

- C E 806 Dynamic Analysis of Structures 3(3,0)** Analysis and design of structures subjected to dynamic loading; response of lumped and distributed parameter systems of one or many degrees of freedom; approximate design methods; introduction to earthquake analysis and design. *Preq:* C E 801 or consent of instructor.
- C E 807 Wind Engineering 3(2,2)** 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.
- C E 808 Earthquake Engineering 3(3,0)** 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. *Preq:* C E 806 or consent of instructor.
- C E 809 Forensic Engineering 3(3,0)** Study of civil engineering failures including analyses of conditions just prior to the failure, load or event causing failure. Also covers methods of investigation and design of remedial measures, case histories of failures illustrating common errors and failures. Student projects involve design of remedial measures and alternatives.
- C E 813 Highway and Airport Pavement Design 3(3,0)** 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:* C E 311 and 321, or consent of instructor.
- C E 815 Transportation Safety Engineering 3(3,0)** 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:* C E 311 or consent of instructor.
- C E 820 Geotechnical Site Characterization 3(3,0)** 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:* C E 321 or equivalent.
- C E 821 Advanced Soil Mechanics 3(3,0)** Study of stresses in soils, plastic equilibrium of soil masses, failure conditions, earth pressures, analysis of flexible retaining wall bulkheads, and solution of problem by elastic theory. *Preq:* C E 321 or consent of instructor.
- C E 822 Foundation Engineering 3(3,0)** 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:* C E 821 or consent of instructor.
- C E 823 Asphalt Concrete Properties 3(3,0)** 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. *Preq:* C E 351 or consent of instructor.
- C E 825 Soil Dynamics and Geotechnical Earthquake Engineering 3(3,0)** 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. *Preq:* C E 421, 424, or consent of instructor.
- C E 826 Properties of Portland Cement Concrete 3(3,0)** 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. *Preq:* C E 351 or consent of instructor.
- C E 827 Special Cements and Concrete 3(3,0)** 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. *Preq:* C E 826 or equivalent.
- C E 828 Repair and Rehabilitation of Concrete Structures 3(3,0)** 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. *Preq:* C E 826.
- C E 829 Geosynthetics 3(3,0)** 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. *Preq:* C E 321 and 351 or their equivalents.
- C E 835 Construction Project Modeling 3(3,0)** 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. *Preq:* C E 331 or consent of instructor.
- C E 836 Civil Engineering Quality Management 3(3,0)** 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.
- C E 837 Construction Specifications and Contracts 3(3,0)** 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. *Preq:* C E 331 or consent of instructor.
- C E 838 Materials Management 3(3,0)** 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. *Preq:* Consent of instructor.
- C E 840 Project Management Applications 3(3,0)** 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. *Preq:* C E 433 and 434, or consent of instructor.
- C E 846 Flow in Open Channels 3(3,0)** 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. *Preq:* C E 342 or consent of instructor.
- C E 851 Reliability 3(3,0)** 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.
- C E 853 Applications in Traffic Engineering 3(2,3)** Highway capacity analysis; design of unsignalized intersections; intelligent transportation systems; parking; traffic signal coordination; microscopic and macroscopic traffic simulation. *Preq:* C E 410 or consent of instructor.
- C E 854 Travel Demand Forecasting 3(2,3)** 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. *Preq:* C E 412 or consent of instructor.
- C E 855 Transportation Seminar 1(1,0)** Practical discussion of the transportation profession featuring faculty and off-campus experts. Course is highlighted by a retreat where students present their transportation research.
- C E 860 Advanced Fluid Mechanics 3(3,0)** Laminar and turbulent flows; boundary layer and free shear flows (jets, wakes, etc.); descriptions of velocity, shear stress and pressure measurements, and aerodynamic drag.
- C E 861 Mechanics of Sediment Transport 3(3,0)** 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. *Preq:* C E 342 or consent of instructor.

C E 865 Hydrologic Systems Analysis 3(3,0) Hydrologic cycle as a hydrologic system; deterministic hydrology; aspects of physical hydrology emphasizing balanced approach to groundwater hydrology and surface water hydrology; infiltration; soil moisture and evapotranspiration; probability analysis and system synthesis by convolution. *Preq:* C E 342 or consent of instructor.

C E 867 Pipeline Hydraulics 3(3,0) Pressurized pipeline design including economic analysis, pipe sizing and selection; applications in civil engineering; prediction and control of cavitation; transient analysis; and methods of suppression. Students participate in a team-oriented design project. *Preq:* C E 341 or consent of instructor.

C E 868 Environmental Fluid Mechanics and Hydraulics 3(3,0) 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.

C E 875 Numerical Models in Hydraulics 3(3,0) 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. *Preq:* C E 342 or consent of instructor.

C E 889 Special Problems I 1-3 Research design problems from field of structures, construction, soil mechanics, transportation, ocean and coastal engineering, or materials engineering. Subject matter varies with interest and experience of student and instructor.

C E 890 Special Problems II 1-3 Research design problems from field of structures, construction, soil mechanics, transportation, ocean and coastal engineering, or materials engineering. Subject matter varies with interest and experience of student and instructor.

C E 891 Master's Thesis Research 1-12

C E 893 Selected Topics in Civil Engineering 1-6(1-6,1-6) Topics not covered in other courses. May be repeated for credit.

C E 895 Civil Engineering Seminar 1(0,2) Current and historic topics in various areas of civil engineering. Speakers may include off-campus experts, faculty, and graduate students. Presentation of at least one seminar is required.

C E 991 Doctoral Dissertation Research 1-12

COLLEGE OF ENGINEERING AND SCIENCE

CES 603 Career Success in Research and Development 1(1,0) Assists students in making personal and professional transition into industrial research careers. Offers advice and introduces and demonstrates practical techniques to help students avoid early career land mines. *Preq:* Junior standing in engineering or science discipline.

CES 850 Special Topics in Engineering and Science Education 1-4(1-4,0) Advanced topics intended to develop in-depth areas of particular student interest. May be repeated for a maximum of 15 credits. *Preq:* Consent of instructor.

COMMUNICATION STUDIES

COMM (ENGL) 651 Film Theory and Criticism 3(2,3) See ENGL 651.

COMM 664 Advanced Organizational Communication 3(3,0) Application of speech communication methodology to the analysis of organizational communication processes. Students study methods of organizational communication analysis and intervention. *Preq:* COMM 364 or consent of instructor.

COMM 670 Communication and Health 3(3,0) Considers institutional and health-care communication issues as well as the relationship between social issues, communication, and health. *Preq:* COMM 201 with a C or better or consent of instructor.

COMM (ENGL) 691 Classical Rhetoric 3(3,0) See ENGL 691.

COMM (ENGL) 692 Modern Rhetoric 3(3,0) See ENGL 692.

COMM (ENGL) 804 Fundamentals of Health Communication 3(3,0) See ENGL 804.

COMM (ENGL) 807 Health Communication Campaign Planning and Evaluation 3(3,0) See ENGL 807.

COMM (A A H, ENGL) 840 Selected Topics 3(3,0) See ENGL 840.

COMM 871 Leadership Communication 3(3,0) 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 applications, including implications of institutional structures and their impact on society.

COMM 873 Designing Workplace/Electronic Performance Support 3(3,0) Analysis and design of application components and on-line design processes that solve organizational performance issues and contribute to workplace enhancement.

COMM 874 Special Topics in Communication Studies 3(3,0) Varying topics within the field of communication studies. May be repeated for a maximum of six credits, but only if different topics are covered.

COMMUNITY AND RURAL DEVELOPMENT

C R D (AP EC) 611 Regional Impact Analysis 3(3,0) Techniques for analysis of the growth and decline of regions including economic-base theory, shift share, regional input-output, regional econometric models, and fiscal impact models. *Preq:* AP EC 202 or ECON 211 and 212.

C R D (AP EC) 612 Regional Economic Development Theory and Policy 3(3,0) Development of rural economic activity in the context of historical, theoretical, and policy aspects of friction associated with spatial separation. Location factors, transfer costs, location patterns, and regional-growth policy are considered. *Preq:* AP EC 202 or ECON 211 or equivalent.

C R D 692 Case Study Project 3(3,0) Capstone course engaging students in in-depth case study projects in community and economic development. Designed to enhance professional development, career interests, and practical experience. Students may participate in an internship, field experience, service learning activity, or investigation of a community, leadership, or economic development topic. *Preq:* C R D 336 and consent of instructor.

COMPUTER ENGINEERING

See courses listed under *Electrical and Computer Engineering*.

COMPUTER SCIENCE

CP SC 605 Introduction to Graphical Systems Design 3(3,0) Principles, computational techniques, and design concepts needed for designing systems for effective graphical displays. *Preq:* CP SC 212, 215, MTHSC 108, 311, with a C or better.

CP SC 611 Virtual Reality Systems 3(3,0) Design and implementation of software systems necessary to create virtual environments. Techniques for achieving real-time, dynamic display of photo-realistic, synthetic images are discussed. Includes hands-on experience with electromagnetically-tracked, head-mounted displays and requires, as a final project, the design and construction of a virtual environment. *Preq:* CP SC 405 with a C or better.

CP SC 612 Eye Tracking Methodology and Applications 3(3,0) Introduction to the human visual system; visual perception; eye movements; eye tracking systems and applications in psychology, industrial engineering, marketing, and computer science; hands-on experience with real-time, corneal-reflection eye trackers, experimental issues. Final project requires execution and analysis of an eye tracking experiment. *Preq:* CP SC 360 or PSYCH 310 or MKT 431.

CP SC 614 Human and Computer Interaction 3(3,0) 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. *Preq:* CP SC 212 and 215 with a C or better, or equivalent.

CP SC 616 2-D Game Engine Construction 3(3,0) Introduction to the tools and techniques necessary to build 2-D games. Techniques draw from subject areas such as software engineering, algorithms, and artificial intelligence. Students employ techniques such as sprite animation, parallax scrolling, sound, AI incorporated into game sprites and the construction of a game shell. *Preq:* CP SC 212 and 215 with a C or better.

CP SC 620 Computer Security Principles 3(3,0)

Covers principles of information systems security, including security policies, cryptography, authentication, access control mechanisms, system evaluation models, auditing, and intrusion detection. Computer security system case studies are analyzed. *Preq:* CP SC 322 and 360 with a C or better.

CP SC 624 System Administration and Security 3(3,0)

Topics related to the administration and security of computer systems are covered. Primary emphasis is placed on the administration and security of contemporary operating systems. *Preq:* CP SC 360 and 332 or 422 with a C or better.

CP SC 628 Design and Implementation of Programming Languages 3(3,0)

Overview of programming language structures and features and their implementation. Control and data structures found in various languages are studied. Runtime organization and environment and implementation models are also included. *Preq:* CP SC 231, 350, and 360 with a C or better.

CP SC 655 Computational Science 3(3,0)

Introduction to the methods and problems of computational science. Course uses problems from engineering and science to develop mathematical and computational solutions. Case studies use techniques from Grand Challenge problems. Emphasizes the use of networking, group development, and modern programming environments. *Preq:* MTHSC 108, 311 and previous programming experience in a higher level language.

CP SC 662 Database Management Systems 3(3,0)

Introduction to database/data communications concepts as related to the design of on-line information systems. Problems and solutions 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. *Preq:* CP SC 360.

CP SC 663 On-line Systems 3(3,0)

In-depth study of the design and implementation of transaction processing systems and an introduction to basic communications concepts. A survey of commercially available software and a project using one of the systems is included. *Preq:* CP SC 462.

CP SC 664 Introduction to Computer Architecture 3(3,0)

Survey of von Neumann computer architecture at the instruction-set level. Fundamental design issues are emphasized and illustrated using historical and current mainframe, supermini and micro architecture. *Preq:* CP SC 330 or consent of instructor.

CP SC 672 Software Development Methodology 3(3,0)

Advanced topics in software development methodology. Techniques such as chief programmer teams, structured design, and structured walk-throughs are discussed and used in a major project. Emphasis is on the application of these techniques to large-scale software implementation projects. Additional topics such as mathematical foundations of structured programming and verification techniques are also included. *Preq:* CP SC 360 and 372.

CP SC 681 Selected Topics 1-3(1-3,0) Areas of computer science in which nonstandard problems arise. Innovative approaches to problem solutions which draw from a variety of support courses are developed and implemented. Emphasis is on independent study and projects. May be repeated for a maximum of six credits, but only if different topics are covered. *Preq:* Consent of instructor.

CP SC 740 Computer Science for High School Teachers I 3(2,2) 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. *Preq:* Introductory computer programming.

CP SC 801 Intensive Introduction to Computer Science for MFAC 5(3,2) Fundamental concepts of computing for computer science graduate students who have no undergraduate degree in computing. Topics include object-orientated design and programming, computer organization, software development systems, data structures, and graphical user interfaces. Heavy emphasis is on laboratory and project work. *Preq:* Consent of instructor.

CP SC 805 Advanced Modeling Techniques in Computer Graphics 3(3,0) Advanced techniques used in the artificial rendering of natural scenes; current practice in computer graphics; full software implementation of each technique; extensive coding. *Preq:* CP SC 405.

CP SC 807 3D Production Pipeline 3(3,0) Immerses students in the world of 3-D computer graphics. Makes use of current industry-standard software. Topics include concept development, storyboarding, modeling, rigging, animation, texturing, lighting, rendering, particles, scripting, compositing, and editing. *Preq:* Digital Production Arts major or consent of instructor.

CP SC 808 Computer Animation 3(3,0) Scripting systems, motion control, articulated figures, forward and inverse kinematics, soft object deformation, inbetweening key deformations, morphing, animating analytical models. *Preq:* MTHSC 311 and CP SC 611 or consent of instructor.

CP SC 810 Introduction to Artificial Intelligence 3(3,0) Problem solving and game playing; knowledge representation; expert systems; natural language processing; perception and learning. *Preq:* Consent of instructor.

CP SC 815 Special Effects Production 3(3,0) Video special effects, compositing problems, effects animation, matchmoving and 3-D geometry, color and texture reconstruction from 2-D images; extensive use of scripting languages and high-end software platforms. *Preq:* CP SC 605 or 611 and ART 821 or consent of instructor.

CP SC 820 Parallel Architecture 3(3,0) 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. *Preq:* CP SC 664.

CP SC 822 Case Study in Operating Systems 3(2,2) 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. *Preq:* CP SC 422, consent of departmental graduate affairs chair.

CP SC 823 Operating Systems Design 3(3,0) Analytic, simulation, and conceptual models of operating systems and their application to the design and implementation of actual systems; kernel design and its implementation in UNIX-like systems; models of concurrent processes, processor scheduling, and memory management. *Preq:* CP SC 423, MTHSC 401.

CP SC 824 Advanced Operating Systems 3(3,0) 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. *Preq:* CP SC 623 or consent of instructor.

CP SC 827 Translation of Programming Languages 3(3,0) 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. *Preq:* CP SC 350, 428.

CP SC 828 Theory of Programming Languages 3(3,0) Syntax and semantics of programming languages; finite state and pushdown processors; context-free models of syntax; parsing algorithms and semantic models. *Preq:* CP SC 429, 450.

CP SC 829 Advanced Compiler Topics 3(3,0) Code generation, register allocation, program optimization, data flow, interprocedural operations, parallel compilation and distributed compilation. *Preq:* CP SC 429, 450.

CP SC 830 Systems Modeling 3(3,0) 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. *Preq:* CP SC 630 and MTHSC 400 or 800 or consent of instructor.

CP SC 838 Advanced Data Structures 3(3,0) 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. *Preq:* Consent of instructor.

CP SC 839 Foundations of Theoretical Computer Science 3(3,0) 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. *Preq:* CP SC 350 or consent of department chair.

- CP SC 840 Design and Analysis of Algorithms 3(3,0)** 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. *Preq:* MTHSC 419 or CP SC 650 or equivalent.
- CP SC 851 Software Systems for Data Communications 3(3,0)** 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. *Preq:* Consent of instructor.
- CP SC 852 Internetworking 3(3,0)** 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:* CP SC 851, E C E 638, or consent of instructor.
- CP SC 853 Implementation of TCP/IP Protocols 3(3,0)** 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:* CP SC 822 and 852, or consent of instructor.
- CP SC 854 Performance Analysis of Internet Protocols 3(3,0)** Analyzes network performance, focusing on experimental methods and current Internet protocols. Covers random processes, time series analysis, and simulation concepts. Incorporates experimental-based research in computer networking. *Preq:* CP SC 852 or consent of instructor.
- CP SC (ART) 860 Studio Computer Research 3-15(0,6-30)** See ART 860.
- CP SC 862 Database Management System Design 3(3,0)** 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:* CP SC 462.
- CP SC 863 Multimedia Systems and Applications 3(3,0)** 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. *Preq:* Consent of instructor.
- CP SC 865 Data Mining 3(3,0)** 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. *Preq:* Knowledge of statistics and database systems or consent of instructor.
- CP SC 870 Software Design 3(3,0)** 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-training programming. *Preq:* Proficiency in programming in a procedural language.
- CP SC 871 Foundations of Software Engineering 3(3,0)** 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:* Graduate standing in Computer Science.
- CP SC 872 Software Specification and Design Techniques 3(3,0)** Techniques, tools, environments, and formal methods for software specification and design; verification of design correctness. *Preq:* CP SC 672 or equivalent.
- CP SC 873 Software Verification, Validation, and Measurement 3(3,0)** 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. *Preq:* CP SC 672 or equivalent.
- CP SC 875 Software Architecture 3(3,0)** 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.
- CP SC 881 Selected Topics 1-3(1-3,0)** 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. *Preq:* Consent of instructor.
- CP SC 888 Directed Projects in Computer Science 1-6** Directed individual project supervised by department faculty. To be taken Pass/Fail only.
- CP SC 891 Master's Thesis Research 1-12**
- CP SC 940 Topics in Advanced Algorithms 3(3,0)** 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:* CP SC 840 or consent of instructor.
- CP SC 950 Selected Topics in Computer Science 1-3(1-3,0)** 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/Fail only.
- CP SC 951 Seminar in Algorithms 1-3(1-3,0)** Advanced topics from current problems of interest in algorithms. May be repeated for credit.
- CP SC 953 Seminar in Database Systems 1-3(1-3,0)** Advanced topics from current problems of interest in database systems. May be repeated for credit.
- CP SC 955 Seminar in Programming Languages 1-3(1-3,0)** Advanced topics from current problems of interest in programming languages. May be repeated for credit.
- CP SC 957 Seminar in Software Engineering 1-3(1-3,0)** Advanced topics from current problems of interest in software engineering. May be repeated for credit.
- CP SC 981 Seminar in Computer Science 1-3(1-3,0)** Topics of current research interest. May be repeated for credit.
- CP SC 991 Doctoral Dissertation Research 1-12**

CONSTRUCTION SCIENCE AND MANAGEMENT

- C S M 655 Reducing Adversarial Relations in Construction 3(3,0)** Focuses on the delivery of projects and how adversarial relations can affect the successful completion of the venture. Topics include management of human resources, understanding needs and processes of the participants, where problems lie, methods of avoiding and settling disputes. *Preq:* Construction Science and Management or Architecture major, senior standing, or consent of department chair.
- C S M 852 Construction Management Research 3(3,0)** Research methodology applied to the construction industry. *Preq:* Consent of instructor.
- C S M 860 Construction Financial Planning and Analysis 3(3,0)** Theory of financial management as it relates to the financial challenges faced by the construction firm.
- C S M 861 Construction Control Systems 3(3,0)** Development and analysis of cost, resource, and quality control programs for a company's construction projects.
- C S M 862 Personnel Management and Negotiations 3(3,0)** The role of management and unions in the construction industry. Topics include contract negotiation, collective bargaining, dispute resolution, and management for productivity improvement. *Preq:* Consent of instructor.
- C S M 863 Advanced Planning and Scheduling 3(3,0)** Analysis and control of construction projects using advanced techniques for planning, scheduling, and resources control. *Preq:* Consent of instructor.
- C S M 864 Construction Business Strategy and Marketing 3(3,0)** Techniques for business strategy development and marketing of various types of construction companies.

- C S M 865 Project Management 3(3,0)** Theory of project administration and control with special emphasis on the role and responsibilities of the project manager.
- C S M 866 Contractor Role in Development 3(3,0)** Addresses the various roles and responsibilities of the contractor in development including discussion of the owner/designer/constructor relationship. Does not count toward Master's in Construction Science and Management degree requirements. *Preq:* Consent of instructor.
- C S M 881 Professional Seminar 3(3,0)** New and emerging methods for management of the construction or construction-related firm. *Preq:* Consent of instructor.
- C S M 889 Special Problems 3(3,0)** Research design problem on a construction-related topic.
- C S M 890 Directed Studies 3-6** Special topics not covered in other courses. Emphasis is on field studies, research activities, and current developments in building science. *Preq:* Consent of instructor.
- C S M 891 Master's Thesis Research 1-9** With approval of the advisory committee, students carry out independent research and analysis. Thesis is presented orally and in writing and in strict compliance with the guidelines of the Graduate School.

CROP AND SOIL ENVIRONMENTAL SCIENCES

- CSENV 603 Soil Genesis and Classification 2(1,3)** Soil morphology and characterization, pedogenic processes, soil-forming factors, and classification of soils. Offered fall semester only. *Preq:* CSENV 202 or consent of instructor.
- CSENV 604 Soils and Land Use 2(1,3)** Soils interpretations for nonagricultural purposes and facilities. Emphasizes use of modern soil surveys; properties and features of soils important in nonfarm land uses. Not open to Crop and Soil Environmental Sciences minors or to students who have taken CSENV 202. Offered fall semester only.
- CSENV 605 Plant Breeding 3(2,2)** Application of genetic principles to the development of improved crop plants. Principle topics include the genetic and cytogenetic basis of plant breeding, mode of reproduction, techniques in selfing and crossing, methods of breeding, inheritance in the major crops, and biometrical methods. Offered spring semester only. *Preq:* GEN 302 or equivalent.
- CSENV 607 Introductory Weed Science 3(2,2)** Weed management in crops and pastures of the Southeast. Topics include weed identification, herbicide families and modes of action, herbicide formulations, herbicide diagnosis on crops and weeds, sprayer calibration and spray application, and nonchemical weed control strategies. *Preq:* AGRIC 104 or consent of instructor.
- CSENV (B E) 608 Land Treatment of Wastewater and Sludges 3(3,0)** 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 trip(s) are planned. *Preq:* Senior standing in agriculture or engineering or consent of instructor.
- CSENV 617 Weed Morphology and Ecology 3(2,2)** Study of the morphological characteristics of weed plants of economic importance in row crops, pastures, and turf of South Carolina. Succession, reproduction, dissemination, distribution, competition, and allelopathy are discussed. *Preq:* CSENV 407 or HORT (CSENV) 433 or consent of instructor.
- CSENV 621 Principles of Field Crop Production 3(3,0)** 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. Offered fall semester only. *Preq:* AGRIC 104 or equivalent introductory plant science, CSENV 202.
- CSENV 622 Major World Crops 3(3,0)** 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, soybean, cotton, tobacco, and peanuts. Offered spring semester only. *Preq:* AGRIC 104 or equivalent introductory plant science, CSENV 202.
- CSENV 623 Field Crops—Forages 3(3,0)** Establishment, management, and utilization of forage crops in a forage-livestock agro-ecosystem context. Hay, silage, and pasture utilization are discussed. Computer model is used to study complexity of forage-livestock production systems. *Preq:* AGRIC 104, CSENV 202, or consent of instructor.
- CSENV 624 Applied Aspects of Forage Management 1(0,2)** Hands-on exposure to forage plantings, establishment, and management practices. Pasture and harvested forage systems, equipment and practices; analysis of forage-livestock systems. *Preq:* CSENV 423 (or concurrent enrollment).
- CSENV 625 Seed Science and Technology 3(2,2)** Topics include seed development, germination, dormancy, pathology, storage, and deterioration. Seed testing and commercial production of seed are also covered. Emphasis is on useful applications of current seed science knowledge. Offered spring semester of even-numbered years only. *Preq:* AGRIC 104, BIOSC 205.
- CSENV (AP EC) 626 Cropping Systems Analysis 3(2,2)** Application of agronomic and economic principles in solving problems relating 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 formal written and oral presentations of results. Offered fall semester only. *Preq:* AGRIC 104, AP EC 202, Junior standing.
- CSENV (HORT) 633 Landscape and Turf Weed Management 3(2,2)** See HORT 633.
- CSENV 646 Soil Management 3(3,0)** Basic soil properties are related to compaction, water and solute movement, and root growth. Practical management problems are considered and solutions developed based on basic soil characteristics. Problems include erosion, no-tillage, compaction, irrigation, leaching, waste application, golf-green management, and orchard establishment. Offered fall semester only. *Preq:* CSENV 202.
- CSENV 652 Soil Fertility and Management 3(3,0)** Soil properties, climatic factors, and management systems in relation to soil fertility maintenance for crop production; plant nutrition and growth in relation to crop fertilization and management. Offered spring semester only. *Preq:* CSENV 202 or consent of instructor.
- CSENV 653 Soil Fertility Laboratory 1(0,3)** Evaluation and interpretation of soil fertility production. Offered spring semester only. *Preq:* CSENV 202 or consent of instructor.
- CSENV 675 Soil Physics and Chemistry 3(2,3)** Study of the principles of soil physics and chemistry and their applications. Topics include soil texture, structure, compaction, water relations, solute movement, mineral composition, adsorption phenomenon, and soil acidity. Offered fall semester only. *Preq:* CH 101, CSENV 202, PHYS 207.
- CSENV 690 Beneficial Soil Organisms in Plant Growth 3(3,0)** 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. Students who desire laboratory experience in these topics may register for CSENV 406 after consultation with instructor. Offered spring semester only. *Preq:* CSENV 202, MICRO 305, PL PA 401, or consent of instructor.
- CSENV 701 Soils and Man 3(3,0)** Different kinds of soils, their properties, uses, management, conservation, and relationship with the environment and other human endeavors.
- CSENV 801 Crop Physiology and Nutrition 3(3,0)** Basic concepts and physiologic aspects of growth and culture applied to crop management practices. Offered fall semester of odd-numbered years only. *Preq:* BIOSC 401, 402; or equivalent.
- CSENV 802 Pedology 3(3,0)** Current concepts and theories in soil genesis and morphology; advanced study of soil taxonomy. Offered fall semester of odd-numbered years only. *Preq:* CSENV 403.
- CSENV 804 Theory and Methods of Plant Breeding 3(3,0)** 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. *Preq:* CSENV 405, EX ST 801, or consent of instructor.
- CSENV 805 Soil Fertility 3(3,0)** 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. *Preq:* CSENV 403 or 452 or consent of instructor.

- CSENV 806 Special Problems 1-3(0,3-9)** Research not related to a thesis.
- CSENV 807 Soil Physics 4(3,3)** Principles and applications of transport of water and solutes in soils emphasizing unsaturated flow phenomenon. Offered fall semester of even-numbered years only. *Preq:* MTHSC 108 or equivalent.
- CSENV 808 Soil Chemistry 3(2,3)** 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.
- CSENV 810 Soil Microbiology 3(3,0)** 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. *Preq:* CSENV 690 or MICRO 610 and consent of instructor.
- CSENV 812 Crop Ecology and Land Use 3(3,0)** 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.
- CSENV (PES) 850 Agricultural Biotechnology 2(2,0)** Fundamentals of biotechnology for students specializing in applied life sciences. Scientific principles, limitations, novel concepts, and wide-ranging applications of biotechnology to agricultural industry.
- CSENV 890 Special Topics in Agronomy 1-3(1-3,0)** Group discussion of recent developments in agronomic research. May be repeated for a maximum of six credits. *Preq:* Consent of instructor.

EARLY CHILDHOOD EDUCATION

- ED EC 800 Parent Education in Early Childhood Multicultural Settings 3(3,0)** Focuses on a multicultural perspective on parent education and involvement in early childhood settings (birth to age eight). Theory and comparative applications of parent involvement in multicultural classroom and home environments are studied.
- ED EC 810 Advanced Early Childhood Education Foundations and Methods 3(3,0)** 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.
- ED EC 820 Advanced Early Childhood Education Curriculum 3(3,0)** 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.
- ED EC 840 Theories of Early Childhood Education 3(3,0)** Examines the theoretical, philosophical, and research foundations of early childhood education. Students develop skills in critical inquiry as they explore specific topics related to early child care and education.

- EDEC 850 Creative and Cognitive Development in Early Childhood: Creating Connections to Math and Science 3(3,0)** 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.
- ED EC 880 Current Issues in Early Childhood 3(3,0)** Focuses on factors that impact early childhood policy, identification of current problems/issues, and development of research-based advocacy strategies.
- ED EC 885 Thesis Hours in Early Childhood Education 3(3,0)** Required of students enrolled in thesis track of Early Childhood Education master's degree program. Student works with thesis advisor and committee to complete course requirements. May be repeated for a maximum of six credits. *Preq:* 18 credit hours, including ED F 778, 879; consent of thesis advisor.
- ED EC 890 Assessment and Program Planning in Early Childhood 3(3,0)** Addresses multiple assessment and screening strategies for infants, toddlers, and preschool children in inclusive early childhood settings. Focuses on both quantitative and qualitative assessment methods for program planning for very young children with typical and atypical development.
- EDEC 895 Integrating Math, Science, and Technology in Inclusive Early Childhood Settings 3(3,0)** Emphasizes theory to practice and exploration of developmentally appropriate strategies for integrating math, science, and technology into the overall early childhood curriculum.

ECONOMICS

- ECON 605 Introduction to Econometrics 4(3,3)** Introduction to the 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 211 and 212; MTHSC 108 or 207; EX ST 301 or MTHSC 301 or 309.
- ECON 606 Advanced Econometrics 3(3,0)** 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 405 or consent of instructor.
- ECON 610 Economic Development 3(3,0)** 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 314 or consent of instructor.
- ECON 611 Economics of Education 3(3,0)** 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 314 or consent of instructor.
- ECON 625 Antitrust Economics 3(3,0)** Analysis of economic and legal issues created by the exercise of market power. The motivation and execution of government policy toward mergers, predatory conduct, and various restraints of trade are extensively examined. *Preq:* ECON 309 or 314 or consent of instructor.
- ECON 626 Seminar in Sports Economics 3(3,0)** 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 314 and 405 or consent of instructor.
- ECON 628 Cost-Benefit Analysis 3(3,0)** Develops techniques for the appraisal of public expenditure programs with particular emphasis on investment in infrastructure. Topics include the choice of an appropriate discount rate and the calculation of social costs and benefits in the presence of market distortions. *Preq:* ECON 314 or consent of instructor.
- ECON 640 Game Theory 3(3,0)** 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 314 and MTHSC 106, or ECON 430, or consent of instructor.
- ECON 655 Applied Microeconomic Research 3(3,0)** 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. *Preq:* ECON 314 or consent of instructor.
- ECON 751 Selected Topics for Teachers 3(3,0)** 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 200, 211.
- ECON (AP EC) 800 History of Economic Thought 3(3,0)** 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.
- ECON (AP EC) 801 Microeconomic Theory 3(3,0)** Microeconomic theory and its use to analyze and predict the behavior of industries, firms, and consumers under various market conditions. Offered fall semester only.

- ECON (AP EC) 802 Advanced Economic Concepts and Applications 3(3,0)** Rigorous development of price theory under alternative product and resource market structures. *Prq:* Consent of instructor.
- ECON (AP EC) 804 Applied Mathematical Economics 3(3,0)** See AP EC 804.
- ECON 805 Macroeconomic Theory 3(3,0)** Macroeconomic theory involving static and dynamic models and their use in analysis of economic problems and policies.
- ECON (AP EC) 806 Econometrics I 3(3,0)** See AP EC 806.
- ECON 807 Econometrics II 3(3,0)** 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 fall semester only.
- ECON (AP EC) 808 Econometrics III 3(3,0)** Continuation of ECON 807. Covers current economic models and estimation procedures. Offered spring semester only. *Prq:* ECON 807.
- ECON (AP EC) 809 Advanced Natural Resource Economics 3(3,0)** See AP EC 809.
- ECON (AP EC) 810 Natural Resources Management and Policy 3(3,0)** See AP EC 810.
- ECON (AP EC) 811 Economics of Environmental Quality 3(3,0)** 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. *Prq:* ECON 314 or equivalent.
- ECON (AP EC) 816 Labor Economics 3(3,0)** Wage and employment theory; labor markets; labor history; current problems in labor and manpower economics.
- ECON (AP EC) 817 Advanced Production Economics 3(3,0)** See AP EC 817.
- ECON (AP EC) 820 Public Finance 3(3,0)** Impact of government on resource allocation, income distribution and stability; role of regulation; principles of taxation.
- ECON 821 Public Choice 3(3,0)** 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 (AP EC) 822 Contemporary Public Policy 3(3,0)** See AP EC 822.
- ECON 823 Microeconomics for Public Policy 3(3,0)** 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. *Prq:* Admission to the Policy Studies program or consent of instructor.
- ECON (AP EC) 824 Organization of Industry 3(3,0)** 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.
- ECON 825 Antitrust Economics 3(3,0)** Theoretical analysis of monopoly, monopolizing practices, and the exercise of market power. Study of government policy towards mergers, predation, and restraints of trade. *Prq:* ECON (AP EC) 801.
- ECON (AP EC) 826 Economic Theory of Government Regulation 3(3,0)** 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. *Prq:* ECON 314 or equivalent.
- ECON (AP EC) 827 Economics of Property Rights 3(3,0)** 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. *Prq:* ECON 801.
- ECON (AP EC) 828 Market Structure in Agricultural Industries 3(3,0)** See AP EC 828.
- ECON (AP EC) 831 Economic Development 3(3,0)** 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 (AP EC) 832 Community and Regional Economics 3(3,0)** See AP EC 832.
- ECON 836 Research in Economics of Education 3(3,0)** 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:* AP EC (ECON) 806 or consent of instructor.
- ECON (AP EC) 840 International Trade Theory 3(3,0)** 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. *Prq:* ECON 314 and (AP EC) 802 or consent of instructor.
- ECON (AP EC) 841 International Finance 3(3,0)** 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. *Prq:* ECON 315 or equivalent.
- ECON 845 Advanced Game Theory 3(3,0)** 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 (AP EC) 855 Financial Economics 3(3,0)** Study of modern theory of corporate finance. Includes basic theories of efficient markets, portfolio selection, capital asset pricing, option pricing, and agency costs. *Prq:* ECON (AP EC) 801 or consent of instructor.
- ECON 888 Directed Reading in Economics 1-3(1-3,0)** Directed reading and research in the student's field of interest. May be repeated for a maximum of three credit.
- ECON 891 Master's Thesis Research 1-12**
- ECON (AP EC) 899 Selected Topics 1-3(1-3,0)** See AP EC 899.
- ECON 900 Selected Topics in Economics 3(3,0)** Current topics in economic theory and empirical research. May be repeated for credit, but only if different topics are covered.
- ECON (AP EC) 901 Price Theory 3(3,0)** 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. *Prq:* ECON (AP EC) 801 or equivalent.
- ECON 905 Advanced Macroeconomic Issues 3(3,0)** 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. *Prq:* ECON 805 or equivalent.
- ECON (AP EC) 906 Seminar in Area Economic Development 3(3,0)** See AP EC 906.
- ECON 909 Time-Series Econometrics 3(3,0)** Introduces methods and models of time-series analysis. Reviews statistical concepts and introduces unique aspects of time-series data. Covers models useful for estimation, forecasting, and inference in macroeconomics and finance. Topics include autoregressive-moving average models, their multivariate generalization, nonlinear models of conditional heteroskedasticity, regime-switching models, and nonstationary processes. *Prq:* ECON 807.
- ECON 911 Problems in Price Theory 3(3,0)** Price theory problems and exercises in preparation for standing the comprehensive examination preliminary to admission to candidacy to the PhD degree in Applied Economics. May be repeated up to three times.
- ECON 915 General Equilibrium and Economic Growth 3(3,0)** 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. *Prq:* ECON 805

ECON 916 Advanced Economic Growth 3(3,0)
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. *Preq:* ECON 915.

ECON (AP EC) 917 Advanced Seminar in Labor Economics 3(3,0) Continuation of ECON 816, 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 (AP EC) 816.

ECON 920 Empirical Public Economics 3(3,0) 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. *Preq:* ECON (AP EC) 801, 807, (AP EC) 820.

ECON (AP EC) 950 Monetary Economics 3(3,0) Economic analysis of money in our economy and effects of monetary policy on prices, interest rates, output, and employment.

ECON 980 Workshop in Applied Economics 3(3,0) 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. *Preq:* Consent of instructor.

ECON (AP EC) 991 Doctoral Dissertation Research 1-12 See AP EC 991.

EDUCATION

ED 641 Middle School Curriculum 3(3,0) 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 (CTE) 700 Supervising the Student Teacher in the Public School 2-3(2-3,0) 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/Fail only. *Preq:* Professional teaching certificate, at least one year of teaching experience, recommendation from employing school district, or consent of instructor.

ED 735 Teacher Professional Development: Selected Topics 1-3(1-3,0) 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 738 Selected Topics in Education 1-3(1-3,0) Specific master's-level topics not found in other courses. May be repeated for a maximum of six credits, but only if different topics are covered.

ED 739 Independent Study in Education 1-3(1-3,0) Master's-level study of selected topics under direction of a faculty member chosen by the student; development of a course of study different from any existing courses and designed for the individual student. May be repeated for a maximum of six credits, but only if different topics are covered.

ED 745 Integrating Arts into the Curriculum 3(3,0) 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 839 Introduction to Linguistics 3(3,0) 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. *Preq:* Graduate standing in Education of consent of instructor.

ED 860 Classroom Action Research 3(3,0) 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. *Preq:* Teaching certification, admission to MEd degree program, ED F 778, 808, or consent of instructor.

ED (AG ED, CTE) 889 Research in Education 3(3,0) See AG ED 889.

ED (ED F, ED SP) 894 Directed Research 1-4(1-4,0) Research in a line of inquiry in education under the direction of faculty. Specific educational question is investigated and reported using appropriate methodology. To be taken Pass/Fail only. *Preq:* ED F 778, 808 or consent of instructor.

ED 901 Selected Topics Doctoral Study 1-3(1-3,0) Doctoral-level education topics not covered in other courses. May be repeated for a maximum of six credits, but only if different topics are covered.

ED 902 Independent Doctoral Study 1-3(1-3,0) Doctoral-level study of selected topics in education under the direction of a faculty member chosen by the student; development of a course of study different from any existing courses and designed for the individual student. May be repeated for a maximum of six credits, but only if different topics are covered.

ED 954 Curriculum Theory 3(3,0) Main currents of curriculum theory in American education. *Preq:* ED EL 760.

ED 955 Theoretical Bases of Instruction 3(3,0) Seminar in the application of learning theory to instructional practice emphasizing instructional strategies in the classroom.

ED (ED F, ED SP) 980 Internship in Curriculum and Instruction 1-6(0,3-18) Practical experiences linking the student's program of study to his/her field of professional service. To be taken Pass/Fail only. *Preq:* Consent of advisor.

ED (ED F, ED SP) 991 Doctoral Dissertation Research 1-18

EDUCATIONAL COUNSELING (Counselor Education)

ED C 764 Theoretical and Practical Application of Student Development and Leadership in a University Setting 3(3,0) Development of leadership, programming, problem-solving, conflict-resolution, confrontation, and referral skills; legal and ethical issues and the implications for practitioners; comparative studies of housing programs and utilization of resources and support services available on the campus.

ED C 801 Foundations of Professional School Counseling 3(3,0) Theory and practice of school counseling; principles and policies underlying programs.

ED C 803 Student Development Services in Higher Education 3(3,0) Pupil personnel services offered by institutions of higher education.

ED C 804 Theories of Student Development in Higher Education 3(3,0) Developmental aspects of the young adult age group and the relationship to postsecondary schools and training programs.

ED C 805 Community Counseling 3(3,0) History and description of various counseling services provided in agency settings; the type of client populations served and existing legislative acts mandating these services.

ED C 806 Student Affairs Issues 3(3,0) Introduction to the current issues in the student personnel profession and future challenges facing student affairs departments. *Preq:* ED C 803, 804, or consent of instructor.

ED C 807 Counseling Children and Adolescents 3(3,0) Theory and techniques in the area of counseling youth in educational institutions and other settings; history and definition of disordered behavior, the etiology and occurrence of childhood disorders, developmental context, classification and assessment, and treatment issues. *Preq:* ED F 701, ED C 801, 810, or consent of instructor.

ED C 808 Legal and Ethical Issues in Student Affairs Practice and Counselor Education 3(3,0) 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.

ED C 809 Program Administration and Leadership in Higher Education 3(3,0) Process of organizing the personnel and financial resources needed to meet student development and institutional goals and objectives effectively. *Preq:* Consent of instructor.

ED C 810 Theories and Techniques of Counseling 3(3,0) Counseling theories and techniques. *Preq:* ED C 801 or consent of instructor.

ED C 811 Multicultural Counseling 3(3,0) Responsibility of counselors to all people regardless of race, sex, gender, socioeconomic status, subculture, etc.; content and theory related to counseling multicultural individuals/groups.

ED C 812 Career Counseling 3(3,0) Gathering, interpreting, and utilizing educational, social, and occupational information; techniques used in placement, survey, and follow-up.

- ED C 813 Appraisal Procedures 3(2,2)** Experience in gathering, interpreting, and utilizing data related to the individual; especially significant to counselors. *Preq:* ED F 808 or consent of instructor.
- ED C 814 Development of Counseling Skills 3(3,0)** On-campus experience to help counselors develop communication skills through role-playing activities, audio and videotaping, interviewing, lecture, and discussion. *Preq or Coreq:* ED C 810.
- ED C 815 Group Counseling 3(3,0)** 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. *Preq:* Consent of instructor.
- ED C 816 Introduction to Marriage and Family Counseling 3(3,0)** 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. *Preq:* ED C 810 or 814 or consent of instructor.
- ED C 818 Psychopathology for Counselors 3(3,0)** Conceptual models employed in classifying and describing various mental disturbances as well as approaches used to alleviate these disturbances. *Preq:* ED C 810, enrollment as Counseling master's student, consent of instructor.
- ED C 819 The American College Student 3(3,0)** How college students change and develop and how college can enhance that development. *Preq:* ED L 855 or consent of instructor.
- ED C 821 Counseling Psychodiagnosis 3(3,0)** Comprehensive overview of the DSM-IV-TR; multiaxial assessment and diagnosis of mental disorders including coding and reporting procedures. *Preq:* ED C 810, 818, enrollment as Counseling master's student, or consent of instructor.
- ED C 822 Addictions Counseling 3(3,0)** 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.
- ED C 823 Advanced Counseling Techniques and Strategies 3(3,0)** Development of in-depth counseling skills; techniques for working with a wide variety of populations and/or problems. *Preq:* ED C 814, 815, completion of 30 hours in a master's program in Counseling, or certification as a school counselor.
- ED C 830 Professional School Counseling Practicum 3(1,6)** Supervised field experience in counseling and other services in a school setting. To be taken Pass/Fail only. *Preq:* ED C 807, 813, 814, 815, or consent of instructor.
- ED C 834 Student Affairs Practicum 3(1,6)** Supervised field experience in counseling and other student services in a postsecondary school setting. To be taken Pass/Fail only. *Preq:* ED C 803 804, or consent of instructor (100 clock hours).
- ED C 836 Community Practicum 3(1,6)** Supervised field experiences in counseling and other services in a community-agency setting. To be taken Pass/Fail only. *Preq:* ED C 805, 814, and 815; or consent of instructor.
- ED C 840 Independent Study in Counseling 1-3(1-3,0)** 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.
- ED C 841 School Counseling Internship 3-6** Students apply previous knowledge in consulting, counseling, and coordinating services in a supervised field experience for the school student. May be repeated for a maximum of six credits. To be taken Pass/Fail only. *Preq:* ED C 830 or consent of instructor.
- ED C 844 Student Affairs Internship 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/Fail only. *Preq:* ED C 834, consent of instructor.
- ED C 846 Community Counseling Internship 3-6** Students apply previous knowledge of counseling theory and techniques in a supervised field experience to professional mental health counseling settings. May be repeated for a maximum of six credits. *Preq:* ED F 701, ED C 805, 813, 814, 815, 836, consent of instructor.
- ED C 885 Selected Topics 1-3(1-3,0)** Developing trends in counseling not covered in other courses. May be repeated, but only if different topics are covered.
- ED C 915 Internship in Counseling Setting 3(1,6)** 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. *Preq:* Master's degree in Counseling or related field approved by program coordinator.
- ED C 920 Counselor Supervision 3(3,0)** Overview of conceptual and empirical literature on counselor supervision that includes models, approaches, techniques, relationship/process issues, legal concerns, and ethical considerations. Students develop supervision skills through readings, seminar discussions, and supervision of master's-level students. *Preq:* Master's degree in Counseling or related area or consent of instructor.
- ED F (AG ED, CTE) 682 Advanced Educational Applications of Microcomputers 3(2,2)** 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:* ED F (AG ED, CTE) 480.
- ED F 690 Student Management and Discipline 3(3,0)** Aids pre-service and in-service teacher development and refines knowledge, skills, and values important for managing students in school settings. Practical application of theory and research and legal and ethical considerations are emphasized. *Preq:* ED F 302 or PSYCH 201; ED F 334 and 335 or suitable alternative; minimum grade-point ratio of 2.0.
- ED F 697 Instructional Media in the Classroom 3(3,0)** Integrated approach to the use of audiovisual media stressing systematic planning, selection, utilization, and evaluation as well as production of materials and equipment operation. *Preq:* 2.0 minimum grade-point ratio.
- ED F 701 Human Growth and Development 3(3,0)** Theory and research in human development and its impact on the teaching/learning process. *Preq:* ED F 334, 335, 336, or equivalent; classroom teaching experience.
- ED F 702 Advanced Educational Psychology 3(3,0)** Educational applications of research and theory on objectives, motivation, class climate, class management, and learning theory. *Preq:* ED F 302 or equivalent; classroom teaching experience recommended.
- ED F 703 Early Adolescent Growth and Development 3(3,0)** Theory and research in early adolescent growth and development and the teaching/learning process for middle-grades youth. *Preq:* Graduate standing or consent of instructor.
- ED F 766 Integrating Service Learning into Curriculum 3(2,3)** 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. *Preq:* Teaching certification.
- ED F 778 Experimental and Nonexperimental Research Methods in Education I 3(3,0)** 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. *Preq:* EX ST 301 or equivalent or consent of instructor; ED F 808 recommended.
- ED F (ED L) 800 Philosophy, Schooling, and Educational Policy 3(3,0)** See ED L 800.
- ED F 808 Educational Tests and Measurements 3(3,0)** Construction, use, and interpretation of subjective and standard tests; measurement applications.
- ED F 870 Schooling as a Cultural Process 3(3,0)** Critical analysis of the interdependence of schooling and culture.

ED F 872 History of American Education 3(3,0)

Historical development of educational purpose and the social and cultural forces which shaped that development.

ED F 875 Seminar in Human Growth and Development 3(3,0)

Selected topics in human development from any area of the lifespan. Development topics are examined for their impacts on the teaching/learning process, administrative processes, and/or counseling approaches. *Prq:* ED F 701 or equivalent and teaching, counseling, or administrative experience.

ED F 878 Experimental and Nonexperimental Research Methods in Education II 3(3,0)

Advanced concepts and skills needed to analyze, conduct, and evaluate educational research; nonexperimental, quasiexperimental, and experimental design specific to problems in educational research; complementary educational research methods involving qualitative approaches; coding and computer analysis of sample data; summarization and interpretation of data; applications of measurement and evaluation in educational research. *Prq:* ED F 778, 808, EX ST 801, or equivalent.

ED F 879 Qualitative Research in Education 3(3,0)

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. *Prq:* ED F 778, 878, or equivalent.

ED F 880 Instructional Technology in the Elementary and Middle School 3(2,2)

Research-based strategies for integrating instructional technology within the curriculum; methodologies for deploying technology in support of national standards through participation in and development of project-based learning activities. *Prq:* Consent of instructor.

ED F (ED, ED SP) 894 Directed Research 1-4(1-4,0)

See ED 894.

ED F 908 Advanced Educational Tests and Measurement 3(3,0)

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:* ED F 808 or equivalent; ED F 778 or equivalent.

ED F 978 Multivariate Educational Research 3(3,0)

Investigates descriptive and inferential statistical methods for the exploratory analysis of outcomes in multigroup educational settings in which individuals tend to differ on multiple independent and dependent variables. *Prq:* ED F 878 or consent of instructor.

ED F 980 (ED, ED SP) Internship in Curriculum and Instruction 1-6(0,3-18)

See ED 980.

ED F (ED, ED SP) 991 Doctoral Dissertation Research 1-18

See ED 991.

EDUCATIONAL LEADERSHIP**ED L 700 Public School Administration 3(3,0)**

Theoretical bases of school administration; organizational principles, patterns, and practices in public schools; decision making; administration of programs and services. *Prq:* Three graduate education courses or consent of instructor.

ED L 705 The Principalship 3(3,0)

Roles and responsibilities of the principalship including the organization and administration of schools.

ED L 710 Organizational Theory for School Administrators 3(3,0)

Theory of management, communication, human relations, social systems, motivation, contingency, decision making, and change. *Prq:* ED L 700.

ED L 715 School and Community Relationships 3(3,0)

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.

ED L 720 School Personnel Administration 3(3,0)

School personnel selection, practices, and problems. *Prq:* ED L 700, 705.

ED L 725 Legal Phases of School Administration 3(3,0)

Legal principles involved in school administration and in court actions. *Prq:* ED L 710.

ED L 730 Techniques of Supervision—the Public Schools 3(3,0)

Improving, coordinating, and evaluating instruction; modern trends of supervisory practices. *Prq:* ED L 710.

ED L 735 Educational Evaluation 3(3,0)

Evaluation theory and design applied to classroom instruction and to evaluation procedures applicable to school center and district programs and projects. *Prq:* ED L 710.

ED L 740 Curriculum Planning and Improvement for School Administrators 3(3,0)

Role of leadership in curriculum planning and improvement: curriculum evaluation and development, change, programmatic requirements, cocurriculum, organization, scheduling, planning, management, and technology. *Prq:* ED L 710.

ED L 745 School Finance 3(3,0)

School finance relative to programs, revenues, and experience. *Prq:* ED L 735.

ED L 750 Elementary Principal and Supervisor Field Experience I 3(1,4)

First practicum in a series of two with an experienced elementary/middle (pre-K–8) school principal or supervisor. ED L 750 and 751 must be taken in a sequence in a single academic year. *Prq:* ED L 705.

ED L 751 Elementary Principal and Supervisor Field Experience II 3(1,4)

Second practicum in a series of two with an experienced elementary/middle (pre-K–8) school principal or supervisor. ED L 750 and 751 must be taken in a sequence in a single academic year. *Prq:* ED L 750.

ED L 755 Secondary Principal and Supervisor Field Experience I 3(1,4)

First practicum in a series of two with an experienced secondary (grades 7–12) principal or supervisor. ED L 755 and 756 must be taken in a sequence in a single academic year. *Prq:* ED L 705.

ED L 756 Secondary Principal and Supervisor Field Experience II 3(1,4)

Second practicum in a series of two with an experienced middle/high school (grades 7–12) principal or supervisor. ED L 755 and 756 must be taken in a sequence in a single academic year. *Prq:* ED L 755.

ED L 765 Assessment in Higher Education 3(3,0)

Outcomes assessment and institutional effectiveness movement including assessment techniques, instrument selection, analysis of assessment data, and reporting of assessment findings. *Prq:* Consent of instructor.

ED L 795 School Leadership Information Systems 3(2,2)

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.

ED L (ED F) 800 Philosophy, Schooling, and Educational Policy 3(3,0)

Development of contemporary educational theory and its impact on current schooling practices and educational policy development.

ED L 805 Advanced Educational Leadership: Theory and Practice 3(3,0)

Principles and theories of leadership as practiced in the institutional setting. *Prq:* ED L 715, 730.

ED L 810 Introduction to School Building Planning 3(2,2)

Planning of educational facilities from conception of need through utilization of facility. *Prq:* ED L 700.

ED L 815 The Superintendency 3(3,0)

Current, in-depth study of the superintendency including relationships with school boards, faculty, staff, and community. For practicing and aspiring educational administrators. *Prq:* Admission to the Educational Specialist program or the doctoral program.

ED L 820 Politics of Education 3(3,0)

Politics of education in the United States including complex interrelationships among administrators, special interest groups, politicians, and knowledge brokers.

ED L 830 Business Management in Education 3(2,3)

Fiscal management of individual schools and districts including budgeting, purchasing, and accounting for funds. *Prq:* ED L 725, 745.

ED L 839 Research Methods in Educational Leadership 3(3,0)

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. *Prq:* ED L (ED F) 800, 805, 820, consent of instructor.

ED L 840 Field Problems in School Administration and Supervision of Instruction 3(2,3)

Application of research techniques and practices in solution of field problems in school administration and supervision. *Prq:* ED F 778, ED L 700.

ED L 850 Practicum in School System Leadership I 3

First in a two-semester practicum with an experienced school-system-level administrator or supervisor. *Prq:* ED L (ED F) 800, 805, 815, or consent of instructor.

ED L 851 Practicum in School System Leadership II 3

Second in a two-semester practicum with an experienced school-system-level administrator or supervisor. *Prq:* ED L 850.