CVEN 207 Introduction to the Civil Engineering Profession
Credit 1. 1 Lecture Hour.
Introduction to the study and practice of civil engineering; specialized subdisciplines of civil engineering; professionalism and professional registration; engineering ethics; exercises in engineering technical communications.
Prerequisite: ENGL 104.

CVEN 221 Engineering Mechanics: Statics
Credits 3. 2 Lecture Hours. 2 Lab Hours.
General principles of mechanics; concurrent force systems; statics of particles; equivalent force/moment systems; centroids and center of gravity; equilibrium of rigid bodies; trusses, frames, and machines; internal forces in structural members; friction; second moments of areas.
Prerequisites: Grade of C or better in MATH 251 or MATH 253, or concurrent enrollment; grade of C or better in PHYS 218; admitted to major degree sequence in civil engineering.

CVEN 250 Introduction to Graphics and Visualization Applications in Civil Engineering Design
Credits 2. 1 Lecture Hour. 3 Lab Hours.
Graphical communication in the civil engineering design process; introduction to industry standard software; construction documents and contract drawings in civil engineering applications; data analysis; introduction to project visualization.

CVEN 289 Special Topics in...
Credits 1 to 4. 1 to 4 Lecture Hours. 0 to 4 Lab Hours.
Selected topics in an identified area of civil engineering. May be repeated for credit.
Prerequisite: Approval of department head.

CVEN 301/EVEN 301 Environmental Engineering
Credits 3. 3 Lecture Hours.
Water quality; material balances; chemical, physical and biological processes; water quality modeling; water and wastewater treatment; air quality; solid and hazardous waste management.
Prerequisites: Grade of C or better in CHEM 107, PHYS 208, and CVEN 302, junior or senior classification, or approval of instructor.

CVEN 302 Computer Applications in Engineering and Construction
Credits 3. 2 Lecture Hours. 3 Lab Hours.
Application of computers to solution of civil engineering problems using various numerical methods; structured computer programming; mathematical modeling and error analysis; solution of algebraic and differential equations; numerical differentiation and integration; curve-fitting; root-finding.
Prerequisites: Grade of C or better in ENGR 112; grade of C or better in MATH 308 or concurrent enrollment; admitted to major degree sequence in civil engineering.

CVEN 303 Civil Engineering Measurement
Credits 3. 2 Lecture Hours. 3 Lab Hours.
Introduction to geodetic positions, datums, map projections; theory of civil engineering measurements and errors applied to horizontal and vertical control, curves, earthwork and mapping using state-of-the-art technology for data capture; processing and presentation of result.
Prerequisite: MATH 151; admitted to major degree sequence in civil engineering.

CVEN 304/EVEN 304 Environmental and Water Resources Engineering Lab
Credit 1. 3 Lab Hours.
Environmental measurements on physical, chemical, biological and biotechnological parameters of water.
Prerequisites: CVEN 301/EVEN 301 or CVEN 301/CVEN 301, or concurrent enrollment; CVEN 311/EVEN 311 or concurrent enrollment; or approval of instructor.
Cross Listing: EVEN 304/CVEN 304.

CVEN 305 Mechanics of Materials
Credits 3. 3 Lecture Hours.
Applications of conservation principles and stress/deformation relationships for continuous media to structural members; axially loaded members; thin-walled pressure vessels; torsional and flexural members; shear; moment; deflection of members; combined loadings; stability of columns; nonsymmetrical bending; shear center; indeterminate members; elastic foundations.
Prerequisites: Grade of C or better in CVEN 221, MEEN 221 or MEEN 225.

CVEN 306 Materials Engineering for Civil Engineers
Credits 3. 2 Lecture Hours. 2 Lab Hours.
Scientific concepts of civil engineering materials; relationship between macroscopic material properties and response and microscopic properties; physical, mechanical, surface, fracture, and rheological properties of civil engineering materials including metals, composites, and polymers.
Prerequisites: Grade of C or better in CHEM 107, PHYS 208, and CVEN 221; grade of C or better in CVEN 305 and MATH 308, or concurrent enrollment.

CVEN 307 Transportation Engineering
Credits 3. 3 Lecture Hours.
Fundamental principles and methods in planning, design, and operation of transportation systems; driver and vehicle performance capabilities; highway geometric and pavement design principles; traffic analysis and transportation planning.
Prerequisite: Grade of C or better in CVEN 302 or concurrent enrollment.

CVEN 311/EVEN 311 Fluid Dynamics
Credits 3. 3 Lecture Hours.
Fluid properties; statics; kinematics; basic conservation principles of continuity, energy and momentum; similitude and hydraulic models; incompressible flow in pipes; fluid dynamic drag.
Prerequisites: Grade of C or better in MATH 251 and CVEN 221; grade of C or better in CVEN 302, or concurrent enrollment.
Cross Listing: EVEN 311/CVEN 311.

CVEN 315 Sensor Technology for the Built Environment
Credits 3. 2 Lecture Hours. 3 Lab Hours.
Fundamentals of sensor technology including laboratory safety, error analysis, statistical analysis, electric circuits, data acquisition, signal conditioning, signal analysis, strain gages, laser technology, image acquisition and analysis, fiber optic sensors, wireless sensors; its applications in civil engineering; and hands-on demonstrations relevant to the natural and built environment.
Prerequisites: CVEN 302, junior or senior classification, or approval of instructor.
CVEN 322 Civil Engineering Systems  
Credits 3. 3 Lecture Hours.  
Economic analysis and evaluation of engineering projects; application of systems analysis to civil engineering design; systems synthesis and optimization techniques; assignments apply engineering economics, statistical methods and optimization techniques to civil engineering problems.  
Prerequisite: Grade of C or better in STAT 211 or concurrent enrollment; grade of C or better in CVEN 302 or concurrent enrollment; admitted to major degree sequence in civil engineering.

CVEN 336 Fluid Dynamics Laboratory  
Credit 1. 2 Lab Hours.  
Introduction to laboratory techniques; calibration principles, reports and fluid measurements; determination of fluid properties; visualization of types of flow; experiments in closed conduit flow of air, water and oil; fluid drag and turbomachinery tests; open channel and gravity wave demonstrations.  
Prerequisites: CVEN 311/EVEN 311 or registration therein. Enrollment in MASE major degree sequence. Junior or senior classification or approval of instructor.

CVEN 339 Water Resources Engineering  
Credits 3. 3 Lecture Hours.  
Quantitative hydrology, precipitation, hydrograph analysis, reservoir and stream routing; groundwater, Darcy equation, well equation, well design; probability concepts in design; water law; dams; reservoirs; spillways; open channel and pipe network hydraulics; pumps; urban stormwater drainage; flood damage mitigation.  
Prerequisite: CVEN 311/EVEN 311.

CVEN 342 Materials of Construction  
Credits 3. 2 Lecture Hours. 3 Lab Hours.  
Physical and mechanical properties of construction materials; portland cement concrete, bituminous materials, wood, ferrous and non-ferrous metals, glass, plastics and masonry units; proportioning of concrete mixtures including admixtures.  
Prerequisites: CVEN 302 or registration therein; CVEN 305 and CVEN 306; ENGL 203, ENGL 210, ENGL 241 or ENGL 301.

CVEN 343 Portland Cement Concrete Materials for Civil Engineers  
Credits 3. 2 Lecture Hours. 3 Lab Hours.  
Physical and chemical characteristics of Portland cement concrete systems; constituent materials; mixture proportioning; fresh concrete characteristics; hardened concrete properties; durability characteristics; and concrete construction methods.  
Prerequisites: CVEN 302 or registration therein; CVEN 305 and CVEN 306; ENGL 203, ENGL 210, ENGL 241 or ENGL 301.

CVEN 345 Theory of Structures  
Credits 3. 3 Lecture Hours.  
Structural engineering—functions of structure, design loads, reactions and force systems; analysis of statically determinate structures including beams, trusses and arches; energy methods of determining deflections of structures; influence lines and criteria for moving loads; analysis of statically indeterminate structures including continuous beams and frames.  
Prerequisites: Grade of C or better in CVEN 302 or concurrent enrollment; grade of C or better in CVEN 305.

CVEN 349 Civil Engineering Project Management  
Credits 3. 3 Lecture Hours.  
Basic elements of management of civil engineering projects; roles of all participants in the process—owners, designers, contractors and suppliers; emphasis on contractual aspect of the process—project estimating, planning and controls.  
Prerequisite: CVEN 302 and CVEN 322, or concurrent enrollment.

CVEN 363 Engineering Mechanics: Dynamics  
Credits 3. 2 Lecture Hours. 2 Lab Hours.  
Application of first principles to model dynamic particles and rigid body systems with ordinary differential equations; solutions to models using analytical and numerical approaches; interpreting solutions/performance measures; linear vibrations; modeling of civil engineering systems and evaluating dynamic response to natural hazards.  
Prerequisites: CVEN 302, CVEN 305 and MATH 308.

CVEN 365 Introduction to Geotechnical Engineering  
Credits 3. 2 Lecture Hours. 3 Lab Hours.  
Physical properties of soils, classification systems, soil exploration, permeability, consolidation, compaction, and shear strength; laboratory tests conducted to determine the physical and engineering soil properties needed for application in geotechnical engineering design.  
Prerequisites: CVEN 302 or registration therein; CVEN 305; ENGL 203, ENGL 210, ENGL 241 or ENGL 301.

CVEN 399 Mid-Curriculum Professional Development  
Credits 0. 0 Lecture Hours. 0 Lab Hours. 0 Other Hours.  
No Credit. Participation in an approved high-impact learning practice; reflection on professional outcomes from civil engineering body of knowledge; documentation of experience appropriate to eventual professional licensure; self-assessment of learning at mid-curriculum point.  
Prerequisites: Grade of C or better in CVEN 207, CVEN 250, CVEN 303, CVEN 306, CVEN 311/EVEN 311, CVEN 322, CVEN 345, and CVEN 363.

CVEN 400 Design Problems in Civil Engineering  
Credits 3. 2 Lecture Hours. 3 Lab Hours.  
Applications of civil engineering principles to the design and preparation of the plans and specifications of civil engineering projects.  
Prerequisites: CVEN 303, CVEN 322, CVEN 345 and CVEN 399; senior classification; or approval of instructor.

CVEN 402 Engineered Environmental Systems  
Credits 3. 3 Lecture Hours.  
Unit operations and processes in environmental engineering; physical, chemical and biological treatment of water and wastewater; treatment system analysis and design.  
Prerequisite: CVEN 301/EVEN 301.

CVEN 403 Applied Civil Engineering Surveying  
Credits 2. 6 Lab Hours.  
Application of land surveying principles; topographic surveying, boundary surveying, and construction staking through field exercises using state-of-the-art equipment and data capture/analysis techniques; preparation of topographic and boundary maps with related documents; presentation of results.  
Prerequisites: CVEN 303; junior or senior classification.

CVEN 405 Construction Management of Field Operations  
Credits 3. 3 Lecture Hours.  
Effects of industrialization on construction methods and resultant construction management problems.  
Prerequisite: CVEN 349.
CVEN 406 Environmental Protection and Public Health
Credits 3. 3 Lecture Hours.
Communicable and noncommunicable diseases; environmental risk assessment; environmental assessments; comprehensive environmental planning; small water and wastewater systems; solid waste management; hazardous spills and waste management; vector control; environmental administration.
Prerequisite: CVEN 301/EVEN 301 or approval of instructor.

CVEN 413/EVEN 413 Natural Environmental Systems
Credits 3. 3 Lecture Hours.
Water quality assessment of natural environmental systems; development and calibration of models to describe fate and transport of contaminants in aquatic systems; application of models to design of water quality control facilities.
Prerequisite: Grade of C or better in EVEN 301/CVEN 301 or CVEN 301/EVEN 301.
Cross Listing: EVEN 413/CVEN 413.

CVEN 417 Bituminous Materials
Credits 3. 2 Lecture Hours. 3 Lab Hours.
Origin, production, specifications and tests of bituminous materials and paving mixtures used in construction and maintenance of roads and pavements, pavement surface properties, pavement distress and correction alternatives.
Prerequisites: Senior classification in engineering; CVEN 342 or CVEN 343 or approval of instructor.

CVEN 418 Highway Materials and Pavement Design
Credits 3. 3 Lecture Hours.
Theory and practice in pavement design; pavement performance; structural design of pavement layers; types of materials used in pavement layers; characterization of pavement layer materials; introduction to pavement management concepts.
Prerequisites: CVEN 307; CVEN 342 or CVEN 343.

CVEN 423 Geomatics for Civil Engineering
Credits 3. 2 Lecture Hours. 3 Lab Hours.
Use of GIS, GPS, Survey and Remotely-sensed data integrated with predictive models for infrastructure management systems.
Prerequisite: CVEN 303 or approval of instructor.

CVEN 424 Civil Engineering Professional Practice
Credits 2.1 Lecture Hour. 2 Lab Hours.
Professional practice issues; current civil engineering issues that impact design, construction, and operation of the civil engineer facilities; developing engineering solutions that better serve society; business and public policy concerns; life-long learning; problem solving; professional licensure.
Prerequisites: CVEN 322 and CVEN 399; senior classification in civil engineering.

CVEN 435 Geotechnical Engineering Design
Credits 3. 2 Lecture Hours. 3 Lab Hours.
A design course covering prediction of settlement, analysis of the stability of slopes, prediction of bearing capacity of shallow and deep foundations and determination of earth pressures acting on retaining structures; a general course in geotechnical engineering design for undergraduates and for graduate students not primarily interested in the geotechnical field, but desiring additional study beyond the introductory undergraduate level.
Prerequisite: CVEN 365.
CVEN 455 Urban Stormwater Management  
Credits 3. 3 Lecture Hours.  
Hydrologic, hydraulic, and general civil engineering design and implementation of stormwater systems including drainage and detention storage facilities, floodplain regulation measures, and flood control structures; stormwater aspects of land development and public works engineering; flood hydrology and hydraulics; institutional aspects of urban stormwater management.  
Prerequisite: CVEN 339 or approval of instructor.

CVEN 456 Highway Design  
Credits 3. 2 Lecture Hours. 3 Lab Hours.  
Theory and practice in highway design; highway classification and design criteria, location studies, design of vertical and horizontal alignment, cross section, pavement, intersections and highway drainage elements.  
Prerequisites: CVEN 307 and CVEN 399; senior classification; or approval of instructor.

CVEN 457 Urban Traffic Facilities  
Credits 3. 3 Lecture Hours.  
Driver, vehicle and roadway characteristics related to design and operation of traffic facilities; selection and design of traffic control devices and information systems for streets and highways; accident analysis and tort liability related to traffic engineering.  
Prerequisite: CVEN 307.

CVEN 458/EVEN 458 Hydraulic Engineering of Water Distribution Systems  
Credits 3. 3 Lecture Hours.  
Pressure conduit hydraulics; design, modeling, and analysis of water conveyance and distribution systems including pipelines, pipe networks, and pumps.  
Prerequisite: Grade of C or better in CVEN 339 or EVEN 339 or approval of instructor.  
Cross Listing: EVEN 458/CVEN 458.

CVEN 462/EVEN 462 Engineering Hydrogeology  
Credits 3. 3 Lecture Hours.  
Groundwater in the hydrologic cycle; aquifer properties; well hydraulics, testing, and design; groundwater quality; and groundwater management and sustainability.  
Prerequisites: Grade of C or better in CVEN 311/EVEN 311 or EVEN 311/CVEN 311; Grade of C or better in CVEN 301/EVEN 301, EVEN 301/CVEN 301, CVEN 339, or EVEN 339; junior or senior classification; or approval of instructor.  
Cross Listing: EVEN 462/CVEN 462.

CVEN 463/EVEN 463 Engineering Hydrology  
Credits 3. 3 Lecture Hours.  
Occurrence, distribution and properties of natural waters of the earth; measurement and engineering analysis of hydrologic phenomena including precipitation, streamflow and groundwater, hydrologic design of water resources development and management projects.  
Prerequisite: Grade of C or better in CVEN 339 or EVEN 339.  
Cross Listing: EVEN 463/CVEN 463.

CVEN 473 Engineering Project Estimating and Planning  
Credits 3. 2 Lecture Hours. 3 Lab Hours.  
Application of cost estimating and planning techniques for civil engineering projects; introduction to labor, materials and equipment costing; productivity analysis; indirect and general overhead costs; preparation of approximate and definitive estimates; and integration of time/cost relationships through critical path method and resource leveling.  
Prerequisites: CVEN 349; senior classification.

CVEN 483 Analysis and Design of Structures  
Credits 3. 2 Lecture Hours. 3 Lab Hours.  
Overall procedure of analysis and design including functions, loads, layouts of force systems; analysis, specifications, cost comparisons, and maintenance as applied to typical building structures.  
Prerequisites: CVEN 365 or concurrent enrollment; CVEN 399, CVEN 444 and CVEN 446; senior classification; or approval of instructor.

CVEN 485 Directed Studies  
Credits 0 to 3. 0 to 3 Other Hours.  
Research and design problems of limited scope approved on an individual basis intended to promote independent study; results of study presented in writing.  
Prerequisite: Approval of department head.

CVEN 489 Special Topics in...  
Credits 1 to 4. 0 to 4 Lecture Hours. 0 to 4 Lab Hours.  
Selected topics in an identified area of civil engineering. May be repeated for credit.  
Prerequisite: Approval of department head.

CVEN 491 Research  
Credits 0 to 4. 0 to 4 Other Hours.  
Research conducted under the direction of faculty members in civil engineering. May be taken three times for credit.  
Prerequisites: Junior or senior classification and approval of instructor.