CIVIL AND COASTAL ENGINEERING

CCE 5035 Construction Planning and Scheduling 3 Credits
Grading Scheme: Letter Grade
Planning, scheduling, organizing, and control of civil engineering projects with CPM and PERT. Application of optimization techniques.
Prerequisite: Knowledge or experience with theory and practice of construction operations, equipment utilization and construction methods, and analysis of costs.

CCE 5405 Construction Equipment and Procedures 3 Credits
Grading Scheme: Letter Grade
Design and optimization of equipment systems for heavy construction.
Prerequisite: Knowledge or experience with theory and practice of construction operations, equipment utilization and construction methods, and analysis of costs.

CCE 6015 Advanced Soil Mechanics 3 Credits
Grading Scheme: Letter Grade
Nature and origin of soil. Stresses within a soil body. Stress-strain behavior and shear strength of dry, saturated no flow, saturated transient flow soils.
Prerequisite: Fundamentals of Geotechnical Engineering including soil classification, soil strength assessment, consolidation, slope stability, retaining walls and seepage.

CCE 6016 Advanced Engineering Cost Estimating 3 Credits
Grading Scheme: Letter Grade
The application of scientific principles and techniques to the problem of cost estimation, cost control and profitability of infrastructure renewal projects, in support of engineering planning, design and construction practice.
Prerequisite: Graduate Standing or consent of instructor.

CCE 6037 Civil Engineering Operations I 3 Credits
Grading Scheme: Letter Grade
Advanced construction engineering and management procedures at the project level to support quantitative decision making.
Prerequisite: Graduate standing.

CEG 5114 Advanced Geotechnical Aspects of Landfill Design 3 Credits
Grading Scheme: Letter Grade
Settlement analysis, slope stability, liner design, and LCRS design.
Prerequisite: Fundamentals of Geotechnical Engineering including soil classification, soil strength assessment, consolidation, slope stability, retaining walls and seepage.

CEG 6116 Advanced Shallow Foundation Design 3 Credits
Grading Scheme: Letter Grade
Application of soil mechanics to design and analysis of shallow foundations.
Prerequisite: Fundamentals of Geotechnical Engineering including soil classification, soil strength assessment, and consolidation. Also, fundamentals of structural analysis including loads, shear and moment diagrams, and classical methods for determining displacements.

CEG 6117 Advanced Deep Foundation Design 3 Credits
Grading Scheme: Letter Grade
Application of soil mechanics to design and analysis of deep foundations.
Prerequisite: Fundamentals of Geotechnical Engineering including soil classification, soil strength assessment, consolidation, slope stability, retaining walls and seepage.

CEG 6405 Seepage in Soils 3 Credits
Grading Scheme: Letter Grade
Focusing on Darcy's law, coefficient of permeability, flownets, seepage forces; engineering applications: use of computer software for seepage and slope stability analyses in dewatering systems, embankment design, filter design, earth dams, and drainage problems.
Prerequisite: Fundamentals of Geotechnical Engineering including soil classification, soil strength assessment, consolidation, slope stability, retaining walls and seepage.

CEG 6505 Numerical Methods of Geomechanics 3 Credits
Grading Scheme: Letter Grade
Application of computer solutions to geotechnical engineering problems.
Prerequisite: Fundamentals of Geotechnical Engineering including soil classification, soil strength assessment, consolidation, slope stability, retaining walls and seepage.

CEG 6515 Earth Retaining Systems and Slope Stability 3 Credits
Grading Scheme: Letter Grade
Applications of soil mechanics to design and analysis of earth retaining systems and slope stability.
Prerequisite: Fundamentals of Geotechnical Engineering including soil classification, soil strength assessment, consolidation, slope stability, retaining walls and seepage.

CES 5010 Probabilistic and Stochastic Methods in Civil Engineering 3 Credits
Grading Scheme: Letter Grade
Fundamental aspects of uncertainty and their roles in determining system reliability. Probability and statistics, stochastic processes, random data analysis, and reliability methods.
Prerequisite: Fundamentals of structural analysis including loads, shear and moment diagrams, and classical methods for determining displacements.
C E S 5 1 1 6  F i n i t e  E l e m e n t s  i n  C i v i l  E n g i n e e r i n g  3  C r e d i t s  
Grading Scheme: Letter Grade
Introduction to finite elements, use of finite element concepts for structural analysis. Application of 1-, 2-, and 3-D elements of structural problems.
Prerequisite: Theory and application of the direct stiffness method.

C E S 5 3 2 5  D e s i g n  o f  H i g h w a y  B r i d g e s  3  C r e d i t s  
Grading Scheme: Letter Grade
Analysis by influence lines, slab and girder bridges, composite design, prestressed concrete, continuity, arch bridges, design details, highway specifications.
Prerequisite: Behavior and design of reinforced concrete members subjected to flexure, shear, and compression. Behavior and design of steel members and connections subjected to tension, compression, flexure, and torsion.

C E S 5 6 0 6  T o p i c s  i n  S t e e l  D e s i g n  3  C r e d i t s  
Grading Scheme: Letter Grade
Plate girders, torsion, biaxial bending, frame design, composite beams and columns, fatigue, monosymmetric members, and moment connections.
Prerequisite: CES 4605.

C E S 5 6 0 7  B e h a v i o r  o f  S t e e l  S t r u c t u r e s  3  C r e d i t s  
Grading Scheme: Letter Grade
Plastic analysis and designs of beams and frames. Buckling and stability problems. Shear and torsion.
Prerequisite: Behavior and design of steel members and connections subjected to tension, compression, flexure, and torsion.

C E S 5 7 1 5  P r e s t r e s s e d  C o n c r e t e  3  C r e d i t s  
Grading Scheme: Letter Grade
Analysis and design of prestressed concrete flexural members; pre- and post-tensioned construction, allowable stress, strength evaluation; design for bending moments and shear; evaluation of serviceability requirements; design of simple bridges.
Prerequisite: Behavior and design of reinforced concrete members subjected to flexure, shear, and compression.

C E S 5 8 0 1  D e s i g n  a n d  C o n s t r u c t i o n  i n  T i m b e r  3  C r e d i t s  
Grading Scheme: Letter Grade
Analysis and design of beams, columns, connections, and diaphragm/shearwall structures using sawn timber, laminated timber, and plywood and including a comprehensive design project.
Prerequisite: Fundamentals of structural analysis including loads, shear and moment diagrams, and classical methods for determining displacements.

C E S 5 8 3 5  D e s i g n  o f  R e i n f o r c e d  M a s o n r y  S t r u c t u r e s  3  C r e d i t s  
Grading Scheme: Letter Grade
Properties, specifications, and construction requirements for structures incorporating clay brick, concrete block, and mortar; analysis and design of masonry structures including a comprehensive diaphragm/shearwall masonry structure design project.
Prerequisite: Behavior and design of reinforced concrete members subjected to flexure, shear, and compression.

C E S 6 1 0 6  A v a n c e d  S t r u c t u r a l  A n a l y s i s  3  C r e d i t s  
Grading Scheme: Letter Grade
Traditional methods of analyses for forces and deformations; modern matrix methods including the direct stiffness method.
Prerequisite: Fundamentals of structural analysis including loads, shear and moment diagrams, and classical methods for determining displacements.

C E S 6 1 0 8  S t r u c t u r a l  D y n a m i c s  3  C r e d i t s  
Grading Scheme: Letter Grade
Evaluating structural response to the effect of dynamic loads for single-degree and multidegree of freedom systems. Considers seismic and wind effects, modal analysis, numerical methods, structural idealization, response spectra, and design codes.
Prerequisite: EGM 3400, CES 6106.

C E S 6 5 5 1  D e s i g n  o f  F o l d e d  P l a t e s  a n d  S h e l l s  3  C r e d i t s  
Grading Scheme: Letter Grade
Prerequisite: Behavior and design of reinforced concrete members subjected to flexure, shear, and compression. Behavior and design of steel members and connections subjected to tension, compression, flexure, and torsion.

C E S 6 5 7 1  D e s i g n  o f  T e m p o r a r y  S t r u c t u r e s  3  C r e d i t s  
Grading Scheme: Letter Grade
Introduction to structural engineering principles in the design of temporary structures and operations used in the construction of permanent structures.

C E S 6 5 8 5  W i n d  E n g i n e e r i n g  3  C r e d i t s  
Grading Scheme: Letter Grade
The nature of wind related to wind-structure interaction and design loads for extreme winds, tornadoes and hurricanes.
Prerequisite: Fundamentals of structural analysis including loads, shear and moment diagrams, and classical methods for determining displacements.

C E S 6 5 8 8  P r o t e c t i v e  S t r u c t u r e s  3  C r e d i t s  
Grading Scheme: Letter Grade
Addressing a range of tissues to mitigate blast, shock, and impact effects. It will include extensive course notes, references, manuals, handouts, and special computer codes. Also, it is expected that guest lectures on several topics will be given by invited experts.
Prerequisite: BS in Civil Eng; CES 6108

C E S 6 5 9 0  I m p a c t  E n g i n e e r i n g  3  C r e d i t s  
Grading Scheme: Letter Grade
Addressing a broad range of technical issues on mitigating the severe loading effects associated with impact loading incidents. The course will address static and dynamic structural behavior of elastic and elastic-perfectly-plastic systems that include: contact between bodies, classical impact problems for ideal systems, beams under concentrated or distributed loads, transverse shear and rotary inertia, strain rate effects, and instability.
Prerequisite: B.S. in Civil Engineering; CES 6108

C E S 6 5 9 1  A p p l i e d  P r o t e c t i v e  S t r u c t u r e s  3  C r e d i t s  
Grading Scheme: Letter Grade
Expanding knowledge gained from the course on protective structures for expedient applications that can be deployed under emergency situations associated with abnormal loading incidents (e.g., blast, shock, impact, etc.).
Prerequisite: B.S. in Civil Engineering; CES 6588

C E S 6 5 9 2  R e f o r m  P r o t e c t i v e  S t r u c t u r e s  3  C r e d i t s  
Grading Scheme: Letter Grade
Focusing on engineering approaches, innovative materials, and structural systems for enhancing the performance of protective structures against blast, shock, impact.
Prerequisite: B.S. in Civil Engineering; CES 6588: Protective Structures
Advanced Protective Structures 3 Credits
Grading Scheme: Letter Grade
Expanding the basic knowledge gained by the students in the previous course on Protective Structures by deeper treatments of the various key topics handled there.
Prerequisite: B.S. in Civil Engineering; CES 6588

Advanced Reinforced Concrete 3 Credits
Grading Scheme: Letter Grade
Torsion in structural members. Ultimate load theories and application to design. Columns and beam columns. Shear walls, combined shear walls and frames. Research topics.
Prerequisite: Fundamentals of structural analysis including loads, shear and moment diagrams, and classical methods for determining displacements. Behavior and design of reinforced concrete members subjected to flexure, shear, and compression.

Legal Aspects of Civil Engineering 3 Credits
Grading Scheme: Letter Grade
Engineer’s view of contracts for design and construction. Legislation and policy affecting labor-management relationships in construction.

Civil Engineering Systems 3 Credits
Grading Scheme: Letter Grade
Civil engineering applications of operations research techniques, models of scheduling, linear programming, queuing theory, and simulation.

Public Works Planning 3 Credits
Grading Scheme: Letter Grade
Functional approach to planning and implementing public works needs with emphasis on role of engineer.

Public Works Management 3 Credits
Grading Scheme: Letter Grade
Nature of profession, duties, and administrative responsibilities. Organization and management of operating divisions with emphasis on role of engineer.

Experimentation and Instrumentation in Civil Engineering Materials Research 3 Credits
Grading Scheme: Letter Grade
Fundamentals and applications of testing and measuring systems commonly used; constitutive models, testing methods, instrumentation, and error analysis.

Engineering Project Management 3 Credits
Grading Scheme: Letter Grade
Engineering project management skills and procedures in support of engineering project development and management.

Civil Engineering Practice I 3 Credits
Grading Scheme: Letter Grade
Advanced construction engineering management skills and procedures in support of design and construction practice at the project level.
Prerequisite: graduate standing.

Construction Engineering II 3 Credits
Grading Scheme: Letter Grade
Advanced construction engineering management skills and procedures in support of design and construction practice above the project level.
Prerequisite: Knowledge or experience with theory and practice of construction operations, equipment utilization and construction methods, and analysis of costs Advanced construction engineering management skills and procedures in support of design and construction practice above the project level.

Properties, Design and Control of Concrete 3 Credits
Grading Scheme: Letter Grade
Portland cement and aggregate properties relating to design, control, and performance of concrete. Concrete forming and construction methods. Laboratory testing and analysis.
Prerequisite: Course in introduction to civil engineering materials.

Bituminous Materials 3 Credits
Grading Scheme: Letter Grade
Analysis of strength and deformation mechanism for asphalt concrete, properties, and their effect on flexible pavement performance. Pavement construction and quality assurance methods, testing and evaluation of asphalts and mixture.
Prerequisite: Course in introduction to pavement design.

Sustainable Materials 3 Credits
Grading Scheme: Letter Grade
Providing a contemporary perspective to the sustainability problems associated with our dependence on materials and the consequences of their use. It introduces a method of decision making regarding materials selection, and design with materials, that considers the environmental and social impacts, in addition to the traditional assessment of the economic impact.
Prerequisite: Graduate standing.

Special Problems in Civil Engineering 1-15 Credits
Grading Scheme: Letter Grade
Studies in areas not covered by other graduate courses.

Supervised Teaching 1-5 Credits, Max 5 Credits
Grading Scheme: S/U
Credits do not apply to any graduate degree.

Civil Engineering Graduate Seminar 1 Credit, Max 6 Credits
Grading Scheme: S/U
Lectures by graduate students, faculty members, and invited speakers.

Civil Engineering or Engineer Degree Report 1-15 Credits
Grading Scheme: S/U
Individual work culminating in a professional practice-oriented report suitable for the requirements of the Master of Engineering or Engineer degree. Three credits only are applicable toward the requirements of each degree.

Research for Master’s Thesis 1-15 Credits
Grading Scheme: S/U
Research for Master’s Thesis

Master of Engineering or Engineer Degree Report 1-6 Credits, Max 10 Credits
Grading Scheme: S/U
Research for Doctoral Dissertation 1-12 Credits
Grading Scheme: S/U
Research for Doctoral Dissertation
CWR 5125 Groundwater Flow I 3 Credits  
**Grading Scheme:** Letter Grade  
**Prerequisite:** Undergraduate coursework including Differential Equations, Dynamics, Hydrodynamics (Fluid Mechanics), and Hydraulics.

CWR 5127 Evaluation of Groundwater Quality 3 Credits  
**Grading Scheme:** Letter Grade  
Characteristics of flow in saturated and unsaturated zones; solute convection and dispersion; effects of chemical reactions and adsorption; management of groundwater quality.  
**Prerequisite:** CWR 5125 or CWR 6525.

CWR 5235 Open Channel Hydraulics 3 Credits  
**Grading Scheme:** Letter Grade  
Classification of flow, Normal depth. Specific energy and critical depth. Gradually varied flow. Transitions.  
**Prerequisite:** Undergraduate coursework including Differential Equations, Dynamics, Hydrodynamics (Fluid Mechanics), and Hydraulics.

CWR 6115 Surface Hydrology 3 Credits  
**Grading Scheme:** Letter Grade  
Occurrence and distribution of water by natural processes including atmospheric thermodynamics, precipitation, runoff, infiltration, water losses, flood routing and catchment characteristics, analysis, and methods of runoff prediction. Current hydrologic computer models.  
**Prerequisite:** Undergraduate coursework including Differential Equations, Dynamics, Hydrodynamics (Fluid Mechanics), and Hydraulics.

CWR 6116 Advanced Surface Hydrology 3 Credits  
**Grading Scheme:** Letter Grade  
Physical and quantitative concepts and principles of hydrologic processes and their engineering applications. Reynolds Transport Theorem, the Continuity and Momentum Equations applied to phenomena and processes. Hydrologic analyses, including unit hydrograph theory, lumped flow routing, and distributed flow routing. Engineering concepts of hydrologic design, design storms and hydrologic chemistry.  
**Prerequisite:** ENV 3040C or equivalent numerical methods, STA 3032 or equivalent statistics, CWR 3201 or equivalent hydrodynamics.

CWR 6126 Variable-Density Groundwater Flow 3 Credits  
**Grading Scheme:** Letter Grade  
Numerical groundwater modeling, including groundwater flow, contaminant transport, and variable-density flow and transport equations and finite-difference approximations.  
**Prerequisite:** CWR 5125 Groundwater Flow I or consent of instructor.

CWR 6240 Mixing and Transport in Turbulent Flow 3 Credits  
**Grading Scheme:** Letter Grade  
Applying fluid mechanics to problems of turbulent mixing and transport of substances in the natural environment.  
**Prerequisite:** Undergraduate coursework including Differential Equations, Dynamics, Hydrodynamics (Fluid Mechanics), and Hydraulics.

CWR 6525 Groundwater Flow II 3 Credits  
**Grading Scheme:** Letter Grade  
Analytical and computer modeling of groundwater flow problems by means of finite difference, finite element, and boundary element methods.  
**Prerequisite:** CWR 5125.

CWR 6536 Stochastic Subsurface Hydrology 3 Credits  
**Grading Scheme:** Letter Grade  
Stochastic modeling of subsurface flow and transport including geostatistics, time series analysis, Kalman filtering, and physically based stochastic models.  
**Prerequisite:** senior-level course in probability and statistics, calculus through differential equations, soil physics, and/or subsurface hydrology.

CWR 6537 Contaminant Subsurface Hydrology 3 Credits  
**Grading Scheme:** Letter Grade  
Physical-chemical-biological concepts and modeling of retention and transport of water and solutes in unsaturated and saturated media. Applications of environmental aspects of soil and groundwater contamination.  
**Prerequisite:** MAP 2302 or 4341 or equivalent; CGS 2420 or equivalent; SWS 4602C or ABE 6252 or CWR 5125 or CWR 5127 or equivalent; or EES 6208 or equivalent.

EGM 5816 Intermediate Fluid Dynamics 3 Credits  
**Grading Scheme:** Letter Grade  
Basic laws of fluid dynamics. Introduction to potential flow, viscous flow, boundary layer theory, and turbulence.  
**Prerequisite:** EGN 3353C (or CWR 3201), MAP 2302.

EGN 5949 Practicum/Internship/Cooperative Work Experience 1-6 Credits, Max 6 Credits  
**Grading Scheme:** S/U  
Practical cooperative engineering work under approved industrial and faculty supervision.  
**Prerequisite:** graduate student.

EGN 6640 Entrepreneurship for Engineers 3 Credits  
**Grading Scheme:** Letter Grade  
Introduction to entrepreneurship, idea generating and feasibility analysis, and business planning. Lectures, case studies, student-led discussions, team business plans, and investor presentations.  
**Prerequisite:** EGN 3353C (or CWR 3201), MAP 2302.

EGN 6913 Engineering Graduate Research 0-3 Credits  
**Grading Scheme:** S/U  
Course will provide the student with supervised research in a laboratory setting.  
**Prerequisite:** EGN 3353C (or CWR 3201), MAP 2302.

EOC 5860 Port and Harbor Engineering 3 Credits  
**Grading Scheme:** Letter Grade  
Principles of port design; wave penetration; harbor oscillations; sediment movement and pollutant mixing; port structures, port operations; case studies.  
**Prerequisite:** EGN 3353C (or CWR 3201), MAP 2302 or equivalent.

EOC 6196 Littoral Processes 3 Credits  
**Grading Scheme:** Letter Grade  
Shoreline developments; nearshore hydrodynamics; sediment transport phenomena by waves and wind; methods of determining littoral transport quantities; effects of groins, jetties, and other coastal structures on littoral processes.  
**Prerequisite:** OCP 6165.

EOC 6430 Coastal Structures 3 Credits  
**Grading Scheme:** Letter Grade  
Planning and design for beach nourishment, breakwaters, jetties, seawalls and coastal protection structures.  
**Prerequisite:** OCP 6165.
EOC 6850 Numerical Simulation Techniques in Coastal and Ocean Engineering 3 Credits
Grading Scheme: Letter Grade
Numerical treatment of problems in ordinary and partial differential equations with application to incompressible geophysical fluid flows.

EOC 6905 Individual Study in Coastal and Oceanographic Engineering 1-4 Credits, Max 8 Credits
Grading Scheme: Letter Grade
Individual Study in Coastal and Oceanographic Engineering

EOC 6934 Advanced Topics in Coastal and Oceanographic Engineering 1-6 Credits, Max 9 Credits
Grading Scheme: Letter Grade
Waves; wave-structure interaction; coastal structures; ocean structures; sediment transport; instrumentation; advanced data analysis techniques; turbulent flow and its applications.

EOC 6939 Graduate Seminar 1 Credit, Max 6 Credits
Grading Scheme: S/U
Guest lecturers; lectures by COE faculty and students.

EOC 6971 Research for Master's Thesis 1-15 Credits
Grading Scheme: S/U
Research for Master's Thesis

EOC 7979 Advanced Research 1-12 Credits
Grading Scheme: S/U
Research for doctoral students before admission to candidacy. Designed for students with a master's degree in the field of study or for students who have been accepted for a doctoral program. Not appropriate for students who have been admitted to candidacy.

EOC 7980 Research for Doctoral Dissertation 1-15 Credits
Grading Scheme: S/U
Research for Doctoral Dissertation

OCP 6050 Physical Oceanography 3 Credits
Grading Scheme: Letter Grade
Structure of ocean basins; physical and chemical properties of sea water; basic physical laws used in oceanography; ocean current; thermohaline effects; numerical models; heat budget.
Prerequisite: MAP 2302, EGN 3353C (or CWR 3201).

OCP 6165 Ocean Waves I: Linear Theory 3 Credits
Grading Scheme: Letter Grade
Ocean wave classification, solution of the linearized boundary value problem; simple harmonic waves; shoaling effects; internal waves.
Prerequisite: MAP 2302, EGN 3353C (or CWR 3201).

OCP 6167 Ocean Waves II: Nonlinear Theory 3 Credits
Grading Scheme: Letter Grade
Perturbation development of nonlinear water wave theories; regions of validity of various theories; dynamics and kinematics of nonlinear wave trains composed of single and multiple fundamental components.
Prerequisite: OCP 6165: Ocean Waves I: Linear Theory.

OCP 6168 Data Analysis Techniques for Coastal and Ocean Engineers 3 Credits
Grading Scheme: Letter Grade
Data editing, fundamentals of spectral analysis, subsurface and surface signal analysis, directional spectral analysis.

OCP 6295 Estuarine and Shelf Hydrodynamics I 3 Credits
Grading Scheme: Letter Grade
Kinematics and dynamics of estuaries, small scale motions, tidal hydrodynamics, non tidal circulations, shelf waves, estuary and shelf interactions, mathematical models.
Prerequisite: OCP 6050.

OCP 6297 Coastal and Estuarine Sediment Transport 3 Credits
Grading Scheme: Letter Grade
Sediment properties including size, mineralogy and plasticity, cohesion and floculation; settling velocity and initiation of motion; coarse and fine sediment transport; wave-sediment interaction; fluid mud rheology and transport; consolidation; sedimentation in estuaries and at coasts.

OCP 6298 Coastal Sediment Transport Processes 3 Credits
Grading Scheme: Letter Grade
Physical sedimentation processes, including boundary layer hydrodynamics, suspended sediment dynamics, and bedload mechanics under wave and current conditions.
Prerequisite: CWR 6236, OCP 6165.

TTE 5006 Advanced Urban Transportation Planning 3 Credits
Grading Scheme: Letter Grade
Analytical techniques for estimating future travel demands; and for for planning transportation facilities and locations. Review of transportation technology and future systems.
Prerequisite: Students are expected to be familiar with elementary statistics and have the ability for analytical/quantitative problem solving.

TTE 5256 Traffic Engineering 3 Credits
Grading Scheme: Letter Grade
Traffic characteristics, studies and analyses, street operations, level of service analysis, congestion and access management, signs and markings, pedestrians, bicycles, parking, roadway lighting.
Prerequisite: Students are expected to be familiar with elementary statistics and have the ability for analytical/quantitative problem solving.

TTE 5305 Advanced Transportation Systems Analysis 3 Credits
Grading Scheme: Letter Grade
Systems analysis in transportation planning and engineering, including supply, demand, equilibrium, evaluation, and decision analysis.
Prerequisite: Students are expected to be familiar with elementary statistics and have the ability for analytical/quantitative problem solving.

TTE 5805 Geometric Design of Transportation Facilities 3 Credits
Grading Scheme: Letter Grade
Geometric design criteria and controls of highways and intersections.
Prerequisite: Students are expected to be familiar with elementary statistics and have the ability for analytical/quantitative problem solving.

TTE 5837 Pavement Management Systems 3 Credits
Grading Scheme: Letter Grade
Evaluation, analysis, design, performance prediction, planning, and maintenance of pavements.
Prerequisite: Background in fundamentals of Civil Engineering Materials and Pavement Design.

TTE 6205 Freeway Operations and Simulation 3 Credits
Grading Scheme: Letter Grade
TTE 6207 Advanced Highway Capacity Analysis 3 Credits
Grading Scheme: Letter Grade
Procedures defined within the current Highway Capacity Manual (HCM), including analytical chapters for uninterrupted and interrupted flow.
Prerequisite: Students are expected to be familiar with elementary statistics and have the ability for analytical/quantitative problem solving.

TTE 6259 Urban Streets Simulation and Control 3 Credits
Grading Scheme: Letter Grade
Principles of simulation modeling and applications. Simulating urban street operations using commercially available packages; traffic signal control and optimization for urban streets; signal control hardware.
Prerequisite: TTE 5256.

TTE 6267 Traffic Flow Theory 3 Credits
Grading Scheme: Letter Grade
Vehicle-roadway-infrastructure interactions, equations of motion, and car-following; microscopic and macroscopic traffic characteristics and traffic stream models; simulation, queueing theory, and shockwave analysis.
Prerequisite: TTE 5256.

TTE 6306 Computational Methods in Transportation Engineering 3 Credits
Grading Scheme: Letter Grade
Applying numeric methods to traffic engineering/analysis. Key issues in implementing a computational methodology into a software format. Fundamentals of developing simulation software.
Corequisite: TTE 5256.

TTE 6315 Highway Safety Analysis 3 Credits
Grading Scheme: Letter Grade
Statistics and characteristics of accidents, accident reconstruction, accident causation and reduction.

TTE 6505 Discrete Choice Analysis 3 Credits
Grading Scheme: Letter Grade
Theory and models of individual choice behavior; unordered and ordered multinomial choice models, empirical specifications, maximum likelihood estimation, state-of-the-art methods, travel modeling applications.

TTE 6606 Urban Transportation Models 3 Credits
Grading Scheme: Letter Grade
Mathematical models for decision making in planning and operations of urban highway and transit systems.
Prerequisite: TTE 5305.