

CIVIL ENGINEERING (CE)

CE 199, SPECIAL TOPICS, 1-4 Credits

CE 202, CIVIL ENGINEERING: GEOSPATIAL INFORMATION AND GIS, 3 Credits

Introductory design principles presented with the use of GIS and geospatial information (remote sensing, GPS, surveying, and aerial photography) for civil engineering problem solving. Introduction to the integration of geospatial data and analysis for decision making and management for site selection, mitigation, change analysis, modeling and assessment. Standard software and custom programming used in course. Students participate in both individual and team projects and presentations. Projects from the area of civil engineering. Lec/lab.
Prerequisite: CCE 201 with C or better or ENGR 248 with C or better

CE 299, SPECIAL TOPICS, 1-4 Credits

Graded P/N.

Equivalent to: CE 299H

CE 299H, SPECIAL TOPICS, 1-4 Credits

Graded P/N.

Attributes: HNRS – Honors Course Designator

Equivalent to: CE 299

CE 301, CE JUNIOR SEMINAR, 1 Credit

Professional practices of civil engineering.

CE 311, FLUID MECHANICS, 4 Credits

Fluid properties, fluid statics, fluid motion, conservation of mass, momentum and energy for incompressible fluids, dimensional analysis, civil engineering applications.

Prerequisite: (MTH 256 with C or better or MTH 256H with C or better) and PH 213 [C] and ENGR 213 [C] and ENGR 212 [C]

CE 313, HYDRAULIC ENGINEERING, 4 Credits

Analysis of large civil engineering fluid systems including conduit flow, multiple reservoirs, pipe networks, pumps, turbines, open channel flow, and hydraulic structures.

Prerequisite: CE 311 with C or better or CHE 331 with C or better or CHE 331H with C or better

CE 361, SURVEYING THEORY, 4 Credits

Use of surveying equipment, Gaussian error theory applied to measurements, calculations of position on spherical and plane surfaces, state plane coordinate systems, introduction to global positioning systems.

Prerequisite: (CCE 201 with C or better or CE 202 with C or better) and ENGR 213 [C] and PH 213 [C] and ST 314 [C]

CE 365, HIGHWAY LOCATION AND DESIGN, 3 Credits

Curve problems in highway design, including circular, vertical, compound curves and spirals; earth distribution analysis; preliminary office studies; paper location procedures and field layout problems.

Prerequisite: CE 361 with C or better or CEM 263 with C or better or FE 208 with C or better

CE 372, GEOTECHNICAL ENGINEERING I, 4 Credits

Basic soil mechanics including the identification and classification of soil, principles of compaction and consolidation, flow through porous media, effective stress, and shear strength. Lec/lab.

Prerequisite: ENGR 213 with C or better or ENGR 213H with C or better and (CE 311 (may be taken concurrently) [C] or CEM 311 (may be taken concurrently) [C] or CHE 331 (may be taken concurrently) [C] or CHE 331H (may be taken concurrently) [C]) and CH 201 [C] and PH 212 [C]

CE 373, GEOTECHNICAL ENGINEERING II, 4 Credits

Application of fundamental soil mechanics principles to analyses of slope stability, retaining structures, and foundation support. Lec/rec.

Prerequisite: CE 372 with C or better or FE 315 with C or better

CE 381, STRUCTURAL THEORY I, 4 Credits

Analysis of statically determinate structures (beams, frames, trusses, arches, and cables). Approximate analysis, influence lines, deflections.

Prerequisite: ENGR 213 with C or better or ENGR 213H with C or better

CE 382, STRUCTURAL THEORY II, 4 Credits

Analysis of statically indeterminate structures (beams, frames, trusses). Deflections. Energy methods, introduction to matrix methods.

Prerequisite: CE 381 with C or better and (MTH 306 [C] or MTH 306H [C] or (MTH 264 [C] and MTH 265 [C]))

CE 383, DESIGN OF STEEL STRUCTURES, 4 Credits

Introduction to design of steel members, connections and structural systems. Lec/lab.

Prerequisite: CE 382 with C or better

CE 392, INTRODUCTION TO HIGHWAY ENGINEERING, 4 Credits

Highway engineering standards, geometric design, cross section and roadside design, highway surfaces, pavement design, highways and the environment, highway construction and maintenance.

Prerequisite: (ENGR 212 with C or better or ENGR 212H with C or better) and CE 361 [C]

CE 401, RESEARCH, 1-16 Credits

This course is repeatable for 16 credits.

CE 403, THESIS, 1-16 Credits

This course is repeatable for 16 credits.

CE 405, READING AND CONFERENCE, 1-16 Credits

This course is repeatable for 16 credits.

CE 406, PROJECTS, 1-16 Credits

This course is repeatable for 16 credits.

CE 407, SEMINAR, 1-3 Credits

Understanding complexity and systems thinking.

Equivalent to: CE 407H

This course is repeatable for 16 credits.

CE 407H, SEMINAR, 1-3 Credits

Understanding complexity and systems thinking.

Attributes: HNRS – Honors Course Designator

Equivalent to: CE 407

This course is repeatable for 16 credits.

CE 408, WORKSHOP, 1-3 Credits

This course is repeatable for 3 credits.

CE 410, INTERNSHIP, 1-12 Credits

This course is repeatable for 16 credits.

CE 411, OCEAN ENGINEERING, 4 Credits

Introduction to linear wave theory and wave forces on piles. Guided design of wave gauge facility at Coos Bay, Oregon, that requires synthesizing fluid mechanics, structural design and foundation design.

Prerequisite: CE 313 with C or better or CEM 311 with C or better

CE 412, HYDROLOGY, 4 Credits

Fundamentals of hydrology, the hydrologic cycle, precipitation, streamflow, hydrograph analysis and hydrologic measurements.

Prerequisite: CE 313 with C or better

CE 413, GIS IN WATER RESOURCES, 3 Credits

Course presents Geographic Information System (GIS) technology for developing solutions to water resource problems: water quality, availability, flooding, the natural environment, and management of water resources. Typical GIS data models for hydrologic information are presented. Synthesis of geospatial and temporal water resources to support hydrologic analysis and modeling are covered.

Recommended: Senior standing or a previous introductory GIS course

CE 415, COASTAL INFRASTRUCTURE, 3 Credits

Planning and design criteria of coastal infrastructure, including breakwaters, jetties, sea walls, groins, piers, submerged pipelines, harbor design, and tsunami defense. Use of laboratory models, numerical simulations, and field observations for design.

Prerequisite: CE 313 with C or better

CE 417, HYDRAULIC ENGINEERING DESIGN, 4 Credits

Theory, planning, analysis, and design of hydraulic structures. Application of basic principles detailed analysis and design. Engineering planning and design of water resource systems.

Prerequisite: CE 313 with C or better

CE 418, ^CIVIL ENGINEERING PROFESSIONAL PRACTICE, 3 Credits

Engineering career paths; ethics and professionalism, project planning, execution and delivery; team building/management; marketing proposals; engineering overseas; dispute resolution; partnering; effective decision making; uncertainty and risk analysis; and current industry design and construction methods. (Writing Intensive Course)

Attributes: CWIC – Core, Skills, WIC

Prerequisite: CE 382 with C or better and CE 313 [C] and (CE 372 [C] or FE 315 [C])

Equivalent to: CE 454

CE 419, ^CIVIL INFRASTRUCTURE DESIGN, 3 Credits

A capstone design project experience exposing students to problems and issues similar to those encountered in the practice of civil engineering. Students should have completed ALL other required courses in their degree program prior to registering for this course. Lec/rec.

Attributes: CWIC – Core, Skills, WIC

Prerequisite: CE 418 with C or better

CE 420, ENGINEERING PLANNING, 4 Credits

The application of systems analysis to structuring, analyzing, and planning for civil engineering projects. Concept of the system and its environment; setting goals, objectives, and standards; evaluation criteria; solution generation and analysis; evaluation and optimization. Project management using precedence node diagramming; resource allocation and leveling; time-cost trade-off; and PERT.

CE 424, CONTRACTS AND SPECIFICATIONS, 4 Credits

Fundamentals of construction industry contracts, including technical specifications, and issues related to time, money, warranty, insurance, and changed conditions.

Prerequisite: CEM 442 with C or better

CE 427, TEMPORARY CONSTRUCTION STRUCTURES, 4 Credits

Design and construction of temporary structures including formwork, shoring, and earth retaining structures.

Prerequisite: (CE 321 with C or better or CCE 321 with C or better) and (FE 315 [C] or CE 372 [C]) and (CEM 383 [C] or CE 383 [C])

CE 429, OPTIMIZATION IN WATER RESOURCES ENGINEERING, 3 Credits

Introduction to problem formulation and optimization techniques for design of complex water resources systems.

Recommended: CE 412

CE 461, PHOTOGRAMMETRY, 3 Credits

Geometry of terrestrial and vertical photographs, flightline planning, stereoscopy and parallax, stereoscopic plotting instruments, analytical photogrammetry, orthophotography, introduction to photo interpretation, and aerial cameras.

Prerequisite: CE 361 with C or better or CEM 263 with C or better or FE 208 with C or better

CE 463, CONTROL SURVEYING, 4 Credits

Global Positioning Systems (GPS) theory, networks, and fieldwork; control specifications, methods and problems in obtaining large area measurements; precise leveling; network adjustments using least square techniques; field instrument adjustments.

Prerequisite: CE 361 with C or better or CEM 263 with C or better or FE 208 with C or better

CE 465, OREGON LAND SURVEY LAW, 3 Credits

Introduction to U.S. public land survey; Oregon state statutes, common law decisions, and administrative rules dealing with boundary law; case studies; unwritten land transfers; original and resurvey platting laws; guarantees of title; deed descriptions.

Prerequisite: CE 361 with C or better or CEM 263 with C or better or FE 208 with C or better

CE 469, PROPERTY SURVEYS, 3 Credits

U.S. public land survey; restoration of corners, subdivision of sections; topographic mapping; subdivision and partition plats, resurvey plats, subdivision design; introduction to LIS/GIS; field astronomy.

Prerequisite: CE 361 with C or better or CEM 263 with C or better or FE 208 with C or better

CE 471, FOUNDATIONS FOR STRUCTURES, 3 Credits

Criteria, theory, design, and construction for foundations of structures; use of in-situ tests for geotechnical engineering; computer applications.

Prerequisite: CE 373 with C or better or FE 316 with C or better

CE 479, SLOPE AND EMBANKMENT DESIGN, 3 Credits

A comprehensive overview of evaluating stability and performance for natural and engineered slopes. Design aspects include construction of road embankments, slope remediation techniques and application of geosynthetics for slope stabilization, slope and wall construction, and drainage. **CROSSLISTED** as CE 479/FE 479 and CE 579/FE 579.

Prerequisite: CE 373 with C or better or FE 316 with C or better

Equivalent to: FE 479

CE 481, REINFORCED CONCRETE I, 4 Credits

Basic principles of reinforced concrete design; strength, stability, and serviceability criteria; design of reinforced concrete members for flexure and shear. Detailing, development length and splices.

Prerequisite: CE 382 with C or better

CE 482, MASONRY DESIGN, 3 Credits

A critical examination in depth of masonry design topics.

Prerequisite: CE 481 with C or better

CE 484, WOOD DESIGN, 4 Credits

Study of basic wood properties and design considerations. Design and behavior of wood connectors, beams, columns and beam columns. Introduction to plywood and glued laminated members. Analysis and design of structural diaphragms and shear walls. Lec/lab.

Prerequisite: CE 383 with C or better or CE 481 with C or better

Equivalent to: WSE 458

CE 486, PRESTRESSED CONCRETE, 3 Credits

Prestressed concrete analysis and design, systems of prestressing, materials, economics.

Prerequisite: CE 481 with C or better

CE 489, SEISMIC DESIGN FUNDAMENTALS, 3 Credits

Fundamentals of earthquake engineering, introduction to structural dynamics principles, response spectra, and ASCE 7 design and analysis provisions.

Prerequisite: CE 481 with C- or better and CE 383 [C-]

CE 491, TRANSPORTATION ENGINEERING, 3 Credits

Introduction to transportation engineering systems characteristics, traffic estimation, comprehensive transportation planning, highway economics, driver and vehicle characteristics, highway operations and capacity, signalization and control. Introduction to intelligent transportation.

Prerequisite: CE 392 with C or better and ST 314 [C]

CE 492, PAVEMENT STRUCTURES, 3 Credits

Design and rehabilitation of pavement structures for streets, highways, and airports.

Prerequisite: CE 392 with C or better

CE 499, SPECIAL TOPICS, 1-16 Credits

This course is repeatable for 16 credits.

CE 501, RESEARCH, 1-16 Credits

This course is repeatable for 16 credits.

CE 503, THESIS, 1-16 Credits

This course is repeatable for 999 credits.

CE 505, READING AND CONFERENCE, 1-16 Credits

This course is repeatable for 16 credits.

CE 506, PROJECTS, 1-16 Credits

This course is repeatable for 16 credits.

CE 507, SEMINAR, 1-16 Credits

This course is repeatable for 16 credits.

CE 508, WORKSHOP, 1-3 Credits

Graded P/N.

This course is repeatable for 3 credits.

CE 510, INTERNSHIP, 1-16 Credits

This course is repeatable for 16 credits.

CE 511, OCEAN ENGINEERING, 4 Credits

Introduction to linear wave theory and wave forces on piles. Guided design of wave gauge facility at Coos Bay, Oregon, that requires synthesizing fluid mechanics, structural design and foundation design.

Recommended: CE 313 or CEM 311

CE 512, HYDROLOGY, 4 Credits

Fundamentals of hydrology, the hydrologic cycle, precipitation, streamflow, hydrograph analysis and hydrologic measurements.

CE 513, GIS IN WATER RESOURCES, 3 Credits

Course presents Geographic Information System (GIS) technology for developing solutions to water resource problems: water quality, availability, flooding, the natural environment, and management of water resources. Typical GIS data models for hydrologic information are presented. Synthesis of geospatial and temporal water resources to support hydrologic analysis and modeling are covered.

Recommended: Senior standing or a previous introductory GIS course

CE 514, GROUNDWATER HYDRAULICS, 4 Credits

Principles of groundwater flow and chemical transport in confined and unconfined aquifers, aquifer testing and well construction. Design of dewatering and contaminant recovery systems.

Prerequisite: CE 547 with B or better

Equivalent to: BEE 514

Recommended: CE 313 and MTH 252

CE 515, COASTAL INFRASTRUCTURE, 3 Credits

Planning and design criteria of coastal infrastructure, including breakwaters, jetties, sea walls, groins, piers, submerged pipelines, harbor design, and tsunami defense. Use of laboratory models, numerical simulations, and field observations for design.

Recommended: CE 313

CE 516, STORMWATER DESIGN AND MANAGEMENT, 4 Credits

Introduction to urban stormwater drainage systems; urban hydrologic analysis; water quality in urban storm water; design of stormwater control systems; low impact development; storm water monitoring; and computer modeling of urban storm water systems.

Prerequisite: CE 512 with C or better or BEE 512 with C or better

CE 517, HYDRAULIC ENGINEERING DESIGN, 4 Credits

Theory, planning, analysis, and design of hydraulic structures. Application of basic principles detailed analysis and design. Engineering planning and design of water resource systems.

Recommended: CE 313

CE 518, GROUNDWATER MODELING, 4 Credits

Application of numerical methods to the solution of water flow and solute transport through saturated and unsaturated porous media. Analysis of confined and unconfined aquifers. Computer solution of large-scale field problems including groundwater contamination and aquifer yield.

Prerequisite: CE 514 with C or better

CE 520, ENGINEERING PLANNING, 4 Credits

The application of systems analysis to structuring, analyzing, and planning for civil engineering projects. Concept of the system and its environment; setting goals, objectives, and standards; evaluation criteria; solution generation and analysis; and evaluation and optimization.

Project management using precedence node diagramming; resource allocation and leveling; time-cost trade-off; and PERT.

CE 524, CONTRACTS AND SPECIFICATIONS, 4 Credits

Fundamentals of construction industry contracts, including technical specifications, and issues related to time, money, warranty, insurance, and changed conditions.

CE 525, STOCHASTIC HYDROLOGY, 3 Credits

Introduction to fundamental concepts that are needed for stochastic modeling of hydrologic processes in presence of nonstationarity and uncertainty. CROSSLISTED as BEE 525/CE 525.

Prerequisite: CE 512 with C or better or BEE 512 with C or better

Equivalent to: BEE 525

CE 527, TEMPORARY CONSTRUCTION STRUCTURES, 4 Credits

Design and construction of temporary structures including formwork, shoring, and earth retaining structures.

Recommended: (CE 321 or CCE 321) and (FE 315 or CE 372) and (CEM 383 or CE 383)

CE 529, OPTIMIZATION IN WATER RESOURCES ENGINEERING, 3 Credits

Introduction to problem formulation and optimization techniques for design of complex water resources systems.

Recommended: CE 512 or BEE 512

CE 530, SELECTED TOPICS IN STRUCTURAL ANALYSIS AND MECHANICS, 3 Credits

A critical, in-depth examination of topics selected by the instructor from among topics not covered in other structural analysis and mechanics courses.

Prerequisite: CE 585 with C or better

This course is repeatable for 16 credits.

CE 531, STRUCTURAL MECHANICS, 3 Credits

Theories of failure, multi-axial stress conditions, torsion, shear distortions, energy methods of analysis, beams on elastic foundations. Nonlinear and inelastic behavior.

CE 532, FINITE ELEMENT ANALYSIS, 4 Credits

Applications of the finite element method to structural analysis, fluid flow and elasticity problems. Use and development of large finite element computer programs.

Prerequisite: (CE 585 with C or better or ME 520 with C or better)

CE 533, STRUCTURAL STABILITY, 3 Credits

Stability theory and applications, with emphasis on design of steel structures.

Recommended: CE 383

CE 534, STRUCTURAL DYNAMICS, 4 Credits

Analytical and numerical solutions for single, multi-degree of freedom and continuous vibrating systems. Behavior of structures, dynamic forces and support motions. Seismic response spectra analysis.

Recommended: CE 382

CE 535, INTRODUCTION TO RANDOM VIBRATIONS, 4 Credits

Introduction to probability theory and stochastic processes. Correlation and spectral density functions. Response of linear systems to random excitations. First excursion and fatigue failures. Applications in structural and mechanical system analysis and design.

Prerequisite: CE 534 with C or better or ME 522 with C or better

CE 536, MATRIX METHODS OF STRUCTURAL ANALYSIS, 4 Credits

Development of matrix methods for linear structural analysis. Force and displacement methods of analysis. Virtual work principles. Use of computer programs to analyze structures. Introduction to the finite-element method.

Equivalent to: CE 585

Recommended: CE 382 with a minimum grade of C

Available via Ecampus

CE 537, NONLINEAR STRUCTURAL ANALYSIS, 4 Credits

Material and geometric nonlinear analysis of frame and truss structures. Solution strategies for nonlinear structural analysis. Nonlinear constitutive models of steel and reinforced concrete members. Development and use of computer programs for nonlinear analysis.

Available via Ecampus

CE 538, STRUCTURAL RELIABILITY AND RISK ANALYSIS, 4 Credits

Application of probability and statistics in the reliability-based analysis and design of civil and mechanical engineering systems. Probabilistic modeling of loading and resistance including load and resistance factor design. Introduction to risk analysis and robustness.

Prerequisite: (CE 536 with C or better or ME 520 with C or better)

Recommended: ST 314

CE 540, SPECIAL TOPICS IN HYDRAULIC ENGINEERING, 3-4 Credits

Introduction to the tools and methods employed to characterize hydrologic properties of subsurface systems. Hands-on use of GPR, TDR, resistivity, and methods of determining hydraulic conductivity, sorptivity, bulk density, and other fundamental hydrologic properties.

Equivalent to: BRE 540

This course is repeatable for 16 credits.

CE 543, APPLIED HYDROLOGY, 4 Credits

Advanced treatment of hydrology covering major components of the hydrological cycle with special emphasis on surface water; hydrologic analysis and design of water resource systems; runoff prediction; and simulation of surface water systems. Offered alternate years.

Equivalent to: BRE 543

Recommended: BEE 512 and CE 412

CE 544, OPEN CHANNEL FLOW, 3 Credits

Steady, uniform, and nonuniform flow in natural and artificial open channels; unsteady flow; interaction of flow with river structures; and computational methods.

Equivalent to: BEE 544, BRE 544

Recommended: (CE 311 and CE 313) or CE 547

CE 547, WATER RESOURCES ENGINEERING I: PRINCIPLES OF FLUID MECHANICS, 4 Credits

Fluid mechanics for water resources engineers, classifications of fluid flows; fluid statics and dynamics, incompressible viscous flows; dimensional analysis; applications to fluid machinery, flow through porous media, fluid motion in rivers, lakes, oceans.

CE 552, ISOLATED SIGNALIZED INTERSECTIONS, 3 Credits

Relationships between signal display, user response, vehicle detection, and signal timing parameters are examined in detail. Traffic simulation is introduced to visualize and design the various elements of isolated signalized intersections.

Recommended: CE 595

CE 553, RAILROAD ENGINEERING, 3 Credits

The principal subject of this course is the railway infra-structure and operational issues related to high speed passenger rail and freight rail (class 1 and regional rail). The course will cover the techniques used to design, construct, monitor and maintain railway track. Class will include field trips.

Corequisites: CE 392

CE 554, DRIVING SIMULATION, 3 Credits

Relationships between the functional elements of driving simulation (simulation computer processing, sensory feedback generation, sensory display devices, and the human operator) are examined in detail. The role of driving simulation in transportation engineering research and practice is also considered in depth. Students will design experiments, analyze and interpret data, and extrapolate simulator results to real-world scenarios.

Recommended: CE 595

CE 556, TRANSPORTATION SAFETY ANALYSIS, 3 Credits

Provides students with a general knowledge of major transportation safety issues and a general background in the application of various statistical and econometric safety analysis techniques. In addition, this course presents a number of model-estimation methods used in transportation safety data analysis, and other subject areas that deal with safety analysis.

Recommended: CE 392 with a minimum grade of C and ST 511

CE 557, NETWORK FLOW ANALYSIS AND OPTIMIZATION, 3 Credits

Acquaints students with the basic elements of operations research through transportation networks, optimal paths in transportation networks, vehicle routing and scheduling problems on networks, facility location problems, transportation network design problems, transportation network flows, and to indicate the directions for future research in this area. Although the course utilizes examples from transportation, the techniques and models are generalizable to other areas of engineering, e.g., water networks, computer networks, energy networks, agricultural, power, telecommunication, etc.

Recommended: CE 392 with a minimum grade of C

CE 560, SELECTED TOPICS IN GEOMATICS ENGINEERING, 0-4 Credits

Selected topics on contemporary problems in geomatics engineering; application of ongoing research from resident and visiting faculty.

This course is repeatable for 16 credits.

CE 561, PHOTOGRAMMETRY, 3 Credits

Geometry of terrestrial and vertical photographs, flightline planning, stereoscopy and parallax, stereoscopic plotting instruments, analytical photogrammetry, orthophotography, introduction to photo interpretation, and aerial cameras.

Recommended: CE 361 or CEM 263 or FE 208

CE 562, DIGITAL TERRAIN MODELING, 4 Credits

Fundamentals of LIDAR and creating digital terrain models. Computational geometry, Delaunay triangulations, spline interpolations, statistical gridding methods, ground filtering, data optimizations, and advanced topics in 3D modeling.

Recommended: CE 361 or CEM 263 or equivalent surveying or GIS course.

CE 563, CONTROL SURVEYING, 4 Credits

Global Positioning Systems (GPS) theory, networks, and fieldwork; control specifications, methods and problems in obtaining large area measurements; precise leveling; network adjustments using least square techniques; field instrument adjustments.

Recommended: CE 361 or CEM 263 or FE 208

CE 564, GLOBAL NAVIGATION SATELLITE SYSTEM, 4 Credits

Theories and applications of surveying using satellites, focusing on the use of Global Navigation Satellite System (GNSS). The course will begin with the comprehensive overviews of the GNSS, reference and time systems as well as basic orbital mechanics. A description of the satellite signals and the data collected by GNSS receivers will also be covered. Different positioning and navigation techniques for using GNSS data (absolute/relative positioning, static/kinematic positioning, stand-alone/network based positioning) and different user applications will be reviewed, followed by practices of data collections and processing techniques.

Recommended: CE 361 or CE 202

CE 565, OREGON LAND SURVEY LAW, 3 Credits

Introduction to U.S. public land survey; Oregon state statutes, common law decisions, and administrative rules dealing with boundary law; case studies; unwritten land transfers; original and resurvey platting laws; guarantees of title; deed descriptions.

Recommended: CE 361 or CEM 263 or FE 208

CE 566, 3D LASER SCANNING AND IMAGING, 4 Credits

Fundamentals of lidar acquisition, registration, processing, modeling, analysis, and verification. Use of sensor platforms for 3D acquisition. Effective data management procedures. Introduction to other imaging techniques including structure from motion and structured light. Lec/lab.

CE 567, COASTAL REMOTE SENSING, 4 Credits

Application of remote sensing technologies (e.g., unmanned aircraft systems, multi- and hyperspectral imagery, high-resolution commercial satellite imagery, synthetic-aperture radar, and topographic and bathymetric lidar) to coastal mapping and charting, coastal engineering and coastal zone management. Both the theory and applications of advanced remote sensing technologies are covered. Lec/lab.

Recommended: An undergraduate surveying course, such as CE 361, CEM 263 or FE 208 and some exposure to MATLAB

CE 568, LEAST SQUARES ADJUSTMENTS, 3 Credits

Examines the theory of random error and statistical testing. Discusses the propagation of error in both indirect observations and direct observations from survey. Studies weights of observations and the principles of least squares. Explains how to adjust redundant observations in level nets, horizontal surveys, GNSS networks, and GNSS and terrestrial survey networks by least squares. Estimates the error ellipses of the adjusted observations. Evaluates methods for performing coordinate transformations.

Recommended: CE 361 or CEM 263 or FE 208

CE 569, PROPERTY SURVEYS, 3 Credits

U.S. public land survey; restoration of corners, subdivision of sections; topographic mapping; subdivision and partition plats, resurvey plats, subdivision design; introduction to LIS/GIS; field astronomy.

Recommended: CE 361 and CEM 263 or FE 208

CE 570, GEOTECHNICAL SPECIAL TOPICS, 1-16 Credits

Development and management of actual projects through the examination of case histories; evaluation of geotechnical data; development of design recommendations and preparation of project reports.

This course is repeatable for 16 credits.

CE 571, ADVANCED FOUNDATION ENGINEERING, 4 Credits

Presents the planning, analysis, and design of shallow and deep foundations from the geotechnical engineering perspective. Topics supporting course objectives include planning and execution of subsurface investigations, interpretation of in-situ tests, analysis and design of deep and shallow foundations, including geotechnical capacity, and immediate settlement. Assessment of deep foundation installation, axial and lateral loading tests, and group effects is presented. Evaluation of foundation performance is conducted under deterministic and probabilistic frameworks.

Recommended: CE 373 and CE 471

CE 572, ADVANCED GEOTECHNICAL LABORATORY, 4 Credits

Examination of soil composition and engineering properties of soils including volume change, pore pressure generation, strength, and deformation behavior of soils in the laboratory. Advanced static and cyclic shear strength testing of soils will also be discussed. Lec/lab.

Recommended: CE 373 and CE 471

CE 575, EARTH RETENTION AND SUPPORT, 4 Credits

Presents the theory and practice of design and construction of earth retaining structures. Topics include rigid and flexible retaining structures, ranging from gravity and cantilever systems, cantilever and anchored sheet piling, tied-back shoring elements, soil nailing, and mechanically stabilized earth walls. These topics are developed with a view on compaction stresses and surface loading, and invokes approaches that range from the static equations of equilibrium to empirical rules of thumb.

Recommended: CE 373

CE 576, GROUND IMPROVEMENT, 3 Credits

Presents the analysis and design of ground improvement techniques. Topics supporting course objectives include design for accelerated settlement (surcharge design) with and without pre-fabricated vertical drains, vibro-compaction, vibro-replacement (stone columns) and aggregate piers, deep soil mixing, jet grouting, EPS geofoam, and other improvement techniques for improving soil strength and stability, and limiting deformations and the effects of liquefaction.

Prerequisite: CE 572 with C or better and CE 577 [C]

CE 577, STATIC AND DYNAMIC SOIL BEHAVIOR, 3 Credits

An advanced coverage of volume change and strength behavior of soil. Specific course topics include effective stress, one-dimensional compression of soil, rate of soil consolidation, Mohr circle analysis, shear strength of sands, clays, and silts, and dynamic soil properties, strength, and testing.

Recommended: CE 372 and CE 373

CE 578, GEOTECHNICAL EARTHQUAKE ENGINEERING, 4 Credits

Major course topics include engineering seismology, strong ground motion, seismic hazard analysis, soil dynamics, seismic site response, earthquake motion selection, liquefaction, and seismic slope stability. Attention will be given to earthquakes created by the Cascadia Subduction Zone. Lec/lab.

Recommended: CE 373 and CE 471

CE 579, SLOPE AND EMBANKMENT DESIGN, 3 Credits

A comprehensive overview of evaluating stability and performance for natural and engineered slopes. Design aspects include construction of road embankments, slope remediation techniques and application of geosynthetics for slope stabilization, slope and wall construction, and drainage. CROSSLISTED as CE 479/FE 479 and CE 579/FE 579.

Equivalent to: FE 579

Recommended: CE 373 or FE 316

CE 580, SELECTED TOPICS IN STRUCTURAL DESIGN, 3 Credits

A critical examination in depth of topics selected by the instructor from among topics not covered in other structural design courses.

This course is repeatable for 18 credits.

CE 581, REINFORCED CONCRETE I, 4 Credits

Basic principles of reinforced concrete design; strength, stability, and serviceability criteria; design of reinforced concrete members for flexure and shear. Detailing, development length and splices.

Recommended: CE 382

CE 582, MASONRY DESIGN, 3 Credits

A critical examination in depth of masonry design topics.

Recommended: CE 581

CE 583, BRIDGE DESIGN, 3 Credits

AASHTO specifications for bridge design; load models; design for moving loads; design and analysis of bridge decks and simple and continuous bridge spans.

Recommended: Completion of CE 381 and CE 382 and (CE 481 or CE 581) and concurrent enrollment in CE 383

CE 584, WOOD DESIGN, 4 Credits

Study of basic wood properties and design considerations. Design and behavior of wood connectors, beams, columns and beam columns. Introduction to plywood and glued laminated members. Analysis and design of structural diaphragms and shear walls. Lec/lab. CROSSLISTED as CE 584/WSE 558.

Equivalent to: WSE 558

Recommended: CE 383 or CE 481 with a minimum grade of C

CE 586, PRESTRESSED CONCRETE, 3 Credits

Prestressed concrete analysis and design, systems of prestressing, materials, economics.

Recommended: CE 581

CE 589, SEISMIC DESIGN, 4 Credits

Design of structures to resist the effects of earthquakes. Introduction to structural dynamics, dynamic analysis, seismic design philosophy, code requirements, and detailing for steel and reinforced concrete.

Recommended: CE 383 or CE 481

CE 590, SELECTED TOPICS IN TRANSPORTATION ENGINEERING, 1-3 Credits

Selected topics on contemporary problems in transportation engineering; application of ongoing research from resident and visiting faculty.

This course is repeatable for 9 credits.

CE 591, TRANSPORTATION SYSTEMS ANALYSIS, PLANNING, AND POLICY, 3 Credits

The systems approach and its applications to transportation engineering and planning. The making of transportation plans and policies.

Development of transportation models. Transportation system performance. Decision analysis. Evaluation of transportation projects. Environmental and social impacts of transportation.

CE 592, PAVEMENT STRUCTURES, 3 Credits

Design and rehabilitation of pavement structures for streets, highways, and airports.

Recommended: CE 392

CE 593, TRAFFIC FLOW ANALYSIS AND CONTROL, 4 Credits

Traffic operations and control systems; traffic flow theory and stream characteristics; capacity analysis; traffic models and simulation; accident and safety improvement. Offered alternate years.

CE 594, TRANSPORT FACILITY DESIGN, 4 Credits

Location and design of highways, and other surface transportation terminals; design for safety, energy efficiency, and environmental quality. Offered alternate years. Lec/rec.

Recommended: CE 392

CE 595, TRAFFIC OPERATIONS AND DESIGN, 3 Credits

Traffic operations and engineering; human and vehicular characteristics; traffic stream characteristics; highway capacity analysis; intersection operation, control and design.

Recommended: Completion or concurrent enrollment in CE 491

CE 596, PAVEMENT EVALUATION AND MANAGEMENT, 3 Credits

Advanced topics in pavement evaluation techniques and pavement management procedures.

Recommended: CE 492

CE 597, PUBLIC TRANSPORTATION, 3 Credits

Characteristics and nature of public transportation systems, including bus, light and heavy rail; financing policy considerations; planning transit service; managing and operating transit systems for small and large urban areas. Offered alternate years.

CE 598, AIRPORT PLANNING AND DESIGN, 3 Credits

Characteristics and nature of the air transport system. Airport financing, air traffic control. Analysis and design of airports and the airport planning processes. Airport appurtenances. Airport pavement design, environmental facilities and drainage. Offered alternate years.

CE 599, INTELLIGENT TRANSPORTATION SYSTEMS, 3 Credits

Introduction to intelligent transportation systems, including enabling surveillance, navigation, communication and computer technologies. Application of technologies for monitoring, analysis evaluation and prediction of transportation system performance. Intervention strategies, costs and benefits, safety, human factors, institutional issues and case studies. Offered alternate years.

Recommended: CE 491 for new graduate students

CE 601, RESEARCH, 1-16 Credits

This course is repeatable for 16 credits.

CE 603, THESIS, 1-16 Credits

This course is repeatable for 999 credits.

CE 605, READING AND CONFERENCE, 1-16 Credits

This course is repeatable for 16 credits.

CE 606, PROJECTS, 1-16 Credits

This course is repeatable for 16 credits.

CE 607, OCEAN ENGINEERING SEMINAR, 1 Credit

Presentations from on-campus and off-campus speakers discussing state of technology topics in ocean engineering research, development, and construction. Graded P/N.

This course is repeatable for 16 credits.

CE 630, OCEAN WAVE MECHANICS I, 3 Credits

Linear wave boundary value problem formulation and solution, water particle kinematics, shoaling, refraction, diffraction, and reflection. Linear long wave theory with applications to tides, seiche, and storm surge.

CROSSLISTED as CE 630/OC 630.

Equivalent to: OC 630

CE 631, OCEAN WAVE MECHANICS II, 3 Credits

Second in the sequence of ocean wave engineering mechanics, covers the following topics: introduction to long wave theory, wave superposition, wave height distribution, and the wind-wave spectrum, introduction to wave forces, and basic nonlinear properties of water waves. May include additional selected topic in wave mechanics. CROSSLISTED as CE 631/OC 631.

Prerequisite: (CE 630 with C or better or OC 630 with C or better)

Equivalent to: OC 631

CE 634, LONG WAVE MECHANICS, 3 Credits

Theory of long waves. Depth-integrated Euler's equation and its jump conditions. Evolution equations and their solutions. Nonlinear shallow-water waves, the Korteweg-deVries equation and Boussinesq equation. Boundary-layer effects. Shallow-water waves on beaches. Applications of the fundamentals to problems of tsunamis. CROSSLISTED as CE 634/OC 634.

Prerequisite: (CE 630 with C or better and CE 631 [C])

Equivalent to: OC 634

Recommended: OC 670

CE 639, DYNAMICS OF OCEAN STRUCTURES, 3 Credits

Dynamic response of fixed and compliant structures to wind, wave and current loading; Morison equation and diffraction theory for wave and current load modeling, time and frequency domain solution methods; application of spectral and time series analyses; system parameter identification; and stochastic analysis of fatigue and response to extreme loads. Offered alternate years.

CE 640, SELECTED TOPICS IN OCEAN AND COASTAL ENGINEERING, 1-3 Credits

Selected topics on contemporary problems in ocean and coastal engineering; application of ongoing research from resident and visiting faculty. Offered alternate years.

This course is repeatable for 9 credits.

Recommended: CE 630

CE 642, RANDOM WAVE MECHANICS, 3 Credits

Random wave theories, probability and statistics of random waves and wave forces, time series analyses of stochastic processes, ocean wave spectra. Offered alternate years.

Prerequisite: CE 630 with C or better

CE 643, COASTAL ENGINEERING, 3 Credits

Coastal sediment transport including nearshore currents, longshore onshore-offshore transport, and shoreline configuration; equilibrium beach profile concept with application to shore protection; shoreline modeling; tidal inlet hydrodynamics and inlet stabilization; design criteria for soft structures. Offered alternate years.

Prerequisite: CE 630 with C or better

CE 645, WAVE FORCES ON STRUCTURES, 3 Credits

Wave forces on small and large members, dimensional analyses and scaling of equations, identification and selection of force coefficients for Morison equation; compatibility of wave kinematics and force coefficients in Morison equation, diffraction and radiation of surface gravity waves by large floating bodies, wavemaker problem, and reciprocity relations.

Prerequisite: CE 630 with C or better

CE 647, OCEAN AND COASTAL ENGINEERING MEASUREMENTS, 3 Credits

Hands-on experience in the conduct of field and laboratory observations, including waves, currents, wind, tides, tsunamis, sediments, bathymetry, shore profiles, wave forces on structures, and structural response. Online data archival and retrieval systems.

Prerequisite: CE 630 with C or better

CE 661, KINEMATIC POSITIONING AND NAVIGATION, 3 Credits

Application of Global Navigation Satellite System (GNSS) aided Inertial Navigation Systems (INS) to directly georeference survey data acquired from a moving platform, such as an unmanned aircraft system (UAS), conventional aircraft, survey boat, or all-terrain vehicle. Topics include 3D coordinate transformations, dead-reckoning, inertial navigation, kinematic GNSS, Kalman filtering, and sensor modeling.

Recommended: Undergraduate surveying course, such as CE 361, CE 263 or FE 208, and some exposure to MATLAB

CE 663, GEODESY, 4 Credits

Covers the geometrical aspects of terrestrial and celestial reference systems as well as modern realizations of these coordinate systems. In addition, an introductory level of the physical geodesy is also included, such as gravitational and gravity fields in order to deal with the geoid and heights. From this course, students are expected to understand the core elements of geometric and physical earth, which will assist them to have a solid background for other geospatial related studies.

Recommended: CE 202 or CE 361

CE 808, WORKSHOP, 1-16 Credits

This course is repeatable for 16 credits.