiological fundamentals of nutrition applicable to man and domestic animals. Considers digestive processes and absorption and metabolism of carbohydrates, lipids, proteins, water, minerals, and vitamins. Discusses energy metabolism and comparative anatomy and physiology of digestive systems. Offered fall semester only. Preq: BCHM 3050, CH 2230, or consent of instructor.

NUTR 6240 Medical Nutrition Therapy I 4 (3) Principles of nutritional assessment, education, and counseling skills; development of medical nutrition therapy for individuals with obesity and eating disorders, gastrointestinal disorders, metabolic and renal disorders. Preq: BIOL 2220 and BIOL 2230 and NUTR 4510; or consent of instructor. Coreq: NUTR 6241.

NUTR 6241 Medical Nutrition Therapy I Laboratory 0 (3) Non-credit laboratory to accompany NUTR 6240. Coreq: NUTR 6240.

NUTR 6250 Medical Nutrition Therapy II 4 (3) Development of medical nutrition therapy for individuals with various disease states, including cardiovascular, hepatic, musculoskeletal, and neoplastic disorders. Also considers sociocultural and ethnic aspects of food consumption and alternative nutrition therapies. Preq: BIOL 2220 and BIOL 2230 and NUTR 4240. Coreq: NUTR 6251.

NUTR 6251 Medical Nutrition Therapy II Laboratory 0 (3) Non-credit laboratory to accompany NUTR 6250. Coreq: NUTR 6250.

NUTR 6260 Community Nutrition 3 (3) Study of fundamentals of nutrition care delivery in community programs beginning with assessment and problem identification and continuing through the development, implementation, and evaluation of nutrition intervention programs. Preq: NUTR 2030 and NUTR 4510.
NUTR 6510 Human Nutrition 3 (3) Advanced concepts of nutrition, including physiological handling of nutrients, nutrient-nutrient interactions, and principles of nutritional deficiency and overnutrition. Factors affecting methods of determining nutritional status, development of nutrition standards, and recent advances in human nutrition. Peq: BCHM 3050 or consent of instructor.

NUTR 6550 Nutrition and Metabolism 3 (3) Concepts of metabolism fundamental to understanding normal and therapeutic nutrition are examined. Bioenergetics as well as metabolism of carbohydrates, lipids, amino acids, vitamins, and minerals as they relate to nutrition are discussed. Peq: BCHM 3050 and BIOL 2220. Peq or concurrent enrollment: BIOL 2230.

NUTR 7060 Nutrition for Teachers 3 (3) Principles of nutrition applied to nutrition education. Peq: Consent of instructor.

NUTR 8010 Topical Problems in Nutrition 1-3 (1-3) Topics not covered in other courses or by thesis research. Credit varies with problems selected.

NUTR 8020 Special Topics in Nutrition 1-3 (1-3) Topics of special interest or contemporary subjects not examined in other courses.

NUTR 8030 Advanced Human Nutrition 4 (4) Biochemistry and physiology related to human nutrition and their application to formation and adoption of healthy eating patterns. Emphasis is on individual nutrients in the context of healthy eating patterns throughout the life cycle and on recent advances in human nutrition. Peq: BCHM 3050 and NUTR 4510; or consent of instructor.

NUTR 8040 Nutrition Education of the Public 3 (3) Analysis of community-based food and nutrition programs to include management, program provision, outcome-based evaluation and integration of services. Emphasis is on outcome-based nutrition education across the lifespan, management and integration of multiple services for targeted populations, and public policy development. Peq: NUTR 4260 or consent of instructor.

NUTR 8050 Metabolic Basis of Medical Nutrition Therapy 3 (3) Integration of metabolism and pathophysiology into medical nutrition therapy recommendations. Peq: BIOL 2220 and BIOL 2230 and NUTR 4240 and NUTR 4250; or consent of instructor.

NUTR 8060 Dietetic Internship 1-6 (1-6) Internship consisting of preceptors-supervised and faculty-led dietetic experiences in community, clinical and food service settings. Must be taken for six credits during the internship rotations. Peq: Acceptance into the Dietetic Internship Program.

NUTR 8070 Current Issues in Culinary Nutrition Science 3 (3) Applies the science and practice of healthy cooking to the foods of today and explores the development of future food products. Students participate in research on current issues relevant to the interconnections between food, its preparation, and the consumer.

NUTR 8510 Nutrition Seminar 1 1 (1) Current research and developments in nutrition. Topics, selected by the instructor and students, come from student research and nutrition literature. May be repeated for a maximum of two credits, but only if different topics are covered.

NUTR 8910 Master's Thesis Research 1-12 (1-12) Master's Thesis Research

NUTR 9910 Doctoral Dissertation Research 1-12 (1-12) Doctoral Dissertation Research

PUBLIC ADMINISTRATION

PADM 7020 Research Methods for Public Administration 3 (3) Use of social science research methods for addressing issues in public management and policy; research design; measurement; sampling and polling; various aspects of locating, collecting and processing data, including survey design and archive searches.

PADM 8210 Perspectives on Public Administration 3 (3) Study and practice of public administration in the United States in the 20th century; historical development of the field of public administration; current approaches to the study and practice of public administration.

PADM 8220 Public Policy Process 3 (3) Major models of policy making including incrementalism, rationalism, pluralism, and elitism; selected areas of public policy including transportation, poverty, energy and the environment.

PADM 8270 Public Personnel Administration 3 (3) Organization, techniques and theories of personnel management; interpersonal relations in organizations; personnel change and development; changing conditions in the public service; educational specializations, unions, collective bargaining, etc.; ethics for the public service. May also be offered as FCS 8270.

PADM 8280 Public Financial Management 3 (3) Organization and techniques of governmental financial management; budgetary theories; intergovernmental financial relations. May also be offered as FCS 8280.

PADM 8340 Administrative Law 3 (3) Legislative, adjudicatory and general policy-making powers of administrative agencies and regulatory commissions; the scope of judicial review of administrative action. Directed primarily toward the analysis of the political nature of bureaucracy.

PADM 8410 Public Data Analysis 3 (3) Consider various aspects of database management, storage and retrieval; data description; univariate, bivariate and multivariate analysis in policy studies and decision-making theory. Peq: STAT 3010 and MATH 3010.

PADM 8420 Geographic Information Systems for Public Administrators 3 (3) This course is designed to provide the knowledge and understanding of GIS technology, application and theory needed by those who administer GIS programs, interact with GIS programs, and integrate GIS programs into their organization, whether it be government, private, non-profit or other. Students must have the ability to function in a Windows PC environment.

PADM 8430 Information Systems for Public Administrators 3 (3) The importance, role, protection, and management of information in the public and nonprofit sector.

PADM 8450 Grant Writing for Public Administration 3 (3) In this course, students learn how to develop a fundable project; research public/governmental, corporate, and foundation funding sources; find and use statistics to support the need for funding; write a grant proposal; evaluate and disseminate project outcomes; and manage grants, including finances, personnel, accountability reporting, and project sustainability.

PADM 8460 Administrative Law 3 (3) Provides an understanding of the history of the rise of governmental agencies in America, the Constitutional and statutory vehicles used to delegate power to these agencies, the process agencies use to govern, and the judiciary's role in checking the power of agencies and providing citizens with remedies when agencies act improperly.

PADM 8480 Strategic Planning and Practice for Public and Nonprofit Organizations Sector 3 (3) This course provides analytic frameworks and conceptual theories that undergird planning and their application to the public sector, as well as strategic planning processes, from conducting a thorough needs assessment through SWOT, into plan implementation and outcomes assessment. It also includes discussion of the communication and evaluation of a strategic plan.

PADM 8500 Fundamentals of Homeland Security 3 (3) Dimensions of homeland security at the national, regional, state and local level are covered. The overall goal of this course is to provide a basic understanding of the origins, threats, organizational environment, policies, strategies, constitutional/privacy issues, and activities that comprise homeland security.

PADM 8510 Fundamentals of Emergency Management 3 (3) This course presents a holistic review of emergency management concepts and issues. Students examine public and private sector utilization of emergency management. Focus is on gaining a practical understanding of the concepts, tools, and relationships necessary to provide emergency management to an entity.

PADM 8520 Emergency Management Planning and Preparation 3 (3) This course is the study of hazard mitigation and response through planning and preparation for emergency management. An environmental approach to the understanding of natural and man-made disasters, risk reduction, and hazard mitigation is utilized to study the common types of disasters, assessment of disaster probabilities, emergency planning for disaster hazard mitigation, and emergency planning and response for disaster events.

PADM 8530 Homeland Security and Emergency Management Law 3 (3) Examination of the legal aspects of homeland security through the identification and study of controlling constitutional, statutory and case authorities. Four groups—national security entities, domestic security entities, emergency managers, and the military, including National Guard and Coast Guard—are studied in both pre- and post-September 11, 2001 contexts.
PADM 8540 Cybersecurity 3 (3) Explores the fundamental concepts within cybersecurity from a research and practitioner perspective. Students examine current practices utilized within government and industry to secure information systems and discuss their strengths and weaknesses. Topics include risks and vulnerabilities, mitigations and remediations, organizational processes and procedures, policy development, compliance, and metrics.

PADM 8550 Homeland Security and Intelligence 3 (3) This course presents concepts and practices involved in collecting, analyzing, and evaluating intelligence, and in managing homeland security intelligence functions. Also covered is the role intelligence plays in shaping homeland security decision-making at federal, state and local levels.

PADM 8600 American Government 3 (3) Examines literature of the American political system, its institutions and processes.

PADM 8620 Administrative Leadership 3 (3) Foundations of leadership in public organizations; personal and organizational values underlying decision processes in the public service. May also be offered as FCS 8620.

PADM 8630 Contemporary Administrative Organizations 3 (3) Problems, processes and theories of communication, decision-making, agency planning and control in administrative agencies.

PADM 8650 Nonprofit Governance and Leadership 3 (3) An in-depth examination of issues and concerns inherent in leading and maintaining nonprofit organizations. Focus is on organization, regulation, responsibilities, planning and funding in the nonprofit sector.

PADM 8660 Nonprofit Fundraising 3 (3) This course examines the common methods used by fundraisers to move individuals, corporations, public organizations and foundations from prospects to donors, and strategically applies knowledge of these tools and methods to real-world fundraising situations. In addition to annual and major giving, students examine capital campaigns, the role of boards and volunteers, grant writing, the use of technology, and ethics and accountability in fundraising.

PADM 8670 State Government Administration 3 (3) State government problems and policy issues emphasizing the modernization of government institutions and comparative state politics.

PADM 8680 Local Government Administration 3 (3) Administration of local government from the perspective of the professional administrator; the growth of the manager form of local government; the role of local government administrators with regard to policy making, management and the delivery of services.

PADM 8700 Sustainability for Public Administrators 3 (3) Examines the history, foundations and components of the sustainability movement in the public sector. Aspects of the three components of sustainability, environment, and economics and society are investigated. Emphasis is placed on analysis, evaluation, communication and understanding how sustainability approaches are important in business and the public sector.

PADM 8710 Applications of Sustainability Practices 3 (3) Covers the history, foundations and components of the sustainability movement and investigates the application of sustainability principles in government, business, education and non-government agencies, giving students exposure to and experience with current and evolving practices. Group activities and a project demonstrating applications are included.

PADM 8720 Rural Development 3 (3) This course provides the tools needed to evaluate the strengths and weaknesses of rural communities, and assess the kinds of development strategies that would enhance community and economic wellbeing.

PADM 8770 Public Policy Evaluation Seminar 3 (3) Investigates conceptual and analytic issues in policy and program evaluation including problem definition, goal setting and criteria formulation; design of evaluation research; indicator design; treatment of uncertainty; and special problems raised by constraints of the political context.

PADM 8780 Selected Topics in Public Administration 1-3 (1-3) In-depth study of an applied problem in public administration as seen through the practitioner’s eyes; investigates the methods used to address these problems. May be repeated for credit, but only if different topics are covered. May also be offered as FCS 8780.

PADM 8790 [POLI 779] Internship in Public Administration 1-3 (1-3) Internship with a government agency requiring a written report detailing the experience.

PADM 8800 Capstone Seminar in Public Administration 3 (3) Term project integrating the material from other courses in the analysis of a contemporary public administration problem. Field work and applied project required. Students must have completed thirty credit hours toward the MPA degree before enrolling in this course. Prq: Consent of instructor.

PAN AFRICAN STUDIES

PAS 6980 Seminar on Pan African Studies 3 (3) Research/writing seminar on the African American experience. Selected topics and themes from 1900 to present. Prq: HIST 3110, 3120, or 3390, PAS 3010.

PLANNING, DESIGN, AND THE BUILT ENVIRONMENT

PDBE 8010 Advanced Theory in Environmental Design and Planning 3 (3) Critical assessment of history and theory in the fields of design, planning and construction. Topics include scientific knowledge, interpretive and critical inquiry, theories of urban form and human settlement. Students are expected to have completed a Master’s-level course in theory related to design, planning and construction before enrolling in this course.

PDBE 8040 Readings in Real Estate 3 (3) Historical and contemporary readings in real estate designed to provide exposure and depth of coverage for important works in the field. May be repeated for a maximum of six credits. Prq: Student in Planning, Design and the Built Environment.

PDBE 8050 Readings in Architecture 3 (3) Historical and contemporary readings in architecture designed to provide exposure and depth of coverage for important works in the field. May be repeated for a maximum of six credits. Prq: PDBE 8010 and consent of instructor.

PDBE 8060 Readings in Landscape Architecture 3 (3) Historical and contemporary readings in landscape architecture designed to provide exposure and depth of coverage for important works in the field. May be repeated for a maximum of six credits. Prq: PDBE 8010 and consent of instructor.

PDBE 8070 Readings in City and Regional Planning 3 (3) Historical and contemporary readings in city and regional planning designed to provide exposure and depth of coverage for important works in the field. May be repeated for a maximum of six credits. Prq: PDBE 8010 and consent of instructor.

PDBE 8080 Readings in Construction Science and Management 3 (3) Historical and contemporary readings in construction science and management provide exposure and depth of coverage for important works in the field. May be repeated for a maximum of six credits. Prq: PDBE 8010 and consent of instructor.

PDBE 8100 Contemporary Issues in Environmental Design and Planning 3 (3) Interdisciplinary seminar providing an overview of theory and methods related to environmental design and planning. With that background, focus is on important contemporary and emerging issues affecting the built environment. Prq: CRP 8700 or POST 8700, or consent of instructor.

PDBE 8120 Seminar in Environmental Design and Planning 1 (1) Weekly colloquium to provide a forum for faculty, students and invited speakers to address important issues of the day. May be repeated for a maximum of four credits.

PDBE 8150 Research Design in Environmental Design and Planning 3 (3) Philosophy and method of scientific research. Within that context, students prepare a preliminary proposal for their dissertation research. Prq: PDBE 8010 and STAT 8010.

PDBE 8160 Research Design Practicum 3 (3) Provides an opportunity to improve and test the ability to employ the craft of research by carrying through a semester-length research project that will be the preliminary research for the student’s dissertation project. Prq: Consent of instructor.

PDBE 8200 Instructional Design Delivery 3 (3) Presents information on teaching techniques including discussions of cognitive learning, motivation, course organization, interactive lecturing and experiential learning.

PDBE 9900 Directed Studies 3 (3) Special topics not covered in other courses. Emphasizes field studies, research activities and current developments in architecture, construction science and management, landscape architecture and planning. May be repeated for a maximum of six credits. Prq: Consent of advisor.

PLANT AND ENVIRONMENTAL SCIENCES


PES 6031 Soil Genesis and Classification Laboratory 0 (3) Non-credit laboratory to accompany PES 6030. Coreq: PES 6030.

PES 6050 Plant Breeding 3 (3) Application of genetic principles to the development of improved crop plants. Principal topics include the genetic and cytogenetic basis of plant breeding, mode of reproduction, techniques in selecting and crossing, methods of breeding, inheritance in the major crops, and biometrical methods. Offered spring semester only. Preq: GEN 3000. Coreq: PES 6051.

PES 6051 Plant Breeding Laboratory 0 (2) Non-credit laboratory to accompany PES 6050. Coreq: PES 6050.

PES 6080 Land Treatment of Wastewater and Sludges 3 (3) Principles for designing environmentally acceptable land application systems using municipal and industrial wastewater and sludges are presented. Topics include land-limiting constituent analysis; soil-plant interactions; system equipment and design; system operation and management; public acceptance, social, and regulatory issues. Case studies and field trips are planned. Preq: Senior standing. May also be offered as BE 6080.

PES 6090 Biology of Invasive Plants 3 (3) Introductory course covering mechanisms of plant invasions. Emphasizes unique traits that confer invasiveness and/or weediness to plants, and how these plant traits interact with the environment to facilitate invasion of agricultural lands, forests, rangelands and less-managed landscapes. Covers various cultural, chemical and biological control aspects. Preq: BIOL 1040 and BIOL 1060; or BIOL 1040.

PES 6210 Principles of Field Crop Production 3 (3) Principles for production of field crops. Topics include botany and physiology, tillage, harvesting, storage, and crop quality. Principles are illustrated using examples from various crops. Preq: CSEN 2020; and PES 1010 or PES 1040.

PES 6220 Major World Crops 3 (3) Examines the distribution, adaptation, production, and utilization of major agronomic crops of the world. Emphasizes crops important to U.S. agriculture. Specific crops discussed in more detail include corn, wheat, rice, sorghum, soybeans, cotton, tobacco, and peanuts. Preq: PES 2020; and PES 1010 or PES 1040.


PES 6260 Cropping Systems Analysis 3 (2) Application of agronomic and economic principles in solving problems related to the production and marketing of agronomic crops. Major part of the course is a case study in which detailed analysis of a farm, agribusiness, or environmental situation is made with students forming formal written and oral presentations of results. Preq: PES 1040; and Junior standing; and APEC 2020 or ECON 2000 or ECON 2110. Coreq: PES 6261. May also be offered as APEC 6260.

PES 6261 Cropping Systems Analysis Laboratory 0 (2) Non-credit laboratory to accompany PES 6260. Coreq: PES 6260. May also be offered as APEC 6261.

PES 6330 Landscape and Turf Weed Management 3 (2) Weed management strategies that include cultural, biological, and chemical methods are studied for landscape and turfgrass areas. Problem-solving skills and herbicide characteristics are emphasized. Coreq: PES 6331. May also be offered as HORT 6330.

PES 6331 Landscape and Turf Weed Management Laboratory 0 (2) Non-credit laboratory to accompany PES 6330. Coreq: PES 6330. May also be offered as HORT 6331.

PES 6450 Regulatory Issues and Policies 2 (2) Introduction to regulations of plant agriculture. Emphasizes risk assessment, patenting biotechnology inventions, and ethical issues. Includes survey of state and governmental agencies with responsibilities to avoid risk to humans, non-target organisms, and preservation of food safety, agricultural resources, and natural ecosystems.

PES 6460 Soil Management 3 (3) Basic soil properties are related to compaction, water and solute movement, and root growth. Considers practical management problems and develops solutions based on basic soil characteristics. Problems include erosion, no-tillage, compaction, irrigation, leaching, waste application, golf green management, and orchard establishment. Preq: PES 2020.

PES 6510 Agricultural Biotechnology and Global Society 1 (1) In-depth discussion of recent articles on agricultural biotechnology and related global issues. Includes independent and comprehensive literature survey and critical discussions on implementation of biotechnology products in the context of world agricultural production systems and economics. Discusses the role of international agencies and social and ethical issues.


PES 6850 Environmental Soil Chemistry 3 (3) Study of soil chemical processes (sorption, desorption, ion exchange, precipitation, dissolution, and redox reactions) of nutrients and inorganic and organic contaminants in soils and organic matter. Chemical complex equilibria and adsorption phenomena as the solid (soil, sediment, and mineral) water interface are emphasized. Preq: CH 1020 or PES 2020. May also be offered as ETOX 6850 or GEOL 6850.

PES 6900 Beneficial Soil Organisms in Plant Growth 3 (3) Aspects of biological nitrogen fixation, mycorrhizal fungi, microbial-pesticide interactions, bioremediation, nutrient cycles, and biological pest control related to plant growth, soil/environmental quality; and sustainable agriculture are covered. Students who desire laboratory experience in these topics may register for PES 4060 after consultation with instructor. Preq: MIRC 3050 or PES 2020 or PLPA 3100.

PES 8250 Seminar 1 (1) Special topics and original research in plant and environmental sciences. To be taken Pass/No Pass only.

PES 8260 Scientific Writing 1 (1) Written communication in the plant sciences. To be taken Pass/No Pass only.


PES 8910 Master’s Thesis Research 1-12 (1-12) Master’s Thesis Research

PES 9910 Doctoral Dissertation Research 1-12 (1-12) Doctoral Dissertation Research

PHILOSOPHY

PHIL 6010 Studies in the History of Philosophy 3 (3) In-depth study of a selected philosopher, philosophical school, or movement. Topics vary. With departmental consent, may be repeated once for credit. Current topics and course descriptions are available in the department’s course offering brochure.

PHIL 6020 Topics in Philosophy 3 (3) Thorough examination of a particular philosophical topic, issue, or problem. Topics vary. May be repeated once for credit with departmental consent. Current topics and course descriptions are available in the department’s course offering brochure.

PHIL 6990 Independent Study 1-3 (1-3) Course of study designed by the student in consultation with a faculty member who agrees to provide guidance, discussion, and evaluation of the project. Student must confer with the faculty member prior to registration. May be repeated for a maximum of six credits. Preq: Consent of instructor.

PHYSICS

PHYS 6170 Introduction to Biophysics 1 (3) Introduction to the application of physics to biological problems. Topics include review of elementary chemical and biological principles, physics of biological molecules, and fundamentals of radiation biophysics. Preq: MATH 2060 and PHYS 2210; or consent of instructor.

PHYS 6200 Atmospheric Physics 3 (3) Study of physical processes governing atmospheric phenomena. Topics include thermodynamics of dry and moist air, solar and terrestrial radiative processes, convection and cloud physics, precipitation processes, hydrodynamic equations of motion and large-scale motion of the atmosphere, numerical weather prediction, atmospheric electricity. Preq: MATH 1080; and PHYS 2080 or PHYS 2210.
PHYs 6210 Mechanics I 3 (3) Statics, motions of particles and rigid bodies, vibratory motion, gravitation, properties of matter, flow of fluids. Prq: PHYS 2210.

PHYs 6220 Mechanics II 3 (3) Dynamics of particles and rigid bodies, Lagrangian and Hamiltonian formulations, vibrations of strings, wave propagation. Prq: PHYS 3210 or consent of instructor.

PHYs 6320 Optics 3 (3) Covers a selection of topics, depending on the interest of the student. Topics may include the formation of images by lenses and mirrors, design of optical instruments, electromagnetic wave propagation, interference, diffraction, optical activity, lasers, and holography. Prq: PHYS 2210.

PHYs 6410 Electromagnetics I 3 (3) Study of the foundations of electromagnetic theory. Topics include electric fields, electric potential, dielectrics, electric circuits, solution of electrostatic boundary-value problems, magnetic fields, and magnetostatics. Prq: PHYS 2210 and MATH 2080; or consent of instructor.

PHYs 6420 Electromagnetics II 3 (3) Continuation of PHYS 4410. Study of foundations of electromagnetic theory. Topics include magnetic properties of matter, microscopic theory of magnetization, electromagnetic induction, magnetic energy, AC circuits, Maxwell's equations, and propagation of electromagnetic waves. Other topics may include waves in bounded media, antennas, electromagnetism, special theory of relativity, and plasma physics. Prq: PHYS 4410 or consent of instructor.

PHYs 6450 Solid State Physics I 3 (3) Topics include an overview of crystal structures, chemical and atomic bonding, and periodicity in relation to solid materials. Covers electronic, thermal, and magnetic properties of materials, electrical conduction in metals and semiconductors. Overview of the role of electrons and photons and their interactions is presented.

PHYs 6460 Solid State Physics II 3 (3) Continuation of PHYS 4450, including selected topics in solid-state physics such as optical properties, superconductivity, non-crystalline solids, dielectrics, ferroelectrics, and nanomaterials. Plasmons, polarons, and excitons are discussed. Brief introduction into methods of solid-state synthesis and characterization tools is presented. Prq: PHYS 4450 or consent of instructor.

PHYs 6520 Nuclear and Particle Physics I 3 (3) Study of our present knowledge concerning subatomic matter. Experimental results are stressed. Topics include particle spectra, detection techniques, Regge pole analysis, quark models, proton structure, nuclear structure, scattering, and reactions.

PHYs 6550 Quantum Physics I 3 (3) Discussion of solution of the Schrödinger equation for free particles, the hydrogen atom, and the harmonic oscillator. Prq: PHYS 3220 and PHYS 4410, or consent of instructor.

PHYs 6560 Quantum Physics II 3 (3) Continuation of PHYS 4550. Application of principles of quantum mechanics as developed in PHYS 4550 to atomic, molecular, solid state, and nuclear systems. Prq: PHYS 4550.

PHYs 6650 Thermodynamics and Statistical Mechanics 3 (3) Study of temperature development of the laws of thermodynamics and their application to thermodynamic systems. Introduction to low temperature physics is given. Prq: Six hours of physics beyond PHYS 2220 or consent of instructor.

PHYs 6750 Selected Topics I-3 (1-3) Comprehensive study of a topic of current interest in the field of physics. May be repeated for a maximum of six credits, but only if different topics are covered. Prq: Consent of instructor.

PHYs 8110 Methods of Theoretical Physics I 3 (3) Analytical methods and techniques used in theoretical physics: vector and tensor analysis as applied to physical problems, use of matrices and groups in classical and quantum mechanics, complex variables and partial differential equations of physics. PHYs 8120 Methods of Theoretical Physics II 3 (3) Continuation of PHYS 8110. Use of integral transforms, integral equations, special functions, calculus of variations and numerical approximations in solutions of physical problems.

PHYs 8150 Statistical Thermodynamics I 3 (3) Fundamental principles of kinetic theory and quantum statistical mechanics; Boltzmann statistics, Fermi-Dirac statistics and Bose-Einstein statistics. Students are expected to have completed a course in thermodynamics or obtained consent of instructor before enrolling in this course. May also be offered as ME 8150.

PHYs 8160 Statistical Thermodynamics II 3 (3) Generalized ensemble theory and fluctuations; applications to solids, liquids, gases and blackbody radiation. Prq: ME 8150 or PHYS 8150.

PHYs 8180 Biophysics I 3 (3) Application of physical techniques to biological macromolecules and complexes, including discussion of theory and practice of spectroscopic methods, bulk solution and single molecule techniques, x-ray crystallography, small-angle x-ray scattering, cryo-electron microscopy, atomic force microscopy, computational modeling, and molecular dynamics simulations. Prq: Consent of instructor.

PHYs 8190 Computational Biophysics I 3 (3) Comprehensive coverage of all major areas of Computational Biophysics. Covers beginning basic objects such as DNA, RNA, protein and membrane; reviews the forces and effects acting between atoms and among the molecules; covers modeling protein folding and protein stability; analysis of molecular association; and practical exercises. Prq: PHYS 4170 or consent of instructor.

PHYs 8210 Classical Mechanics I 3 (3) Dynamics of particles; variational principles and Lagrange's equations; two-body central force problems; dynamics of rigid bodies; matrix formulations freely used.

PHYs 8220 Classical Mechanics II 3 (3) Special relativity in classical mechanics; Hamilton's equations; canonical transformations; Hamilton-Jacobi theory; small oscillations.

PHYs 8250 Atmospheric Dynamics 3 (3) Focuses on middle and upper atmosphere dynamics, including the general circulation, atmospheric tides, gravity waves, planetary waves, instabilities, and wave-meanflow interactions, such as sudden stratospheric warnings, mesoscale circulations, and equatorial dynamics. Prq: PHYS 4200 or consent of instructor.

PHYs 8260 Ionospheric Physics 3 (3) Focuses on the electrodynamics and plasma physics of the earth's ionosphere, including the unique processes that characterize the auroral zone, mid latitudes, and magnetic equator; and on the interactions between the plasma and neutral components of the ionosphere. Prq: PHYS 4200 or consent of instructor.

PHYs 8270 Measurement Techniques in Aeronomy 3 (3) Course focuses on experimental techniques used in aeronomy and ionospheric research, including sounding rocket instrumentations, ground-based radar and optical techniques, and satellite measurements. Prq: PHYS 8240 or PHYS 8250 or consent of instructor.

PHYs 8410 Electrodynamics I 3 (3) Field theory of electromagnetism; Maxwell's equations and their application to study of electromagnetic wave production and propagation; wave optics and theories of interference and diffraction.

PHYs 8420 Electrodynamics II 3 (3) Production and propagation of electromagnetic waves beginning with use of Maxwell's equations; wave guides, diffraction phenomena; boundary effects; theory of electrons and microscopic phenomena.

PHYs 8450 Solid State Physics I 3 (3) Physical properties of crystalline solids; crystalline state determination by diffraction methods; theories of specific heat; properties of metallic lattices and alloys; lattice energy and ferroelectrics.

PHYs 8460 Solid State Physics II 3 (3) Continuation of PHYS 8450. Electronic properties of solids, band theory of solids, physics of semiconductors, theories of magnetism, and magnetic resonance phenomena.

PHYs 8750 Selected Topics I-3 (1-3) Students and interested faculty study areas of physics currently being extensively investigated. May be repeated for credit, but only if different topics are covered.

PHYs 8900 Directed Activities in Applied Physics 1-6 (1-6) Training and work on practical problems are supervised by department faculty or by appropriate adjunct professor. Written description of student's activities must be submitted to course supervisor at completion of activity. Maximum credit limits are six credit hours in a semester and three credit hours in a single summer session. To be taken Pass/No Pass only.

PHYs 8910 Master's Thesis Research 1-12 (1-12) Master's Thesis Research

PHYs 9510 Quantum Mechanics I 3 (3) Review of wave mechanics, operator algebra and theory of representation, approximate methods for stationary problems, theory of scattering applied to atomic and nuclear problems.

PHYs 9520 Quantum Mechanics II 3 (3) Continuation of PHYS 9510. Time-dependent perturbations, radiation, absorption and emission, relativistic quantum mechanics, introduction to quantum electrodynamics.

PHYs 9660 Relativity 3 (3) Special and general theory of relativity including tensor calculus, Lorentz transformation and three experimental tests of general theory: planetary motion and advance of perihelion of Mercury, bending of light rays in gravitational fields, and gravitational shift of spectral lines.

PHYs 9910 Doctoral Dissertation Research 1-12 (1-12) Doctoral Dissertation Research
PACKAGING SCIENCE

PKSC 6010 Packaging Machinery 3 (3) Systematic study of types of machinery used to form, fill, seal, and handle various packaging, products, and packaging materials. Emphasizes basic mechanical, electrical, pneumatic, and hydraulic components of packaging machinery along with packaging machinery terminology. Discusses methods for machine line optimization and layout. Prereq: PKSC 2040; and either PHYS 2080 or PHYS 2210.

PKSC 6040 Mechanical Properties of Packages and Principles of Protective Packaging 3 (3) Study of the mechanical properties of products and packages and standard methods of determining these properties. Focuses on the functional properties of packages related to shock and vibration isolation and compression. Prereq: PHYS 2120; or one of PHYS 1220 or PHYS 2070; or consent of instructor.

PKSC 6160 Application of Polymers in Packaging 4 (3) Detailed study of polymer science and engineering as applied to packaging science. Includes polymer morphology, rheology, physical properties, processing methods, and polymerization. Emphasizes relationships among processing, structure, and properties. Prereq: PKSC 2040; and one of CH 2210 or CH 2230; and one of PHYS 1220 or PHYS 2070; or consent of instructor. Coreq: PKSC 6161.

PKSC 6161 Application of Polymers in Packaging Laboratory 0 (3) Non-credit laboratory to accompany PKSC 6160. Coreq: PKSC 6160.

PKSC 6200 Package Design and Development 3 (2) Study of the principles and methods practiced in designing and developing packages and packaging systems and of methods used to coordinate and analyze package development activities including interfacing with product development, manufacturing, marketing, purchasing, and accounting. Prereq: Second semester senior standing; and PKSC 3200 and PKSC 3680 and PKSC 4010 and PKSC 4040 and PKSC 4160 PKSC 4300 PKSC 4400 and PKSC 4640; or consent of instructor. Coreq: PKSC 6201.

PKSC 6201 Package Design and Development Laboratory 0 (3) Non-credit laboratory to accompany PKSC 6200. Coreq: PKSC 6200.

PKSC 6230 3D Parametric Design Online 3 (3) Provides an overview of the techniques used in designing 3D parametrics solid parts for packaging science applications. The course begins with a basic overview of design software and progresses to cover advanced applications, including simulation, surfacing, tooling, photorendering and sustainability. Additionally, this course prepares students for a professional certification exam. Recommended for students who have experience with design software.

PKSC 6240 Structural Packaging Design Online 3 (3) Provides a comprehensive overview of how to design structural packaging for cardboard and corrugated mediums. This course begins with a basic overview and transitions into covering advanced applications. Access to design software (vector-based 2D CAD software, such as Illustrator or ArtiosCAD) is required. Recommended for students with design software experience.

PKSC 6300 Converting for Flexible Packaging 3 (1) Study of materials, methods, processes, and equipment used in converting web materials for flexible packaging. Laboratory provides hands-on experience preparing and operating pilot-scale converting equipment. Prereq: PKSC 2040 or consent of instructor. Coreq: PKSC 6301.

PKSC 6301 Converting for Flexible Packaging Laboratory 0 (6) Non-credit laboratory to accompany PKSC 6300. Coreq: PKSC 6300.

PKSC 6400 Packaging for Distribution 3 (3) Packages are exposed to various shipping methods and numerous hazards during distribution. To ensure adequate product protection, packaging professionals need to understand the fundamental principles of distribution packaging design. Topics include ASTM and ISTA packaging test methods, packaging design guidelines for distribution, terminology, transport modes, distribution hazards, and protective packaging materials. Prereq: PKSC 4040 or consent of instructor.

PKSC 6540 Product and Package Evaluation Laboratory 1 (3) Laboratory experiments to determine properties of packaging materials and to evaluate the response of packages and products to shock, vibration, and compression. Students operate standard testing equipment and become familiar with industry recognized test methods and standards. Prereq or concurrent enrollment: PKSC 6040.

PKSC 6640 Food and Health Care Packaging Systems 4 (3) Characteristics, engineering properties, and applications of various materials and systems used in the packaging of foods, pharmaceuticals, and medical devices. Packaging systems for specific food and medical applications are considered. Laboratory and field exercises with food and medical packaging operations and packaging materials are included. Emphasis is on evaluation methods. Prereq: One of PKSC 2010 or FDSC 2140; and PKSC 2040; or consent of instructor. Coreq: PKSC 6641.

PKSC 6641 Food and Health Care Packaging Systems Laboratory 0 (3) Non-credit laboratory to accompany PKSC 6640. Coreq: PKSC 6640.

PKSC 8100 Biopolymers in Packaging 3 (3) In-depth study of the chemical characteristics of biological-based polymers and how these materials can be used in packaging. Students review literature, organize and present material. Prereq: Consent of instructor.

PKSC 8170 Packaging Materials Science and Technology 3 (3) In-depth study of the structure, properties, manufacturing processes and applications of packaging materials. A classical materials science approach is utilized to contrast metals, ceramics, polymers and composites in packaging applications. Course sections include structure, properties and manufacturing of packaging materials. Prereq: Consent of instructor.

PKSC 8200 Advanced Packaging Design 3 (2) Study of structural, graphical and aesthetic considerations of packaging design and development. Lecture topics center on advanced color theory, space, shape, texture, pattern, typography, branding, marketing, consumer studies, ergonomics, sustainability and applied packaging. Coreq: PKSC 8201.

PLANT PATHOLOGY

PLPA 6080 Diseases and Insects of Turfgrasses 2 (2) Host-parasite relationships, symptomatology, diagnosis, economics, and control of infectious diseases of turfgrasses and life histories, diagnosis, and control of important insect pests of turfgrasses. May also be offered as ENT 6080. Prereq: ENT 3030 and PLPA 3100.

PLPA 6080 Diseases and Insects of Turfgrasses Laboratory 1 (3) Laboratory to complement PLPA 4060 or ENT 4060 to learn symptomatology, diagnosis, and control of infectious diseases of turfgrasses and diagnosis of damage caused by important insect pests of turfgrasses. May also be offered as ENT 6080. Coreq: PLPA 4060 or ENT 4060.

PLPA 6110 Plant Disease Diagnosis 13 (2) Methods and procedures used in the diagnosis of plant diseases, especially late spring and early summer diseases. Basic techniques of pure culture and identification of plant pathogens and Koch's postulates are taught. Diagnosis of a wide variety of diseases of cultivated and wild plants is carried out. Offered summer session only. Coreq: PLPA 3100. Coreq: PLPA 6111.

PLPA 6111 Plant Disease Diagnosis Laboratory 0 (3) Non-credit laboratory to accompany PLPA 6110. Coreq: PLPA 6110.

PLPA 6250 Introductory Mycology 3 (3) Introduction to the biology of all the groups of fungi and some related organisms, with considerations of the taxonomy, morphology, development, physiology, and ecology of representative forms. May also be offered as BIOL 6250. Prereq: BIOL 1040 and BIOL 1060, or BIOL 1110. Prereq or concurrent enrollment: BIOL 4260 or PLPA 4260.

PLPA 6260 Mycology Practicum 2 (1) Application of the principles of mycological techniques, microscopic study of fungi. Examples from all major groups of fungi are included. May also be offered as BIOL 6260. Prereq or concurrent enrollment: BIOL 4250 or PLPA 4250. Coreq: PLPA 6261.

PLPA 6261 Mycology Practicum Laboratory 0 (2) Non-credit laboratory to accompany PLPA 6260. May also be offered as BIOL 6261. Coreq: PLPA 6260.
Courses of Instruction

PLPA 6540 Plant Virology 4 (3) Study of plant viruses: their morphology, biochemistry, purification, and transmission; symptoms resulting from virus infection; virus vector relationships. Serological and nucleic acid hybridization procedures. Diagnosis of viral diseases and the identification of causal agents. Replication of plant viruses, the interaction between viral host and plant genome. Control of plant viral diseases. May also be offered as BIOL 6540. Preq: BCHM 3010 or BCHM 3050 or MIRC 3050. Coreq: PLPA 6541.

PLPA 6541 Plant Virology Laboratory 0 (3) Non-credit laboratory to accompany PLPA 6540. Coreq: PLPA 6540. May also be offered as BIOL 6541.

PLPA 6590 Plant Nematology 3 (2) Introduction to nematodes emphasizing plant parasitic nematodes. Introduces morphology of nematodes as it relates to their taxonomic position and ability to cause disease. Includes diagnosis and control of nematode diseases, along with the use of nematodes in studies of molecular interaction and genetics involvement in developing resistance. Preq: PLPA 3100.

PLPA 6591 Plant Nematology Laboratory 0 (3) Non-credit laboratory to accompany PLPA 6590. Coreq: PLPA 6590.

PLPA 6700 Molecular Plant Pathogen Interactions 3 (3) Study of the interactions of plants and pathogens at the molecular level. Investigates the molecular and genetic components of plant disease and how these can be used for improvement and understanding of how diseases occur and how these can be used for possible disease management. Preq: PLPA 3100.

PLPA 8020 Selected Topics 1-3 (1-3) Current advances in phytopathology and physiology, diseases of specific crops and specialized laboratory protocols. May be repeated for credit. Coreq: Consent of instructor. Coreq: PLPA 8021.

PLPA 8021 Selected Topics Laboratory 0 (1-6) Non-credit laboratory to accompany PLPA 8020. Coreq: PLPA 8020.

PLPA 8050 Special Problems in Plant Pathology 1-12 (1-12) Research not related to a thesis. Preq: PLPA 4110.

PLPA 8070 Seminar 1 (1) Areas of plant pathology and plant physiology not covered by formal courses. Relevant literature is reviewed. Material is organized and presented by students. To be taken Pass/No Pass only.

PLPA 8090 Analytical Techniques in Plant Science 3 (2) Theory of and practice in current techniques of separation science; hands-on experience with extraction, isolation and characterization of chemical compounds associated with plants and microorganisms using techniques such as thin layer chromatography, gas chromatography, mass spectroscopy, high pressure liquid chromatography and electrophoresis. Preq: BCHM 4230 and CH 2230 and CH 2240. Coreq: PLPA 8091.

PLPA 8091 Analytical Techniques in Plant Science Laboratory 0 (1) Non-credit laboratory to accompany PLPA 8090. Coreq: PLPA 8090.

PLPA 8130 Fungal Ecology and Pathology 3 (2) Study of the biology and activities of fungi with emphasis on their interactions with other organisms and roles in natural and managed ecosystems. Includes survey of different types of symbiotic relationships with particular attention to plant pathogens and mycorrhizae and their management. Preq: BIOL 4250 and BIOL 4260. Coreq: PLPA 8131.

PLPA 8131 Fungal Ecology and Pathology Laboratory 0 (3) Non-credit laboratory to accompany PLPA 8130. Coreq: PLPA 8130.

POLITICAL SCIENCE

POSC 6090 Directed Study in American Politics 1-3 (1-3) Supervised reading/research in selected areas of American politics. May be repeated for a maximum of six credits. No more than three hours from POSC 3050, 3100, 3110, 3120, 3130, 4090, 4100 may be applied toward a Political Science major, minor, or a Global Politics minor. Preq: Consent of instructor.

POSC 6160 Interest Groups and Social Movements 3 (3) Empirical and normative examination of the origins, roles, and influence of interest groups and social movements in the United States and of the relationships among interest groups, social movements, and democratic theory. Preq: Consent of instructor.

POSC 6210 Public Policy 3 (3) Introduction to the major approaches to public policy making in American government. Topics include theories and models of policy making, the identification of policy problems, agenda setting, the formulation and adoption of policy, implementation, and program evaluation. Preq: Consent of instructor.

POSC 6230 Urban Politics 3 (3) Examines the nature and scope of politics in urban communities and offers an analysis of urban governance, especially in the interaction of public authority and private institutions in metropolitan areas. Emphasis is on the structure, processes, and problems facing local governments in urban America. Preq: Consent of instructor.

POSC 6240 Federalism and Intergovernmental Relations 3 (3) Introduction to the historical, theoretical, legal, and fiscal aspects of constitutionally divided government. Federal, state, and local division of responsibility for public services is emphasized, along with the emerging devolution of those responsibilities from the federal government to states and localities. Preq: Consent of instructor.

POSC 6280 National Security Policy 3 (3) National security threats and policy decision making. Issues covered include weapons of mass destruction, terrorism, organized crime, narcotics, arms control, intelligence, and homeland security. Students deliberate and assess threat priorities and crisis management. Preq: Consent of instructor.

POSC 6290 Global Issues 3 (3) Analysis, assessment, and management of the principal threats facing global security today. Topics include rogue nations, regional superpowers, alliances, organized crime, illegal weapons proliferation, and corruption. Emphasis is on the strategies available to the international community for dealing with these threats. Preq: Consent of instructor.

POSC 6370 American Constitutional Law: Rights and Liberties 3 (3) Examination and analysis of Supreme Court decisions and other legal materials in the areas of civil rights and civil liberties, with an emphasis on freedom of speech, freedom of religion, equal protection of the laws, and privacy rights. Preq: Consent of instructor.

POSC 6380 American Constitutional Law: Structures of Government 3 (3) Examination and analysis of Supreme Court decisions and other legal materials in the areas of national power, federalism, the separation of powers, and the role of the judiciary. Preq: Consent of instructor.

POSC 6420 Political Parties and Elections 3 (3) Study of the distinctive features of the American two-party system with emphasis on presidential elections. Parties are examined as formal organizations, coalitions of voters and interest groups, coordinators of nomination and election processes, and managers of policymaking institutions. Preq: Consent of instructor.

POSC 6480 International Political Economy 3 (3) Provides students with background knowledge and conceptual tools for understanding the politics of contemporary international economic relations. Students are introduced to the major issues of the international political economy and different perspectives approaching these issues. Preq: Sophomore standing.

POSC 6540 Southern Politics 3 (3) Examination of the unique political environment of the American South, with emphasis on the events and social forces that have shaped politics in the region since World War II. Course material is approached from a variety of perspectives, including history, literature, social themes, and political culture. Preq: Consent of instructor.

POSC 6570 Political Terrorism 3 (3) Examination and analysis of the international phenomenon of terrorism in terms of origins, operations, philosophy, and objectives. Preq: Consent of instructor.

POSC 6580 Political Leadership 3 (3) Comparative examination of political leaders, focusing particularly on types, methods, and consequences of leadership and on the relationship between leaders and followers. Preq: Consent of instructor.

POSC 6600 American Diplomacy and Politics 3 (3) Analyses the process of making and implementing foreign policies to protect and promote American national interests. Focuses on the role of government agencies and executive-legislative relations, as well as the participation and influence of interest groups and the media. Includes a five-day seminar in Washington, DC. Preq: Consent of instructor.

POSC 6800 Gender and Politics 3 (3) Examination of the role of gender in politics in the United States and in other countries. Particular emphasis on the role of women in electoral politics, issues of gender, women's rights as human rights, and feminist theory. Preq: Consent of instructor.

POSC 6850 Global Affairs and Governments 3 (3) See POSC 4850.

POSC 6890 Selected Topics 1-3 (1-3) Intensive examination of a selected area of political science. May be repeated for a maximum of six credits, but only if different topics are covered. Preq: Consent of instructor.

POSC 8410 Public Data Analysis 3 (3) Various aspects of database management, storage and retrieval; data description; univariate, bivariate and multivariate analysis in political studies and decision-making theory. Preq: STAT 3010 and MATH 3010.

POSC 8600 American Government 3 (3) Literature of the American political system, its institutions and processes.
POST 8770 Public Policy Evaluation Seminar 3 (3) Conceptual and analytic issues in policy and program evaluation including problem definition, goal setting and criteria formulation; design of evaluation research; indicator design; treatment of uncertainty; and special problems raised by constraints of the political context.

POST 8780 Selected Topics in Political Science 3 (3) In-depth, graduate-level study of a selected political science topic.

POLICY STUDIES

POST 8100 Political Economy 3 (3) Exploration of how public policy can be analyzed within a common framework that considers the objectives and constraints imposed on individuals in political and economic situations, decision rules consistent with these objectives and constraints and the likely outcomes of various policy objectives. Preq: AEC 8200 or ECON 8200; or consent of instructor.

POST 8220 Policy Analysis and Political Choice 3 (3) Opportunities and constraints in political systems; political feasibility and policy strategy assessment. Topics include role of power, ideas, organizational interaction, cognitive processes, interest groups, policy analysis, media and random opportunity in determining policy outcomes. Preq: Admission to Policy Studies program or consent of instructor.

POST 8420 Ethics and Public Policy 3 (3) Exploration of the ethical dimensions of policy by examining moral and ethical issues raised by problem solving and decision making, evaluation procedures integrating ethical dimensions into policy assessment. Topics include model codes of ethics for public officials and comparable standards for privately employed policy professionals. Preq: Admission to certificate or PhD program in Policy Studies or consent of instructor.

POST 8430 Organization Theory and Public Management 3 (3) Theoretical and analytical foundations for understanding bureaucracies and leadership roles in public management; clarification of the distinctly “public” dimensions and challenges of management. Interdisciplinary in nature, course draws on business and public administration, social psychology, economics, political science and sociology. Preq: Admission to certificate or PhD program in Policy Studies or consent of instructor.

POST 8450 Water Policy and Law 3 (3) Surveys the history, science, economics, politics, legal framework and current debates regarding the allocation of freshwater resources in the U.S., with emphasis on relevant Southeastern issues. Scientists, engineers, planners, landscape architects, policy makers and economists will benefit from understanding water allocation and associated conflicts. May also be offered as CRP 8450.

POST 8510 Rural Sustainable Development Evolution of Public Policy 3 (3) Formulation of current national and local public policies that impact rural community development; the constraints and opportunities they provide; interaction among government institutions, decision makers and interest groups; associated influence on rural sustainability. Preq: Admission to certificate or PhD program in Policy Studies or consent of instructor.

POST 8610 Space Policy 3 (3) Space science technology, civilian and military government programs and private-sector activities. Case studies of long-term space policy issues impacting remote sensing, communications and manned space stations. Examination of origins of programs and evolution of associated policy issues from a national and international perspective. Preq: Admission to certificate or PhD program in Policy Studies or consent of instructor.

POST 8700 Seminar in Sustainable Development 3 (3) Concept of sustainable development traced from its historical roots through the popularization of the term in the international development literature; scientific base and the application of sustainability through economic sectors and building practice. Students conduct individual/group research projects. May also be offered as CRP 8700.

POST 8900 Directed Study in Public Policy 3 (3) Students pursue readings and research in individual public policy topics under the direction of a Public Policy faculty member. May be repeated for a maximum of six credits, but only if different topics are covered. Preq: Consent of instructor.

POST 8930 Internship in Policy Analysis 3 (9) Twelve-week supervised internship with an approved public or private entity focusing on policy analysis. Monthly reports by student and agency are required. To be taken Pass/No Pass only. Students are expected to have completed two semesters of coursework in Policy Studies program before enrolling in this course.

POST 8980 Policy Analysis Workshop 3 (6) Provides experience with contemporary policy issues. Students work in small groups with clients compiling information, developing policy options and conducting analysis to address a policy issue. White paper is prepared analyzing policy options and making recommendations to policy makers. Typically taken in fourth semester. Students are expected to have completed three semesters of coursework in Policy Studies program before enrolling in this course.

POST 8990 Selected Topics in Policy Studies 3 (3) Intensive investigation of selected current and emerging public policy issues emphasizing current literature and results of current research. May be repeated for a maximum of six credits, but only if different topics are covered. Preq: Consent of instructor.

POST 9040 Policy Analysis Seminar I 2 (2) Seminar module focusing on research methodology with readings and discussion. Students are expected to have completed three semesters of coursework in Policy Studies program before enrolling in this course.

POST 9050 Policy Analysis Seminar II 1 (1) Seminar involving student research with articles prepared for a professional audience and presented as part of the seminar. Students are expected to have completed three semesters of coursework in Policy Studies program before enrolling in this course. Preq: POST 9040.


PARKS, RECREATION AND TOURISM MANAGEMENT

PRTM 6210 Recreation Financial Resources Management 3 (3) Analysis of recreation financial resources management. Deals with revenue sources and their allocation.

PRTM 6300 World Geography of Parks and Equivalent Reserves 3 (3) Major international patterns in the provision and use of urban and rural parks and recreation are examined. May also be offered as GEOG 6300.

PRTM 6310 Methods of Environmental Interpretation 3 (2) Practice and instruction in the use of equipment and methods available to the interpreter in public contact work. Coaching in presentation and evaluation of live programs and in design, execution, and evaluation of mediated programs is the major emphasis. Programs are delivered to public audiences in the Clemson area. Coreq: PRTM 6311.

PRTM 6311 Methods of Environmental Interpretation Laboratory 0 (3) Non-credit laboratory to accompany PRTM 6310. Coreq: PRTM 6310.

PRTM 6410 Commercial Recreation 3 (3) Components of offering leisure services and products to the public by individuals, partnerships, and corporations for the purpose of making a profit.

PRTM 6440 Tour Planning and Operations 3 (3) Provides the opportunity to understand the psychology of touring, with emphasis on packaged and group tours and how tours of different types and scale are planned, organized, marketed, and operated.

PRTM 6450 Conference/Convention Planning and Management 3 (3) Provides the opportunity to understand the problems of and solutions to conference and convention planning and management from both the sponsoring organization’s and facility manager’s perspectives.

PRTM 6460 Community Tourism Development 3 (3) Provides a community-based perspective of organizational, planning, development, and operational needs for a successful tourism economy at the local level.

PRTM 6470 Perspectives on International Travel 3 (3) Using the United States as a destination, international travel patterns and major attractions are presented. Factors which influence foreign travel to the United States are analyzed.

PRTM 8010 Philosophical Foundations of Recreation and Park Administration 3 (3) Current theories and philosophies in recreation as they are influenced by and have influence on leisure and the changing environment in America. Students develop their own professional philosophies of recreation and leisure.

PRTM 8030 Seminar in Recreation and Park Administration 3 (3) Case problems relating to administration of a park, recreation, or tourism agency.

PRTM 8040 Independent Study 1-3 (1-3) Topics in recreation, leisure and tourism not covered in other courses. Written report of findings is required. May be repeated for a maximum of three credits. Preq: Consent of supervising faculty prior to registration.
PRTM 8050 Internship 1-3 (1-3) Field placement in an approved agency under qualified supervision. To be taken Pass/No Pass only. Preq: PRTM major or consent of instructor.

PRTM 8060 Special Problems 1-3 (1-3) Directed, individual comprehensive investigation of a special problem to use knowledge gained in formal courses, provide experience and training in research and prepare for professional goals. Report of findings is required. May be repeated with a maximum of three credits applied toward graduation requirements. To be taken Pass/No Pass only.

PRTM 8070 Human Dimension of Outdoor Recreation and Public Land Visitation 3 (3) Social, psychological and environmental influences on human behavior; identification of theoretical perspectives to explain behavior and to resolve problems in recreation resource management.

PRTM 8080 Behavioral Aspects of Parks, Recreation and Tourism Management 3 (3) Behavioral aspects of recreation, focusing on the social and psychological dimensions of the recreation experience in a variety of environments and activities.

PRTM 8110 Research Methods in Parks, Recreation and Tourism Management 3 (3) Principles, methods and strategies for planning, designing, evaluating and applying studies of recreation. Students are expected to have completed a graduate-level statistics course or obtained consent of instructor before enrolling in this course.

PRTM 8130 Qualitative Research Methods in Parks, Recreation and Tourism Management 3 (3) Students investigate theoretical foundations for, evolution of use of, and practical experience with qualitative research methods. Focus is on qualitative research methods and linking these with quantitative methods through reading texts and current peer-reviewed literature. Class activities provide experience with major concepts studied.

PRTM 8200 Recreation Resource Policy Issues and Processes 3 (3) Outdoor recreation policy formulation structures and processes are surveyed through case studies involving past and current public policy issues.

PRTM 8210 Grants and Alternative Funding for Parks, Recreation and Tourism 3 (3) Examines alternative funding options for public and nonprofit parks and recreation agencies. Students gain practical experience in grant identification and writing, as well as identifying potential funding sources for agencies.

PRTM 8220 Strategic Planning in PRTM Organizations 3 (3) Overview of strategic planning geared towards public sector and nonprofit leisure service agencies, including strategic planning models and approaches, developing organizational vision and mission, data gathering and analysis, identifying and understanding stakeholders, and implementation, assessment and revision of strategic plans.

PRTM 8250 Understanding Populations in Parks, Recreation and Tourism Management 3 (3) Students develop a conceptual understanding of the leisure patterns and constraints of people across the lifespan and of diverse populations. Populations might include ethnic and racial minorities, people with disabilities, people with diverse socioeconomic backgrounds, status, gender, and people with alternate cultures and beliefs.

PRTM 8400 Tourism Planning 3 (3) Tourism planning procedures and techniques; planning process and associated concerns such as market, facility, infrastructure, environment, culture and economics.

PRTM 8420 Understanding the Discipline of Tourism 3 (3) Introduction at the graduate level to understanding tourism from a global perspective. Students are introduced to the contributions that other fields have made to understanding tourism research. Course begins with an examination of how to read academic literature from a critical perspective.

PRTM 8430 Tourism Analysis 3 (3) Selected theories, methods, techniques, practices and principles that govern tourism behavior. Preq: Graduate standing or one graduate-level statistics course or consent of instructor.

PRTM 8440 Outdoor Recreation Resource Management and Planning 3 (3) Issues relating to planning and development of natural areas for recreational purposes. Emphasis is on the policy-making process at the federal, state, regional and local levels. May also be offered as CRP 8440. Preq: Consent of instructor.

PRTM 8460 Event Management: Special Events 3 (3) An overview of the meetings, conventions and events industry. Topics include feasibility, viability and sustainability of the event process in addition to event creation and orchestration.

PRTM 8470 Event Marketing 3 (3) Examines a wide range of activities involved with the marketing of special events. Familiarizes students with event production and promotion and the development of marketing plans for public and private events, meetings, fairs, festivals and expositions.

PRTM 8480 Risk Management for Events and Meetings 3 (3) Focuses on the legal, ethical and financial responsibilities of event managers. Topics include risk identification, risk analysis and the planning of events and festivals; health, safety and fire codes; loss prevention, and security controls. Utilizes practices and procedures used by events and festivals.

PRTM 8490 Sustainable Event Management 3 (3) Examines the impacts events have on the environment. Practices related to reduction of social and environmental impacts events have are discussed. Topics include green positioning, carbon reductions, water use and conservation, ethics, and waste management.

PRTM 8500 Sustainable Tourism Myth or Reality? 3 (3) Provides students with exposure to issues related to developing sustainable tourism, both in developing and developed countries. Emphasis is on understanding global and local politics, policies, environments and social and cultural impacts stemming from developing sustainable tourism.

PRTM 8560 Heritage Tourism 3 (3) Many tourist itineraries invariably contain a heritage component, whether visiting a local museum or witnessing a traditional ceremony. Heritage can be one of the focal points of a vacation. Course offers critical readings and discussion about heritage and its role in tourism.

PRTM 8620 Sports Development Through the Lifespan 3 (3) Explores the role that sports and physical recreation programs play in promoting positive development processes throughout the lifespan. Course focuses on the major domains of human development for children through older adults, with a focus on how activity contexts can best be designed to promote healthy outcomes.

PRTM 8810 Therapeutic Recreation Theories and Concepts 3 (3) Provides students with the opportunity to analyze critically the philosophical positions influencing service delivery and the theories underling therapeutic recreation practice models and service delivery. Preq: PRTM 8800. Students who have not completed PRTM 8800 but hold an undergraduate degree in Parks, Recreation and Tourism Management should request a registration override from the course instructor.

PRTM 8910 Master’s Thesis Research 1-12 (1-12) Master’s Thesis Research

PRTM 9000 Selected Topics 1-3 (1-3) In-depth, timely study of trends or problems in parks, recreation and tourism not covered in other courses. May be repeated for a maximum of six credits.

PRTM 9080 Advanced Topics 1-3 (1-3) Topics not covered in other PRTM courses and not directly related to a thesis or dissertation topic. Formal paper is required. May be repeated for a maximum of six credits. Preq: Consent of instructor.

PRTM 9100 Research Seminar 1 (1) Current research developments in PRTM and presentation of research projects. May be taken for credit for two semesters. To be taken Pass/No Pass only.

PRTM 9110 Professional Issues in Parks, Recreation and Tourism Management 1 (1) Multi-disciplinary perspectives to examine concepts and methods related to professional development of parks, recreation and tourism management graduate students. Preq: Admission to PRTM graduate program or consent of instructor.

PRTM 9910 Doctoral Dissertation Research 1-12 (1-12) Doctoral Dissertation Research

PSYCHOLOGY

PSYC 6800 Health Psychology 3 (3) Study of the role of health-related behaviors in the prevention, development and/or exacerbation of health problems. Emphasis on the biopsychosocial model and its application in the assessment, treatment, and prevention of health problems.

PSYC 6890 Selected Topics 3 (3) Seminar in current topics in psychology. Topics change from semester to semester and are announced prior to each semester’s registration. May be repeated once for credit, but only if different topics are covered.

PSYC 8100 Research Design and Quantitative Methods I 3 (3) Overview of applied data analysis in industrial and other workrelated settings. Analysis techniques focus on the General Linear Model approach to ANOVA and regression. Students are expected to have completed six credits of statistics and research methods before enrolling in this course.
PSYC 8110 Research Design and Quantitative Methods I 3 (3) Research methodologies; experimental, quasi-experimental and nonexperimental designs emphasizing applied psychological research; scientific method; basic versus applied research; technical writing; grant writing and ethics. Preq: PSYC 8100.

PSYC 8130 Research Design and Quantitative Methods III 3 (3) Advanced course in applications of multivariate data analysis in industrial and other work-related settings. Topics include the major advanced and multivariate data analytic tools needed for research in applied psychology. Preq: PSYC 8100.

PSYC 8140 Laboratory in Quantitative Methods 1 (2) Laboratory in data analysis. Emphasis is on determining and conducting appropriate analyses, along with interpreting and presenting results. Analytic procedures covered include regression diagnostics, mediation, moderation, generalized linear models, hierarchical linear models, and factor analysis. Preq: PSYC 8100. Preq or concurrent enrollment: PSYC 8130.

PSYC 8150 Advanced Studies in Systems and Theories 3 (3) Foundations of contemporary psychology, origins of major theories, conceptions of scientific knowledge implicit in them and reasons for accepting or rejecting them.

PSYC 8220 Human Perception and Performance 3 (3) Basic research on human perception as applied to task performance; vision and audition in adults; basic knowledge of human sensory and perceptual characteristics as applied to such tasks as machine operation, task performance, etc.

PSYC 8330 Advanced Cognitive Psychology 3 (3) Research and theory concerning perception, memory, reasoning, problem solving, knowledge representation, psychology of language, semantics, attention, concept formation and other high-level mental processes. Applications of these areas are considered.

PSYC 8350 Advanced Human Factors Psychology 3 (0) Foundation from which to study interactions between human beings and systems in order to maximize safety, performance and user satisfaction. Integration and application of basic research and theory in sensation, perception, cognition and motor control.

PSYC 8370 Ergonomics for Applied Psychology 3 (3) Perception and action capabilities of humans as they relate to the design of machines and environments; biomechanics, anthropometry, human movement and work, and the perceptual support of action.

PSYC 8400 Usability Analysis and Crew Assessment 3 (3) Hands-on exposure to human factors methods for evaluating the usability of computer interfaces and assessing team performance in fast-paced tasks. May include cognitive task analysis, heuristic evaluation, usability testing, sequential data analysis, cognitive modeling, workload and situation-awareness measurement, measurement of team knowledge, operating simulators.

PSYC 8520 Advanced Studies in Social Psychology 3 (3) Human social behavior from the perspective of the individual as a participant in social relationships; contemporary theories of human social behavior and human behavior in social settings.

PSYC 8600 Psychology of Training and Evaluation 3 (3) Evaluation issues such as criteria development, organizational assessment, process, and outcome criteria along with instructional methodologies such as fairness in training, special populations, second careers, hard-core unemployment and ethics of organizational and industrial change.

PSYC 8610 Personnel Psychology 3 (3) Theory, techniques and legal issues involved in the effective matching of individuals’ needs, preferences, skills and abilities with the needs and preferences of organizations. Topics include research methods, prediction issues, tests and other predictors, decision making and job evaluation. Preq: PSYC 8100.

PSYC 8620 Organizational Psychology 3 (3) Investigation of forms of organizational structure and basic theories of organizations. Includes research and theories on human behavior in organizations including motivation, leadership and job satisfaction. Discusses relationships between theories and research on human behavior and organization development and change.

PSYC 8630 Work Motivation and Satisfaction 3 (3) Explanations for absenteeism, productivity, job satisfaction and withdrawal, as well as their interrelations. Methods of measuring attitudes and opinions and general theories of human motivation. Preq: PSYC 8620.


PSYC 8670 Legal Issues in Personnel 3 (3) Discrimination law and its relevance to the practice of industrial/organizational psychology. Compliance with Title 7, the Age Discrimination in Employment Act and the Americans with Disabilities Act.

PSYC 8680 Advanced Personnel Selection 3 (3) Advanced seminar covering details of personnel selection techniques used in organizations. Techniques covered may include biodata, cognitive and physical ability tests, personality tests, interviews and assessment centers. Preq: PSYC 8610.

PSYC 8710 Psychological Tests and Measurement 3 (3) Advanced survey of psychological test development, evaluation and utilization in organizational and research settings; professional guidelines for the practice of testing in industrial/organizational psychology and legal guidelines for using tests in industry.

PSYC 8730 Structural Equation Modeling in Applied Psychology 3 (3) Fundamentals of the statistical techniques involved in structural equation modeling (SEM) in applied psychology. SEM is a regression-based technique that incorporates elements of path analysis, confirmatory factor analysis and structural models. Preq: PSYC 8100 or consent of instructor.

PSYC 8820 Survey of Occupational Health Psychology 3 (3) Issues in the newly developing field of occupational health psychology; integration of knowledge bases from human factors, industrial-organizational, health psychology and related disciplines; biopsychosocial perspective where students develop problem-solving skills and interdisciplinary knowledge. Preq: PSYC 8620.

PSYC 8850 Organizational Stress 3 (3) Considers stressors in the workplace that have the capacity to undermine an individual’s well-being and performance. Addresses comprehensive models of organizational stress, methodological challenges in studying workplace stress, factors that reduce the negative impact of stress, and organizational interventions to reduce the negative consequences.

PSYC 8910 Master’s Thesis Research 1-3 (1-3) Master’s Thesis Research

PSYC 8950 Applied Psychology Internship 3 (3-6) Supervised field experience in industry, business, or government. Site location, on-site supervision and credit hours must be approved in advance by graduate coordinator.

PSYC 8970 Special Problems in Applied Psychology I 1-9 (1-9) Study of a particular topic under the direction of a faculty member. Specific program is organized by student and faculty member and submitted to graduate coordinator for approval. Project is not used to support MS thesis or dissertation. May be repeated for a maximum of 21 credits.

PSYC 8990 Selected Topics 3 (3) Selected current and classic topics not covered in other courses. May be repeated for credit.

PSYC 9910 Doctoral Dissertation Research 1-9 (1-9) Doctoral Dissertation Research

RHETORICS, COMMUNICATION AND INFORMATION DESIGN

RCID 8010 Histories of Rhetorics 3 (3) Details historical beginnings from preplatonic, Sophists, Plato, Aristotle to early work of K. Burke (c. 1940). Attention is given to primary-secondary works, including historiographical principles of rhetorics, “the sister arts” (ut pictura poesis, ephorism), and thecne (as human faculty and mechanical technol.) Preq: RCID major or consent of instructor.

RCID 8020 Cultural Research Methods 3 (3) Continuation of RCID 8010, from 1940 to the present. Focuses on rhetorical inventions as traditional memory and innovative counter-memory. Includes such theorists as K. Burke, G. Ulmer and P. Miller. Includes algorithms, heuristic, aleatory procedures; classical, modern, postmodern topoi and ethnographies/grammatologies; gestural, oral (aural), literate and electrologies; graphic/filmic collage-montage; “rhythm science,” and sampling-remixing. Preq: RCID 8010.

RCID 8030 Empirical Research Methods 3 (3) Study of assumptions/applications of empirical method in research. Includes sampling techniques, measurement, reliability, validity in collecting-analyzing data, using parametric/nonparametric statistical procedures. Considers approaches to content studies as well as survey and quasi-experimental research. Discusses philosophic writings of scholars such as Popper and Kuhn and content-specific work of Lazarfeld, Lasswell, Howland, among others. Preq: RCID major or consent of instructor.
RCID 8040 Visual Rhetorics 3 (3) Examines post-1945 modes of visual rhetoric and differing critical perspectives on their functions. Attention is given to key texts and visual creations to gain awareness of how visual codes operate in interior worlds and public life. Topics include the Challenge of Abstraction, Culture of Display, Body as Marketing Tool. Prq: RCID major or consent of instructor.

RCID 8050 Rhetorics, Communication, Information Technologies 3 (3) Hands-on examination of communication technologies used widely in academic and industry settings. Focuses on such intermedia as audio, video, Web, MOOs, Blogs, serious computer games and all emerging technologies. Prq: RCID major or consent of instructor.

RCID 8100 Pedagogy, Administration and Assessment 3 (3) Theory and praxis of professional communication in academic instruction and selected methods of pedagogical and programmatic assessment. Emphasizes communication-intermedia across the curriculum, academic program administration, and scholarship of teaching and learning. May be repeated for a maximum of six credits. Prq: RCID major or consent of instructor.


RCID 8130 Special Topics 3 (3) Study of varying topics determined by such rubrics as history, method, criticism, place, time, subjectivity, models, memory, styles; or determined by such permutations and combinations of rubrics as ethos-gender-sex, theory-practice, rhetoric-poetics, politics-poetics, technology, cultural-digital studies, analog-digital. May be repeated for a maximum of nine credits, but only if different topics are covered. Prq: RCID 8020 and RCID 8030; or consent of program director.

RCID 8330 Graduate Readings 3 (3) Independent research/study focusing on preparation of dissertation project, with two support areas. May be repeated for a maximum of nine credits. Students must have completed five RCID cognate seminars before enrolling in this course. Prq: RCID 8020 and RCID 8030 and RCID 8040 and RCID 8050 and consent of program director and chair of advisory committee.

REAL ESTATE DEVELOPMENT

RED 8000 Real Estate Development Process 3 (3) Real estate and land development process from the developer's perspective. Cases and lectures are presented by leading experts in the development industry. Emphasizes participants of the development team and how to become a developer/"master builder" to create a superior built environment. Prq: Consent of instructor.

RED 8010 Real Estate Market Analysis 3 (3) Processes and data sources used to analyze the supply and demand for various building types. Explores demographic, technological and economic trends affecting markets. General market analysis supply and demand approaches, including the use of GIS, are developed and applied primarily to residential, retail and office markets at specific sites. Prq: Consent of instructor.

RED 8020 Real Estate Development Field Tour Seminar 3 (9) Examines the processes of creating quality development within the risk-reward framework focusing on design feasibility from the perspectives of the development team. Approximate two-week tour of the South Carolina Coast or other environs visits approximately forty developments and the key actors involved. To be taken Pass/No Pass only. Prq: MRED student or consent of instructor.

RED 8030 Public/Private Partnership Development 3 (3) Focuses on public/private partnerships in the structuring, negotiating and implementing the design, development, construction and management of buildings and areas. Emphasis is on re-development/rehab and infill development; incentive tools and techniques, and market and feasibility issues for development within the risk-reward framework. Prq: RED 8000 and consent of instructor.

RED 8040 Practicum in Residential Development 3 (3) Exploration of the residential development process. Guest speakers, case studies and field visits are used. Feasibility, market studies and financial analysis for a real world proposed development are completed by diverse student teams. Prq: Consent of instructor.

RED 8050 Practicum in Commercial Development 3 (3) Exploration of the commercial development process, especially for office and retail properties. Guest speakers, case studies and field visits are used. Capstone preliminary feasibility analysis is completed by diverse student teams for a real world proposed development. Prq: Consent of instructor.

RED 8100 Real Estate Seminar Roundtable 1 (1) Weekly course that brings students and premier real estate professionals together through on-site or video conference sessions. Presentations and discussions occur regarding cutting-edge projects and industry issues from around the country and internationally. Prq: Enrollment in MRED program or consent of instructor.

RED 8110 Summer Internship in Real Estate Development 3 (9) Preplanned, preapproved, faculty-supervised internship designed to give students on-the-job learning in support of classroom education. Internships must be no less than ten full-time, consecutive weeks with same internship provider. Ancillary study abroad experience or two, three-credit classes in place of internship requirement are possible with approval of MRED Director. To be taken Pass/No Pass only.

RED 8120 Real Estate Technology 2 (2) Demonstrates the technology used by the real estate industry pertaining to site analysis and land planning, vertical design, location analysis and market research and feasibility analysis. Prq: Consent of instructor.

RED 8130 Real Estate Development Strategic Planning 3 (3) Seminar examines the importance of strategy in the success of real estate companies and projects. Leadership, current economic conditions and the real estate cycle are also explored as a way of identifying successful strategies and the role leadership plays in their execution. Prq: Second year MRED student.

RED 8140 Resort and Second-Home Communities Seminar 3 (3) Advanced seminar on resort and second-home communities focuses on the full range of development issues pertaining to this important and expanding real estate market. Special emphasis on market and feasibility issues, including analysis of value creation amenities such as golf/tennis, eco-environment, marina, equestrian, skiing and wellness. Prq: Second year MRED student.

RED 8160 Preservation Feasibility for Real Estate Professionals 3 (3) Students gain familiarity with historic tax incentives, the adaptive use of historic structures and the feasibility of historic rehabilitation projects within the context of contemporary real estate development processes. Prq: Enrollment in the Master of Real Estate Development program.

RED 8890 Selected Topics 3 (3) Topics emphasizing current literature and results of current research. May be repeated for a maximum of nine credits, but only if different topics are covered. Prq: Consent of instructor.

RED 8990 Directed Study 1-3 (1-3) Students pursue individual professional interests under guidance of individual faculty as approved by MRED Director. Offered for elective credit for students in MRED program. May be repeated for a maximum of six credits.
RELIGION

REL 6010 Studies in Biblical Literature and Religion 3 (3) Critical examination of a selected topic in biblical studies. Topics vary from year to year. May be repeated once for credit.

REL 6020 Studies in Religion 3 (3) Thorough examination of a selected topic in one or more of the religious traditions of the world or of religious life in a particular region. Topics vary from year to year. May be repeated once for credit.

REL 6100 Holy Lands 3-6 (3-6) Rotating study abroad trips to areas of historical importance to Judaism, Christianity, Islam and other religious traditions. Students visit archaeological sites, museums, and sacred spaces of global importance and gain needed world perspective as they encounter other cultures.

REL 6520 History of Early Christianity 3 (3) Study of the history, social and doctrinal, of early Christianity up to 600 A.D. May also be offered as HIST 6520.

REL 6590 Independent Study 1-3 (1-3) Study of selected problems, issues, or movements in religion under the direction of a faculty member chosen by the student. Student and faculty member develop an individualized course of study approved by the department chair prior to registration. May be repeated for a maximum of six credits. Prq: Consent of instructor.

RURAL SOCIOLOGY

RS 6010 Human Ecology 3 (3) Analysis of the interrelationships between the physical world, modifications in natural environments, human settlement patterns, and institutions that both encourage and regulate environmental modification. Emphasizes conditions whereby natural resources become public policy concerns. Offered spring semester only. May also be offered as SOC 6010. Prq: Junior standing.

RS 6590 The Community 3 (3) Close analysis of the development of contemporary communities and their place in society. Continuing effects of industrialization, migration, and technological change on community location and structure are examined. Structural relations of social class, status, and the associations among institutions are explored. May also be offered as SOC 6590. Prq: Junior standing.

SOCIOLOGY

SOC 6010 Human Ecology 3 (3) Analysis of the interrelationships between the physical world, modifications in natural environments, human settlement patterns, and institutions that both encourage and regulate environmental modification. Emphasizes conditions whereby natural resources become public policy concerns. Offered spring semester only. May also be offered as RS 6010. Prq: Junior standing.

SOC 6040 Sociological Theory 3 (3) Survey of the development of sociological theory. Required of all Sociology majors. Prq: SOC 2010 or SOC 2020; and Junior standing.

SOC 6140 Policy and Social Change 3 (3) Uses the sociological perspective to examine policy development, implementation, and evaluation in the public and private sectors. Specifically, focuses on values and ethics and effects of social change efforts on the outcomes of policy formation, social planning, and implementation. Prq: SOC 2010 or SOC 2020 and Junior standing.

SOC 6330 Globalization and Social Change 3 (3) Examination of the social and historical causes of development and underdevelopment. Various sociological theories of development are reviewed. Selected countries are examined in an international context. Prq: SOC 2010 or SOC 2020 and Junior standing.

SOC 6590 The Community 3 (3) Close analysis of the development of contemporary communities and their place in society. Continuing effects of industrialization, migration, and technological change on community location and structure are examined. Structural relations of social class, status, and the associations among institutions are explored. May also be offered as RS 6590. Prq: Junior standing.

SOC 6600 Race and Ethnicity 3 (3) Investigation of sociological perspectives on race, ethnic relations, and social stratification. Includes analysis of the impact of social class on minority movements. Prq: SOC 2010 or SOC 2020 and Junior standing.

SOC 6710 Population Issues and Methods 3 (3) Study of demographic concepts, theory, and research methods for vital statistics, migration, and population distribution and projections. Considers collection and processing of demographic data and organization of demographic data systems. Offered fall semester only. Includes Honors sections. Prq: ANTH 2010 or RS 3010 or SOC 2010 or SOC 2020.

SOC 6800 Medical Sociology 3 (3) Study of sociocultural factors in the etiology and treatment of physical illness, medical occupations and professions, and the organization of health care delivery systems. Prq: SOC 2010 or SOC 2020 and Junior standing.

SOC 6810 Aging and Death 3 (3) Sociological orientation to aging populations focusing on the impact of health care, welfare, and retirement systems. Includes dying as a social phenomenon, suicide, euthanasia, and funerals. Prq: SOC 2010 or SOC 2020 and Junior standing.

SOC 6840 Child Abuse and Treatment 3 (3) Comprehensive examination of child abuse, neglect, and exploitation as major social problems; causes, effects, and prevalence of physical, sexual, and emotional maltreatment; definitional controversies; social policy and legal considerations; therapeutic approaches for children and their caretakers; child maltreatment and the judicial system. Prq: Junior standing.

SOC 6910 Soc of Policing 3 (3) Introduction to the major issues of contemporary policing in the U.S. from a sociological perspective. Topics include the changing functions and structure of policing, the police subculture, and the role of the police in a liberal democracy. Prq: SOC 3880.

SOC 6930 Sociology of Corrections 3 (3) Analysis of correctional alternatives. Topics include sentencing strategies and their impact, prison populations (male, female, and juvenile), inmate social structures, treatment and custody issues, community-based alternatives (probation, parole, electronic monitoring, and work release), and correctional management issues. Prq: SOC 3880.

SOC 6940 Sociology of Organized Crimes 3 (3) Examines the multifarious aspects of criminal organizations, namely their structure, methods, and networks. Specific topics may include white-collar crime and traditional, nontraditional, and transnational organized crime. Prq: SOC 3880.

SOC 8030 Survey Designs for Applied Social Research 4 (3) Survey research design principles, procedures and techniques used in applied sociology; instrumentation; data collection, management and interpretation. Offered fall semester only. Prq: RS 3030 or SOC 3030. Coreq: SOC 8031.

SOC 8031 Survey Designs for Applied Social Research Laboratory 0 (2) Non-credit laboratory to accompany SOC 8030. Coreq: SOC 8030.

SOC 8050 Evaluation Research 3 (3) Research methods and techniques of computer-assisted data management and analyses used in evaluating policies, operation, organization and effectiveness of social programs in the private and public sectors; microcomputer software packages available for these purposes. Offered spring semester only. Prq: SOC 8030.

SOC 8070 Advanced Research Methods 3 (3) Advanced methods in social research; measuring techniques and data analysis strategies; practical experience in various phases of social research. Offered spring semester only. Prq: SOC 8030.

SOC 8100 Theoretical Models in Applied Social Research 3 (3) Comparative analysis of theoretical models in sociology and their uses in applied research; uses of these models in research concerned with the processes of industrial and economic growth and development. Prq: SOC 4040.

SOC 8120 Social Stratification 3 (3) Stratification is the comprehensive study of social inequalities as manifest in multiple dimensions of economic class, political power, and occupational status, their intercorrelations, and the uneven distributions of these across gender, racial, and ethnic demographics. Stratification cuts across the major sociological subfields and is relevant for academic, public, and policy-centered sociology.

SOC 8300 Human Systems Development: Organizations and Society 3 (3) Complex organizations such as human systems with primary focus on development and change, interorganizational relations and the influence of these structures on the community life. Offered fall semester only. Prq: SOC 4300.

SOC 8360 Environmental Sociology 3 (2) Introduction to environmental sociology; relationship among human behavior, society and the environment; focuses on the natural rather than the built environment; U.S. and global issues. Coreq: SOC 8361.

SOC 8361 Environmental Sociology Laboratory 0 (3) Non-credit laboratory to accompany SOC 8360. Coreq: SOC 8360.

SOC 8910 Master’s Thesis Research 1-12 (1-12) Master’s Thesis Research
SOC 8920 Selected Topics in Sociology 3 (3) Current topics in applied sociology not covered in other graduate courses. May be repeated once for credit.

SOC 8950 Field Experience I-6 (1-6) Supervised work experience in a public agency or private enterprise to gain planning, research and policy experience. May be repeated once for a maximum of six credits. Students are expected to have completed 12 hours of 8000-level coursework in Sociology before enrolling in this course.

SOC 8960 Independent Study 1-3 (1-3) Individual readings or research in a topic area selected according to a student's interests or program needs. May be repeated for a maximum of six credits. Prq: Approval of director of graduate studies.

SOC 8970 Departmental Research and Professional Development Seminar 1 (1) Presentation of current research by Department of Sociology faculty, staff, graduate students and visiting researchers. Professional development seminars related to the research process, internships and employment opportunities. May be repeated for a maximum of four credits. To be taken Pass/No Pass only.

SPAN

SPAN 6990 Special Topics 3 (3) Study of timely or special topics in Spanish. May be repeated for a maximum of six credits, but only if different topics are covered. Prq: Consent of department chair.

EXPERIMENTAL STATISTICS

STAT 6020 Introduction to Statistical Computing 3 (3) Introduction to statistical computing packages. Topics include data importation, basic descriptive statistic computation, basic graphic preparation, and statistical analysis methods and procedures. Students are expected to have completed an introductory statistics course before enrolling in this course.

STAT 6110 Statistical Methods for Process Development and Control 3 (3) Experimental design techniques for use in process development, application of screening experiments and response surface experiments, techniques for process control with implications for product quality control. Includes discussions of the use of statistical computer analyses and interpretations including computer-generated graphics. Students are expected to have completed a course in multivariable calculus before enrolling in this course.

STAT 8010 Statistical Methods I 4 (3) Role and application of statistics in research; estimation, test of significance, analysis of variance, multiple comparison techniques, basic designs, mean square expectations, variance components analysis, simple and multiple linear regression, and correlation, and nonparametric procedures. Coreq: STAT 8011.

STAT 8011 Statistical Methods I Laboratory 0 (3) Non-credit laboratory to accompany STAT 8010. Coreq: STAT 8010.

STAT 8020 Statistical Methods II 3 (3) Extended coverage of several methods introduced in STAT 8010: multiple regression model building and diagnostics, experiment design and analysis, and nonparametric methods; mixed models and repeated measures analyses; categorical data analysis; multivariate methods and sampling designs; appropriate use of statistical software. Prq: STAT 8010.

STAT 8030 Regression and Least Squares Analysis 3 (3) Regression analysis: simple and multiple linear, curvilinear and multiple curvilinear; curve fitting; least squares and computer techniques for fitting of constants and analysis of planned experiments. Offered spring semester only. Prq: STAT 8010.

STAT 8040 Sampling 3 (3) Principles of scientific sampling; finite population sampling; simple random, stratified, multistage and systematic sampling; optimum allocation; methods of obtaining, processing and reporting survey information; sampling as related to the environment, natural resources and social and economic problems. Prq: STAT 8010.

STAT 8050 Design and Analysis of Experiments 3 (3) Basic designs and analysis; data transformations; single degree of freedom, orthogonality and responses in ANOVA; covariance; response surfaces; incomplete blocks; introduction to least squares analysis of experiments; uses of standard computer programs for selected analyses. Prq: STAT 8010.

STAT 8110 Special Problems in Experimental Statistics I-3 (1-3) Statistical aspects of an individualized research problem; determining an appropriate experimental design; performing proper analyses and generating effective reports.

STAT 8120 Selected Topics 1-3 (1-3) Topics in applied statistics not covered in other courses. May be repeated, but only if different topics are covered.

STAT 8150 Environmental and Ecological Statistics 3 (3) Overview of statistical techniques in Environmental Science and Ecology. Probability distributions and sampling; population estimation using capture/recapture, line transect and line intercept methods; spatial point pattern analysis; modelling environmental and ecological data; environmental monitoring. Prq: STAT 8010 and STAT 8030.

STAT 8160 Spatial Statistics 3 (3) Introduction to spatial data analysis emphasizing concepts and interpretation, spatial point processes, clustering, spatial autocorrelation, semivariograms, kriging, spatial regression and analysis of variance. Prq: STAT 8010 and STAT 8030.

STAT 8170 Multivariate Statistics in Agriculture, Forestry and Natural Resources 3 (3) Application of multivariate techniques for linear models (MANOVA, Hotellings T2), covariance structure (principal components, factor analysis), classification (discriminant and cluster analyses) and structural equation modeling drawing examples from life sciences, natural resources, tourism and related programs. Prq: STAT 8010 and STAT 8030.

STAT 8190 Biostatistics 3 (3) Statistical analyses applicable to disease/mortality occurrence. Introduction to epidemiology study designs and appropriate statistical analyses. Statistical methodology applicable to life-tables and survival curves and clinical trials. Prq: STAT 8010.

STAT 8420 Introduction to Statistical Methods 3 (3) Online course focused on the role and application of statistics in research: estimation, tests of significance, analysis of variance, multiple comparison techniques, basic experimental designs, simple and multiple linear regression, and correlation procedures. Prq: Consent of instructor.

SYSTEMS ENGINEERING

SYSE 8010 Systems Engineering I 3 (3) Educates students on the complete system design process using a project-oriented format. Course consists of topical areas in needs analysis, concept generation and development, prototyping, evaluation, cost analysis, implementation and delivery. Prq: Consent of instructor.

SYSE 8020 Systems Engineering II 3 (3) Addresses analysis and design of complex systems by considering human, hardware and software components of the system. Techniques for unambiguously defining a problem and designing a solution are applied to a model problem. Architectural techniques are used to assemble a solution that satisfies functional and non-functional requirements. A range of qualitative and quantitative verification and validation techniques for evaluating the fitness of a solution are examined and used. Prq: SYSE 8010.

SYSE 8530 Improving Systems Using Quality and Lean Principles 3 (3) Course focuses on educating students in the theory of quality control, its principles, and the application of Quality and Lean techniques to manufacturing and service systems.

SYSE 8590 Capstone Project 3 (3) Capstone experience in the analysis and design of systems by carrying out a substantial project. May be repeated for a maximum of six credits. Prq: Admission to the Systems Engineering program.

THEATRE

THEA 6290 Dramatic Literature I 3 (3) Selected reading in the dramatic literature from the classical era of Greece and Rome to the Renaissance. Prq: ENGL 3100 or consent of instructor. May also be offered as ENGL 6290.

THEA 6300 Dramatic Literature II 3 (3) Principles and progress of drama from the Restoration to the present; analysis of representative plays; critical reports; discussion of trends in dramatic literature. Prq: ENGL 3100 or consent of instructor. May also be offered as ENGL 6300.

THEA 6470 Playwriting Workshop 3 (3) Workshop in the creative writing of plays. May be repeated once. Prq: ENGL 3470 or THEA 3470 or consent of instructor. May also be offered as ENGL 6470.

THEA 6720 Improvisation 3 (3) Practical applications using drama to motivate collaboration, heighten analytical skills, and strengthen group thinking and processing skills. Explorations include workshop design and leadership among various venues and participant groups, honing strengths toward positive and creative problem-solving. Techniques include strategies for writers, actors, directors, visual artists, teachers, and workshop leaders.
THEA 6870 Stage Lighting I 3 (2) Theory and practice of stage lighting through an understanding of various lighting instruments, lighting control systems, and execution of lighting designs. Coreq: THEA 6871.

THEA 6871 Stage Lighting I Laboratory 0 (1) Non-credit laboratory to accompany THEA 6870. Coreq: THEA 6870.

THEA 6970 Scene Painting 3 (2) Practical study of basic painting techniques for the theatre including layout, proper use of materials, painting styles, and texturing techniques. Coreq: THEA 6971.

THEA 6971 Scene Painting Laboratory 0 (1) Non-credit laboratory to accompany THEA 6970. Coreq: THEA 6970.

THEA 6990 Independent Studies 1-3 (1-3) Tutorial work for students with special interests outside the scope of existing courses. May be repeated for a maximum of six credits. Prereq: Consent of instructor.

VOCATIONAL-TECHNICAL EDUCATION

VTED 8100 Foundations of Vocational and Technical Education 3 (3) Evolution of vocational and technical education during the 20th century and current trends; sociological, psychological and philosophical theories underlying current objectives; definition of broad parameters of the field.

VTED 8330 Curriculum Construction in Vocational and Technical Education 3 (3) Students develop a specific course in a selected vocational and technical education area by specifying performance goals and building around these objectives. Prereq: AGED 6400.

VTED 8500 Programs, Concepts and Issues in Vocational and Technical Education 3 (3) Current activities and debates in vocational and technical education; traditional and innovative programs, career education, school finance, disadvantaged students, handicapped youth, sex equality and other specialized programs.

VTED 8820 Seminar 1 (1) Current issues and problems and proposed research projects.

VTED 8910 Advanced Research Design and Analysis 3 (3) Emphasis on the dissertation from the proposal to the fully developed outline of all chapters. Required of all doctoral candidates in the vocational/technical education program. Prereq: AGED 8890 or ED 8890.

VTED 9550 The Two-Year College 3 (3) Historical developments, functions, organization and administration of the two-year college. Prereq: Admission to PhD program in Educational Leadership or consent of instructor. May also be offered as EDL 9550.

VTED 9900 Internship in Vocational/Technical Education 1-16 (0,3-18) Internship in which students gain experience working in a chosen area of specialization in vocational/technical education; field experience activities must be planned to build competence in the student’s field of specialization. To be taken Pass/No Pass only. Prereq: Consent of major advisor.

VTED 9910 Doctoral Dissertation Research 1-12 (1-12) Doctoral Dissertation Research

WILDLIFE, FISHERIES AND BIOLOGY

WFB 6100 Wildlife Management Techniques 3 (1) Covers field and laboratory methods commonly used in wildlife management and research. Students interact with wildlife professionals. Topics include research methodology, estimating wildlife population characteristics, condition measures, and food habits; species determination, sex, and age; capture; population monitoring methods; GIS and mapping techniques, habitat evaluation and improvement. Prereq: WFB 3000 and WFB 3500. Coreq: WFB 6101.

WFB 6101 Wildlife Management Techniques Laboratory 0 (6) Non-credit laboratory to accompany WFB 6100. Coreq: WFB 6100.

WFB 6120 Wildlife Management 3 (2) Basic principles and general practices of wildlife management and conservation are covered. Major problems concerning the management of wildlife resources, with emphasis on upland game species. Laboratory work includes practical work on the Clemson University woodlands and field trips to several areas where wildlife management is being practiced. Prereq: WFB 3000 and WFB 3500. Coreq: WFB 6121.

WFB 6121 Wildlife Management Laboratory 0 (3) Non-credit laboratory to accompany WFB 6120. Coreq: WFB 6120.

WFB 6140 Wildlife Nutritional Ecology 3 (3) Concepts of how terrestrial wildlife obtains and utilizes energy and nutrients in wild ecosystems are taught. Energy and nutrient availability are discussed in the ecological context of distribution, flow, and cycling in natural and modified foraging areas. Physiology of digestion is discussed for major homeotherms. Prereq: WFB 3000 and WFB 3500.

WFB 6150 Quality Deer Management 3 (3) Quality Deer Management (QDM) is a stewardship philosophy that provides desirable hunting experiences by producing white-tailed deer herds with a natural age and sex structure and population size appropriate for habitat conditions. The course will emphasize herd management, habitat management, hunter management and herd monitoring. Online course. Prereq: Junior standing.

WFB 6160 Fishery Biology 3 (2) Principles underlying freshwater fish production. Introduction to major groups of freshwater fishes and their habitats. Topics include identification, age and growth, fecundity, food habits, populations estimation, environmental evaluation, management practices, and fish culture. Prereq: WFB 3000 and WFB 3500. Coreq: WFB 6161.

WFB 6161 Fishery Biology Laboratory 0 (3) Non-credit laboratory to accompany WFB 6160. Coreq: WFB 6160.

WFB 6300 Wildlife Conservation Policy 3 (3) Deals with the ecological rationale and management implications of public policy designed for the conservation of American wildlife resources. Emphasis is on managed-land issues. Prereq: WFB 3000 and WFB 3500.

WFB 6440 Wildlife Damage Management 3 (2) Covers the philosophical, sociological, ecological, and economical basis for controlling damage caused by animals problem wildlife populations. Emphasis is placed on fundamentals of prevention and control of damage caused by vertebrate species, especially mammals and birds. Includes interaction with federal and state agencies and private consultants. Prereq: WFB 3000 and WFB 3500. Coreq: WFB 6441.

WFB 6441 Wildlife Damage Management Laboratory 0 (3) Non-credit laboratory to accompany WFB 6440. Coreq: WFB 6440.

WFB 6520 Aquaculture 3 (3) Basic aquacultural techniques applied to freshwater and marine organisms; past and present culture of finfishes and shellfishes around the world; principles underlying fish production; water quality, feeding, and nutrition as they influence production of cultured aquatic organisms. Prereq: WFB 3000 and WFB 3500.

WFB 6600 Warmwater Fish Diseases 2 (2) Study of diseases in warmwater fish including infectious and noninfectious processes. Prereq: WFB 3000 and WFB 3500.

WFB 6620 Wetland Wildlife Biology 3 (3) Study of wetland wildlife habitats, emphasizing classification by physical, chemical, and biological characteristics; importance of wetland habitat for management and production of wetland wildlife species. Offered fall semester only. Prereq: WFB 3000 and WFB 3500.

WFB 6680 Herpetology 4 (3) Physiology, functional morphology, ecology, evolution, biomeschanics and current literature of amphibians and reptiles. Laboratory study examines morphology and identification of world families and United States genera, as well as southeastern species. Field trips are required. May also be offered as BIOL 6680. Prereq: BIOL 1040 and BIOL 1060; or BIOL 1110. Coreq: WFB 6681.

WFB 6681 Herpetology Laboratory 0 (3) Non-credit laboratory to accompany WFB 6680. May also be offered as WFB 6681. Coreq: WFB 6680.

WFB 6690 Aquatic Insects 3 (1) Identification, life history, habitats, and interrelationships of aquatic insects; techniques of qualitative field collecting; important literature and research workers. Prereq: ENT 3010. Coreq: WFB 6691. May also be offered as BIOL 6690 or ENT 6690.

WFB 6691 Aquatic Insects Laboratory 0 (6) Non-credit laboratory to accompany WFB 6690. May also be offered as BIOL 6691 or ENT 6691. Coreq: WFB 6690.

WFB 6750 Economics of Wildlife Management and Policy 3 (3) Integrated approach to the study of the economics of wildlife. Topics include determination of market and nonmarket value, single and multiple species management, enterprise cost and returns, marketing wildlife, leasing methods, complementarity and competitiveness with agricultural and forestry enterprises, and timber and crop damage cost estimates and control. May also be offered as APEC 6750. Prereq: APEC 2020 or ECON 2000 or ECON 2110 or FOR 3040 or WFB 3060.
WFB 6760 Bird Conservation and Ecology 3 (1)
Field-intensive introduction to the identification, ecology, and conservation of North American birds and their habitats with an emphasis on management and applied field ornithology. Includes bird/habitat survey and census techniques. At least one weekend (Friday-Sunday) field trip is required. Preq: BIOL 1040 and BIOL 1060; or BIOL 1110. Coreq: WFB 4761.

WFB 6761 Bird Conservation and Ecology Laboratory 0 (4)
Non-credit laboratory to accompany WFB 6760. Coreq: WFB 6761.

WFB 7120 Wildlife Conservation for Teachers 2-3 (2-3)
Principles and practices of wildlife conservation providing an overview of wildlife diversity, ecology, and management in the state; population census, wildlife identification, capture and habitat management of game and nongame species. For in-service teachers only. Preq: Consent of instructor.

WFB 8150 Principles of Wildlife Biology 3 (2)
Theories and principles applicable to wildlife biology emphasizing upland game species. Offered fall semester of even-numbered years only. Coreq: WFB 8151.

WFB 8151 Principles of Wildlife Biology Laboratory 0 (3)
Non-credit laboratory to accompany WFB 8150. Coreq: WFB 8151.

WFB 8180 Waterfowl Ecology and Management 3 (2)
Identification, ecology, and management of waterfowl. Laboratory work includes demonstration and application of relevant waterfowl management techniques, current literature topics and field trips. Offered fall semester of odd-numbered years only. Preq: BIOL 4410 or WFB 4120. Coreq: WFB 8181.

WFB 8181 Waterfowl Ecology and Management Laboratory 0 (3)
Non-credit laboratory to accompany WFB 8180. Coreq: WFB 8181.

WFB 8400 Fish Management 3 (2)
Principles and techniques of managing aquatic systems for recreational and/or commercial fishing, emphasizing streams, rivers, estuaries, and impoundments. Laboratory work includes demonstration and application of management techniques and field trips to observe management practices. Offered fall semester of odd-numbered years only. Preq: WFB 4160. Coreq: WFB 8401.

WFB 8401 Fish Management Laboratory 0 (3)
Non-credit laboratory to accompany WFB 8400. Coreq: WFB 8401.

WFB 8600 Diagnostic Procedures of Warmwater Fish Diseases 2 (1)
Warmwater fish disease diagnostic procedures employing proper protocol to be followed by a fish disease diagnostician. Offered summer session of odd-numbered years only. Preq: WFB 4600. Coreq: WFB 8601.

WFB 8601 Diagnostic Procedures of Warmwater Fish Diseases Laboratory 0 (2) Non-credit laboratory to accompany WFB 8600. Coreq: WFB 8600.

WFB 8610 Selected Topics 1-4 (1-4)
Current areas of aquaculture, fisheries and wildlife management and research. May be repeated for credit. Preq: Consent of instructor. Coreq: WFB 8611.

WFB 8611 Selected Topics Laboratory 0 (1-12) Non-credit laboratory to accompany WFB 8610. Coreq: WFB 8610.

WFB 8630 Special Problems in Wildlife and Fisheries Biology 1-4 (1-4)
Research not related to a thesis. Credit varies with problems selected. Preq: Consent of instructor.

WFB 8910 Master's Thesis Research 1-12 (1-12)
Master's Thesis Research


WOMEN'S STUDIES

WS 6230 Women in the Developing World 3 (3)
Comparative anthropological study of women and their status in developing countries around the world. A survey of women's daily lives in a global context, emphasizing education, economics, and the environment. Case studies include microfinance, literacy, reproductive rights and practices, and the impact of religious fundamentalism on women. May also be offered as ANTH 6230. Preq: Sophomore standing.

WS 6360 Feminist Literary Criticism 3 (3)
Introduces the germinal works of feminist literary theory and criticism. Outlines the development of modern literary criticism by studying feminist versions of the major critical methodologies. May also be offered as ENGL 6360. Preq: ENGL 3100 or consent of instructor.