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 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.

CCE 6515C Engineering and Construction Analytics using BIM 3 Credits
Grading Scheme: Letter Grade
Provides an exploration of model-based engineering and construction analytics using Building Information Modeling (BIM) to understand structural properties, constructability, and maintainability of structures. Topics include model-based designs; finite element analysis based on BIM; mechanical, electrical and plumbing (MEP) models; constructability and maintainability assessment; model-informed construction time and cost analysis, and reality capture for infrastructure assessment.
Prerequisite: Instructor approval.

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 Insitu 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 6206 Nondestructive Testing and Geophysical Methods 3 Credits
Grading Scheme: Letter Grade
Covers nondestructive and geophysical methods, and their engineering related applications. It includes (i) the principles of elastic waves and associated computational methods; (ii) the fundamentals on inverse theory and signal processing; (iii) inversion methods (e.g., global and deterministic); and (iv) real-world applications. The applications include geotechnical site characterization (soil/rock and sinkhole) and evaluation of concrete structural components (bridge deck/slab).
Prerequisite: CEG 4011 with a minimum grade of C.

CEG 6210 Computational Inelasticity 3 Credits
Grading Scheme: Letter Grade
Implementation of plastic and viscoplastic models including essential components of nonlinear finite element codes as applied to both metal and granular/porous materials. Basic theory of material instability and nonlocal numerical techniques. Return mapping algorithms in strain space; advanced plasticity models (critical state and bounding surface). Final class project to apply an inelastic finite-element material model to a practical problem.
Prerequisite: Solid mechanics and linear finite element method (FEM), or equivalent, or consent of instructor.

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 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
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.

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 and including a comprehensive design project.
Prerequisite: Fundamentals of structural analysis including loads, shear and moment diagrams, and classical methods for determining displacements.

CES 6106 Advanced Structural Analysis 3 Credits
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.

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 6117 Advanced Finite Element Analysis in Civil Engineering 3 Credits
Grading Scheme: Letter Grade
This course focuses on the application of advanced finite element techniques to the analysis of civil engineering systems. Topics covered include constraints, material nonlinearity, strain-rate effects, geometric nonlinearity, incrementation and iteration procedures, critical load analysis, dynamic analysis, contact analysis, nonlinear analysis of concrete structures with non-prestressed and prestressed reinforcement, analysis of staged construction.
Prerequisite: CES 5116.
Corequisite: CES 6018.

CES 6164C Structural Health Monitoring 3 Credits
Grading Scheme: Letter Grade
Through the application of sensors, IoT systems, and data informatics students will gain skills to meaningfully evaluate structural condition. This course covers theoretical background and practical application of structural monitoring and assessment for a variety of infrastructure types. Includes end-to-end design of monitoring systems based on decision support needs and appropriate selection of sensors and components, sensor placement, data acquisition and processing, and result generation.
Prerequisite: Dynamics, structural analysis, basic programming, statistics.

CES 6165 Concrete Structural Rehabilitation 3 Credits
Grading Scheme: Letter Grade
This course will cover the basic mechanisms that cause degradation of concrete pavements and structures, methods for diagnosing concrete degradation mechanisms, and structural repair and strengthening methods.
Prerequisite: Understanding of behavior of civil engineering materials (concrete, timber, steel, asphalt) with laboratory experience; analysis and design in reinforced concrete.

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 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 6425 Applied Data Science in Civil and Environmental Engineering 3 Credits
Grading Scheme: Letter Grade
Introduces the workflows of data science applications, covering the state-of-art techniques in data acquisition, data processing and management, analytics and modeling, and visualization. Critical application of data science concepts and techniques in complex socioeconomic and environmental contexts. Basics of problem formulation and major ethical considerations of applying data science in practice
Prerequisite: Computer programming and numerical methods for engineering.

CGN 6504 Concrete Durability 3 Credits
Grading Scheme: Letter Grade
Mechanisms, test methods, and mitigation methods for concrete deterioration. Mechanisms covered include cracking, freeze-thaw, reinforcing steel corrosion, alkali silica reaction, sulfate attack, chemical attack, and abrasion.
Prerequisite: Instructor permission or understanding of behavior of civil engineering materials (concrete, timber, steel, asphalt) with laboratory experience, analysis and design in reinforced concrete.

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 6877C Nondestructive Evaluation of Civil Infrastructure 3 Credits
Grading Scheme: Letter Grade
This course provides students' knowledge and experience to evaluate existing civil infrastructure. The course covers nondestructive and geophysical methods and their engineering related applications, including (i) the principles of elastic waves and associated computational method; (ii) the fundamentals on inverse theory and signal processing; (iii) inversion methods; and (iv) real-world applications. Applications include geotechnical site characterization and evaluation of concrete components.
Prerequisite: Permission of Instructor.

CGN 6905 Special Problems in Civil Engineering 1-6 Credits, Max 18 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.
Prerequisite: CVE_PhD & Academic Level 7 or Academic Level 8.

CGN 7980 Research for Doctoral Dissertation 1-15 Credits
Grading Scheme: S/U
Research for Doctoral Dissertation
Prerequisite: CVE_PhD & Academic Level 9.

CWR 5125 Groundwater Flow I 3 Credits
Grading Scheme: Letter Grade
Porous media flow. Darcy's law. Conservation of mass. Laplace equation. Flownets. Well hydraulics.
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.

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 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 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 6308 Advanced Urban Stormwater Systems Design 3 Credits
Grading Scheme: Letter Grade
Stormwater system design including: time of concentration, peak runoff rate, open-channel flow, gravity storm sewer, culvert, stormwater pumping, filtration systems, hydrograph generation, flood routing, site layout, site grading and permitting.
Prerequisite: Understanding of undergraduate-level fluid mechanics and applied hydraulics.

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, Max 12 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 6085 Field Methods for Coastal Engineers 3 Credits
Grading Scheme: Letter Grade
Introduces basic coastal engineering and physical oceanographic tools used to obtain and analyze field data. Data processing and analysis techniques will be introduced for spatially and temporally varying data sets collected via commonly employed instruments such as conductivity-temperature-depth profilers and recorders, current profilers, tide gauges, wave gauges, and meteorological instruments.
Prerequisite: Permission of instructor.

EOC 6086C Python Programming for Coastal Oceanography 3 Credits
Grading Scheme: Letter Grade
Fundamental and advanced Python programming techniques to analyze and visualize coastal and oceanographic data. Practical exercises and projects will emphasize real-world applications, including data collection, processing, analysis, and modeling of coastal phenomena.
Prerequisite: Prior knowledge of Python programming and fundamental concepts in oceanography is recommended.

EOC 6116 Nearshore Coastal Processes 3 Credits
Grading Scheme: Letter Grade
Introduction to coastal engineering and coastal processes highlighting practical coastal engineering projects. Coastal geology, wave generation and propagation, coastal nearshore hydrodynamics, coastal sediment processes, coastal inlet behavior, and coastal protection measures. Recent innovations in coastal engineering practice will be discussed.
Prerequisite: Permission of instructor.

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 6855 Coastal Storms: Processes and Impacts 3 Credits
Grading Scheme: Letter Grade
Extreme water levels and waves caused by coastal storms rank among the most significant hazards threatening coastal communities. This hands-on course explores storm independent water level components, such as astronomical tides and mean water levels, and storm induced components, including storm surge, rainfall-driven water levels, and wave runup. Students select a historical tropical cyclone that impacted the Florida coast and analyze the different contributions to total water levels.
Prerequisite: Understanding of basic wave mechanics and data analysis techniques. Programming experience in Python and/or MATLAB.EOC 6855

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 18 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.
Prerequisite: COA_PhD & Academic Level 7 or Academic Level 8.

EOC 7980 Research for Doctoral Dissertation 1-15 Credits
Grading Scheme: S/U
Research for Doctoral Dissertation
Prerequisite: COA_PhD & Academic Level 9.

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

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 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.

OCP 6605 Estuarine Circulation 3 Credits
Grading Scheme: Letter Grade
Physical and environmental aspects of estuaries with a special emphasis on engineering challenges within complex ecosystems at the interface between coastal and terrestrial environments. Estuarine classification, tidal processes and dynamics, transport of sediment and salinity, estuarine modeling, natural and anthropogenic change and impacts, and estuarine ecology. A field trip to a local estuary will allow students to experience estuarine environments.
Prerequisite: Permission of instructor.

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 5835 Pavement Design 2 Credits
Grading Scheme: Letter Grade
Design of flexible and concrete pavements.
Prerequisite: Understanding of the principal materials used for engineering purposes with special attention to mechanical properties and their importance to the engineer. Hands-on experience in testing of civil engineering materials.

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 6008 Fundamentals of the Transportation Profession 3 Credits
Grading Scheme: Letter Grade
Provides a holistic view of the professional practice of transportation including history, organizational structures, legal aspects, finances, human resources, asset management, leadership, marketing and communications, innovation, and technical overview of select topics to prepare students for a career in the field of transportation rapidly undergoing transformation.
Prerequisite: Students are expected to have a background in a transportation-related field.

TTE 6205 Freeway Operations and Simulation 3 Credits
Grading Scheme: Letter Grade
Uninterrupted traffic flow theory. Highway capacity analysis. Microscopic simulation. Freeway management and control methods.

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 6275 Connected & Automated Vehicles 3 Credits
Grading Scheme: Letter Grade
Prepares students to understand Connected and Automated Vehicles (CAVs) and address the myriad of issues related to the safe and efficient deployment of CAVs in the transportation system. Technology, policy/legal aspects, human factors, traffic operations/safety, and ethics/equity will be addressed in the context of passenger vehicles, public transit vehicles, and freight vehicles.
Prerequisite: Permission of Instructor.

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 6605 Smart Multimodal Transportation Systems 3 Credits
Grading Scheme: Letter Grade
Prepares students to operate multimodal transportation systems (intersections, urban streets, freeways, and transit systems) efficiently and safely in the light of all the transformation happening in the field of transportation engineering such as intelligent infrastructure and data for real-time decision making. Real world data will be used for quantitative analyses using emerging visualization techniques and optimization/ modeling methods.
Prerequisite: Permission of Instructor.

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.

TTE 6615 Electric, Shared, and Micro Mobility 3 Credits
Grading Scheme: Letter Grade
Prepares students to understand three critical trends in transportation namely electrification, shared mobility (Uber/Lyft etc.), and micro mobility (e-scooters, micro transit, etc.). Technology, policy/legal aspects, human factors, traffic operations/safety, and equity are addressed. Analyses will be undertaken using emerging visualization techniques and optimization/ modeling methods
Prerequisite: Permission of Instructor.