Contents
The College Engineering
2008-2009 Graduate Course Descriptions

Architectural Engineering Courses

AE 551   Building Energy Systems I
This course covers inverse modeling as a scientific approach to data analysis, different types of inverse methods as applied to building & HVAC & refrigeration equipment energy use, calibrated simulation approach, current research trends.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

AE 552   Building Energy Systems II
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

AE 790   Special Topics
Covers selected advanced level topics in architectural engineering. May be repeated for credit if topics vary.
Credits: 0.00 to 12.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

Chemical Engineering Courses

CHE 502   Math Methods Chem Engr
Emphasizes formulation of differential and difference equations, both ordinary and partial, governing chemical engineering operations in the steady and unsteady state.
Credits: 3.00
College: College of Engineering
Department: Chemical Engineering

CHE 513   Chem Engr Thermodynamics
Examines thermodynamic principles from a classical viewpoint, including properties of materials, equations of state of mixtures, and chemical and phase equilibria of complex mixtures.
Credits: 3.00
College: College of Engineering
Department: Chemical Engineering

CHE 525   Transport Phenomena I
Presents a unified treatment of transport rate theory, with emphasis on analogies among momentum, energy, and mass transfer, and continuum and molecular theories of matter.
Credits: 3.00
College: College of Engineering
Department: Chemical Engineering

CHE 534   Mass Transfer Operations I
Theory and design of equilibrium stage operations. Separation processes for binary and multicomponent mixtures.
Credits: 3.00
College: College of Engineering
Department: Chemical Engineering

CHE 543   Kinetics & Catalysis I
Covers chemical reaction kinetics as applied to chemical engineering. Introduces chemical kinetics and mechanisms and heterogeneous

kinetics and catalysis. Includes design of ideal and non-ideal chemical reactors.
Credits: 3.00
College: College of Engineering
Department: Chemical Engineering

CHE 554   Process Systems Engineering
Covers the basic concepts of the systems engineering approach to the design and operation of processing plants. Includes methods for developing control strategies.
Credits: 3.00
College: College of Engineering
Department: Chemical Engineering

CHE 556   Process Optimization
Focuses on optimization of processes from the viewpoint of economic return.
Credits: 3.00
College: College of Engineering
Department: Chemical Engineering

CHE 560   Transport Phenom Bio Sys
Covers gas-liquid mass transfer in microbial systems, mass transfer in cells and biofilms, membrane transport, fluid mechanics of fermentation broth, power consumption in agitated vessels, heat transfer, and scale-up of mass transfer equipment.
Credits: 3.00
College: College of Engineering
Department: Chemical Engineering

CHE 562   Bioreactor Engineering
Covers growth and product formation kinetics, batch and continuous stirred tank bioreactors, tower reactors, immobilized-cell reactors, and immobilized-enzyme reactors.
Credits: 3.00
College: College of Engineering
Department: Chemical Engineering

CHE 564   Unit Oper-Bioprocess Sys
Covers liquid-liquid extractions, membrane separations, chromatographic separations, filtration, centrifugation, distillation, and leaching.
Credits: 3.00
College: College of Engineering
Department: Chemical Engineering

CHE 566   Dyn & Cntl Bio Proc Sys
Dynamics of pH and temperature control systems, dynamics of bioreactors to feed upsets, substrate feed rate control, start-up of bioreactors, dynamics of multiple microbial populations, instrumentation of bioreactors, and computer interfacing.
Credits: 3.00
College: College of Engineering
Department: Chemical Engineering

CHE 626   Transport Phenomena II
Transport of mass, energy, and momentum of turbulent systems.
Credits: 3.00
College: College of Engineering
Department: Chemical Engineering

CHE 631   Heat Transfer

Advanced topics in heat conduction, convection, and radiation with application to design.
Credits: 3.00
College: College of Engineering
Department: Chemical Engineering

CHE 635   Mass Transfer Operations II
Theory and design of continuous contact operations including fixed-bed and fluid-bed processes
Credits: 3.00
College: College of Engineering
Department: Chemical Engineering

CHE 644   Kinetics & Catalysis II
Advanced topics in kinetics and catalysis including: diffusion and catalysis; optimization of chemical reaction systems; analysis and treatment of kinetic data.
Credits: 3.00
College: College of Engineering
Department: Chemical Engineering

CHE 658   Advanced Process Design
Covers flowsheet analysis and synthesis, batch process design and scheduling, project scheduling, and economic considerations.
Credits: 3.00
College: College of Engineering
Department: Chemical Engineering

CHE 670   Real-Time Microcomp Appl
Application of microcomputers in monitoring and control of external devices and processes. Topics include: digital input/output, real-time clock, analog-to-digital and digital-to-analog conversion, noise removal, signal processing, and data communications. Includes hands-on computer laboratory.
Credits: 0.00 to 3.00
College: College of Engineering
Department: Chemical Engineering

CHE 799   Independ Study Chem Engr
Provides advanced independent study in chemical engineering or related interdisciplinary fields.
Credits: 0.00 to 9.00
College: College of Engineering
Department: Chemical Engineering

CHE 800   Special Topics
Covers selected advanced-level topics in chemical engineering. May be repeated for credit when topics vary.
Credits: 0.50 to 9.00
College: College of Engineering
Department: Chemical Engineering

CHE 898   Master's Thesis
Requires fundamental research in chemical engineering. Hours and credits to be arranged.
Credits: 0.00 to 9.00
College: College of Engineering
Department: Chemical Engineering

CHE 998   Ph.D. Dissertation
Requires dissertation research in chemical engineering. Hours and credits to be arranged.

Credits: 1.00 to 9.00
College: College of Engineering
Department: Chemical Engineering

Civil Engineering Courses

CIVE 501 Model Analysis of Structures
Open to advanced undergraduates. Covers application of models for the analysis and design of complex structures, including development of laws of similitude, methods of fabricating, and testing and instrumentation of models.
Credits: 0.00 to 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 510 Prestressed Concrete
Open to advanced undergraduates. Covers definitions and general principles, anchorage systems, and loss of prestress; analysis and design of simple beams for flexure, shear, bond, and bearing; partial prestressed and post-tensioned reinforcement; continuous beams.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 520 Advanced Concrete Technology
This course covers the mechanical, physical and chemical properties of concrete: characteristics of concrete in the fresh, setting and hardening states; high performance concrete. Factors influencing the mechanical performance of concrete are discussed as well as field testing methods.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 530 Geotechnical Engr for Highways
Covers design if stable right-of-way, USDA classification, frost and swell expansion, capillary moisture retention, subgrade compaction, beam on elastic foundation pavement model, loads and resistance of buried pipes, subdrainage, basic slope stability an
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 531 Adv Foundation Engineering
Covers design of shallow foundations (footing and mats), deep foundations (piles, augered, drilled shafts) and retaining structures for stability and deformation performance.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 560 Intro Coastal & Port Engr
Provides an overview of coastal engineering problems and their solution, including shoreline erosion, ocean waves and wave theories, wave generation, diffraction, refraction, harbor hydraulics, coastal currents, and tidal inlet hydraulics and sedimentation.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 561 Introduction to Hydrology

Covers climate and weather, precipitation, evaporation and transpiration, drainage basins, and hydrographs.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 563 Coastal Processes
This course provides a detailed presentation of hydraulic and sedimentary processes occurring in the coastal zone with a view toward applying knowledge of the processes to coastal erosion and shoreline stabilization problems.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 585 Trans Planng & Capacity
Open to undergraduates. Covers prediction of travel demand; principles of highway and transit capacity; level-of-service concepts; uninterrupted and interrupted flow; traffic characterization by volume, speed, and density; operational analysis and design.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 586 Geometric Design of Highways
Open to undergraduates. Covers classification of highway and transit systems with relation to function, funding, ownership, and design; characteristics of design vehicles, drivers, and traffic; and elements of design including sight distance.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 605 Adv Mechanics Of Material
Open to advanced undergraduates. Covers shear flow and shear center, unsymmetrical bending, torsion of non-circular and open sections, bending of curved beams, stress at a point, and failure theories.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 615 Infrastructure Condtn Eval
This course covers the tools necessary for the inspection and evaluation of infrastructure. Non-destructive testing (NDT) techniques are introduced and applications and limitations of NDT techniques for a variety of structures are illustrated.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 632 Advanced Soil Mechanics
Consolidation magnitude and time rate of settlement, secondary compression, mitigating settlement problems, shear strength of cohesive and non-cohesive soils, critical state soil mechanics, undrained pore pressure response, SHANSEP undrained strength.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 635 Slope Stability and Landslides
Slope process and mass wasting; landslide characteristics, features and terminology; limit equilibrium slope stability analysis, including Bishop,

Janbu, Spenser, Morgenstern-Price methods; effects of water on slop stability; dynamic (earthquake) stability.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 636 Ground Modification
This course covers the improvement of soil properties to meet project requirements, including surface and in situ technologies: compaction, densification, precompression, stabilization with admixtures, grouting and dewatering.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 640 Environmental Geotechnics
This course covers the analysis and control of subsurface exploration, groundwater remediation, pollutant-soil interaction and waste containment barriers and drains.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 650 Geosynthetics I
Open to advanced undergraduates. Presents a basic description of the various products, relevant aspects of polymeric materials, and an overview of each category of geosynthetics. Covers geotextile testing and design on the basis of primary application function: separation, reinforcement, filtration, drainage, barrier, and combined.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 651 Geosynthetics II
Continues CIVE 650. Covers design and testing of geogrids for reinforcement applications and geonets for drainage applications. Presents geomembrane design and testing from an applications perspective in the areas of environmental, geotechnical, transport
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 652 Geosynthetics III
Continues CIVE 651. Covers design and testing of geosynthetic clay liners as a hydraulic/gas barrier and geopipes as drainage materials in numerous application. Presents geocomposites in separation, reinforcement, filtration, and drainage.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 660 Hydrology-Stream Flow
Covers precipitation, runoff, evaporation and transpiration, streamflow, floodflow, and minimum flow. Pays special attention to factors affecting water supply and quality.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 661 Groundwater Hydraulics
Covers occurrence of underground flow, groundwater supply, pollution problems, and well and aquifer hydraulics.

Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 662 Hydrodynamics I
Covers theory of perfect fluids, Euler's equations of motion, continuity equation and energy equation, velocity potential and stream function, sources and sinks, circulation and vorticity, flow-around bodies and flow in channels, and jet flow.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 663 Hydrodynamics II
Extends the theory of perfect fluids to cover fluid forces and moments on bodies, free streamline theory, and extension of vorticity theory.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 664 Open Channel Hydraulics
Covers principles of flow in open channels, conservation laws, uniform flow, critical flow, gradually varied flow, backwater computations, channel design, and numerical computation of flows having a free surface.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 665 Computational Hydraulics I
This course continues CIVE 664 to cover the application of mathematical and numerical techniques to model complex open channel hydraulic processes. At each stage the fundamental hydraulic principles are reviewed.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 666 Free Surface Flows
This course extends the concepts of one-dimensional open channel flow to cover both the physical under-standing and the application of mathematical and numerical techniques to model very complex open channel hydraulics problems including transients.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 701 Structural Analysis I
Covers basic principles of structural analysis, including elastic deflection; elastic analysis of statically indeterminate structures by methods of virtual work, Castigliano's theorems, and moment distribution; and the Muller-Breslau principle.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 702 Structural Analysis II
Covers matrix analysis of structures using finite elements, including elastic analysis of structures by influence coefficients, Argyris force method, direct stiffness method, and the displacement method.
Credits: 3.00
College: College of Engineering

Department: Civil, Arch, & Environ Engr

CIVE 703 Structural Analysis III
Covers development of stiffness functions for planar and three-dimensional finite elements, and application to frame, plate, shell, and massive structures. Introduces the general application of finite elements to continuum problems.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 704 Bhvr & Stab Struc Membs I
Covers development of the basic differential equations of member behavior, including second-order effects, in-plane beam-column behavior, column buckling, elastic and inelastic behavior, energy methods, and approximate methods.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 705 Bhvr & Stab Struc Membs II
Covers general torsion of thin-walled open, closed, and combined open-and-closed cross-sections; lateral torsional buckling; biaxial bending; elastic and inelastic behavior; approximate methods; and frame buckling.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 710 Desn & Struc Int Bldg Sys
Covers integration of design and building cycle, building envelope, structural morphology, composite structures, thermal and moisture design, fire and smoke, sound and vibration, building failure, and repair and restoration.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 711 Engineered Masonry I
Covers masonry materials, structural behavior of masonry assemblages, and deformational characteristics of brick and block masonry; performance of load-bearing wall systems and design of unreinforced masonry elements.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 712 Engineered Masonry II
Covers fundamental concepts of reinforced masonry, reinforced wall design, column and pilaster design, seismic resistance of masonry structures, prestressed masonry, and applied design of low-and high-rise buildings.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 714 Behavior Concrete Struc I
Covers reinforced concrete members; relationship between results of research and current specifications for design of members subjected to axial loads, flexure, combined axial load and flexure, combined shear and flexure, long columns, and bond and anchorage.
Credits: 3.00

College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 715 Behav Concrete Struct II
Continues CIVE 714.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 717 Behavior of Metal Structures I
Covers load and resistance factor design, including tension, bolted and welded connections, block-shear, compression, built-up compression members, lateral-torsional instability, light-gauge metal buckling and post-buckling strength, and behavior.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 718 Behavior Metal Struct II
Covers load and resistance factor design, including design and behavior of metal structural members and connections, flexural members including plate girders, bracing and lateral-torsional buckling resistance, torsion and other combined loading, and composite beams and columns.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 719 Behavior Metal Struct III
Covers load and resistance factor design, including idealization and design of structures and their connections, frame bracing and sway, frame design philosophy, optimization, fatigue, and fracture.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 730 Experimental Soil Mechanics I
Covers methods and techniques of soil testing, including interpretation and evaluation of test data, and fundamentals of soil behavior.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 731 Experimental Soil Mechanics II
Continues CIVE 730.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 732 Exp Soil Mechanics III
Continues CIVE 731.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 737 Seismic Geotechnics
Introduction to earthquake hazards and seismology; strong ground motion parameters, deterministic and probabilistic seismic hazard analysis, influence of subsurface conditions and topography and ground motion, soil liquefaction.
Credits: 3.00
College: College of Engineering

Department: Civil, Arch, & Environ Engr

CIVE 752 Coastal Structures
This course briefly reviews the functional design of costal and port structures and deals in detail with forces on those structures. Forces caused by waves and currents, and mooring and vessel impacts are addressed.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 754 Props & Proc Polymeric Matls
This course focuses on the uses and characteristics of polymeric materials used in civil and architectural engineering infrastructure. Also covered are micro-structure, physical and chemical properties and mechanical behavior.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 755 Durabil Polymric Constr Matls
This is a continuation of CIVE 754 and concentrates on protecting and predicting service lifetimes. It covers physical aging, mechanical stabilization and chemical degradation of polymeric materials and the products in which they are incorporated.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 756 Eval Polymer Constr Matls
This lab course is designed to integrate and extend the coverage of CIVE 754 and 755 so that students have a full concept of the behavior of polymeric construction materials.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 767 Surface Water Mixing Processes
This course covers hydrodynamic mixing and transport processes in free-surface flows. Basic mixing processes including molecular diffusion, turbulent diffusion, and dispersion are also covered.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 768 Sediment & Contamin Trnsport
This course covers the transport of sediments and reactive solutes in surface waters. Reviewed is the classic theory for bed-load and suspended sediment transport; interplay of stream flow, frictional resistance and sediment transport.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 799 Independent Study
Independent study on a topic selected by the student. Independent study is supervised by a faculty member and guided by a plan of study.
Credits: 0.00 to12.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 801 Dynamics of Structures I

Covers formulation of equations of motion, including generalized single-degree-of-freedom systems, free vibration response, undamped and damped systems, harmonic analysis, resonance and vibration isolation, response to periodic loading, and impulsive loading.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 802 Dynamics of Structures II
Covers formulation of multi-degree-of-freedom equations of motion, including evaluation of structural property matrices; elastic properties, mass properties, damping, and external loading; geometric stiffness; and undamped free vibrations.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 803 Dynamics of Structures III
Covers distributed parameter dynamic systems, equations of motion, free and forced vibrations, analysis of structural response to earthquakes, seismological background, deterministic analysis of single-degree-of-freedom and multi-degree systems.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 811 Plates and Shells I
Covers analysis of circular, rectangular, and continuous plates by classical and approximate methods, including the folded plate theory.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 812 Plates and Shells II
Covers the general theory of thin shells, cylindrical shells, surfaces of revolution, hyperbolic paraboloids, and other shells of double curvature.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 813 Plates and Shells III
Covers buckling and vibration analysis, including application of finite-elements methods and anisotropic behavior.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 831 Deep Foundations
Covers topics including mat foundation design using plate theory, continuous beam design using beam-on-elastic foundation theory, and pile design.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 833 Earth Retaining Structures
Covers lateral earth pressure theories, analysis and design of temporary and permanent retaining structures, surcharge load, excavations, and loads on buried conduits.
Credits: 3.00
College: College of Engineering

Department: Civil, Arch, & Environ Engr

CIVE 838 Soil Behavior
Particle-scale behavior of soil and assemblages; clay mineralogy; soil formation, composition, structure and properties; soil water interaction; clay-water-electrolyte systems, adsorption-desorption and ion exchange; conduction phenomena; an micromechanics.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 839 Geomechanics Modeling
This course covers constitutive laws in goemechanics, including linear elastic, quasi-linear (hyperbolic) elastic, linear elastic-perfectly plastic and elasto-plastic models based on critical state soil mechanics.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 898 Master's Thesis
Involves investigation of an approved topic. Required of full-time master's degree students.
Credits: 0.50 to 20.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 997 Research
Research.
Credits: 1.00 to 12.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

CIVE 998 Ph.D. Dissertation
Involves investigation of an approved topic. Required of Ph.D. students.
Credits: 1.00 to 12.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

Computer Science Courses

CS 500   Database Theory
Introduces relational and knowledge base data models and contrasts the expressiveness of the two models. Covers semantics of knowledge bases, negation, dependencies, Armstrong's axioms, decompositions, and normal forms.
Credits: 3.00
College: College of Engineering
Department: Computer Science

CS 510   Intro to Artificial Intel
Well-formed problems; state spaces and search spaces; Lisp and functional programming; uniformed search; heuristic search; stochastic search; knowledge representation; propositional logic; first order logic; predicated calculus; planning; partial order planning; hierarchical planning.
Credits: 3.00
College: College of Engineering
Department: Computer Science

CS 520   Computer Science Foundations

Survey of basic mathematics concepts needed for the study of computer science at the graduate level: induction, iteration, recursion; analysis of program running time; elementary probability and combinatorics; relations, graphs and trees.
Credits: 3.00
College: College of Engineering
Department: Computer Science

CS 521   Data Structures/Algorithms I
Techniques for analyzing algorithms: asymptotic notation, recurrences, and correctness of algorithms; divide and conquer: quick sort, merger sort, median and order statistics; elementary data structures: hashing, binary heaps, binary search trees.
Credits: 3.00
College: College of Engineering
Department: Computer Science

CS 522   Data Structures/Algorithms II
Discussion of algorithm design techniques, augmented data structures including Binomial and Fibonacci heaps and Splay tree; Amortized analysis of data structures, topics in pattern and string matching, network flow problem, matching in bipartite graphs.
Credits: 3.00
College: College of Engineering
Department: Computer Science

CS 525   Theory of Computation
Theory of computation introduces basic mathematical models of computation and the finite representation of infinite objects. These topics covered in the course include: finite automata and regular languages, context free languages, Turning machines.
Credits: 3.00
College: College of Engineering
Department: Computer Science

CS 530   Developing User Interfaces
This course examines the implementation of multimodal user interfaces within the context of interface design and evaluation. The course involves both practice implementing interfaces using current technologies and study of topical issues.
Credits: 3.00
College: College of Engineering
Department: Computer Science

CS 536   Computer Graphics
An introduction to the basic concepts of computer graphics, including the graphics pipeline, 2D drawing, 3D viewing, mathematical representations of objects (lines, curves, surfaces and solids), color, and how these concepts are implemented.
Credits: 3.00
College: College of Engineering
Department: Computer Science

CS 540   High Performance Computing
Covers basic von Neumann architectural concepts involving memory organization, instruction, and data representations, including computer number systems, assembler and linker operations, character codes, floating point numbers, IEEE standard, and subroutines.
Credits: 3.00
College: College of Engineering
Department: Computer Science

CS 543   Operating Systems
Covers the classical internal algorithms and structures of operating systems, including CPU scheduling, memory management, and device management. Considers the unifying concept of the operating system as a collection of cooperating sequential processes.
Credits: 3.00
College: College of Engineering
Department: Computer Science

CS 544   Computer Networks
Computer networks and computer communication; network topologies; local area networks and store-and-forward networks; circuit, message, and packet switching; CBX vs. LAN; network protocols and OSI reference model; and performance analysis.
Credits: 3.00
College: College of Engineering
Department: Computer Science

CS 550   Programming Languages
Covers basic concepts of the design and implementation of programming languages, including data representation and types, functions, sequence control, environments, block structure, subroutines and coroutines, storage management. Emphasizes language features and implementation, not mastery of any particular languages.
Credits: 3.00
College: College of Engineering
Department: Computer Science

CS 551   Compiler Construction I
Provides a thorough study of modern compiler techniques. Topics include scanners, parsers with emphasis on LR parsing, and syntax-directed translation. Requires students to use a parser generator to write a compiler for a non-trivial language.
Credits: 3.00
College: College of Engineering
Department: Computer Science

CS 552   Compiler Construction II
Continues CS 551. Examines several advanced topics in depth, such as automatic code generation, error recovery, optimization techniques, data flow analysis, and formal semantics.
Credits: 3.00
College: College of Engineering
Department: Computer Science

CS 567   Applied Symbolic Computation
For uses of symbolic computation (maple, mathematica, derive, macsyma) who which to gain an understanding of fundamental symbolic mathematical methods. Includes introduction to a symbolic mathematical computation system and application to problems from m
Credits: 3.00
College: College of Engineering
Department: Computer Science

CS 571   Prog Tools and Environments
Covers UNIX operating system, Shell programming, PERL, JAVA, and advanced features of C++ from the viewpoint of efficient software development.
Credits: 3.00
College: College of Engineering

Department: Computer Science

CS 575   Software Design
Intended for CS and MSSE students; others must obtain departmental permission to enroll. Introduces techniques and notations with formal (mathematical) underpinnings for specifying the structural and behavioral properties of software systems.
Credits: 3.00
College: College of Engineering
Department: Computer Science

CS 576   Dependable Software Systems
Intended for CS and MSSE students; others must obtain departmental permission to enroll. Offers an in-depth treatment of software testing and software reliability, two components of developing dependable software systems.
Credits: 3.00
College: College of Engineering
Department: Computer Science

CS 583   Intro to Computer Vision
Theoretical and algorithmic foundation and applications of computer vision. Covered topics include image formation, image sensing, image filtering, lightness, radiometry, motion, image registration, stereo, photometric stereo, shape-from-shading.
Credits: 3.00
College: College of Engineering
Department: Computer Science

CS 610   Adv Artificial Intelligence
Representation, reasoning, and decision-making under uncertainty; dealing with large, real world data sets, learning; and solving problems with time-varying properties; how to apply AI techniques toward building intelligent machines.
Credits: 3.00
College: College of Engineering
Department: Computer Science

CS 612   Knowledge-based Agents
Fundamentals of agent-based computing; distributed AI; representations; agent communication languages; reasoning (expert, rule-based, case-based, production systems); network communication protocols; emergent behavior; swarm intelligence.
Credits: 3.00
College: College of Engineering
Department: Computer Science

CS 613   Machine Learning
Fundamentals of machine learning; concept learning; decision tree learning; artificial neural networks; hypothesis testing; bayesian learning; computational learning theory; instance-based learning; genetic algorithms; reinforcement learning.
Credits: 3.00
College: College of Engineering
Department: Computer Science

CS 614   Natural Language Processing
Application of machine learning to text collections or corpra; statistical language learning; information retrieval; parsing of natural language; classifier systems; natural language translation; processing of spoken language; language understanding.
Credits: 3.00

College: College of Engineering
Department: Computer Science

CS 615   Time-Critical Intelligent Sys
Foundations, theory, and applications of intelligent systems that reason explicitly about their limited computational resources; anytime algorithms; real-time AI; application domains, including graphics rendering, and web page prefetching.
Credits: 3.00
College: College of Engineering
Department: Computer Science

CS 620   Adv Data Structure/Algorithms
This course studies how advanced topics are used in the real world and generates an appreciation of where algorithms are used to understand various considerations that make a good algorithm.
Credits: 3.00
College: College of Engineering
Department: Computer Science

CS 621   Approximation Algorithms
Study of techniques for designing approximation solution to NP-hard problems. Classification of problems into different categories based on the difficulty of finding approximately sub-optimal solutions for them.
Credits: 3.00
College: College of Engineering
Department: Computer Science

CS 623   Computational Geometry
Introduction to algorithms and Data Structures for computational problems in discrete geometry (for points, lines and polygons) primarily in finite dimensions. Topics include triangulation and planar subdivisions, geometric search and intersections.
Credits: 3.00
College: College of Engineering
Department: Computer Science

CS 636   Advanced Computer Graphics
Open GL; texture and bump maps; rendering techniques (phong, gourmand, radiosity); particle systems; hierarchical models; photorealism; non-photorealistic rendering; geometric compression; mathematical structures for graphics.
Credits: 3.00
College: College of Engineering
Department: Computer Science

CS 637   Interactive Computer Graphics
This is a project-oriented class that covers the concepts and programming details of interactive computer graphics. These include graphics primitive, display lists, picking, shading, rendering buffers and transformations. Students will learn an industry-standard graphics system by implementing weekly programming assignments. The course culminates with a student-defined project.
Credits: 3.00
College: College of Engineering
Department: Computer Science

CS 645   Network Security
The purpose of this course is to cover the principles and practice of cryptography and network security. The first half of the course covers cryptography and network security techniques. The second part deals

with the practice of network security, i.e. with the processes and application that have to be in place to provide security.
Credits: 3.00
College: College of Engineering
Department: Computer Science

CS 647   Distributed Systems Software
Survey of fundamental concepts of distributed computer systems from the viewpoint of application building. Interprocess communication, remote procedure calls and method invocation: middleware, distributed services and distributed coordination.
Credits: 3.00
College: College of Engineering
Department: Computer Science

CS 650   Program Gen & Opt
This course introduces the student to the foundations and state-of-the-art techniques in high performance software development for numeric libraries and other important kernels. Topics include: 1) fundamental tools in algorithm theory, 2) optimizing compilers, 3) effective utilization of the memory hierarchy and other architectural features, 4) how to use special instruction sets, and 5) an introduction to the concepts of self-adaptable software and program generators.
Credits: 3.00
College: College of Engineering
Department: Computer Science

CS 668   Computer Algebra
Introduction to Foundations of Symbolic Computation. Typical : Arithmetic with large integers, rational numbers, polynomials, modular arithmetic, greatest common divisors, chinese remainder algorithm.
Credits: 3.00
College: College of Engineering
Department: Computer Science

CS 669   Computer Algebra II
The course continues the introduction to symbolic computation. Typical topics include polynomial root computation, exact arithmetic with real algebraic numbers and the solution of polynomial systems of equations using groebner or elimination methods.
Credits: 3.00
College: College of Engineering
Department: Computer Science

CS 675   Reverse Software Engineering
Expose students to the challenges of understanding large legacy software systems. Course approach is based on hands-on practical experience, where teams of students work on real software using state of the art reverse engineering tools.
Credits: 3.00
College: College of Engineering
Department: Computer Science

CS 676   Parallel Programming
Covers a variety of paradigms and languages for programming parallel computers. Several tools for debugging and measuring the performance of parallel programs will be introduced.
Credits: 3.00
College: College of Engineering
Department: Computer Science

CS 680   Special Top Computer Science

Special Topics Covers topics of special interest to students and faculty.
Credits: 0.00 to 12.00
College: College of Engineering
Department: Computer Science

CS 690   Ind Study in Computer Science
Independent study in computer science under faculty supervision. After finding a willing Computer Science Department faculty supervisor and working out the term of study, students obtain approval to take this course from the department's graduate advisor.
Credits: 1.00 to 6.00
College: College of Engineering
Department: Computer Science

CS 741   Computer Networks II
Continues CS 740.
Credits: 3.00
College: College of Engineering
Department: Computer Science

CS 751   Database Theory II
Covers topics in database theory and implementation, varying yearly. May include physical data organization, transaction management, concurrency, distributed data-bases, and semantics.
Credits: 3.00
College: College of Engineering
Department: Computer Science

CS 759   Complexity Theory
Introduces formal models of computation, including inherent difficulty of various problems, lower bound theory, polynomial reducibility among problems, Cook's theorem, NP-completeness, and approximation strategies.
Credits: 3.00
College: College of Engineering
Department: Computer Science

CS 770   Topics Artificial Intell
Covers issues in robotics, vision, and pattern recognition.
Credits: 3.00
College: College of Engineering
Department: Computer Science

CS 780   Adv Topics in Software Eng
A research-intensive course on advanced topics in software engineering suitable for students who are either pursuing or intend to pursue an advanced degree (M.Sc or Ph.D.) in software engineering.
Credits: 3.00
College: College of Engineering
Department: Computer Science

CS 898   Master's Thesis
Master's thesis.
Credits: 1.00 to 12.00
College: College of Engineering
Department: Computer Science

CS 997   Research in Computer Science
Research.
Credits: 1.00 to 12.00
College: College of Engineering

Department: Computer Science

CS 998   Ph.D. Dissertation
Hours and credits to be arranged.
Credits: 1.00 to 12.00
College: College of Engineering
Department: Computer Science

Electrical and Computer Engineering Courses

ECE 501   Topics in Circuits and Systems
Circuit laws, transfer functions, convolution, transform techniques, systems engineering. This series of courses may be used to meet the admission prerequisites to ECE graduate program. One credit per term is creditable to the M.S.E.E. degree.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECE 502   Tops In Commun/Cntls/Cmptrs
Modulation theory, noise, feedback theory, stability, computer engineering fundamentals, computers in communication and controls. This series of courses may be used to meet the admission prerequisites to the ECE graduate program.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECE 503   Topics Math Techn In ECE
Complex variables in communication and control, matrix methods in circuits and systems, vector calculus in fields, two-dimensional image processing. This series of courses may be used to meet the admission prerequisites to the ECE graduate program.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECE 571   Introduction to ECE Research
Topics of departmental research. Thesis selection. Required of all full-time graduate students
Credits: 0.00
College: College of Engineering
Department: Electrical & Computer Engr

ECE 572   Techniques of E.C.E. Research
Techniques for making technical presentations: oral and written modes. Meeting organization, audience awareness. Writer-to-reader communication. Required of all full-time graduate students.
Credits: 0.00
College: College of Engineering
Department: Electrical & Computer Engr

ECE 573   Presentation Of ECE Rsrch
Conference attendance and critique. Student presentation and critique. Topics of concern: professional ethics, liability, etc. Required of all full-time graduate students.
Credits: 0.00
College: College of Engineering
Department: Electrical & Computer Engr

Electrical & Computer Engineering Courses – Computers Courses

ECEC 500   Funds Of Computr Hardware
Covers computer organization and architecture; elements of computer hardware, processors, control units, and memories; hardware for basic mathematical operations; tradeoffs between speed and complexity; examples of embedded systems; microcontrollers.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEC 501 Prin of Repr and Reasoning
This course presents fundamentals of discrete mathematics as applied within the computer engineering and manufacturing environment. Students are given the theoretical background in representation and reasoning for a broad variety of engineering problems
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEC 502 Principles of Data Analysis
This course presents theoretical methods and techniques of model development applicable within the computer engineering design and manufacturing environment. Students are given the theoretical background in data analysis (including "data mining").
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEC 503 Principles of Decision Making
This course presents theoretical fundamentals and engineering techniques of decision making and problem solving applicable within the computer engineering design and manufacturing environment. Students are given the theoretical background in optimization
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEC 511 Combinational Circuit Design
Representing arithmetic. Logic and syntax data for machine processing. Switching algebra: Boolean and multiple values. Identification and classification of functions. Realizing completely specified and incompletely specified Boolean functions.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEC 512 Sequential Circuit Design
Finite automata and their realization by sequential machines, capabilities, transformation, and minimization of finite automata, linear finite automata. Clocked pulsed and level mode sequential circuits. Malfunctions in sequential circuits.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEC 513 Design for Testability
Economics vs. Complexity vs. Strategy of Testing; Fault Models; Test Generation; Testability Analysis & Designing Testable Circuits; Testing Microprocessors, Memories and Computer Components; Test Data Compression; Fault Tolerant Hardware.

Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEC 541 Robot/Comp Intfce Cntls I
Covers sensors, actuators, mechanical components of robots, kinematics, inverse kinematics, dynamics, and equations of motion.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEC 542 Robot/Comp Intf & Cntl II
Covers the robot control problem, including PD, PID, position, force and hybrid controllers, resolved rate and acceleration control, and multiprocessor architecture.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEC 543 Robot/Comp Int & Cntl III
Covers non-linear control techniques, FLDT, and advanced topics.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEC 600 Fundamentals of Comp Networks
Fundamentals design principles of ATM, Internet and local area networks; protocol layers and the Internet Architecture; medium access protocols; application protocols and TCP/IP utilities; basic principles and virtual circuit switching.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEC 621 High Performance Computer Arch
Maximizing single processor performance. Concepts and techniques for design of computer systems. Processor design, instruction set architecture design and implementation, memory hierarchy, pipelines processors, bus bandwidth.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEC 622 Parallel Computer Architecture
Advanced techniques of computer design. Use of parallel processing to achieve high performance levels. Fine and coarse grained parallelism. Multiple CPU parallelism, through multiprocessors, array and vector processors.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEC 623 Adv Parallel Computer Arch
Modern research topics and methods in parallel computer architectures. Parallel algorithms, interconnection networks, SIMD/MIMD machines, processor synchronization, data coherence, dataflow machines, special purpose processors.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEC 631 Prin of Computer Networking

Principles of circuit switching, packet switching and virtual circuits; protocol layering; application layer protocols for e-mail and web applications; naming and addressing; flow control and congestion avoidance with TCP; Internet Protocol (IP).
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEC 632 Perf Analysis of Comp Networks
Covers probability theory and its applications to networks, random variable and random processes; Markov chains, multi-dimensional Markov chains; M/M/1, M/M/m, M/M/m/m, M/G/1 and G/G/1 queuing systems and their applications in computer networks.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEC 633 Adv Topics in Comp Networking
Perspectives in the areas of switch/router architectures, scheduling for best-effort and guaranteed services, QoS mechanisms and architectures, web protocols and applications, network interface design, optical networking, and network economics.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEC 654 Knowledge Engineering I
Covers conceptual modeling, including an overview of knowledge representation. Includes semantic networks, reduced semantic networks, logic of incomplete knowledge bases, extensional semantic networks, and applications of conceptual models.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEC 655 Knowledge Engineering II
Covers expert systems, including language and tools of knowledge engineering. Includes reasoning about reasoning, design and evaluation, heuristics in expert systems, expert systems for decision support, and expert systems in conceptual design.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEC 656 Knowledge Engineering III
Covers information-intensive systems, including information representation in autonomous systems. Includes clauses and their validation; clustering in linguistic structures; linguistic and pictorial knowledge bases; discovery in mathematics.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEC 661 VLSI Design
Covers CMOS design styles, techniques, and performance; VLSI computer hardware, arithmetic units, and signal processing systems; and cat tools for layout design and simulation.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEC 662 VLSI Array Processors I

Covers VLSI testing, including design for testability and parallel computer architectures; signal and image processing algorithms and mapping algorithms onto array structures; and systolic array processors.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEC 663 VLSI Array Processors II
Covers wavefront array processors; matching hardware to arrays; hardware design, systems design, and fault-tolerant design; and implementations and VLSI design projects.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEC 671 EDA for VLSI I
This course focuses on the electronic design automation problems in the design process of VLSI integrated circuits.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEC 672 EDA for VLSI II
This course focuses on the electronic design automation problems in the design process of VLSI integrated circuits. In this second quarter of the course, physical VLSI design steps of technology mapping, floor planning, placement, routing and timing.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEC 673 DSM-IC Design
This course focuses on the design challenges of digital VLSI integrated circuits in deep sub-micron manufacturing technologies. Automation challenges and high-performance circuit design techniques such as low-power and variation-aware design are presented.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEC 690 Special Tops Comp Engr
Covers special topics of interest to students and faculty.
Credits: 0.00 to 9.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEC 697 Research In Computer Engr
Research in computer engineering.
Credits: 0.00 to 9.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEC 699 Supervised Stdy Comp Engr
Supervised study in computer engineering.
Credits: 0.00 to 9.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEC 891 Adv Topics Computer Engr
Advanced topics in computer engineering.
Credits: 0.50 to 9.00

College: College of Engineering
Department: Electrical & Computer Engr

ECEC 898 Master's Thesis Comp Engr
Master's thesis in computer engineering.
Credits: 0.00 to 9.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEC 997 Dissert Rsch Comp Engr
Credits: 1.00 to 12.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEC 998 PhD Dissert Comp Engr
Ph.D. dissertation in computer engineering.
Credits: 1.00 to 12.00
College: College of Engineering
Department: Electrical & Computer Engr

Electrical & Computer Engineering Courses – Electrophysics Courses

ECEE 501 Physical Prin Elec Engr I
Core course. Covers classical mechanics, including generalized coordinates, Lagrangian and Hamiltonian formulation, and variational principle. Introduces quantum mechanics, including Schrodinger equation, wave functions, operators, and expectation values.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEE 502 Phys Princ Elect Engr II
Core course. Continues ECEE 501. Covers atomic orbitals, angular momentum, oscillators, time-independent and time-dependent perturbation theories, many-particle wave functions, and optical transitions. Also covers statistical mechanics.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEE 507 Electromag Field Analys I
Core course. Covers Maxwell's equations; solutions of Laplace's equation, Green's function, and scalar and vector potentials; energy and momentum in electromagnetic fields; and interaction of fields and material media.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEE 508 Electromag Field Anal II
Core course. Continues ECEE 507. Covers em waves, including reflection, refraction, polarization, and dispersion. Includes metallic and dielectric guiding structures, guides, and waveguide circuits and applications to stripline, microstrip, and optical fiber transmission systems.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEE 510 Scat & Diffract Elec Waves

Boundary value problems of EM theory. Exact and approximate methods for scattering by spheres, half plane, slit; radar cross-section theory. Quasi-optical theory, scattering, diffraction coefficients. Applications to radio propagation around the earth.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEE 517 Microwv Ntwk & Trans Media
Core course. Atmospheric wave propagation, solution of wave equation without sources in isotropic media, plane-waves, polarization, dispersion surfaces, wave admittance and impedance, wave propagation in free-space and various media, waves at interfaces,
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEE 518 Microwave Passive Components
Core course. V-I and E-H analogy, Kirchoff's Law, Telegrapher's EQ, voltage and current waves, reflection coefficient and impedance relationship, Smith Chart, impedance matching techniques, Bode-Fano theoretical limit, Broadband Quarter-wave Transformer, N-port linear networks, Z, Y, and S parameters, ABCD and T matrices, signal flow-graph and transfer functions, synthesis of two-port and unitary properties, even-odd mode analysis and dual directional couplers (design and synthesis), periodic structures and Flouke modes, filter design and synthesis using insertion loss and image methods, prototype LO filter and transformation to LP, BP, HP, and BS filters, Richards transform and Kuroda identities.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEE 519 Microwave Active Subsystems
Core course. Overview of physics of P-N junction and Schottky junctions, pin, varactor, and step recovery diodes and their applications, transistors, MESFET and HEMT, BJT and HBT passive microwave circuits: switches, detectors, attenuators, modulators, and phase shifter, active microwave circuits: LNA, power amplifier, distributed amplifier, oscillators (fixed and VCO) power budget and link performance calculations for telecommunication, radar, and EW systems.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEE 520 Solid-State Electronics
This course familiarizes the students with the fundamental properties of semiconductor materials leading to the students of electronic and photonic devices. Covered topics include: atomic structure, crystal structure, theories of electron conduction, scattering, pn junctions, heterojunctions, metal-semiconductor contacts, and junction devices.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEE 521 Bipolar and FETs
This is the second course in a sequence of three on electronic and photonic devices. The course covers families of electronic devices. The course covers various families of electronic devices based on silicon and compound semiconductors.
Credits: 3.00

College: College of Engineering
Department: Electrical & Computer Engr

ECEE 522 Photonic Devices
Covers fundamentals of absorption, spontaneous, and stimulated emission, photodetectors, light emitting diodes, laser oscillation, semiconductor laser diodes, RIN and phase noise, quantum well lasers, optical receivers, and quantum effect devices.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEE 523 Integrated Circuits
Covers growth of single-crystal silicon, growth of oxide and epitaxial layers, photolithography, diffusion of impurities, fabrication of bipolar and unipolar integrated circuits, and interconnections and packaging.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEE 525 Digital IC and CMOS Technology
Covers digital ICs using CMOS technology. Transistor level building blocks, -NOT, NAND, NOR, XOR, OAI, and AOI are designed using industry standard CAD tools, e.g. Cadence. Circuit topologies such as CPL, transmission gates are explored. CMOS technology/fabrication and layout are discussed to optimize speed, power, and area.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEE 526 Custom VLSI Design
Course covers advanced design styles such as dynamic CMOS circuits, low power circuit concepts, bi-CMOS circuits and the design of VLSI sub-systems. A major category is memory design, both DRAM. VLSI design styles, system integration aspects are discussed.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEE 541 Photonic Systems
Introduction to Optical principles through EM theory. Covers the mathematics of wave motion, as well as the idea of light propagating as particles. The course shows how ray (or geometrical) optics and Gaussian optics are derived from the wave theory.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEE 542 Opt Apps of Diffraction
Optical Applications of Diffraction and Interference. This course is an introduction to optical principles through EM theory. Covered topics include wave motion and superposition.
 Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEE 603 Cooperative Phenomena
Covers dielectrics, ferroelectrics, diamagnetism, paramagnetism, ferromagnetism, and antiferromagnetism; superconductivity, London's equations, BCS theory, and Josephson effect; and flux quantization, hard superconductors, GLAG theory, dynamics, and high-temperature superconductors.

Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEE 607 Nanoscale Fields
Course covers essentials of electric and magnetic fields, including thermodynamics of polarizable media. Emphasis is on nano-and micro-scale effects like Van der Waals and double layer interactions, plasmon resonance and others.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEE 621 Thin Film Technology I
Covers vacuum technology, plasma processing, VLSI fabrication, and thin film technologies (e.g., plasma etching, thin film deposition, and thin film characterizations).
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEE 622 Microfabrication Technology
The course provides an overview of basic technological processes typically involved in microfabrication of Micro-Electro-Mechanical Systems (MEMS). The course includes several demonstration laboratories involving basic photolithography, thin film depositions and electroplating.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEE 623 Thin Film Technology III
Presents speakers on state-of-the-art practice and future applications of thin film deposition and processing technology.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEE 641 Fib Ops & Opt Comms I
Covers propagation in guided and unguided media, including step and graded fibers, dispersion, guide deformations, and mode coupling. Involves design.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEE 642 Fib Ops & Opt Comms II
Covers coupling devices, multimode guides, sources, lasers, and radiation patterns. Includes reliability, detectors, circuit models, and noise.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEE 671 Seminar in Electro-Physics I
Advanced graduate seminar. Focuses on recent developments in microwaves, electro-optics, and solid-state devices.
Credits: 2.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEE 672 Seminar in Electro-Physics II

Continues ECEE 671.
Credits: 2.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEE 673 Seminar in Electro-Physics III
Continues ECEE 672.
Credits: 2.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEE 690 Special Top Electro-Phys
Covers special topics of interest to students and faculty.
Credits: 0.00 to 9.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEE 697 Research in Electrophysics
Research in electrophysics.
Credits: 0.50 to 9.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEE 699 Supervis Study Electrophy
Supervised study in electrophysics.
Credits: 0.50 to 9.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEE 811 Microwave & THZ Photonics I
This course focuses on high speed photonic components for microwave and terahertz fiber-optic links, namely high speed lasers, external modulators and photodetectors.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEE 812 Microwave & THZ Photonics II   T
his course focuses on high speed analog and digital fiber-optic links including loss and dynamic range calculations.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEE 813 Microwave & THZ Photonics III
This course focuses on the applications of fiber-optic links; antenna remoting, optically fed and controlled phased array antennas and fiber radio.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEE 820 Carrier Transport Fundamentals
This course introduces the fundamentals of carrier transport in semiconductors, beyond the common drift-diffusion description functions and Boltzmann transport equations are covered. Monte Carlo simulations are used for low field and high field transport studies.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEE 821 Nanoelectronics

Focus is on current transport when the size of electronic medium reaches nanometer scales, that is, deBrogile wavelength. Topics include: characteristic lengths, magneto-electric subbands, conductance from transmission, resistance in a ballistic conductor, quantum Hall effect, electron scattering in quantum structures.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEE 898 Mstrs Thes Electrophysics
Master's thesis in electrophysics.
Credits: 0.00 to 9.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEE 997 Dissert Resrch Electrophy
Credits: 1.00 to 12.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEE 998 PhD Dissertatn Electrophy
Ph.D. dissertation in electrophysics.
Credits: 1.00 to 12.00
College: College of Engineering
Department: Electrical & Computer Engr

Electrical & Computer Engineering Courses – Power Engineering Courses

ECEP 501 Power System Analysis
Core course. Covers modeling of power systems, including: symmetrical components, transmission lines, transformers, per-unit values and one-line diagrams. Introduces power flow. Required of first-year power majors.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEP 502 Computer Analy Power Sys
Core course. Covers digital computation methods, including load flow, fault, and transient stability problems. Required of first-year power engineering majors.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEP 503 Synchronous Machine Modeling
Core course. Covers two-reaction theory, Park's synchronous machine models, modeling of the synchronous machine excitation and governor systems, and the effects on power system stability. Required of first-year power engineering majors.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEP 601 Modeling/Analy Power Dist Sys
Modeling and Analysis of Power Distribution Systems. Introduction to power distribution system; balanced and unbalanced systems, component and load modeling, radial and weakly meshed topologies; algorithms for unbalanced power flow studies.
Credits: 3.00

College: College of Engineering
Department: Electrical & Computer Engr

ECEP 602 Power Dist Automation & Ctrl
Power Distribution Automation and Control. Focuses on distribution management systems and their application: including optimizing network operation -capacitor placement and control, network reconfiguration, service restoration.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEP 603 Service/Power Qual in Dist Sys
Service and Power Quality in Distribution Systems. Focus power distribution systems: service and power quality assessment including stat estimation, voltage quality, trouble call analysis, service restoration, component and system reliability assessment.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEP 610 Power System Dynamics
Covers system parameters and dynamics, swing equation and solutions for two-machine and multimachine systems, equal area criterion, computer solution techniques, system effects due to dynamic behavior of particular system components, and load characteristics.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEP 611 Power System Security
Covers contingency analysis, including operating and security constraints and network sensitivities; corrective dispatch using linear programming; and state estimation, including network observability, detection, and identification of bad data.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEP 612 Econ Oper Power Systems
Covers unit characteristics and economic operation, including transmission loss coefficients, general loss formula, and automatic economic load dispatch.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEP 613 Advanced Power System Design
Covers components, functions, application, and performance; relative cost and scaling parameters; overall planning problem considering present-worth and cost-benefit principles; system reliability; intersystem pooling; and growth.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEP 641 Protective Relaying
Covers relay principles and types, instrumentation of system parameters, relay characteristics and response, system component protection, solid-state relaying, underfrequency relays, and load shedding.
Credits: 3.00

College: College of Engineering
Department: Electrical & Computer Engr

ECEP 642 Protective Relay Laboratory
Covers electromechanical and static relays. Emphasizes application based on observed performance. Includes testing.
Credits: 0.00 to 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEP 643 Solid State Protect Relay
Covers solid-state protective relays as applied to power system stability and protection, including comparisons with electromechanical relays.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEP 661 High Voltage/Power Phenomena
Covers corona, corona losses, electromagnetic noise, dielectric strength, lightning, impulse testing and safety practices, elements of high-power circuit interruption, circuit and physical phenomena, and circuit breakers.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEP 671 AC-DC/DC-AC Pwr Electr Conv
AC-DC and DC-AC Power Electronic Converters. Study of basic power electronic converter circuits: diode and phase controlled rectifiers and inverters; switch-mode converters. Applications to DC and AC power supplies.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEP 672 Power Electronic Experiments
Hardware and Software Lab-Intensive course. Additional lectures on: Study of DC-DC switch-mode converters; Study of power electronic circuitry in residential, industrial and electric utility applications; Optimizing utility interfaces with power electronic systems.
Credits: 0.00 to 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEP 673 Power Electronic Applications
Electric Utility Applications with emphasis on DC Transmission, Optimizing the Utility interface. Resonant converters. Fundamentals of motor drives and their controls: induction, DC, synchronous and specialized motors.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEP 690 Special Topics Power Engr
Covers special topics of interest to students and faculty.
Credits: 0.00 to 9.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEP 697 Research in Power Engineering
Research in power engineering.
Credits: 0.50 to 9.00

College: College of Engineering
Department: Electrical & Computer Engr

ECEP 699 Supervised Stud Powr Engr
Supervised study in power engineering.
Credits: 0.00 to 9.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEP 801 Adv Topics Power Sys I
Discusses the latest innovations, theories, and methodologies for the design, planning, and operation of power systems. Requires students to read and discuss technical articles published in the IEEE Transactions on pas, the Journal of Electric Energy and Systems, and other publications.
Credits: 0.50 to 9.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEP 802 Adv Topics Power Sys II
Continues ECEP 801.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEP 803 Adv Topics Power Sys III
Continues ECEP 802.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEP 821 Load Forecast & Prob Mths
Reviews probability methods. Covers probabilistic generation and load models; forecasting methodologies; load classification and characterization; energy and peak demand forecasting; weather-and non-weather-sensitive forecast; and annual, monthly, weekly, and daily forecast.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEP 822 Power System Planning
Covers deterministic planning, including automated transmission system expansion planning and network sensitivities, and probabilistic planning, including generation and load models, generation cost analysis, production costing, and energy production cost models for budgeting and planning.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEP 823 Power System Reliability
Covers basic reliability concepts, including probabilistic generation and load models, loss of load probability (LOLP), static and spinning generating-capacity reliability, transmission system reliability, and composite system and interconnected system reliability.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEP 898 Master's Thesis Powr Engr
Master's thesis in power engineering.
Credits: 0.00 to 9.00

College: College of Engineering
Department: Electrical & Computer Engr

ECEP 997 Dissert Rsch Power Engr
Credits: 1.00 to 12.00
College: College of Engineering
Department: Electrical & Computer Engr

ECEP 998 PhD Diss Power Engineering
Ph.D. dissertation in power engineering.
Credits: 1.00 to 12.00
College: College of Engineering
Department: Electrical & Computer Engr

Electrical & Computer Engineering Courses – Systems Courses

ECES 510 Analytical Methods in Systems   T
his course is intended to provide graduate student in the field of signal
and image processing with the necessary mathematical foundation,
which is prevalent in contemporary signal and image processing
research and practice.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECES 511 Fundamentals of Systems I
Core course. Covers linear operators, including forms and properties
(differential equations, transfer function, state space, causality,
linearity, and time invariance); impulse response, including
convolution, transition matrices, fundamental matrix, and linear
dynamical system; definition, including properties and classification;
representation, including block diagrams, signal flow, and analog and
digital; properties, including controllability and observability; and
eigenstructure, including eigenvalues and eigenvector and similarity
transformations.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECES 512 Fundamentals of Systems II
Core course. Covers realization and identification, including minimal
realization, reducibility and equivalence of models, and identification of
systems; stability, including bounded input-bounded output,
polynomial roots, and Lyapunov; and feedback compensation and
design, including observers and controllers and multi-input/multi-
output systems.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECES 513 Fundamentals of Systems III
Core course. Covers multivariable systems, numerical aspects of system
analysis and design, design of compensators, elements of robustness,
and robust stabilization.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECES 521 Probability & Random Variables
Probability concepts. Single and multiple random variables. Functions
of random variables. Moments and characteristic functions. Random
number and hypothesis testing. Maximum likelihood estimation.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECES 522 Random Process & Spec Analysis
Random Process. Poisson Process, Shot Noise. Gaussian Process.
Matched Filters. Kalman Filters. Power Spectral Density.
Autocorrelation and cross correlation. PSD estimation. Entropy. Markov
Processes. Queuing Theory.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECES 523 Detection & Estimation Theory
Detection of signals in noise. Bayes criterion. NP criterion. Binary and
M_ary hypotheses. Estimation of signal parameters. MLE and MAP
estimation. 1D and 2D signals. ROC Analyses. Decision fusion.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECES 558 DSP for Sound & Hearing
Introduction to the computational modeling of sound and the human
auditory system. Signal processing issues, such as sampling, aliasing,
and quantization, are examined from an audio perspective. Covers
applications including audio data compression (mp3)
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECES 559 Processing of the Human Voice
Introduction to the computational modeling of the human voice for
analysis, synthesis, and recognition. Topics covered include vocal
physiology, voice analysis-synthesis, voice data coding (for digital
communications, VoIP), speaker identification, speec
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECES 604 Optimal Est & Stochastic Ctrl
Introduction to control system problems with stochastic disturbances;
linear state space filtering, Kalman Filtering, Non-linear systems;
extended Kalman Filtering. Robust and H-infinity methods.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECES 607 Estimation Theory
General characteristics of estimators. Estimators: least squares, mean
square, minimum variance, maximum a posteriori, maximum
likelihood. Numerical solution. Sequential estimators.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECES 614 Passive Network Synthesis
An introduction to approximation theory; driving point functions;
realizability by lumped-parameter circuits; positive real functions;

properties of two and three element driving point functions and their synthesis; transfer function synthesis; all-pass networks.
 Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECES 615 Analy & Desgn Lin Act Net
DC and AC models of bipolar transistors and FETs; design of differential operational amplifiers; optimal design of broad-band IC amplifiers; design of tuned amplifiers; design for optimal power gain, distortion, and efficiency; noise in transistor circuits.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECES 621 Communications I
Covers modulation techniques: baseband PAM, passband PAM, QAM, and PSK; orthogonal signaling: FSK; symbol/vector detection: matched filter and correlation detector; sequence detection: ISI; equalization: adaptive and blind; carrier synchronization; and timing recovery.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECES 622 Communications II
Covers shot noise, noise in detectors, analog fiberoptic systems, carrier and subcarrier modulation, digital systems bit error rates for NRZ and RZ formats, coherent optical communication systems-heterodyne and homodyne systems, wavelength division multiplexing, system design concepts, power budgets, rise time budgets, and optical switching networks.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECES 623 Communications III
Covers fundamentals of information theory: information measure, entropy, and channel capacity; source encoding and decoding; rate distortion theory; linear codes; block codes; convolutional codes, Viterbi algorithm; encryption and decryption; and spread spectrum communications.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECES 631 Fund of Deterministic DSP
Fundamentals of Deterministic Digital Signal Processing. This course introduces the fundamentals of deterministic signal processing.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECES 632 Fund of Statistical DSP
Fundamentals of Statistical Deterministic Digital Signal Processing. The course covers topics on statistical signal processing related to data modeling, forecasting and system identification.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECES 642 Optimal Control

This course introduces the Modern Control concepts: linear quadratic performance and practical designs for engineering applications. Topics include: calculus of variations, differential games and H-infinity methods.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECES 643 Dig Cntl Sys Analy & Desn
Covers analysis and design of sampled-data control system using Z-transform and state-variable formulation, sampling, data reconstruction and error analysis, stability of linear and non-linear discrete time systems by classical and Lyapunov's second method, compensator design using classical methods (e.g., rootlocus) and computer-aided techniques for online digital controls, optimal control, discrete-time maximum principle, sensitivity analysis, and multirate sampled-data systems.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECES 644 Computer Control Systems
Introduction to the fundamentals of real-time controlling electromechanical dynamic systems, including modeling, analysis, simulation, stabilization and controller design. Control design approaches include: pole placement, quadratic and robust control performances.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECES 651 Intelligent Control
Concepts of Intelligence in Engineering Systems, Learning Automation, Principles of Knowledge Representation. Levels of Resolution and Nestedness. Organization of Planning: Axioms and Self-Evident Principles.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECES 660 Machine Listening and Music IR
This course introduces methods for the computational analysis, recognition, and understanding of sound and music from the acoustic signal. Covered applications include sound detection and recognition, sound source separation, artist and song identification.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECES 670 Seminar in Systems I
Involves presentations focused on recent publications and research in systems, including communications, controls, signal processing, robotics, and networks.
Credits: 2.00
College: College of Engineering
Department: Electrical & Computer Engr

ECES 671 Seminar in Systems II
Continues ECES 670.
Credits: 2.00
College: College of Engineering

Department: Electrical & Computer Engr

ECES 672 Seminar in Systems III
Continues ECES 671.
Credits: 2.00
College: College of Engineering
Department: Electrical & Computer Engr

ECES 681 Fund of Computer Vision
Develops the theoretical and algorithmic tool that enables a machine (computer) to analyze, to make inferences about a "scene" from a scene's "manifestations", which are acquired through sensory data (image, or image sequence), and to perform tasks.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECES 682 Fundamentals of Image Proc
The course introduces the foundation of image processing with hands-on settings. Taught in conjunction with an imaging laboratory.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECES 684 Imaging Modalities
This course is intended to produce students and image processing with a background on image formation in modalities for non-invasive 3D imaging. The goal is to develop models that lead to qualitative measures of image quality and the dependence of quality imaging system parameters.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECES 685 Image Reconstruction Algor
This course is intended to provide graduate students in signal and image processing with an exposure to the design and evaluation of algorithms for tomographic imaging.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECES 690 Special Tops Systems Engr
Covers special topics of interest to students and faculty.
Credits: 0.00 to 9.00
College: College of Engineering
Department: Electrical & Computer Engr

ECES 697 Research In Systems Engr
Research in systems engineering.
Credits: 0.00 to 9.00
College: College of Engineering
Department: Electrical & Computer Engr

ECES 699 Supervised Study Sys Engr
Supervised study in systems engineering.
Credits: 0.00 to 9.00
College: College of Engineering
Department: Electrical & Computer Engr

ECES 801 Advanced Topics in Systems I

Familiarizes students with current research results in their field of interest, specifically in works reported in such journals as The IEEE Transactions.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECES 802 Advanced Topics in Systems II
Continues ECES 801.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECES 803 Advanced Topics in Systems III
Continues ECES 802.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECES 811 Optimization Mth Engr Dsn
Applications of mathematical programming and optimization methods in engineering design problems such as networks, control, communication, and power systems optimization. Optimization problem definition in terms of objective function, design variables, and design constraints. Single variable and multivariable search methods for unconstrained and constrained minimization using Fibonacci, gradient, conjugate gradient, Fletcher-Powell methods and penalty function approach. Classical optimization--Lagrange multiplier, Kuhn-Tucker conditions. Emphasis is on developing efficient digital computer algorithms for design.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECES 812 Math Program Engr Desgn
Approximation theory projection theorem. Solution of nonlinear equations by Newton-Raphson method. Resource allocation, linear programming, and network flow problems. Integer programming for digital filter design and power system expansion problems.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECES 813 Computer-Aided Network Design
Simulation and circuit analysis programs: PCAP, MIMIC, GASP. Data structures. Algorithms. Languages. Interactive I/O. Integration of subroutines for simulation.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECES 817 Non-Linear Control Sys
Non-Linear Systems: analysis, stability and control, Lyapunov stability, singular perturbation methods. Feedback system: Describing Functions, Circle and Popov criteria.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECES 818 Mach Learning/Adaptive Control
System identification and parameter estimation, gradient search, least squares and Neural Networks methods. Closed loop implementation of

system learning and self-organizing controllers. Random searching learning systems.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECES 821 Reliable Comm & Coding I
Covers fundamentals of information theory, including measures of communication, channel capacity, coding for discrete sources, converse of coding system, noisy-channel coding, rate distortion theory for memoryless sources and for sources with memory, and universal coding.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECES 822 Reliable Comm & Coding II
Introduces algebra of coding, including groups, rings, fields, and vector fields. Covers finite fields, decoding circuitry, techniques for coding and decoding, linear codes, error-correction capabilities of linear codes, dual codes and weight distribution, important linear block codes, perfect codes, and Plotkin's and Varshamov's bounds.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECES 823 Reliable Comm & Coding III
Continues techniques for coding and decoding. Covers convolutional codes; Viterbi algorithm; BCH, cyclic, burst-error-correcting, Reed-Solomon, and Reed-Muller codes; and elements of cryptography.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECES 898 Master's Thesis Sys Engr
Master's thesis in systems engineering.
Credits: 0.00 to 9.00
College: College of Engineering
Department: Electrical & Computer Engr

ECES 921 Reliable Comm & Coding I
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECES 997 Dissert Rsrch Sys Engr
Credits: 1.00 to 12.00
College: College of Engineering
Department: Electrical & Computer Engr

ECES 998 PhD Dissert Sys Engr
Ph.D. dissertation in systems engineering.
Credits: 1.00 to 12.00
College: College of Engineering
Department: Electrical & Computer Engr

Electrical & Computer Engineering Courses – Telecommunications Courses

ECET 501 Fundamentals of Comm Engr

Fundamentals of Communications Engineering. This course introduces basic modulation, deletion and coding techniques in modern telecommunications systems, including PAM and FSK, spread-spectrum and OFDM, ML receiver, ISI and equalization, compression code and coded modulation. May be repeated once for credit.
 Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECET 511 Phys Foundations of Telecomm
Physical Foundations of Telecommunications Networks. Introduction to wired and wireless telecommunication systems. Review of wave propagation. Review of wireline transmission media.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECET 512 Wireless Systems
Fundamentals of modern wireless systems. Fundamentals of radio propagation and link performance. Cellular concept: interference, base stations and cell sites, handoffs, system capacity. Fading environments: multipath propagation, delay spread, Doppler Spread, statistically fading channel models. Multiple-access schemes: FDMA, TDMA, CDMA, SDMA. Emerging methodologies: phases/adaptive antenna array, multi-array (MIMO) communication systems.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECET 513 Wireless Networks
Introduction to Wireless Networks, Evolution: 1G, 2G, 3G, Next-G. Wireless Networks Operation: Mobility and Resource Management, Security. Wireless WANs: GSM, CDMA, IS-95, and IMT-2000, Mobil Data Networks, Wireless LANs: 802.11, HIPERLAN, Ad Hoc Networks, Mobil IP. Next Generation Wireless Systems.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECET 602 Information Theory and Coding
This course introduces fundamental information theory and source and channel coding technology. Major topics include: Entropy and mutual information, source coding theorem, Huffman code, rate-distortion function and vector quantization, and channel capacity.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECET 603 Optical Comm and Networks
This course introduces fiber-optic based transmission and networking technology. Major topics include: Loss and dispersion characters of fiber, shot noise, modulation, line code, direct receiver, coherent receiver, link budget, optical layer, SONET, WDM, photonic packet switch, Hybrid systems (CATV).
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECET 690 Special Topics in Telecomm
Allows faculty to present material of current research or industrial interest relevant to graduate telecommunications. May be repeated for credit.

Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECET 697 Research in Telecomm
Research credits in telecommunications. May be repeated for credit.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECET 699 Supervised Study in Telecomm
Supervised Study in Telecommunications Engineering. May be repeated
for credit.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECET 898 Master's Thesis Telecomm
Master's thesis in telecommunications. May be repeated for credit.
Credits: 3.00
College: College of Engineering
Department: Electrical & Computer Engr

ECET 998 PhD Dissertation Telecomm
Ph.D. Dissertation in Telecommunications. May be repeated for credit.
Credits: 1.00 to 12.00
College: College of Engineering
Department: Electrical & Computer Engr

Engineering Geology Courses

EGEO 620 Structural Geology
Covers basic principles of structural geology, including deformation and
failure of the earth's crust; folded and faulted structures; orthogonal
and stereographic solutions of structural geology problems;
construction and interpretation of geologic maps, cross-sections, and
block diagrams; and subsurface mapping and graphic presentation of
subsurface data.
Credits: 3.00
College: College of Engineering
Department: Engineering Geology

EGEO 630 Engineering Geology
Covers origin and engineering properties of earth materials;
engineering testing, alteration, and use of earth materials; and special
geologic hazards and problems.
Credits: 3.00
College: College of Engineering
Department: Engineering Geology

EGEO 650 Rock Mechanics
Involves field and laboratory evaluation of rock properties, stress
analysis and measurement, stability of rock masses, design of
underground openings, and permeability and seepage in jointed rock.
Credits: 3.00
College: College of Engineering
Department: Engineering Geology

EGEO 700 Introduction to Hydrology
Covers climate and weather, precipitation, evaporation and
transpiration, drainage basins, and hydrographs.

Credits: 3.00
College: College of Engineering
Department: Engineering Geology

EGEO 701 Hydrology-Ground Water
Covers geologic and hydrologic occurrence of groundwater,
underground flow, groundwater supply, and pollution problems.
Credits: 3.00
College: College of Engineering
Department: Engineering Geology

EGEO 710 Introduction to Geophysics
Applies geophysical techniques to the problems of the earth's planetary
structure, local subsurface conditions, and mineral prospecting.
Credits: 3.00
College: College of Engineering
Department: Engineering Geology

EGEO 750 Hydrology-Stream Flow
Covers precipitation, runoff, evaporation and transpiration, stream
flow, flood flow, and minimum flow. Pays special attention to factors
affecting water supply and quality.
Credits: 3.00
College: College of Engineering
Department: Engineering Geology

EGEO 790 Special Topics
Covers topics of interest in the field of engineering geology.
Credits: 0.50 to 9.00
College: College of Engineering
Department: Engineering Geology

EGEO 799 Independent Study
Credits: 0.50 to 9.00
College: College of Engineering
Department: Engineering Geology

EGEO 898 Master's Thesis
Credits: 0.50 to 20.00
College: College of Engineering
Department: Engineering Geology

EGEO 998 Ph.D. Dissertation
Credits: 1.00 to 12.00
College: College of Engineering
Department: Engineering Geology

Engineering Management Courses

EGMT 501 Engineering Management I
Covers the principles and practices of administration of engineering
and science activities, including nature of management, organization,
planning, controlling action and measuring results, management of
human resources, communication, and decision-making.
Credits: 3.00
College: College of Engineering
Department: Engineering Management

EGMT 502 Engineering Management II

Covers principles and procedures of creative problem-solving, including the use of brainstorming sessions and a step-by-step formulation of the practical techniques by which creative imagination can be more productively utilized.
Credits: 3.00
College: College of Engineering
Department: Engineering Management

EGMT 504 Communications
Provides a thorough review of the essentials of usage and a study of methods of organization and style of both written and spoken communication. Pays special attention to the communication demands of engineers.
Credits: 0.00 to 3.00
College: College of Engineering
Department: Engineering Management

EGMT 531 Economics Engr Mgmt
Provides a review of economic analysis, with emphasis on those phases of major interest to engineering administration. Covers the calculation of economic equivalence, inflation and the purchasing power of money, and decision-making among alternatives.
Credits: 3.00
College: College of Engineering
Department: Engineering Management

EGMT 535 Financial Management I
Studies the features of accounting data essential to the interpretation and evaluation of engineering operations and financial position of the engineering enterprise. Analyzes financial statements and reports from the point of view of management.
Credits: 3.00
College: College of Engineering
Department: Engineering Management

EGMT 536 Financial Management II
Covers advanced problems in planning, controlling, and directing engineering and other operating costs through budgeting and analysis of cost data. Studies judging of profitability, liquidity, and the organizational structure of the engineering functions.
Credits: 3.00
College: College of Engineering
Department: Engineering Management

EGMT 537 Problems In Engr Admini
Uses the case method to provide a thorough study of engineering management and administrative procedures in recognizing and solving engineering problems. Emphasizes strategic planning and policy decisions that affect the image and success of the whole organization.
Credits: 3.00
College: College of Engineering
Department: Engineering Management

EGMT 571 Managerial Statistics I
Covers probability, including random variables and probability distributions, mathematical expectation, discrete probability distributions, continuous probability distributions, sampling and sampling distribution, and estimators and confidence intervals.
Credits: 3.00
College: College of Engineering
Department: Engineering Management

EGMT 572 Managerial Statistics II
Continues EGMT 571. Covers hypothesis testing, linear regression and correlation, multiple regression, and some topics from analysis of variance and non-parametric statistics. Introduces quality control.
Credits: 3.00
College: College of Engineering
Department: Engineering Management

EGMT 573 Operations Research I
Covers deterministic modeling, including linear programming; the Simplex Method; theory of the Simplex Method; duality and sensitivity analysis; transportation, transshipment, and assignment problems; problem formulation; goal programming; network analysis; dynamic programming; and integer and non-linear programming. Discusses case study applications of engineering and management problems.
Credits: 0.00 to 3.00
College: College of Engineering
Department: Engineering Management

EGMT 574 Operations Research II
Continues EGMT 573. Concentrates on probabilistic modeling, including Markov chains, queuing theory and applications, inventory theory, forecasting, and decision analysis and simulation. Discusses case study applications of engineering and management problems.
Credits: 3.00
College: College of Engineering
Department: Engineering Management

EGMT 581 Problems in Human Relations
Covers morale and discipline in management situations. Includes case studies stressing the prevention of and solution to employee problems by means of appropriate policies, techniques, practices, and procedures. Examines group dynamics from the point of view of both psychological and sociological factors under varying situations, especially industrial.
Credits: 3.00
College: College of Engineering
Department: Engineering Management

EGMT 605 R&D Management I
Analyzes the issues and concepts involved in strategic and corporate development planning in the modern technologically oriented company. Pays particular attention to the fundamentals of corporate planning as they relate to the research and development product planning of the corporation. Includes some case studies. May be taken independently of EGMT 606.
Credits: 3.00
College: College of Engineering
Department: Engineering Management

EGMT 606 R&D Management II
Analyzes the issues and concepts involved in the management of research and development and its functional relationship to other elements of the corporate structure. Pays particular attention to the functional characteristics of the product line, company growth by technological innovation, application of systems engineering concepts to the corporate organization, and changing concepts in management structures to accommodate advances in science and technology. May be taken independently of EGMT 605.
Credits: 3.00
College: College of Engineering

Department: Engineering Management

EGMT 607 Marketing for Engineers
Focuses on the marketing of engineering services and engineered products to industrial and governmental customers. Explores the interdependence of engineering marketing, manufacturing, and finance through strategic business planning.
Credits: 3.00
College: College of Engineering
Department: Engineering Management

EGMT 620 Project Mgmt for Engineers
This course provides a comprehensive treatment of project management by examining concepts, theories and applications. Emphasis is placed on planning and control for technology based organizations. Upon successful completion of course, students should be able to use the tools and concepts in project management.
Credits: 3.00
College: College of Engineering
Department: Engineering Management

EGMT 625 Proj Planning, Sched & Control
This course provides a basic understanding of project planning and control by examining concepts and theories. Emphasis is placed on planning and control of technology based organizations. Upon successful completion of this course, students should be able to use the tools and concepts of project control and apply them.
Credits: 3.00
College: College of Engineering
Department: Engineering Management

EGMT 635 Visual Systems Mapping
Visual System Mapping (VSM) through whole-brain thinking is a powerful technique based on more than 40 years of research. VSM was inspired by a technique known as "Mindmapping", which is the technique developed by Tony Buzan in the late 1960's, designed to lead to enhanced creativity and better results in technology based organizations.
Credits: 3.00
College: College of Engineering
Department: Engineering Management

EGMT 652 Engineering Law
Examines the influence of contract, tort, and property law on engineering and construction activities. Includes legal principles relating to management of engineering organizations and governmental departments, and legal procedures of interest to engineers. Covers contracts, professional malpractice, expert testimony, intellectual property law, and business organizations.
Credits: 3.00
College: College of Engineering
Department: Engineering Management

EGMT 660 Sustain Busn Pract for Engrs
The course will give students a broad and practical understanding of various environmental issues as well as sustainability concepts. The challenges associated with sustainable development are multifaceted involving economic, social and environmental concerns. These concerns are altering business strategies and practices and are leading to new opportunities.
Credits: 3.00
College: College of Engineering

Department: Engineering Management

EGMT 680 Special Tops Engr Mgmt
Covers selected advanced-level topics in the field of engineering management. Specific topics for each term will be announced prior to registration.
Credits: 3.00
College: College of Engineering
Department: Engineering Management

EGMT 699 Independent Study
Credits: 0.50 to 9.00
College: College of Engineering
Department: Engineering Management

EGMT 799 Research
Involves the selection and solution of a problem in the field of engineering management. Expects students to conduct independent research and demonstrate the ability to employ one or more of the managerial tools to which they were exposed. Emphasizes the composition and organization of the paper, the logical development of a solution to the problem, and the contribution of the solution to knowledge.
Credits: 0.50 to 20.00
College: College of Engineering
Department: Engineering Management

EGMT 898 Master's Thesis
Involves the study and investigation of a research or development problem in the area of the student's major elective. Requires the problem to be reported in a dissertation under the direction of a faculty adviser. No credit will be granted until thesis is completed and approved.
Credits: 0.50 to 20.00
College: College of Engineering
Department: Engineering Management

Engineering, General Courses

ENGR 701 Career Integrated Education
Industrial and practical training for engineers.
Credits: 3.00
College: College of Engineering
Department: Office of Dean of COE

ENGR 702 Career Integrated Educ II
Credits: 3.00
College: College of Engineering
Department: Office of Dean of COE

Environmental Engineering Courses

ENVE 529 Environmental Noise
Covers the fundamentals of acoustic propagation, instrumentation, noise descriptors, hearing damage and other health effects, occupational noise, noise abatement techniques, modeling the noise near highways and airports, and EPA strategy for reducing environmental noise exposure.
Credits: 3.00
College: College of Engineering

Department: Environmental Engineering

ENVE 534 Industrial Ventilation
Covers principles of air movement related to ventilation and air-conditioning facilities for the maintenance of suitable environmental conditions in work areas. Includes principles of industrial processes and air pollution abatement equipment, including air flow, ducts, fans, motors, and hoods.
Credits: 3.00
College: College of Engineering
Department: Environmental Engineering

ENVE 535 Industrial Safety
Examines the impact of accidents, liability considerations, legislation and regulation of safety, osha codes and standards, hazards and their analysis and control, risk assessment, major types of accidents and their impacts, and accident investigation.
Credits: 3.00
College: College of Engineering
Department: Environmental Engineering

ENVE 546 Solid Waste Systems
Analyzes the public health, economic, and political aspects in the operation and design of storage, collection, and disposal of solid waste materials.
Credits: 3.00
College: College of Engineering
Department: Environmental Engineering

ENVE 555 Geographic Information Systems
The course provides grounding in fundamental principles of GIS, and achieves understanding through hands on practical laboratories. Course topics include: spatial reference systems, geographic data theory and structures, structures, spatial analysis tools, functions and algorithms, GIS data sources, compilation and quality, and GIS project design and planning.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

ENVE 560 Fund Air Poll Control
Fundamental topics with regard to the formation and control of air pollutants are studied. This course provides strong foundation for engineers who will be involved in the development of engineering solutions for industrial air pollution prevention and design, development or selection of air pollution control devices and systems.
Credits: 0.00 to 3.00
College: College of Engineering
Department: Environmental Engineering

ENVE 602 Water Quality Contrl Lab
Introduces analytical procedures in the assessment of water quality as applied to the analysis of natural waters and wastewaters, and to the control of water and waste treatment processes.
Credits: 0.00 to 3.00
College: College of Engineering
Department: Environmental Engineering

ENVE 603 Hazard Waste Analy Lab
Introduces methods of sampling and analysis of hazardous environmental pollutants. Emphasizes inorganic and organic pollutants found at hazardous waste disposal sites. Includes application of leachability and extraction tests.
Credits: 0.00 to 3.00
College: College of Engineering
Department: Environmental Engineering

ENVE 604 Solid Waste Analysis
Uses chemical and physical techniques to analyze the composition of solid waste material. Emphasizes combustible, organic, and toxic fractions of solid wastes.
Credits: 0.00 to 3.00
College: College of Engineering
Department: Environmental Engineering

ENVE 607 Environmental Systems Analysis
Surveys system concepts, theories, and analytical techniques, and their application to urban and environmental problems.
Credits: 3.00
College: College of Engineering
Department: Environmental Engineering

ENVE 642 Control of Gas Poll
In this course, students will learn how different physical and chemical mechanisms can be used to prevent, separate, recover or destroy the gas/vapor air pollutants. The control mechanisms are studied in detail. Students then learn how to apply those mechanisms in the design of conventional, or new, devices and systems for control of gas/vapor air pollutants.
Credits: 0.00 to 3.00
College: College of Engineering
Department: Environmental Engineering

ENVE 644 Design of PM Control Dev.
Students will learn how different mechanisms can control characteristics, formation, transport, separation and destruction of airborne particulate pollutants. Students learn how to apply the studied material in the first part of this course to design conventional or new devices and systems for control of particulate air pollutants.
Credits: 0.00 to 3.00
College: College of Engineering
Department: Environmental Engineering

ENVE 646 Advanced Solid Waste Systems
Introduces and analyzes the newest advances in solid waste technology, with an emphasis on design, treatment, and processing techniques.
Credits: 3.00
College: College of Engineering
Department: Environmental Engineering

ENVE 657 Incineration
Covers destruction of solid and liquid hazardous wastes at high temperature in a combustion device, including requirements for destruction of toxic materials and control of discharges to the atmosphere.
Credits: 3.00
College: College of Engineering
Department: Environmental Engineering

ENVE 660 Chem Kinetics - Envr Engr
Covers chemical and biological kinetics, mass-transfer considerations and hydraulic regimes in water and wastewater treatment, and water

quality management. Includes absorption and stripping of gases and volatile organics and applications to aeration and ozonation processes.
Credits: 3.00
College: College of Engineering
Department: Environmental Engineering

ENVE 661   Env Engr Op-Chem & Phys
Provides a theoretical study of the chemical and physical unit operations of environmental engineering, including sedimentation, coagulation, precipitation, adsorption, oxidation-reduction, ion exchange, disinfection, membrane processes, and filtration.
Credits: 0.00 to 3.00
College: College of Engineering
Department: Environmental Engineering

ENVE 662   Enviro Engr Unit Oper-Bio
Provides a systematic study of the microbiological and biochemical processes for the treatment of aqueous and solid wastes, including aerobic and anaerobic processes and composting.
Credits: 3.00
College: College of Engineering
Department: Environmental Engineering

ENVE 665   Haz Waste & Grndwtr Trtmt
Covers principles of hazardous waste and groundwater treatment and in situ technologies. Presents application of processes, including solvent extraction, steam and air stripping, adsorption, ion exchange, oxidation, dechlorination, stabilization, wet air and supercritical oxidation, incineration, soil washing, and soil vapor extraction.
Credits: 3.00
College: College of Engineering
Department: Environmental Engineering

ENVE 682   Subsurface Contaminant Trnspt
This course covers principles governing contaminant movement in aquifers. It includes advection, dispersion, reactive transport, microbial and colloidal transport, matrix diffusion, desnity-coupled transport, and mutliphase flow. It also emphasizes field-scale applications.
Credits: 3.00
College: College of Engineering
Department: Environmental Engineering

ENVE 683   Stochastic Subsurf Hydrology
Credits: 3.00
College: College of Engineering
Department: Environmental Engineering

ENVE 684   Water Resrc Systems Analysis
This course covers mathematical optimization techniques as applied to water resource systems. Example applications include water supply management, irrigation planning and operation, water quality management and ground water management.
Credits: 3.00
College: College of Engineering
Department: Environmental Engineering

ENVE 702   Adv Enviro Instrumentatn
Uses instrumental analysis to assess environmental quality.
Credits: 0.00 to 3.00
College: College of Engineering
Department: Environmental Engineering

ENVE 726   Environmental Assessment
Examines the National Environmental Policy Act of 1969 and its implementation according to the regulations of the Council on Environmental Quality. Discusses air, water, noise, biological, cultural, and socioeconomic impacts. Includes methods of impact analysis and means to compare alternative actions.
Credits: 3.00
College: College of Engineering
Department: Environmental Engineering

ENVE 727   Risk Assessmemt
Covers quantitative relations between environmental exposures and effects. Includes computer methods for risk analysis and development of environmental guidelines and standards.
Credits: 3.00
College: College of Engineering
Department: Environmental Engineering

ENVE 750   Data-based Engr Modeling
This course covers empirical methods to understand and model engineering systems. Students will learn to develop evaluate statistical models and use three common statistical software packages, Excel, SPSS, and R.
Credits: 3.00
College: College of Engineering
Department: Civil, Arch, & Environ Engr

ENVE 761   Enviro Engr Unit Oper Lab
Covers application of unit operations including filtration, adsorption, oxidation, coagulation, and biodegradation to the treatment of potable water, wastewater, and hazardous waste.
Credits: 0.00 to 3.00
College: College of Engineering
Department: Environmental Engineering

ENVE 766   Waste Wtr Treat Plant Des
Covers application of principles of environmental engineering unit operations to the treatment of municipal, industrial, and hazardous wastes by biological, physical, and chemical means. Includes applications of computers to the design process.
Credits: 3.00
College: College of Engineering
Department: Environmental Engineering

ENVE 767   Surface Water Mixing Processes
This course covers the hydrodynamic mixing and transport processes in free-surface flows. Basic mixing processes including molecular diffusion, turbulent diffusion and dispersion are also covered. Emphasis will be on the solution of the advection-diffus
Credits: 3.00
College: College of Engineering
Department: Environmental Engineering

ENVE 768   Sediment & Contamin Trnsport
This course covers the transport of sediments and reactive solutes in surface waters as well as the classic theory for bed-load and suspended sediment transport. The interplay of stream flow, frictional resistance, and sediment transport is also covered.
Credits: 3.00
College: College of Engineering
Department: Environmental Engineering

ENVE 865 Spec Topics Envr Engineering
Credits: 0.00 to 12.00
College: College of Engineering
Department: Environmental Engineering

Materials Engineering Courses

MATE 500 Struct & Props Of Metals
Covers crystallography, crystal defects, dislocation mechanisms, phase transformations, recovery and recrystallization, diffusional processes, and strengthening mechanisms.
Credits: 3.00
College: College of Engineering
Department: Materials Engineering

MATE 501 Struct & Props Polymers
Covers step and free radical polymers, copolymerization, molecular weight characteristics, polymer morphology, thermodynamics, viscoelasticity, yielding and crazing, and Boltzmann and T-T superpositions.
Credits: 3.00
College: College of Engineering
Department: Materials Engineering

MATE 502 Ceram & Electronic Matls
Covers bonding; crystal structure; defects; diffusion; electrical conductivity; and mechanical, electrical, dielectric, magnetic, and thermal properties.
Credits: 3.00
College: College of Engineering
Department: Materials Engineering

MATE 505 Phase Equilibria
Covers thermodynamic concepts of phase equilibria, including unary, binary, and ternary systems; pressure effects; and relationships between phase diagrams and structure.
Credits: 3.00
College: College of Engineering
Department: Materials Engineering

MATE 506 Diffusion
Covers atomic migration in solids, self-diffusion, concentration gradients, mathematical analysis of diffusion, and applications of numerical methods.
Credits: 3.00
College: College of Engineering
Department: Materials Engineering

MATE 507 Kinetics
Covers nucleation phenomena in homogeneous and heterogeneous metallic and ceramic systems, strain energy analysis, composition fluctuation analysis, growth and solution kinetics of second phases, coarsening processes, martensitic transformations, and crystal defects, and phase diagrams and reaction equilibrium.
Credits: 3.00
College: College of Engineering
Department: Materials Engineering

MATE 510 Thermodynamics of Solids

Covers classical thermodynamics, introduction to statistical mechanics, solution theory, thermodynamics of interfaces and crystal defects, and phase diagrams and reaction equilibrium.
Credits: 3.00
College: College of Engineering
Department: Materials Engineering

MATE 515 Exper Technq In Matls
Covers electron microscopy techniques, scanning transmission and Auger analysis, x-ray diffraction, x-ray wavelength dispersive and energy dispersive analysis, thermal analysis, statistics and error analysis, and design of experiments.
Credits: 3.00
College: College of Engineering
Department: Materials Engineering

MATE 520 Engr Props Fibrous Materials
Covers fiber; yarn; woven, knit, and non-woven fabrics; structure-property relationships; and engineering design and applications.
Credits: 0.00 to 3.00
College: College of Engineering
Department: Materials Engineering

MATE 521 Mech Planar Fibrous Assem
Covers woven, knit, non-woven, and specialty fabrics, including geometry; tensile, biaxial, bending, shear, and compressive deformation; stress-strain analysis; and finite deformation.
Credits: 3.00
College: College of Engineering
Department: Materials Engineering

MATE 525 Intro Composite Materials
Covers classification and definition of composite materials; properties of fibers, matrices, and their interfaces; structural geometry of reinforcing materials; formation and testing of composites; and properties and analysis of composite materials.
Credits: 3.00
College: College of Engineering
Department: Materials Engineering

MATE 530 Solidification Processing I
Covers principles of solidification processing, heat flow during solidification, thermodynamics and kinetics of nucleation and growth, solute redistribution, interfacial stability and morphology, transport phenomena: continuum treatments and structural effects, and rapid solidification.
Credits: 3.00
College: College of Engineering
Department: Materials Engineering

MATE 531 Solidification Processing II
The technology of solidification processing is covered in this course; clean metal processing; crystal growth; squeeze casting; thixo-and compo-casting; diffusion solidification and rheocasting; continuous casting processes, VM, VAR, ESR, and VADER processing; structural control via MDH; rapid solidification processes (RSP); microgravity casting.
Credits: 3.00
College: College of Engineering
Department: Materials Engineering

MATE 535 Numerical Engineering Methods

Covers numerical solution of non-linear equations, linear systems, and integration of ordinary differential equations. Introduces finite differences and finite elements. Provides a user's perspective of finite elements, element selection, convergence, and error estimation. Applications to heat transfer, diffusion, stress analysis, and coupled problems. Maple and ABAQUS (a commercial non-linear finite element program) are used in this course. A term project using ABAQUS is required. Emphasis is placed on materials engineering examples.
Credits: 3.00
College: College of Engineering
Department: Materials Engineering

MATE 540 Polymer Morphology
Covers crystallography, crystallization, single crystals, bulk crystallization, orientation, amorphous polymers, and experimental techniques.
Credits: 3.00
College: College of Engineering
Department: Materials Engineering

MATE 545 Fracture of Polymeric Matrls
Theoretical strength; defects; brittle fracture; fracture surfaces; fracture mechanics; creep failure; fatigue failure; environmental stress cracking; composite failure; crazing; impact and high-speed failure.
Credits: 3.00
College: College of Engineering
Department: Materials Engineering

MATE 550 Viscoelastic Polymer Sys
Covers viscoelastic models, including creep and stress relaxation; time/temperature equivalence; dynamic mechanical properties; non-linear response; slow and fast flow approximations; and applications to processing problems.
Credits: 3.00
College: College of Engineering
Department: Materials Engineering

MATE 555 Copolymers and Blends
Covers random and block copolymers, interpenetrating networks, mixing, phase equilibria, toughened polymers, and reactive processing.
Credits: 3.00
College: College of Engineering
Department: Materials Engineering

MATE 560 Powder Metallurgy I
Covers commercial and near-commercial methods of powder making, material and process variables, atomization mechanisms, powder properties and characterization, powder compaction, and properties in the green state.
Credits: 3.00
College: College of Engineering
Department: Materials Engineering

MATE 561 Powder Metallurgy II
Covers powder consolidation: pressing and sintering; preform forging, rolling, extrusion, and hot isostatic pressing; innovative powder processing techniques, including spray forming; and structure-property relationships in press and sinter and fully dense materials.
Credits: 3.00
College: College of Engineering
Department: Materials Engineering

MATE 565 Crystal Mechanics I
Covers crystal plasticity, texture development, continuum aspects of dislocations, interaction and intersection of dislocations, dislocation multiplication, dislocations in crystalline solids, and dislocation boundaries and configurations.
Credits: 3.00
College: College of Engineering
Department: Materials Engineering

MATE 566 Crystal Mechanics II
Covers Peierls-Nabarro stress, thermally activated flow, work hardening, creep, superplasticity, ductile and brittle fracture, and fatigue.
Credits: 3.00
College: College of Engineering
Department: Materials Engineering

MATE 570 Materials Processing I
Covers metal deformation processes: slab and deformation work analyses; slip line theory; and upper bound analysis applied to upsetting, drawing, extrusion, rolling, and deep drawing.
Credits: 3.00
College: College of Engineering
Department: Materials Engineering

MATE 571 Materials Processing II
Manufacture of objects from powder--atomization, compaction, sintering, and liquid phase consolidation techniques; deformation processing of powder preforms; manufacture of shapes by high-strength cold deformation-preferred orientation, substructure, strengthening mechanisms.
Credits: 3.00
College: College of Engineering
Department: Materials Engineering

MATE 580 Special Tops Matrls Engr
Covers selected advanced-level topics. May be repeated for credit if topics vary.
Credits: 0.50 to 9.00
College: College of Engineering
Department: Materials Engineering

MATE 605 Comp Simulation Mtls & Proc I
Simulation of equilibrium and transport properties of materials by Monte Carlo and molecular dynamics methods
Credits: 0.00 to 4.00
College: College of Engineering
Department: Materials Engineering

MATE 606 Comp Simulat Mtrls & Proc II
Simulation of thermophysical and mechanical properties of atoms, molecules, ions, or polymer chains.
Credits: 0.00 to 4.00
College: College of Engineering
Department: Materials Engineering

MATE 610 Mechanical Behavior of Solids
Covers stress and strain, three-dimensional nomenclature, hydrostatic and deviatoric stresses, isotropic and anisotropic elasticity and plasticity, viscoelasticity, crack growth, and fracture.
Credits: 3.00
College: College of Engineering

Department: Materials Engineering

MATE 650 Viscous Flow Polymer Proc
Linear viscoelasticity; non-Newtonian viscosity; continuum mechanics; viscometric flow; viscous flow in simple geometries; flow instability.
Credits: 3.00
College: College of Engineering
Department: Materials Engineering

MATE 651 Advanced Polymer Processing
Covers continuum mechanics; heat transfer; application to extrusion, calendering, coating, injection molding, film blowing, rotational molding, and fiber spinning; powder processing; design; and equipment selection.
Credits: 3.00
College: College of Engineering
Department: Materials Engineering

MATE 661 Biomedical Materials I
This course covers biocompatibility; implantable devices; survey of materials properties; corrosion;; cardiovascular applications; orthopedic applications; kidney dialysis; artificial heart and lung devices.
Credits: 3.00
College: College of Engineering
Department: Materials Engineering

MATE 662 Biomedical Materials II
This course covers phase equilibria; strengthening of materials; dental cast alloys; denture base materials; adhesives and sealants; porcelain and glasses; dental materials laboratory.
Credits: 3.00
College: College of Engineering
Department: Materials Engineering

MATE 699 Independent Study and Research
Hours and credits to be arranged.
Credits: 0.50 to 9.00
College: College of Engineering
Department: Materials Engineering

MATE 897 Research
Hours and credits to be arranged.
Credits: 1.00 to 12.00
College: College of Engineering
Department: Materials Engineering

MATE 898 Master's Thesis
Hours and credits to be arranged.
Credits: 1.00 to 12.00
College: College of Engineering
Department: Materials Engineering

MATE 998 Ph.D. Dissertation
Hours and credits to be arranged.
Credits: 1.00 to 12.00
College: College of Engineering
Department: Materials Engineering

Mechanical Engineering and Mechanics Courses

MEM 503 Gas Turbines & Jet Propulsion
Covers fundamentals of thermodynamics and aerothermodynamics, and application to propulsion engines; thermodynamic cycles and performance analysis of gas turbines and air-breathing propulsion systems, turbojet, turboprop, ducted fan, ramjet, and ducted rocket; theory and design of ramjets, liquid and solid rockets, air-augmented rockets, and hybrid rockets; aerodynamics of flames, including the thermodynamics and kinetics of combustion reactions; supersonic combustion technology and zero-g propulsion problems; and propulsion systems comparison and evaluation for space missions.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 504 HVAC Equipment
Covers performance of air handlers, pumps, direct expansion systems, chillers, cooling towers, and similar equipment.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 505 HVAC Controls
Covers control theory and application to heating, ventilating, air conditioning, including pneumatic, fluidic, and electronic controls.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 530 Aircrft Flight Dynam & Ctrl I
Covers development of dynamic models, linearization, aerodynamic coefficients, control derivatives, longitudinal and lateral modes, and open-loop analysis.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 569 Intro Composite Materials I
Introduces anisotropic elasticity, lamina stiffness and compliance, plane-stress and plane-strain, stress-strain relations of a lamina, testing methods, engineering elastic constants, failure criteria, and micromechanics.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 570 Intro Composite Materials II
Covers laminated plate theory, stiffness and compliance of laminated plates, effect of laminate configuration on elastic performance, and review of research topics.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 571 Intro To Robot Technology
Covers robot configuration; components, actuators, and sensors; vision; and control, performance, and programming. Includes lectures and laboratory.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 572 Mech Of Robot Manipulatrs
Covers homogeneous transformation, direct and inverse kinematic manipulators, velocities and acceleration, static forces, and manipulators' dynamics, via Lagrange and Newton-Euler formulations. Includes lectures and laboratory.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 573 Industrial Appl Of Robots
Covers path planning and workspace determination, robot accuracy and repeatability measurements, robot call design, application engineering and manufacturing, material transfer, processing operations, and assembly and inspection. Includes lectures and laboratory.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 574 Introduction to CAM
Examines the basic elements used to integrate design and manufacturing processes, including robotics, computerized-numerical controlled machines, and CAD/CAM systems. Covers manufacturability considerations when integrating unit process elements.
Credits: 0.00 to 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 591 Applied Engr Analy Methods I
Covers effective methods to analyze engineering problems. This module focuses on analytical and computational methods for problems tractable with vectors, tensors and linear algebra. Uses symbolic/numerical computational software. Examples drawn from thermal fluid sciences, mechanics and structures, systems and control, and emerging technologies.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 592 Applied Engr Analy Methods II
Covers effective methods to analyze engineering problems. This module focuses on computational and analytical methods for complex variables and ordinary differential equations. Uses symbolic/numerical computational software. Examples drawn from thermal fluid sciences, mechanics and structures, systems and control, and emerging technologies.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 593 Applied Engr Analy Methods III
Covers effective methods to computationally and analytically solve engineering problems. This module focuses on solution methods for partial differential equations, Fourier analysis, finite element analysis and probabilistic analysis. Uses symbolic/numerical computational software. Examples drawn from mechanical and civil engineering.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 601 Statistical Thermodynamics I

Covers probability theory; statistical interpretation of the laws of thermodynamics; systems of independent particles; systems of dependent particles; kinetic theory of dilute gases; quantum mechanics; energy storage and degrees of freedom; and thermochemical properties of monatomic, diatomic, and polyatomic gases.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 602 Statistical Thermodynamics II
Covers analysis of monatomic solids, theory of liquids, chemical equilibrium, kinetic and thermochemical description of rate processes, transport phenomena, and spectroscopy.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 603 Advanced Thermodynamics
Covers reformulation of empirical thermodynamics in terms of basic postulates; presentation of the geometrical, mathematical interpretation of thermodynamics; Legendre transforms; requirements for chemical and phase equilibrium; first-and second-order phase transitions; Onsager reciprocal relations; and irreversible thermodynamics.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 611 Conduction Heat Transfer
Covers conduction of heat through solid, liquid, and gaseous media; advanced analytical methods of analysis, including integral transform and Green's functions, the use of sources and sinks, and numerical and experimental analogy methods; and variational techniques.
Credits: 0.00 to 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 612 Convection Heat Transfer
Covers convective heat transfer without change of phase or constitution, fundamental equations, exact solutions, application of the principle of similarity and the boundary-layer concept to convective heat transfer, similarity between heat and momentum transfer, and heat transfer in high-velocity flows.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 613 Radiation Heat Transfer
Covers radiation heat transfer between surfaces and within materials that absorb and emit. Formulates and applies methods of analysis to problems involving radiation alone and radiation combined with conduction and convection.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 621 Foundations of Fluid Mechanics
Covers kinematics and dynamics of fluid motion; Lagrangian and Eulerian description of motion; transport theorem; continuity and momentum equations (Navier-Stokes equations); vorticity vector and equation; three-dimensional, axisymmetric, and two-dimensional

complex potential flows; constitutive equations of a viscous fluid; dynamic similarity; Stokes flow; and similarity analysis.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 622 Boundry Layers-Lam & Turb
Covers laminar boundary layers; approximate integral method; three-dimensional laminar boundary layer and boundary-layer control; transient boundary-layer flows; the integral momentum equation; origins of turbulence; transition to turbulent flow; Reynolds-averaged equations; Reynolds stress; measurement of turbulent quantities; study of turbulent wall bounded flows, including pipe flow, flow over a flat plate, and flow over a rotating disk; and boundary layer in a pressure gradient.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 630 Linear Multivariable Systems I
State space representation, continuous time and discrete time systems, similarity transformation, invariant subspaces, state response, stability, controllability, observability, Kalman decomposition, spectral and singular value decompositions.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 631 Linear Multivar Sys II
Pole assignment, output feedback, linear quadratic regulator, observer design, stochastic processes, state response to white noise, Kalman filter, linear quadratic Gaussian controller, evaluation of closed loop system.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 632 Linear Multivar Sys III
Model reduction: approximation of transfer functions, modal truncations, oblique projections, component cost analysis, internal balancing; controller reduction: observer-based controller parametrization, Riccati balancing, q-COVER theory, optimal projections.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 633 Robust Control Systems I
Covers linear spaces and linear operators; Banach and Hilbert spaces; time-domain spaces; frequency-domain spaces; singular value decomposition; EISPACK, LINPACK, and MATLAB, including internal stability; coprime factorization over the ring of polynomial matrices; matrix fraction description; properties of polynomial matrices; irreducible mfds; Smith-McMillan form; poles and zeros; canonical realizations; and computation of minimal realizations.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 634 Robust Control Systems II
Covers the structure of stabilizing controllers; coprime factorization over the ring of proper stable rational matrices; algebraic Riccati

equation; state space computation of coprime factorization; yvb controller parametrization; linear fractional transformation; state space structure of proper stabilizing controllers; formulation of control problem, H, and H optimization problem; model matching problem; tracking problem; robust stabilization problem; inner-outer factorization; and Sarason's H interpolation theory.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 635 Robust Control Systems III
Covers Hankel-norm approximations, balanced realizations, two-block H optimization, generalized multivariable stability margins, structured and non-structured stability margins, structured singular values, robust stabilization and performance, and recent developments in robust control.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 636 Theory of Nonlinear Control I
Provides a comprehensive introduction to the geometric theory of non-linear dynamical systems and feedback control. Includes stability, controllability, and observability of non-linear systems; exact linearization, decoupling, and stabilization by smooth developments in robust control.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 637 Theory of Nonlinear Control II
Covers systems with parameters, including bifurcation and stability; static bifurcation; local regulation of parameter-dependent non-linear dynamics; tracking; limit cycles in feedback systems; perturbation methods; frequency domain analysis; and applications.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 638 Theory Nonlinear Ctrl III
Covers high gain and discontinuous feedback systems, including sliding modes, applications, and advanced topics.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 639 Real Time Microcomp Ctrl I
Covers discrete-time systems and the Z-transform, sampling and data reconstruction, the pulse transfer function, discrete state equations, time-domain analysis, digital simulation, stability, frequency-domain analysis, Labview programming, and data acquisition and processing.
Credits: 0.00 to 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 640 Real Time Microcomp Ctrl II
Covers design of discrete-time controllers, sampled data transformation of analog filter, digital filters, microcomputer implementation of digital filters, Labview programming techniques, using the daq library, writing a data acquisition program, and Labview implementation of pid controllers.
Credits: 0.00 to 3.00

College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 660   Theory of Elasticity I
Summarizes mechanics of materials courses. Covers vector and tensor analysis, indicial notation, theory of stress, equilibrium equations, displacements and small strains, compatibility, and strain energy; formulation of the governing equations and the appropriate boundary conditions in linear elasticity, and uniqueness of the solutions; elementary three-dimensional examples and two-dimensional theory; stress functions; solutions in Cartesian and polar coordinates; and Fourier series.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 661   Theory of Elasticity II
Covers two-dimensional problems by the method of Muskhelishvili, torsion problem, stress function and solutions by means of complex variables and conformal mapping, three-dimensional solutions for straight beams, energy theorems, virtual work and their and their applications, and Rayleigh-Ritz method.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 662   Theory of Elasticity III
Covers use of Fourier series and Green's functions for plane problems; three-dimensional problems in terms of displacement potentials; use of the Galerkin vector and the Boussinesq-Papkovitch-Neuber functions; fundamental solutions to the Kelvin, Boussinesq, Cerruti, and Mindlin problems; and elastic contact. Introduces non-linear elasticity.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 663   Continuum Mechanics
Covers kinematics, Eulerian, and Lagrangian formulations of deformation; theory of stress; balance principles; continuum thermodynamics; and constitutive relations in fluids and solids.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 664   Introduction to Plasticity
Reviews stress and strain deviators, invariants and distortional energy, principal and octahedral stresses and strains, Tresca and von Mises yield criteria, yield surface and Haigh-Westergaard stress space, Lode's stress parameter, subsequent yield surface, Prandtl-Reuss relations, work hardening and strain hardening, stress-strain relations from Tresca criteria, incremental and deformation theories, the slip-line field, slip-line equations for stress, velocity equations and geometry of slip-line field, limit analysis, simple truss, bending of beams, lower and upper bound theorems, and plasticity equations in finite-element methods.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 665   Time-Dependent Solid Mechanics
Part a: Covers elastodynamics, including plane, cylindrical, and spherical waves; characteristics; the acoustic tensor; polarizations and wave speeds; transmission and reflection at plane interfaces; critical angles and surface waves; and waveguides and dispersion relationships. Part b: Covers linear viscoelasticity, including relaxation modulus and creep compliance, hereditary integrals, Laplace transform, correspondence principle, creep buckling and vibrations, viscoplasticity, creep, strain-rate effects, shear bands, and shock waves.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 666   Advanced Dynamics I
Covers analytical statics (principle of virtual work), Lagrange's equations, conservation laws, stability analysis by perturbation about steady state, Jacobi first integral, ignoration of coordinates, classification of constraints, solution of constrained dynamical problems by constraint embedding (elimination) or constraint adjoining (Lagrange multipliers), generalized impulse and momentum, and formulation and solution of non-holonomic systems.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 667   Advanced Dynamics II
Covers vector dynamics in three dimensions, including a detailed study of rotational kinematics, motion of the mass center and about the mass center for a system of particles and a rigid body, moments of inertia, three-dimensional dynamical problems, and comparison between Lagrangian techniques and the vector methods of Euler and Newton. Includes vibrations, Euler's angles, motion of a gyroscope, and motion of an axially symmetric body under no force other than its weight.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 668   Advanced Dynamics III
Covers central forces, effect of the earth's rotation, Foucault's pendulum, variational methods, Hamilton's principle, state space techniques for the integration of equations of motion, and numerical integration of equations of motion on microcomputers through the CSMP program. Depending on student interest, includes either Hamiltonian dynamics (canonical equations, contact transformations, Hamilton-Jacobi theory) or rigid body kinematics of complex dynamical systems.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 670   Theory of Plates and Shells
Covers elements of the classical plate theory, including analysis of circular and rectangular plates, combined lateral and direct loads, higher-order plate theories, the effects of transverse shear deformations, and rotatory inertia; matrix formulation in the derivation of general equations for shells; and membrane and bending theories for shells of revolution.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 671 Mechanical Vibrations I
Free and forced responses of single degree of freedom linear systems; two degree of freedom systems; multiple degree of freedom systems;

the eigenvalue problem; modal analysis; continuous systems; exact solutions; elements of analytical dynamics.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 672 Mechanical Vibrations II
Continuous systems; approximate solutions; the finite element method; nonlinear systems; geometric theory, perturbation methods; random vibrations; computational techniques.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 673 Ultrasonics I
Basic elements of ultrasonic nondestructive evaluation, wave analysis, transducers, transform techniques, A,B,C,M,F and Doppler imaging, medical imaging, multiple element arrays, real-time imaging, calibration.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 674 Ultrasonics II
Basic elements of guided wave analysis, oblique incidence reflection factor, critical angle reflectivity, surface waves, lamb waves, plate waves, dispersion, phase and group velocity, experimental techniques for guided waves.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 675 Medical Robotics I
Use of robots in surgery, safety considerations, understanding robot kinematics, analysis of surgeon performance using a robotic devices, inverse kinematics, velocity analysis, acceleration analysis, various types of surgeries case study.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 676 Medical Robotics II
Force and movement for robot arms, robot dynamics, computer vision, vision based control, combining haptics, vision and robot dynamics in a cohesive framework for the development of a medical robotic system.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 677 Haptics for Medical Robotics
Introduction to haptics, physiology of touch, actuators, sensors, non-portable force feedback, portable voice feedback, tactile feedback interfaces, haptic sensing and control.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 681 Finite Element Methods I
Covers formulation of finite element methods for linear analysis of static and dynamic problems in solids, structures, fluid mechanics, heat transfer, and field problems; displacement-based, hybrid, and stress-based methods; variational and weighted residual approaches;

effective computational procedures for solution of finite element equations in static and dynamics analyses; and pre-processing and post-processing.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 682 Finite Element Methods II
Covers formulation of advanced finite element methods for non-linear analysis of static and dynamic problems in solids, structures, fluid mechanics, heat transfer, and field problems; material non-linearity; large displacement; large rotation; large strain; effective solution procedures for non-linear finite element equations in static and dynamic analyses; and effective finite element methods for eigenvalue problems.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 684 Mechanics Of Bio Tissues
Covers composition and structure of tendons, ligaments, skin, and bone; bone mechanics and its application in orthopedics; viscoelasticity of soft biological tissues; models of soft biological tissues; mechanics of skeletal muscle; and muscle models and their applications.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 685 Mechanics of Human Joints
Covers the structure of human joints, including experimental and analytical techniques in the study of human joint kinematics; applications to the design of artificial joints and to clinical diagnosis and treatments; stiffness characteristics of joints and their applications to joint injuries; and prosthetic design and graft replacements.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 686 Mechanics of Human Motion
Examines experimental and analytical techniques in human motion analysis and human locomotion; interdeterminacy of muscle force distribution in human motion; modeling and simulation of bipedal locomotion; energetics, stability, control, and coordination of human motion; and pathological gait.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 687 Manufacturing Processes I
Introduces basic manufacturing process technology and the mechanical properties of metals and plastics. Covers dimensional and geometry tolerancing; surface finishing; material removal processes and machine tools; processing of polymers and reinforced plastics, including general properties of plastic materials and forming, shaping, and processing of plastics; and CNC machining and programming. Combines lectures and laboratory work.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 688 Manufacturing Processes II

Covers processing of polymers and reinforced plastics, including general properties of plastic materials and forming, shaping, and processing of plastics; CNC machining and programming; casting processes; sheet-metal forming processes; bulk deformation processes; and computer integrated manufacturing systems.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 689 Computer-Aided Manufacturing
Covers development of software and hardware for computer-aided manufacturing systems, basic elements used to integrate the manufacturing processes, and manufacturability studies.
Credits: 0.00 to 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 699 Independent Study and Research
Offers independent study and research in mechanical engineering.
Credits: 0.50 to 9.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 701 Physical Gas Dynamics I
Reviews equilibrium kinetic theory of dilute gases. Covers non-equilibrium flows of reacting mixtures of gases, flows of dissociating gases in thermodynamics equilibrium, flow with vibrational or chemical non-equilibrium, non-equilibrium kinetic theory, flow with translational non-equilibrium, and equilibrium/non-equilibrium radiation.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 705 Combustion Theory I
Covers thermochemistry, including the relationship between heats of formation and bond energies, heat capacities and heats of reaction, chemical equilibrium and the equilibrium constant, calculation of adiabatic flame temperature and composition of burned gas, free energy and phase equilibrium, classical chemical kinetics, and chain reaction theory.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 706 Combustion Theory II
Covers laminar flame propagation in premixed gases, detonation and deflagration, heterogeneous chemical reactions, burning of liquid and solid fuels, and diffusion flames.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 707 Combustion Theory III
Covers advanced topics in combustion, including combustion-generated air pollution, incineration of hazardous wastes, supersonic combustion, propellants and explosives, and fires.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 711 Comp Fluid Mech/Ht Tran I

Covers classification of fluid flow and heat transfer phenomena, including time-dependent multidimensional heat conduction and finite-difference and finite-element formulations; convection and diffusion; upwind, exponential, and hybrid schemes; and boundary-layer-type fluid flow and heat transfer problems.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 712 Comp Fluid Mech/Ht Trans II
Covers basic computational methods for incompressible Navier-Stokes equations, including vorticity-based methods and primitive variable formulation; computational methods for compressible flows; inviscid and viscous compressible flows; finite-element methods applied to incompressible flows; and turbulent flow models and calculations.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 714 Two-Phase Flow & Heat Transfer
Covers selected topics in two-phase flow, with emphasis on two-phase heat transfer problems, basic conservation equations for two-phase flows, nucleation, bubble dynamics, pool boiling, forced convective boiling, condensation heat transfer, two-phase flow equipment design, tube vibration and flow instability in two-phase flows, and fouling in heat transfer equipment.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 717 Heat Transfer Mfg Proc
Covers heat conduction fundamentals, including phase change problems (casting, welding, and rapid solidification processes) and cooling controls of rolling, forging, and extrusion processes.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 721 Non-Newt Flu Mech/Ht Tran
Covers the stress-strain rate relationship, simple flow, general constitutive and conservation equations, generalized Newtonian models, molecular theories, rheological property measurements, plane Couette flow, hydrodynamic theory of lubrication, helical flow, boundary layer flows, pipe flows, natural convection, thin film analysis, drag reduction phenomenon, and biorheology.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 722 Hydrodynamic Stability
Introduces stability, including discrete and continuous systems. Covers linear theory; instability of shear flows, spiral flows between concentric cylinders and spheres, thermoconductive systems, and viscous flows; global stability and non-linear theories
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 723 Vortex Inter/Comp Turb Fl
Nonlinear vertex motion and interaction; motion of point vortices; generation and interaction of vortex rings and counter-rotating vortex pairs; vortex impulse, energy, pairing, bifurcation, and bursting; study

of free and separating turbulent flows: mixing layers, wakes, jets, and buoyant plumes; recirculation behind bluff bodies and backsteps; longitudinal and lateral vortex waves and shear layers; sweeps and bursts in turbulent boundary layers; characteristics of turbulence: entrainment and molecular mixing, effects of buoyancy, rotation, acceleration, and heat release; the 3-D turbulent energy cascade and the 2-D inverse cascade.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 725   Compressible Fluid Dynamics
Reviews one-dimensional flows. Covers steady flow of a compressible fluid; two-and three-dimensional subsonic, transonic, supersonic, and hypersonic flow; normal and oblique shock waves; wave reflections; oblique shock wave interactions and generation vorticity; compressible boundary layers; and shock boundary-layer interactions.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 727   Fluid Dyn/Mfg Process
Covers transport of slurries, molten metals, and polymers; hydrodynamics in forming processes; resin flow model in polymer composites; shaped charge jet technology; separation and filtration; coating; lubrication; and melt-spinning process.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 730   Ctrl Flexible Space Struct I
Covers modeling of FSS including PDE description and finite element modeling, model errors, model reduction, component cost analysis, modal cost analysis, stability of mechanical systems, gyroscopic and non-gyroscopic systems, and rate and position feedback.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 731   Ctrl Flexible Space Struct II
Covers probability theory, stochastic processes, Kalman filter, LQG compensators, controller reduction, CCA theory, balancing reductions, and applications.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 733   Applied Optimal Control I
Covers necessary conditions from calculus of variations, equality and inequality constraints, fixed and free final time problems, linear-quadratic control, bang-bang control, and application to problems in flight mechanics.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 734   Applied Optimal Control II
Covers neighboring extremals and the second variation, perturbation feedback control, sufficient conditions, numerical solution methods, and application to problems in flight mechanics.
Credits: 3.00
College: College of Engineering

Department: Mechanical Engr & Mechanics

MEM 735   Adv Topics-Optimal Ctrl
Covers singular arc control, model following control, variable structure control, singular perturbation methods, differential games, and applications.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 760   Mech Composite Material I
Covers anisotropic elastic moduli, stress-strain relations of a lamina, failure criteria of a lamina, introduction to micromechanics, laminated plate theory, residual stresses, and strength of laminates.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 761   Mech Composite Materials II
Covers anisotropic plates and shells, boundary value problem in anisotropic heterogeneous elasticity, vibrations and buckling of laminated plates, and testing methods.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 762   Mech Composite Materials III
Covers classical failure criteria for orthotropic materials, fracture in laminates, three-dimensional stress analysis, simulation of delamination and transverse cracks, fatigue damage, and cumulative damage models.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 770   Theory of Elastic Stability
General stability criteria; beam column; the elastica; energy methods; torsional stability; combined torsion and flexure; lateral buckling of beams in pure bending; buckling of rings; curved bars and arches.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 777   Fracture Mechanics I
Covers fundamental mechanics of fracture, including linear elastic crack mechanics, energetics, small-scale yielding, fully plastic crack mechanics, creep crack mechanics, fracture criteria, mixed mode fracture, stable quasi-static crack growth (fatigue crack growth and environmentally induced crack growth), toughness and toughening, and computational fracture mechanics.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 782   Impact and Wave Propagation I
Governing equations for elastic waves; longitudinal waves in a bar; transverse in a flexible string; flexural waves in a Bernoulli-Euler beam; flexural waves in a Timoshenko beam; Rayleigh surface waves; Pochhammer-Chree waves in circular cylinders; reflection of plane waves at a plane boundary.
Credits: 3.00
College: College of Engineering

Department: Mechanical Engr & Mechanics

MEM 783 Impact and Wave Propagation II
Spherical and cylindrical waves in unbounded medium; method of Laplace transform; method of characteristics; flexural waves in a Timoshenko plate; viscoelastic and viscoplastic waves; dispersion and phase velocity; natural frequency in free vibration.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 784 Impact & Wave Propgtn III
Governing equations for unsteady, nonisentropic fluid flows; shock waves; method of characteristics for nonlinear system; numerical integration along characteristics; impact and vibration of shell topics in wave propagation.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 800 Special Topics Mech Engr
Covers topics of current interest to faculty and students; specific topics for each term will be announced prior to registration. May be repeated for credit if topics vary.
Credits: 0.50 to 9.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 891 Topics In Advanced Engr I
Linear systems; control theory; vibrations and eigenvalue problems; systems dynamics; Fourier transformation; flight dynamics.
Credits: 2.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 892 Topics In Advanced Engr II
Separation of variables; thermodynamics; heat transfer; fluid mechanics; boundary layer theory; elasticity; finite element methods. Solid mechanics; aeroelasticity.
Credits: 2.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 893 Topics In Advanced Engr III
Basic probability and statistics; communication theory; sampled data system; digital and optical processing.
Credits: 2.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 894 Engineering Mathematics
Application of matrices, linear algebra, and complex analysis to engineering problems. Ordinary and partial differential equations.
Credits: 3.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 897 Research
Supervised research in Mechanical Engineering.
Credits: 1.00 to 12.00
College: College of Engineering

Department: Mechanical Engr & Mechanics

MEM 898 Master's Thesis
Master's thesis.
Credits: 1.00 to 20.00
College: College of Engineering
Department: Mechanical Engr & Mechanics

MEM 998 Ph.D. Dissertation
Ph.D. dissertation.
Credits: 1.00 to 12.00
College: College of Engineering
Department: Mechanical Engr & Mechanics