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 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.

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 status.

CEG 5105 Geotechnical Engineer 3 Credits
Grading Scheme: Letter Grade
Shallow foundations, bearing capacity, settlements, deep foundations, pile testing, earth pressures, excavations, retaining structures, dewatering.

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 5115 Foundation Design 3 Credits
Grading Scheme: Letter Grade
Investigations, bearing capacity, and the analysis and design of shallow footings, walls, and deep pile foundations.
Prerequisite: Fundamentals of Geotechnical Engineering including soil classification, soil strength assessment, consolidation, slope stability, retaining walls and seepage.

CEG 5205C In-situ Measurement of Soil Properties 3 Credits
Grading Scheme: Letter Grade
Methods of soil exploration; techniques of soil sampling and insitu testing; field performance of insitu testing.
Prerequisite: Fundamentals of Geotechnical Engineering including soil classification, soil strength assessment, consolidation, slope stability, retaining walls and seepage.

CEG 5805 Ground Modification Design 2 Credits
Grading Scheme: Letter Grade
Introduction to design of ground modification techniques for improvement of marginal construction sites.
Prerequisite: Fundamentals of Geotechnical Engineering including soil classification, soil strength assessment, consolidation, slope stability, retaining walls and seepage.

CEG 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.

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, consolidation; 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.

CES 5116 Finite Elements in Civil Engineering 3 Credits  
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.

CES 5325 Design of Highway Bridges 3 Credits  
Grading Scheme: Letter Grade  
Introduction to 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.

CES 5606 Topics in Steel Design 3 Credits  
Grading Scheme: Letter Grade  
Plate girders, torsion, biaxial bending, frame design, composite beams and columns, fatigue, monosymmetric members, and moment connections.  
Prerequisite: Behavior and design of steel members and connections subjected to tension, compression, flexure, and torsion.

CES 5607 Behavior of Steel Structures 3 Credits  
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.

CES 5715 Prestressed Concrete 3 Credits  
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.

CES 5801 Design and Construction in Timber 3 Credits  
Grading Scheme: Letter Grade  
Analysis and design of beams, columns, connections, and diaphragm/shearwall structures using sawn timber, laminated timber, and plywood including a comprehensive design project.  
Prerequisite: Fundamentals of structural analysis including loads, shear and moment diagrams, and classical methods for determining displacements.

CES 5835 Design of Reinforced Masonry Structures 3 Credits  
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.

CES 6106 Advanced Structural Analysis 3 Credits  
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.

CES 5116 Finite Elements in Civil Engineering 3 Credits  
Grading Scheme: Letter Grade  
Introduction to 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.

CES 6108 Structural Dynamics 3 Credits  
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: Fundamentals of structural analysis including loads, shear and moment diagrams, and classical methods for determining displacements.

CES 6551 Design of Folded Plates and Shells 3 Credits  
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.

CES 6571 Design of Temporary Structures 3 Credits  
Grading Scheme: Letter Grade  
Introduction to structural engineering principles in the design of temporary structures and operations used in the construction of permanent structures.

CES 6585 Wind Engineering 3 Credits  
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.

CES 6588 Protective Structures 3 Credits  
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
CES 6590 Impact Engineering 3 Credits
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

CES 6591 Applied Protective Structures 3 Credits
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

CES 6592 Retrofit Protective Structures 3 Credits
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

CES 6593 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

CES 6706 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.

CGN 5125 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.

CGN 5605 Public Works Planning 3 Credits
Grading Scheme: Letter Grade
Functional approach to planning and implementing public works needs
with emphasis on role of engineer.

CGN 5606 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.

CGN 5715 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.

CGN 6150 Engineering Project Management 3 Credits
Grading Scheme: Letter Grade
Engineering project management skills and procedures in support of
engineering project development and management.

CGN 6155 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

CGN 6156 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.

CGN 6505 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.

CGN 6506 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.

CGN 6525 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.

CGN 6905 Special Problems in Civil Engineering 1-6 Credits, Max 10
Credits
Grading Scheme: Letter Grade
Studies in areas not covered by other graduate courses.

CGN 6910 Supervised Research 1-5 Credits, Max 5 Credits
Grading Scheme: S/U
Credits do not apply to any graduate degree.

CGN 6936 Civil Engineering Graduate Seminar 1 Credit, Max 6 Credits
Grading Scheme: S/U
Lectures by graduate students, faculty members, and invited speakers.

CGN 6940 Supervised Teaching 1-5 Credits, Max 5 Credits
Grading Scheme: S/U
Supervised Teaching

CGN 6971 Research for Master's Thesis 1-15 Credits
Grading Scheme: S/U
Research for Master's Thesis
CGN 6974 Master of Engineering or Engineer Degree Report 1-6 Credits, Max 6 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.

CGN 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.

CGN 7980 Research for Doctoral Dissertation 1-15 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  
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: ENV3040C or Equivalent numerical methods, STA 3032 or equivalent statistics, CWR3201 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 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: None.

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: A proficiency in Fluid Mechanics and Differential equations is needed.

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.

EGN 6913 Engineering Graduate Research 0-3 Credits  
Grading Scheme: S/U  
Course will provide the student with supervised research in a laboratory setting.

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: A proficiency in Fluid Mechanics and Differential equations is needed.

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:** This is an obligatory course and should be taken the first semester. A proficiency in Fluid Mechanics and Differential equations is needed.

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, nontidal 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 flocculation; 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 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.