C E (C R P) 612 Urban Transportation Planning 3(3,0) Urban travel characteristics, characteristics of transportation systems, transportation and land-use studies, trip distribution and trip assignment models, city patterns and subdivision layout. Preq: C E 311 or consent of instructor.

C E 621 Geotechnical Engineering Design 3(3,0) Relationship of local geology to soil formations, groundwater, planning of site investigation, sampling procedures, determination of design parameters, foundation design and settlement analysis. Preq: C E 321 or consent of instructor.

C E 624 Earth Slopes and Retaining Structures 3(3,0) 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: C E 321 or consent of instructor.


C E 634 Construction Estimating and Project Control 3(3,0) Study of 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; overhead and profit items. Preq: C E 331 or consent of instructor.

C E 636 Sustainable Construction 3(3,0) 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: C E 331 or consent of instructor.

C E 638 Construction Support Operations 3(3,0) Describes activities necessary for the completion of a construction job although not specifically recognized as direct construction activities: general conditions, safety, quality assurance, value engineering; organizational support features and typical implementation procedures. Preq: C E 331 and EX ST 301, or consent of instructor.

C E 643 Water Resources Engineering 3(3,0) Extension of the concepts of fluid mechanics to applications in water supply, water resource assessment, water transmission, water distribution networks, pump and pipe selection, pipe networks and analysis of open channel appurtenances. Preq: C E 341.

C E 646 Flood Hazards and Protective Design 3(3,0) Study of flood hazards and methods of protective design of the built environment. Floodplain mapping and delineation. Methods for determining base flood elevations. Flood-resistant construction, flood proofing and governmental regulations are discussed. Includes case studies and design projects. Coreq: C E 342 or consent of instructor.

C E 647 Stormwater Management 3(3,0) 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: C E 342. Coreq: EE&S 401 or consent of instructor.

C E 648 Physical Models in Hydraulics 3(2,3) Tools and techniques of physical modeling to aid in design of complex hydraulic systems. Students participate in construction, operation and testing of physical models to solve hydraulic engineering design problems. Experimental design and operation are covered. Preq: C E 342 or consent of instructor.

C E 649 Hydraulic Structures 3(3,0) Design methods and procedures are taught for a variety of hydraulic structures including intake structures, complex open-channel and closed conduit control structures, transitions, spillways, small dam and pond design. Field trips to actual hydraulic structures may be included. Preq: C E 342 or consent of instructor.

C E 655 Properties of Concrete and Asphalt 3(2,3) Properties of aggregate, concrete and asphalt; concrete and asphalt mix designs are conducted in the laboratory. Preq: C E 351 and EX ST 301, or consent of instructor.

C E 656 Pavement Design and Construction 3(3,0) 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: C E 311, 331 and 351 or equivalent; Coreq: C E 321 or equivalent.

C E 657 Materials Testing and Inspection 3(3,0) 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: C E 321 and 351 or equivalent.

C E 662 Coastal Engineering I 3(3,0) 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: C E 341 or consent of instructor.

C E 682 Groundwater and Contaminant Transport 3(3,0) 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: C E 341. Coreq: EE&S 401.

C E 691 Selected Topics in Civil Engineering 1-6(1-6,0) 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.

C E 801 Matrix and Finite Element Analysis 3(3,0) Matrix and finite element methods in solution of engineering problems; stiffness matrices for triangular, rectangular and quadrilateral elements in planer systems; plate bending, shell and 3-D elements; applications to solutions of structural and soil mechanics problems using special and general purpose programs. Preq: C E 401 or consent of instructor.

C E 802 Advanced Reinforced Concrete Design 3(3,0) Second course in design of reinforced concrete structures; advanced concepts in analysis and design of beams, columns and slabs; introduction to prestressed concrete. Preq: C E 402 or consent of instructor.

C E 803 Advanced Steel Design 3(3,0) 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 and plastic design, beam-columns, plate girders and composite sections and connections. Preq: C E 406 or consent of instructor.

C E 804 Prestressed Concrete 3(3,0) 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: C E 401 and 402, or consent of instructor.

C E 805 Advanced Structural Mechanics 3(3,0) 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; series and finite element solutions to plate and shell structures. Preq: C E 401 or consent of instructor.

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.
Courses of Instruction

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; bearing capacity and settlement of foundation; foundation failures. Preq: C E 321 or consent of instructor.

C E 823 Asphalt Concrete Properties 3(3,0) Study of asphalt concrete, high performance concrete, highly flowable concrete, concrete, underwire concrete, shotcrete and others. Uses 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 824 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 foundation installation. Preq: C E 321 and 351 or their equivalents.

C E 832 Capital Project Management Fundamentals 3(3,0) 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. Preq: Consent of instructor.

C E 833 Capital Project Controls 3(3,0) 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. Preq: C E 832 and consent of instructor.

C E 834 Key Topics in Capital Project Management 3(3,0) 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. Preq: C E 832 and consent of instructor.

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 aero-dynamic drag.
COLLEGE OF ENGINEERING AND SCIENCE

C E 661 Mechanics of Sediment Transport 3(3,0) Characterization of sediments; physical principles governing fluvial, estuarial and coastal transport of cohesiveless and cohesive sediments, including incipient motion, stable channel design, bedforms, and bedload and suspended transport. Prq: C E 342 or consent of instructor.

C E 865 Hydrologic Systems Analysis 3(3,0) Hydrologic cycle as a hydrospheric 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. Prq: 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. Prq: 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, nonbountay 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. Prq: 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 10(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

COM 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. Prq: Junior standing in engineering or science discipline.

C E 860 Engineering and Science Education Research Methods 1(1,0) 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.

C E 880 Teaching Undergraduate Engineering 3(3,0) Designed for engineering graduate students seeking a career in academia. Includes both discussion and practice of effective teaching techniques, assessments and technologies, as well as an overview of current engineering education research.

C E 885 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. Prq: Consent of instructor.

C E 861 Practicum in Engineering and Science Education 1-3(1-3,0) 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.

C E 871 Engineering and Science Education Research Methods 3(3,0) Introduces methods and tools available for conducting pedagogically sound engineering and science education research. Quantitative, qualitative and mixed methods are discussed and practiced.

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. Prq: 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. Prq: 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 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 online 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 photorealistic, 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 2D Game Engine Construction 3(3,0) Introduction to the tools and techniques necessary to build 2D 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 programing 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 walkthroughs 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-oriented 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, storyboard ing, 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, interweaving 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, matching camera 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 600 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 855 Embedded Network Systems 3(3,0) 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. Preq: 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. Prq: 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. Prq: 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. Prq: 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. Prq: 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. Prq: 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. Prq: 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. Prq: 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. Prq: 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(3,0) Special topics not covered in other courses. Emphasis is on field studies, research activities and current developments in building science. Prq: 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. Prq: 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. Prq: GREN 302 or equivalent.

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 trips( ) are planned. Prq: Senior standing in agriculture or engineering or consent of instructor.

CSENV 609 Biology of Invasive Plants 3(3,0) Introductory course covers 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. Prq: BIOL 104/106, or BIOSC 304, 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. Prq: 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. Prq: 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. Prq: AGRIC 104, CSENV 202, or consent of instructor.

CSENV 624 Applied Aspects of Forage Management 10(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. Prq: 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. Prq: 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 640 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, nitrification, 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 phenomena, and soil acidity. Offered fall semester only. Preq: CH 101, CSENV 202, PHYS 207.

CSENV (ENTOX, GEOI) 685 Environmental Soil Chemistry 3(3,0) 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. Preq: CSENV 202, CH 102 or consent of instructor.

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, PI 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 physicologic 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 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.

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 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.

ED EC 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) 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 ED F 778, 879; consent of thesis advisor.

ED EC 890 Assessment and Program Planning in Early Childhood 3(3,0) 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.

ED EC 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.
Courses of Instruction

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 627 Development of the American Economy 3(3,0) Explores several topics relevant to understanding the American experience. Considers the institutions and developments critical to America’s ascendency 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 314, 315.

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. Preq: ECON 314 or consent of instructor.

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. Preq: 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) Econometric 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. Preq: 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. Preq: 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 man power economics.

ECON (AP EC) 817 Advanced Production Econom ics 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. Preq: 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. Preq: 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. Preq: 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. Preq: 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.
COURSES OF INSTRUCTION

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. Prereq: 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. Prereq: 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. Prereq: 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. Prereq: 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 credits.

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. Prereq: 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. Prereq: ECON 805 or equivalent.

ECON (AP EC) 906 Seminar in Area Economic Development 3(3,0) See AP EC 906.


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. Prereq: 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. Prereq: 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. Prereq: 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. Prereq: ECON (AP EC) 801, 807, (AP EC) 820.

ECON 924 Advanced Industrial Organizations 3(3,0) Coverage of advanced concepts and methods involving strategic interaction among firms. Topics may include pricing, capacity choice, advertising, collusion and industry dynamics. Prereq: ECON (AP EC) 824 or consent of instructor.

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. Prereq: 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. Prereq: 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 are selected for indepth study. May be repeated for a maximum of 24 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 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 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. Prereq: 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. Prereq: 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 (EF, ED SP) 894 Directed Research 1-4(1-4,0) 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/Fail only. Prereq: ED F 778, 808 or consent of instructor.
ED C 801 Selected Topics Doctoral Study 1-3(1-3,0) 
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 C 802 Independent Doctoral Study 1-3(1-3,0) 
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 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 Higher Education Administration 3(3,0) 
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. Preq: Consent of instructor.

ED C 810 Theories and Techniques of Counseling 3(3,0) 
Counseling theories and techniques. Preq: 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: 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: ED C 810, 814.

ED C 816 Introduction to Couples 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 Contemporary College Student 3(3,0) 
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: ED L 855 or consent of instructor.

ED C 821 Counseling Psychodiagnosis 3(3,0) 
Comprehensive overview of the DSM-IV-TR; multifaceted 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 801, 810, 814; Preq or coreq: ED C 807, 815.

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 Clinical Mental Health 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, 815 (or concurrent enrollment), 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) 
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/Fail only. Preq: ED C 813, coreq: ED C 812, 813.

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 Clinical Mental Health Counseling Internship 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: ED C 805, 810, 811, 814, 815, 818, 821, 823 (or concurrent enrollment), 836, consent of instructor.