CE 2410 Statics Cr. 3
Basic concepts and principles of statics with applications to Newton's Laws of Motion to engineering problems. Forces, moments, equilibrium, couples, free body diagrams, trusses, frames, fluid statics, friction, area and mass moment of inertia. Offered Every Term.  
Equivalent: ME 2410  

CE 2420 Elementary Mechanics of Materials Cr. 3
Elastic relationships between external forces acting on deformable bodies and the associated stresses and deformations; structural members subjected to axial load, torsion, and bending; column buckling; combined stresses; repeated loads; unsymmetrical bending. Offered Every Term.  
Prerequisites: (BE 1300 with a minimum grade of C-) AND (BE 1310 with a minimum grade of C-) AND (CE 2410 with a minimum grade of C-) AND (ME 2410 with a minimum grade of C-)  
Equivalent: ME 2420  

CE 3010 Introduction to CAD in Civil Engineering Cr. 3
Principles of computer graphics and utilization of computers in the design process. Civil engineering applications of AutoCAD. Offered Biannually.  
Prerequisite: MAT 2020, with a minimum grade of C-; BE 1200, with a minimum grade of C-  
Restrictions: Enrollment limited to students in the following programs: BS in Biomedical Engineering BS in Chemical Engineering BS in Civil Engineering BS in Electrical Engineering BS in Industrial Engineering BS in Mechanical Engineering, enrollment limited to students in the College of Engineering.  

CE 3070 Surveying Cr. 3
Principles of plane surveying; measurement of horizontal and vertical distance, directions and angles, traverses, areas. Offered Irregularly.  
Prerequisite: PHY 2185, with a minimum grade of C-; PHY 2180, with a minimum grade of C-  
Restrictions: Enrollment limited to students in the following programs: BS in Biomedical Engineering BS in Chemical Engineering BS in Civil Engineering BS in Electrical Engineering BS in Industrial Engineering BS in Mechanical Engineering, enrollment limited to students in the College of Engineering.  

Course Material Fees: $20  

CE 3250 Applied Fluid Mechanics Cr. 4
Application of theoretical fluid mechanics to problems of special interest to civil engineers including pipe flow, open channel flow, forces on submerged bodies, and flow measurement. Laboratory component of course provides experimental verification of theories and computer visualization. Offered Fall.  
Prerequisite: MAT 2030, with a minimum grade of C-  
Restrictions: Enrollment limited to students in the following programs: BS in Biomedical Engineering BS in Chemical Engineering BS in Civil Engineering BS in Electrical Engineering BS in Industrial Engineering BS in Mechanical Engineering, enrollment limited to students in the College of Engineering.  
Course Material Fees: $15  

CE 3450 Civil Engineering Materials Cr. 4
Structure, composition and engineering properties of aggregates, cement concrete, asphalt, asphalt concrete, and other civil engineering materials. Mix design, testing, and quality control. Material Fee as indicated in the Schedule of Classes. Offered Winter.  
Prerequisite: BE 2100, with a minimum grade of C-; CE 2420, (may be taken concurrently), with a minimum grade of C-  
Restrictions: Enrollment limited to students in the following programs: BS in Biomedical Engineering BS in Chemical Engineering BS in Civil Engineering BS in Electrical Engineering BS in Industrial Engineering BS in Mechanical Engineering, enrollment limited to students in the College of Engineering.  

CE 4210 Introduction to Environmental Engineering Cr. 3
Introduction to environmental laws; reaction kinetics; principles of mass balances; plug-flow and completely stirred tank reactors; Stoke's Law; Streeter-Phelps oxygen sag curves; water chemistry; hydrologic cycle; population growth models; elements of soil waste management and air pollution. Offered Winter.  
Prerequisite: CE 3250, with a minimum grade of C-  
Restrictions: Enrollment limited to students in the following programs: BS in Biomedical Engineering BS in Chemical Engineering BS in Civil Engineering BS in Electrical Engineering BS in Industrial Engineering BS in Mechanical Engineering, enrollment limited to students in the College of Engineering.  
Course Material Fees: $10  

CE 4240 Environmental Engineering Design Cr. 3
Design of engineered environmental systems, including drinking water distribution systems, sanitary and storm water sewer systems, and municipal waste disposal sites. Offered Fall.  
Prerequisite: CE 4210, with a minimum grade of C-  
Restrictions: Enrollment limited to students in the following programs: BS in Biomedical Engineering BS in Chemical Engineering BS in Civil Engineering BS in Electrical Engineering BS in Industrial Engineering BS in Mechanical Engineering, enrollment limited to students in the College of Engineering.  

CE 4400 Structural Analysis Cr. 4
Basic concepts of structural analysis; reactions, forces, and stresses in trusses and beams; influence lines; elastic deflections; introduction to indeterminate structures; computer applications. Offered Fall.  
Prerequisites: CE 2410 with a minimum grade of C- or CE 2420 with a minimum grade of C-  
Restrictions: Enrollment limited to students in the following programs: BS in Biomedical Engineering BS in Chemical Engineering BS in Civil Engineering BS in Electrical Engineering BS in Industrial Engineering BS in Mechanical Engineering, enrollment limited to students in the College of Engineering.  

CE 4410 Steel Design Cr. 3
First course in design of steel structures. Introduction to the concepts, requirements, and fundamental skills for steel building structural design. Offered Winter.  
Prerequisites: CE 4400 with a minimum grade of C-  
Restrictions: Enrollment limited to students in the following programs: BS in Biomedical Engineering BS in Chemical Engineering BS in Civil Engineering BS in Electrical Engineering BS in Industrial Engineering BS in Mechanical Engineering, enrollment limited to students in the College of Engineering.
CE 4420 Reinforced Concrete Design Cr. 3
First course in design of concrete structures. Design and analysis of reinforced concrete beams, columns, and other structural members; ACI code requirements, cost concerns, safety, industry practices; introduction to prestressed concrete. Offered Fall.
Prerequisite: CE 4400, with a minimum grade of C-
Restriction(s): Enrollment limited to students in the following programs: BS in Biomedical Engineering BS in Chemical Engineering BS in Civil Engineering BS in Electrical Engineering BS in Industrial Engineering BS in Mechanical Engineering, enrollment limited to students in the College of Engineering.

CE 4510 Introduction to Geotechnical Engineering Cr. 4
Composition, engineering properties and behavior of soils. Principles of soil mechanics. Experimental determination of engineering classification, strength and deformation characteristics of natural and artificially placed soils. Offered Fall.
Prerequisite: CE 3450, with a minimum grade of C-; CE 3250, (may be taken concurrently), with a minimum grade of C-
Restriction(s): Enrollment limited to students in the following programs: BS in Biomedical Engineering BS in Chemical Engineering BS in Civil Engineering BS in Electrical Engineering BS in Industrial Engineering BS in Mechanical Engineering, enrollment limited to students in the College of Engineering.

Course Material Fees: $30

CE 4600 Transportation Engineering Cr. 3
Transportation functions; transportation systems including highways, railways and airways. Techniques of transportation systems analysis including optimization, network flows and queueing theory. Offered Winter.
Prerequisite: BE 3220, with a minimum grade of C-; BE 2100, with a minimum grade of C-
Restriction(s): Enrollment limited to students in the following programs: BS in Biomedical Engineering BS in Chemical Engineering BS in Civil Engineering BS in Electrical Engineering BS in Industrial Engineering BS in Mechanical Engineering, enrollment limited to students in the College of Engineering.

Course Material Fees: $10

CE 4640 Transportation Design Cr. 3
A description of design elements of various system components of transportation; including the driver, vehicle and roadway. Traffic flow design elements including volume, density and speed; intersection design elements including delay, capacity and accident countermeasures and terminal design elements including inflow, outflow and circulation. Offered Fall.
Prerequisite: CE 4600, with a minimum grade of C-
Restriction(s): Enrollment limited to students in the following programs: BS in Biomedical Engineering BS in Chemical Engineering BS in Civil Engineering BS in Electrical Engineering BS in Industrial Engineering BS in Mechanical Engineering, enrollment limited to students in the College of Engineering.

CE 4850 Engineering Economy Cr. 3
Economic analysis of engineering projects. Selection of appropriate interest rates and methods of analysis, analysis and evaluation of alternatives, depreciation and tax considerations, and use of accounting data in comparison of investment alternatives. Offered Fall.
Restriction(s): Enrollment limited to students in the following programs: BS in Biomedical Engineering BS in Chemical Engineering BS in Civil Engineering BS in Electrical Engineering BS in Industrial Engineering BS in Mechanical Engineering, enrollment limited to students in the College of Engineering.

Course Material Fees: $10
Equivalent: IE 4850

CE 4990 Directed Study Cr. 1-4
Supervised study and instruction in civil engineering. Written report required. Offered Every Term.
Restriction(s): Enrollment limited to students in the following programs: BS in Biomedical Engineering BS in Chemical Engineering BS in Civil Engineering BS in Electrical Engineering BS in Industrial Engineering BS in Mechanical Engineering, enrollment limited to students in the College of Engineering.
Repeatable for 6 Credits

CE 4995 (WI) Senior Design Project Cr. 3
Capstone design experience through civil engineering projects. Satisfies General Education Writing Intensive requirement. Offered Winter.
Restriction(s): Enrollment limited to students in the following programs: BS in Biomedical Engineering BS in Chemical Engineering BS in Civil Engineering BS in Electrical Engineering BS in Industrial Engineering BS in Mechanical Engineering, enrollment limited to students in the College of Engineering.

CE 5220 Environmental Chemistry Cr. 3
Fundamentals of aqueous chemistry for environmental engineers and scientists. Basic chemistry, equilibria, kinetics and thermodynamics; includes acid/base reactions, precipitation/dissolution, oxidation/reduction reactions and partitioning. Offered Biannually.

Course Material Fees: $5

CE 5230 Water Supply and Wastewater Engineering Cr. 4
Analysis and design of water supply and wastewater treatment systems; water distribution systems; treatment of municipal water supplies, including sedimentation, softening, filtration and disinfection; design of sanitary and storm sewers; primary, secondary and tertiary treatment plant design; sludge handling. Offered Yearly.
Prerequisite: CE 4210, with a minimum grade of C-

CE 5350 Introduction to Structural Dynamics Cr. 4
Prerequisite: ME 3400, with a minimum grade of C-; CE 4400, with a minimum grade of C-

CE 5370 Finite Element Analysis Fundamentals Cr. 4
Matrix structural analysis, discretization of continuous structural systems, stress analysis. Commercial finite element software preprocessing for developing finite element models; post-processing for evaluating analysis results. Offered Fall.
Prerequisites: (CE 4400 with a minimum grade of C-)
CE 5410 Energy, Emissions, Environment (E3) Design Cr. 4
 Provides students the tools to uncover the relation between energy consumption and energy generation and optimize processes to take most advantage of low emitting energy options. Exposes students to design tools and methodologies from a diverse group of sources including US EPA, DOE, EIA, and the latest in emerging research. Offered Fall.
 Equivalent: AET 5410, STE 5410

CE 5510 Geotechnical Engineering I Cr. 4
 Site investigation, site improvement, bearing capacity and settlement of shallow foundations, axial capacity and lateral deflection of deep foundations, design of conventional earth retaining walls, and basics of slope stability analyses. Offered Fall.
 Prerequisites: (CE 4510 with a minimum grade of C-)

CE 5520 Geotechnical Engineering II Cr. 4
 Lateral earth pressure theories, design of conventional earth-retaining walls and of reinforced earth walls, anchored sheet-pile walls and cofferdams, fundamentals of soft-ground tunneling, two- and three-dimensional slope stability analyses, and static design of earth dams. Offered Biannually.
 Prerequisites: (CE 4510 with a minimum grade of C-)

CE 5610 Highway Design Cr. 4
 Application of standards, theory and practice in design of streets and highways. Design of streets and highways including cross section elements, shoulder and roadside features. Pavement design and rehabilitation work. Offered Yearly.
 Prerequisites: (CE 4640 with a minimum grade of C-)

CE 5810 Legal Aspects of Engineering and Construction Cr. 3
 Business of contracting, construction, liabilities of owner, architect, engineer and contractor. Rights in land, boundaries and foundations. Case studies. Offered Fall.
 Course Material Fees: $5

CE 5830 Business of Engineering Cr. 3
 Defining the engineering company, creating the organization, support services, business development, project management, scheduling, budgeting and profitability, operations, financial management and risk management. Offered Every Term.
 Prerequisites: (CE 4850 with a minimum grade of C-)

CE 5995 Special Topics in Civil Engineering I Cr. 4
 Topics to be announced in Schedule of Classes. Offered Irregularly.

Repeatable for 16 Credits

CE 6010 Introduction to Construction Engineering and Management Cr. 3
 Prerequisites: (CE 4850 with a minimum grade of C-)
 Course Material Fees: $5

CE 6050 Construction Cost Estimating Cr. 3
 Estimating construction costs of engineering projects including materials, man-hours, equipment and overhead. Emphasis on construction equipment, including productivity and planning. Bidding and bid documents. Offered Biannually.
 Prerequisites: (CE 4850 with a minimum grade of C-)

CE 6060 Construction Techniques and Methods Cr. 3
 Construction techniques and methods for excavation, foundations, concrete, wood, steel, masonry, heavy construction, wastewater treatment plants, highways and roads, high rise structures, bridges, and tunneling projects. Offered Biannually.
 Prerequisites: (CE 4450 with a minimum grade of C-)

CE 6130 Open Channel Hydraulics Cr. 4
 Theoretical development of equations governing flow in open channels. Application to real-world engineering problems involving water surface profiles, flood studies, and river. Offered Winter.
 Prerequisites: (CE 3250 with a minimum grade of C-)

CE 6150 Hydrologic Analysis and Design Cr. 4
 Principles of surface water hydrology and their application for evaluation of floods and the design of surface runoff control system; watershed characteristics; design storms and SCS methods; unit hydrographs; hydrologic models; application of computer methods. Offered Biannually.
 Prerequisites: CE 6130,

CE 6190 Groundwater Cr. 4
 Historical background, aquifers and aquitard, saturated and unsaturated flow, sources of ground water contamination, artificial recharge of ground water, development of ground water basins and efficient use of ground water resources. Offered Yearly.
 Prerequisites: (CE 3250 with a minimum grade of C-)

CE 6270 Sustainability Assessment and Management Cr. 3
 Sustainability assessment and management for engineering design and development; theoretical, regulatory, and practical implications; Detroit and global applications. Offered Yearly.
 Prerequisites: (CE 4210 with a minimum grade of C-)
 Equivalent: STE 6270

CE 6330 Advanced Structural Analysis Cr. 4
 Prerequisites: (CE 4410 with a minimum grade of C-)

CE 6340 Bridge Design and Evaluation Cr. 4
 Concepts, procedures, methods of design and condition evaluation for modern highway bridges, according to current specifications. Entire system is covered, including superstructure, substructure, and their connections. Offered Biannually.
 Prerequisites: (CE 4420 with a minimum grade of C-)

CE 6370 Advanced Reinforced Concrete Design Cr. 4
 Theory and design of two-way slabs, footings, retaining walls, shear walls, and composite beams using ultimate strength design. Precast and prestressed concrete fundamentals. Offered Winter.
 Prerequisites: (CE 4420 with a minimum grade of C-)

CE 6410 Advanced Steel Design Cr. 4
 Advanced topics of structural steel design: thin walled rolled and built-up members, beam columns, lateral torsional buckling, steel fatigue design, connection details. Steel design project. Offered Winter.
 Prerequisites: (CE 4420 with a minimum grade of C-)

CE 6580 Geoenvironmental Engineering I Cr. 4
 Properties and test methods for natural and synthetic materials used in landfills; analysis of chemical interactions, flow mechanisms, stability and settlement for the design of landfill components. Offered Yearly.
 Prerequisites: (CE 4510 with a minimum grade of C-)
CE 6660 Pavement Management Systems: Principles and Practices Cr. 4  
Principles and practices of pavement management at the network and project level: serviceability, pavement design models, economic analysis, and priority programming. Offered Yearly.  
Prerequisite: (CE 4640 with a minimum grade of C-)  
CE 6880 Building Information Modeling (BIM) Cr. 3  
Lectures, hands-on demonstrations and lab exercises to familiarize students with concepts and tools in Revit Architecture 2010 software; how software integrates 3D and 2D modeling. Offered Biannually.  
Prerequisites: (CE 3010 with a minimum grade of C-)  
CE 6910 Pharmaceutical Waste: Environmental Impact and Management Cr. 2-3  
Course designed for advanced professional and graduate students with sufficient chemistry and/or biological sciences background who are interested in the environmental impact, management, and regulation of waste pharmaceuticals as emerging issues. Offered Spring/Summer.  
Restriction(s): Enrollment is limited to Graduate level students.  
Equivalent: PSC 6910  
CE 6991 Internship in Industry Cr. 1-4  
Written report describing internship experience. Offered Every Term.  
CE 7020 Construction Safety Cr. 4  
Safety problems in the construction industry and their technical and managerial solutions, construction accident and failure analysis and control. Safety program design and implementation with TQM integration. Offered Yearly.  
Prerequisite: CE 6010, with a minimum grade of C  
Restriction(s): Enrollment is limited to Graduate level students.  
CE 7070 Risk and Reliability in Civil Engineering Cr. 4  
Uncertainty in civil engineering practice (e.g., loads, traffic, water demand, construction quality). Reliability theory based on probabilistic and statistical methods. Reliability-based engineering design and decision making. Offered Biannually.  
Restriction(s): Enrollment is limited to Graduate level students.  
CE 7080 Civil Engineering Research Methods Cr. 4  
Methods of data collecting and statistical analysis in context of civil engineering. Applications of advanced statistical analysis techniques, theory, discussion of methodological limitations. Offered Biannually.  
Restriction(s): Enrollment is limited to Graduate level students, enrollment limited to students in the College of Engineering.  
CE 7190 Groundwater Modeling Cr. 4  
Analytical and numerical models of groundwater hydraulics and contaminant transport. Application of theoretical material developed in CE 6190. Case studies of model applications to real field problems. Offered Yearly.  
Prerequisite: CE 6190, with a minimum grade of C  
Restriction(s): Enrollment is limited to Graduate level students.  
CE 7220 Industrial Waste Treatment Cr. 4  
A study of the sources of specific industrial waste waters and their treatability by physical, chemical and biological processes, including the industries’ obligation in the prevention of stream pollution. Problems and solutions involved in combined treatment of industrial and domestic waste waters. Offered Biannually.  
Restriction(s): Enrollment is limited to Graduate level students.  
Course Material Fees: $10  
CE 7260 Surface Water-Quality Modeling and Management Cr. 4  
Principles and mechanisms governing the rate and transport of conventional and toxic pollutants in natural water; mathematical modeling of water quality in surface water systems; model applications for managing waste loads in lakes and rivers. Offered Irregularly.  
Restriction(s): Enrollment is limited to Graduate level students.  
CE 7300 Advanced Structural Mechanics Cr. 4  
Theory of bending and torsion of bars, beams on elastic foundations. Introduction to theory of thin plates. Linear elastic fracture mechanics, application to brittle solids. Offered Fall.  
Prerequisite: CE 6330, with a minimum grade of C  
Restriction(s): Enrollment is limited to Graduate level students.  
CE 7460 Advanced Composite Materials for Civil Infrastructure Cr. 4  
Restriction(s): Enrollment is limited to Graduate level students.  
CE 7530 Advanced Soil Mechanics Cr. 4  
Stress-strain and volume-change behavior of sands and clays for both drained and undrained loading conditions, to gain insight in mechanical behavior of foundation soils. Offered Biannually.  
Restriction(s): Enrollment is limited to Graduate level students.  
CE 7550 Geosynthetics Engineering Cr. 4  
Fundamental principles for testing, design, and construction of geosynthetics in civil engineering applications. Offered Biannually.  
Restriction(s): Enrollment is limited to Graduate level students.  
CE 7580 Environmental Remediation Cr. 4  
Site assessment; soil and groundwater investigation for remediation; application of remediation technologies; legislation related to remediation. Offered Yearly.  
Restriction(s): Enrollment is limited to Graduate level students.  
CE 7600 Highway Safety and Risk Management Cr. 4  
Safety aspects of streets and highways; planning, design, implementation and evaluation of highway safety improvement projects and programs. Highway risk analysis and risk management systems. Offered Biannually.  
Restriction(s): Enrollment is limited to Graduate level students.  
Course Material Fees: $15  
CE 7620 Traffic Engineering Control and Operation Cr. 4  
Traffic flow theories, macroscopic and microscopic models of traffic control, statistical analysis; design and application of intelligent transportation systems on traffic flow characteristics; evaluation. Offered Yearly.  
Restriction(s): Enrollment is limited to Graduate level students.  
Course Material Fees: $10
CE 7630 Urban Transportation Planning Cr. 4
Planning and analysis of urban transportation, travel demand models, land use planning and public transportation; household and origin-destination survey techniques; and demand elasticities multi-criteria evaluation. Offered Fall.
Restriction(s): Enrollment is limited to Graduate level students.
Course Material Fees: $5

CE 7640 Economic Analysis in Transportation Systems Cr. 4
Application of engineering economy and price theory in optimization of transportation systems; analysis of congestion costs, externalities, primary and secondary costs and benefits; evaluation of alternatives and completed projects and programs. Offered Biannually.
Restriction(s): Enrollment is limited to Graduate level students.

CE 7670 Advanced Traffic Signal Systems Cr. 4
Analysis and design of traffic signal systems. Hardware, communication and detection systems associated with microcomputer-based signal systems. Coordinated signal systems. Offered Biannually.
Prerequisite: CE 7620, with a minimum grade of C
Restriction(s): Enrollment is limited to Graduate level students.

CE 7680 Facilities Management Cr. 3
Buildings and grounds operations and maintenance, planning design and construction, facilities economics and financing, real estate administration, environmental health and safety, health issues. Offered Winter.
Prerequisite: CE 6010, with a minimum grade of C
Restriction(s): Enrollment is limited to Graduate level students.

CE 7685 Construction Contract Administration Cr. 3
Project documentation; project setup and contract directory development; adding new contracts; purchase orders; recording materials deliveries; producing daily reports; preparing minutes of meetings; log submittals and handling correspondence; tracking contracts and costs; setup and preparing progress payment requisitions, managing claims and change orders. Offered Biannually.
Prerequisite: CE 6010, with a minimum grade of C
Restriction(s): Enrollment is limited to Graduate level students.

CE 7690 Integrated Construction Project Management Cr. 3
Construction project management framework, construction project integration, project scope management, time management, cost management, quality management, procurement management, risk management, communication management. Offered Biannually.
Prerequisite: CE 7830, with a minimum grade of C
Restriction(s): Enrollment is limited to Graduate level students.

CE 7990 Directed Study Cr. 1-4
Offered Every Term.
Restriction(s): Enrollment is limited to Graduate level students.
Repeatable for 6 Credits

CE 7995 Special Topics in Civil Engineering II Cr. 4
A consideration of special subject matter in civil engineering. Topics to be announced in Schedule of Classes. Offered Irregularly.
Restriction(s): Enrollment is limited to Graduate level students.

CE 7996 Research Cr. 1-4
Offered Every Term.
Restriction(s): Enrollment is limited to Graduate level students.
Repeatable for 6 Credits

CE 8999 Master's Thesis Research and Direction Cr. 1-8
Offered Every Term.
Restriction(s): Enrollment limited to students with a class of Candidate Masters, enrollment is limited to Graduate level students.

CE 9990 Directed Study Cr. 1-4
Offered Every Term.
Restriction(s): Enrollment is limited to Graduate level students.
Repeatable for 12 Credits

CE 9991 Doctoral Candidate Status I: Dissertation Research and Direction Cr. 7.5
Offered Every Term.
Restriction(s): Enrollment is limited to Graduate level students.

CE 9992 Doctoral Candidate Status II: Dissertation Research and Direction Cr. 7.5
Offered Every Term.
Restriction(s): Enrollment is limited to Graduate level students.

CE 9993 Doctoral Candidate Status III: Dissertation Research and Direction Cr. 7.5
Offered Every Term.
Restriction(s): Enrollment is limited to Graduate level students.

CE 9994 Doctoral Candidate Status IV: Dissertation Research and Direction Cr. 7.5
Offered Every Term.
Restriction(s): Enrollment is limited to Graduate level students.

CE 9995 Candidate Maintenance Status: Doctoral Dissertation Research and Direction Cr. 0
Offered Every Term.
Restriction(s): Enrollment is limited to Graduate level students.
Repeatable for 0 Credits