The Department of Civil Engineering (CIVE) offers a complete undergraduate program to students on the Lincoln and Omaha campuses of the University of Nebraska (www.engineering.unl.edu/civil/ [http://www.engineering.unl.edu/civil]). Curriculum requirements are nearly identical on both campuses. The goal is to prepare students for entry into the civil engineering profession immediately after graduation or to pursue graduate-level work. The program educational objectives of the University of Nebraska civil engineering undergraduate program are to prepare our graduates to:

- apply their solid foundation in civil engineering toward the practice and to obtain an advanced-degree education toward a broad range of career choices;
- perform technical analysis or design of a complex system, component or process as acting representative of governmental agencies, private consulting engineering firms, research organizations or industry;
- explain engineering concepts accurately and effectively to inform technical and non-technical audiences using appropriate verbal, written, virtual and graphical means;
- apply basic project management and business concepts and processes;
- engage in lifelong learning to foster technical growth, ethical conduct, and the practice of professional communication, teamwork and leadership skills; and
- obtain licensure in a profession, such as civil engineering, after the requisite number of years of practice.

As a professional discipline, civil engineering is closely related to the total human environment. In all professional endeavors, the civil engineer must consider ecological effects as well as the social, economic, and political needs of people.

The civil engineer designs systems to control and manage our water resources to provide electric power, agricultural irrigation, flood control, recreation, water supplies and wastewater treatment systems for our urban and industrial needs. The civil engineer plans, designs, and constructs our transportation systems including highways, railroads, waterways, and airports to connect rural, urban, and industrial areas. The civil engineer also designs and constructs housing and facilities for recreational, industrial, and commercial complexes, which comprise the urban environment.

It is the responsibility of civil engineering to minimize air, water, and land pollution and protect the environment. Instructional emphasis is placed on fundamental engineering principles derived from mathematics, chemistry, physics, and engineering science. These subjects provide a sound background for the subsequent introductory courses in environmental, geotechnical, structural, transportation, and water resources engineering.

Students are introduced to design concepts in the freshman year. Design is incorporated throughout the curriculum which culminates in CIVE 489, Senior Design Project. Instructional laboratories in environmental engineering, hydraulics, geotechnical engineering, structures, and surveying provide each student with an opportunity to learn, through individual participation, the operation of the testing equipment used to establish engineering design criteria and to monitor and model engineering facilities such as water and wastewater treatment plants, highway systems, river control systems, and structural systems.

**Professional Admission to Civil Engineering**

Students must apply for Professional Admission to the Civil Engineering Degree Program once they have completed 43 credits toward the degree. Once students have been professionally admitted, they are allowed to take 400-level courses to complete their degree. Department-specific Professional Admission requirements are:

- if the cumulative GPA is 2.7 or above, a grade of C or better must be earned in PHYS 2110, MENG 2230, MENG 3730, and MENG 3250
- if the cumulative GPA is below 2.7 a grade of C or better must be earned in all math, science, and engineering courses leading to the degree

To be considered for Professional Admission, the following College of Engineering general criteria must be met:

- completion of at least 12 credits (one semester) after admission to the College of Engineering,
- cumulative grade point average of 2.4 or greater, and
- no more than two declined admission requests to other engineering majors.

**Requirements**

(Lincoln and Omaha campuses)

**Degree Requirements - 130 hours**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td><strong>First Semester</strong></td>
<td></td>
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</tr>
<tr>
<td>MATH 1950</td>
<td>CALCULUS I</td>
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<tr>
<td>CHEM 1180</td>
<td>GENERAL CHEMISTRY I</td>
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<td>CHEM 1184</td>
<td>GENERAL CHEMISTRY I LABORATORY</td>
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<td>CIVE 112</td>
<td>INTRO TO CIVIL ENGR</td>
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<tr>
<td>CIST 1400</td>
<td>INTRODUCTION TO COMPUTER SCIENCE I</td>
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<td>ACE Elective</td>
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<tr>
<td><strong>Second Semester</strong></td>
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<td>MATH 1960</td>
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<tr>
<td>PHYS 2110</td>
<td>GENERAL PHYSICS I - CALCULUS LEVEL</td>
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<td>CMST 1110</td>
<td>PUBLIC SPEAKING FUNDS</td>
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<td></td>
<td>Computer Aided Design</td>
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<td>ACE Elective</td>
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<td><strong>Third Semester</strong></td>
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<td>MATH 1970</td>
<td>CALCULUS III</td>
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<tr>
<td>PHYS 2120</td>
<td>GENERAL PHYSICS-CALCULUS LEVEL</td>
<td>4</td>
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<tr>
<td>CIVE 221/ Cone 2210</td>
<td>GEOMETRIC CONTRL SYS</td>
<td>3</td>
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<tr>
<td>ENGL 3980</td>
<td>TECHNICAL WRITING ACROSS THE DISCIPLINES</td>
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<tr>
<td>MENG 2230</td>
<td>ENGINEERING STATICS</td>
<td>3</td>
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<td></td>
<td>Credits</td>
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<td><strong>Fourth Semester</strong></td>
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<tr>
<td>MATH 2350</td>
<td>DIFFERENTIAL EQUATIONS</td>
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<td>CIVE 361</td>
<td>HIGHWAY ENGINEERING</td>
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<tr>
<td>MENG 3250</td>
<td>MECHANICS OF ELASTIC BODIES</td>
<td>3</td>
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<td>MENG 3730</td>
<td>ENGINEERING DYNAMICS</td>
<td>3</td>
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<td>Professional Development Elective</td>
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<td><strong>Fifth Semester</strong></td>
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<td>STAT 3800</td>
<td>APPLIED ENGINEERING PROBABILITY AND STATISTICS</td>
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<tr>
<td>CIVE 310/ MENG 3100</td>
<td>FLUID MECHANICS</td>
<td>3</td>
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<tr>
<td>CIVE 319</td>
<td>HYDRAULICS LAB</td>
<td>1</td>
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</table>
CIVE 326  INTRODUCTION TO ENVIRONMENTAL ENGINEERING  3
CIVE 327  ENVIRONMENTAL ENGINEERING LABORATORY  1
CIVE 341  INTRODUCTION TO STRUCTURAL ENGINEERING  4

Sixth Semester
CIVE 378  MATERIALS OF CONSTRUCTION  3
CIVE 334  INTRODUCTION TO GEOTECHNICAL ENGINEERING  4
CIVE 352  INTRODUCTION TO WATER RESOURCES ENGINEERING  3
CIVE 385  PROF PRACT & MGMT IN CIVIL ENG  3
CIVE Technical Elective  3

Credits  15

Seventh Semester
Science Elective  4
Technical Elective  3
CIVE Design electives  6
ACE Elective  3

Credits  16

Eighth Semester
CIVE 489  SENIOR DESIGN PROJECT  3
Design Elective  3
Technical Electives  6
ACE Electives  3

Credits  16

Total Credits  130

1. ACE elective: Choose one course from each ACE Student Learning Outcome (SLO) 5, 6, 7, 8 and 9 elective courses.
2. Computer Aided Design: AE 2250 or equivalent.
3. PHYS 2120: CHEM 1190 & CHEM 1194 is an acceptable substitute.
4. CIVE 221: CONE 2210 is acceptable substitute.
5. ENGL 3980: ENGR 3000 is acceptable substitute.
6. Professional Development Elective: The Department has a list of acceptable courses.
7. Technical elective: The department has a list of acceptable courses.

CIVE Design Electives
CIVE Design Electives: Nine (9) credits must be taken from courses designated as Design Electives. CIVE Design electives must be taken from at least two sub-disciplines.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>CIVE 419</td>
<td>FLOW SYSTEMS DESIGN</td>
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<tr>
<td>CIVE 425</td>
<td>PROC DSGN/WTR SUP &amp; WAST TRMT</td>
<td>3</td>
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<tr>
<td>CIVE 426</td>
<td>DSGN WATER TREATMT FACILITIES</td>
<td>3</td>
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<tr>
<td>CIVE 427</td>
<td>DSGN OF WSTWTR TRMT &amp; DSPL FAC</td>
<td>3</td>
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<tr>
<td>CIVE 436</td>
<td>FOUNDATION ENGINEER</td>
<td>3</td>
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<tr>
<td>CIVE 440</td>
<td>REINFORCED CONCRETE DESIGN I</td>
<td>3</td>
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<tr>
<td>CIVE 441</td>
<td>STEEL DESIGN I</td>
<td>3</td>
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<tr>
<td>CIVE 452</td>
<td>WATER RESOURCES DEVL</td>
<td>3</td>
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<tr>
<td>CIVE 462</td>
<td>HIGHWAY DESIGN</td>
<td>3</td>
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<tr>
<td>CIVE 463</td>
<td>TRAFFIC ENGINEERING</td>
<td>3</td>
</tr>
</tbody>
</table>

Civil Engineering Technical Electives
Technical Electives: Technical electives will be selected by the student in consultation with his/her adviser to formulate a coherent program in civil engineering. Two technical electives (up to six credits) can be taken from MENG 2000, ECEN 2110, CONE 2060 or any approved course in science, mathematics, or other engineering areas approved by the department. The department has an approved list.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tr>
<td>CIVE 421</td>
<td>HAZARDOUS WASTE MGT &amp; TREATMT</td>
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<td>CIVE 422</td>
<td>POLLUTN PREVENTN:PRINC &amp; PRACT</td>
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<td>CIVE 424</td>
<td>SOLID WASTE MGT ENGR</td>
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<td>CIVE 430</td>
<td>FUND WATR QUAL MODEL</td>
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<td>CIVE 431</td>
<td>SMALL TREATMENT SYSTEMS</td>
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<td>CIVE 432</td>
<td>BIOREMEDIATION OF HAZARDOUS WASTES</td>
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<tr>
<td>CIVE 434</td>
<td>SOIL MECHANICS II</td>
<td>3</td>
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<tr>
<td>CIVE 439</td>
<td>INTRODUCTION TO BRIDGE ENGINEERING</td>
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<td>CIVE 443</td>
<td>ADVANCED STRUCTURAL ANALYSIS</td>
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<td>CIVE 444</td>
<td>STR DESIGN &amp; PLANNING</td>
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<tr>
<td>CIVE 446</td>
<td>STEEL DESIGN II</td>
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<td>CIVE 447</td>
<td>REINFORC CONCRETE II</td>
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<td>CIVE 451</td>
<td>INTRODUCTION TO FINITE ELEMENT</td>
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<td>CIVE 452</td>
<td>WATER RESOURCES DEVL</td>
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<td>CIVE 454</td>
<td>HYDRAULIC ENGR</td>
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<td>CIVE 455</td>
<td>NONPOINT POLLUTION</td>
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<td>CIVE 456</td>
<td>SURFACE WATER HYDRO</td>
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<td>CIVE 458</td>
<td>GROUND WATER ENGINEERING</td>
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<td>CIVE 459</td>
<td>RELIABILITY OF STRUCTURES</td>
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<td>CIVE 461</td>
<td>URBAN TRANS PLANNING</td>
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<td>CIVE 468</td>
<td>AIRPORT PLANNING AND DESIGN</td>
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<td>CIVE 469</td>
<td>COMPUTER-AIDED INTERCHANGE DESIGN</td>
<td>3</td>
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<tr>
<td>CIVE 472</td>
<td>PAVEMENT DESIGN &amp; EVALUATION</td>
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<td>CIVE 475</td>
<td>WATER QUALITY STRATEGY</td>
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<td>CIVE 481</td>
<td>COMPUTATIONAL PROBLEM SOLVING IN</td>
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<tr>
<td>CIVE 498</td>
<td>SPEC TOPICS IN CIVIL ENGR</td>
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</tr>
</tbody>
</table>

For more information...
Call 402-554-2462 or visit www.engineering.unl.edu/civil/ (http://www.engineering.unl.edu/civil)

CIVE 112 INTRO TO CIVIL ENGR (1 credit)
Introduction to civil engineering as a career by use of case studies; alternate approaches to engineering designs illustrated by use of engineering principles.

CIVE 125 ECOLOGY, THE ENVIRONMENT AND THE ENGINEER (3 credits)
Investigation into the nature of ecology, man's relation with the environment and man's chance of survival in that environment, and the potential influence, for good or bad, of modern man's activities.

CIVE 130 COMPUTER-AIDED DESIGN (2 credits)
Use of computer-aided design software to communicate engineering ideas. Specifications, dimensioning, tolerancing, 2- and 3-D model development, topographic mapping, and process layout with environmental, bioprocess, and biomedical emphases.

Prerequisite(s)/Corequisite(s): CIVE112, not open to nondegree students
CIVE 221 GEOMETRIC CONTRL SYS (3 credits)
Introduction to the theory and application of mensuration and geometric information processing in civil engineering. Measurement of distance, direction, elevation and location using mechanical, electronic and satellite systems; collection of field data, error propagation; elementary geometric data bases for design, construction, operation and control of civil works. (Cross-listed with CONE2210)
Prerequisite(s)/Corequisite(s): MATH1950, not open to nondegree students

CIVE 252 CONSTRUCTION MATERIALS LAB (1 credit)
Introduction to ASTM and AASHTO standard procedures used to measure soil and concrete properties; common modifications to soil and concrete mixes are discussed and analyzed.
Prerequisite(s)/Corequisite(s): MATH1950 and CNST2510 coreq

CIVE 310 FLUID MECHANICS (3 credits)
Fluid statics, equations of continuity, momentum, and energy; dimensional analysis and dynamic similitude. Applications to: flow meters; fluid pumps and turbines; viscous flow and lubrication; flow in closed conduits and open channels. Two-dimensional potential flow.
Prerequisite(s)/Corequisite(s): MATH 2350; and MENG 3730 or EMEC 3730; MENG 2000 coreq. Not open to non-degree graduate student.

CIVE 319 HYDRAULICS LAB (1 credit)
Hydraulic experiments and demonstrations. Velocity, pressure and flow measurements; pipe flow, open channel flow; hydraulic structures and machinery, hydrologic and sediment measurement and student projects.
Prerequisite(s)/Corequisite(s): CIVE310 pre/coreq

CIVE 326 INTRODUCTION TO ENVIRONMENTAL ENGINEERING (3 credits)
Introduction to the principles of environmental engineering, including water quality, atmospheric quality, pollution prevention, and solid and hazardous wastes engineering. Design of water, air, and waste management systems.
Prerequisite(s)/Corequisite(s): CHEM1180 and MATH2350.

CIVE 327 ENVIRONMENTAL ENGINEERING LABORATORY (1 credit)
Environmental engineering experiments, demonstrations, field trips, and projects. Experiments include the measurement and determination of environmental quality parameters such as solids, dissolved oxygen, biochemical and chemical oxygen demand, and alkalinity.
Prerequisite(s)/Corequisite(s): CHEM1180 and MATH2350 and CIVE326 coreq

CIVE 328 CONCRETE MATERIALS (2 credits)
Prerequisite(s)/Corequisite(s): MENG 2230 and CHEM 1180, not open to non-degree graduate students

CIVE 334 INTRODUCTION TO GEOTECHNICAL ENGINEERING (4 credits)
Soil composition, structure and phase relationships; soil classification. Principles of effective stress; loading induced subsurface stresses; load history; deformation and failure of soils. Elastic and limit analysis with applications to design for bearing capacity, settlement, retaining walls and slope stability. Steady state seepage.
Prerequisite(s)/Corequisite(s): EMEC 3250 or MENG 3250; Coreq: CIVE 310.

CIVE 341 INTRODUCTION TO STRUCTURAL ENGINEERING (4 credits)
Introduction to the analysis and design of structural systems. Analyses of determinate and indeterminate trusses, beams, and frames are covered, and design philosophies for structural engineering are explored. Laboratory experiments deal with the analysis of determinate and indeterminate structures.
Prerequisite(s)/Corequisite(s): MENG 3250 or EMEC3250

CIVE 352 INTRODUCTION TO WATER RESOURCES ENGINEERING (3 credits)
Introduction to water resources engineering design and planning, surface hydrology, groundwater hydraulics, reservoirs and other control structures. Introduction to field measurement and computational methods in water resources.
Prerequisite(s)/Corequisite(s): CIVE310 or MENG3100

CIVE 361 HIGHWAY ENGINEERING (3 credits)
Introduction to the principles of highway engineering and traffic operations and control.
Prerequisite(s)/Corequisite(s): MENG 2230 or EMEC 2230; and CIVE 221 or CONE 2210.

CIVE 378 MATERIALS OF CONSTRUCTION (3 credits)
(LEC 2, Lab 2) Introduction to the behavior, testing and design of soil, Portland cement concrete, steel, wood and composites. Experiments covering the concepts of stress and strain under axial, torsional, shear and flexural loading conditions. Common ASTM laboratory test procedures and specifications, field quality control tests and statistical applications.
Prerequisite(s)/Corequisite(s): MENG 3250 or EMEC3250

CIVE 385 PROF PRACT & MGMT IN CIVIL ENG (3 credits)
Basic elements of civil engineering practice. Roles of all participants in the process owners, designers, architects, contractors, and suppliers. Basic concepts in business management, public policy, leadership, and professional licensure. Professional relations, civic responsibilities, and ethical obligations for engineering practice. Project management, contracts, allocation of resources, project estimating, planning, and controls.
Prerequisite(s)/Corequisite(s): Junior standing and CIVE major, not open to nondegree students

CIVE 401 CIVIL ENGINEERING SYSTEMS (3 credits)
Systems analysis approach to civil engineering problems. System model elements and principles of systems theory with applications to civil engineering. (Cross-listed with CIVE801)
Prerequisite(s)/Corequisite(s): MATH2350

CIVE 419 FLOW SYSTEMS DESIGN (3 credits)
Application of hydraulic principles to the design of water distribution systems, wastewater and stormwater collection systems, channelized flow systems and treatment facilities. (Cross-listed with CIVE 819)
Prerequisite(s)/Corequisite(s): CIVE 326 or CIVE 327; CIVE 352 coreq.

CIVE 421 HAZARDOUS WASTE MGT & TREATMNT (3 credits)
Survey of the hazardous waste management system in the USA. State and federal hazardous waste regulations. Chemical characteristics of hazardous waste and unit operations and processes used for treatment of soil, water, and air. (Cross-listed with CIVE821)
Prerequisite(s)/Corequisite(s): CIVE326, not open to nondegree students

CIVE 422 POLLUTN PREVENTN:PRINC & PRACT (3 credits)
Introduction to pollution prevention (P2) and waste minimization methods. Practical applications to small businesses and industries. Legislative and historical development of P2 systems analysis, waste estimation, P2 methods, P2 economics, and sources of P2 information. (Cross-listed with CIVE 822.)

CIVE 424 SOLID WASTE MGT ENGR (3 credits)
Planning design and operation of solid waste collection processing, treatment, and disposal systems including materials, resources and energy recovery systems. (Cross-listed with CIVE824)
Prerequisite(s)/Corequisite(s): CIVE326 and CIVE334

CIVE 425 PROC DSGN/WTR SUP & WAST TRMT (3 credits)
(LEC 3) Design of unit operations and processes associated with drinking water and wastewater treatment facilities.
Prerequisite(s)/Corequisite(s): CIVE326 and CIVE310
CIVE 426 DSGN WATER TREATMNT FACILITIES (3 credits)
Analyses of water supplies and design of water treatment and distribution systems. (Cross-listed with CIVE826)
Prerequisite(s)/Corequisite(s): CIVE425

CIVE 427 DSGN OF WSTWTR TRMT & DPLFAC (3 credits)
Analysis of systems for wastewater treatment and disposal. (Cross-listed with CIVE827)
Prerequisite(s)/Corequisite(s): CIVE425

CIVE 430 FUND WATR QUAL MODEL (3 credits)
A comprehensive study of water quality and the effects of various water pollutants on the aquatic environment; modeling of water quality variables. (Cross-listed with CIVE830)
Prerequisite(s)/Corequisite(s): CIVE326

CIVE 431 SMALL TREATMENT SYSTEMS (3 credits)
Design of small and decentralized wastewater management systems. (Cross-listed with CIVE 831.)
Prerequisite(s)/Corequisite(s): Coreq: CIVE 425. Not open to non-degree graduate students.

CIVE 432 BIOREMEDIATION OF HAZARDOUS WASTES (3 credits)
Principles, applications, and limitations of bioremediation of hazardous wastes and design of some bioremediation systems.
Prerequisite(s)/Corequisite(s): CIVE326 and (CIVE310 or MENG3100), not open to nondegree students.

CIVE 434 SOIL MECHANICS II (3 credits)
(Lecture 3, option Lab 3) Application of the effective stress principle to shear strength of cohesive soils; analysis of stability of slopes. Development of continuum relationships for soils; solutions for stresses and displacements for an elastic continuum, solution of the consolidation equation for various initial and boundary conditions. (Cross-listed with CIVE834)
Prerequisite(s)/Corequisite(s): CIVE334

CIVE 436 FOUNDATION ENGINEER (3 credits)
(Lecture 3, Optional Lab 3) Subsoil exploration and interpretation; selection of foundation systems; determination of allowable bearing capacity and settlement; design of deep foundations; pile driving analysis; control of groundwater. (Cross-listed with CIVE836)
Prerequisite(s)/Corequisite(s): CIVE334

CIVE 439 INTRODUCTION TO BRIDGE ENGINEERING (3 credits)
Structural types, bridge loads, design of bridge slabs, steel girder bridges, and prestressed concrete girder bridges. Evaluation of existing bridges. Problems related to fatigue and corrosion. Field testing of bridges. (Cross-listed with CIVE839)
Prerequisite(s)/Corequisite(s): CIVE440 or CIVE441 or CIVE840

CIVE 440 REINFORCED CONCRETE DESIGN I (3 credits)
Introduction to the design of reinforced concrete building components. Emphasis is placed on the design of flexural and compression members, simple walls, foundations, and floor systems using the latest ACI design requirements. (Cross-listed with CIVE840)
Prerequisite(s)/Corequisite(s): CIVE341

CIVE 441 STEEL DESIGN I (3 credits)
Introduction to the design concepts for structural steel building components. Design of tension members, bolted and welded connections, column members, and beam members are covered. Limit states design concepts are used throughout the course, and emphasis is placed on behavior of members and code design procedures.
Prerequisite(s)/Corequisite(s): CIVE341

CIVE 443 ADVANCED STRUCTURAL ANALYSIS (3 credits)
Matrix analysis methods and computer solutions for indeterminate structures. Additional topics: static condensation, shear deformation, and non-prismatic members in matrix-based analyses, moment distribution method, load cases and load combinations for buildings and bridges, and influence lines and analysis for moving loads. (Cross-listed with CIVE 843)
Prerequisite(s)/Corequisite(s): CIVE 341. Not open to non-degree graduate students.

CIVE 444 STR DESIGN & PLANNING (3 credits)
(Lect 2, Lab 2) Principles of design of steel and reinforced concrete structural building systems, planning of building vertical and horizontal load resisting systems, and bridge systems. Several design projects involve indeterminate analysis and design concepts for both steel and reinforced concrete. (Cross-listed with CIVE844)
Prerequisite(s)/Corequisite(s): CIVE440 and CIVE441

CIVE 446 STEEL DESIGN II (3 credits)
A continuation of CIVE 441. The principles and procedures used in design of steel buildings, design of plate girders, design and analysis of building systems, design and analysis of composite steel-concrete building systems, innovative building systems, and introduction to seismic design of steel buildings. Plate buckling, beam, column, and beam-column design. Frame stability. Introduction to connection design. (Cross-listed with CIVE846)
Prerequisite(s)/Corequisite(s): CIVE441

CIVE 447 REINFORC CONCRETE II (3 credits)
Shear friction theory, strut-and-tie modeling, anchorage, deflection, slender and bi-axially loaded members, torsion, two-way action and punching shear, and footing design. Excel spreadsheets are developed and used for various designs. (Continuation of topics covered in CIVE 440/840.) (Cross-listed with CIVE847)
Prerequisite(s)/Corequisite(s): CIVE440 or CIVE840

CIVE 451 INTRODUCTION TO FINITE ELEMENT ANALYSIS (3 credits)
Matrix methods of analysis. The finite element stiffness method. Computer programs. Applications to structures and soils. Introduction to finite element analysis of fluid flow. (Cross-listed with CIVE851)
Prerequisite(s)/Corequisite(s): MENG 3250 or EMEC 3250; and MENG 4800 or EMEC 4800.

CIVE 452 WATER RESOURCES DEVL (3 credits)
Theory and application of systems engineering with emphasis on optimization and simulation techniques for evaluating alternatives in water resources developments related to water supply, flood control, hydropower, drainage, water quality, water distribution, irrigation and water measurement. (Cross-listed with CIVE852)
Prerequisite(s)/Corequisite(s): CIVE352

CIVE 454 HYDRAULIC ENGR (3-4 credits)
(Lecture 2-3, Lab 0-3) Fundamentals of hydraulics with applications of mechanics of solids, mechanics of fluids; engineering economics to the design of hydraulic structures, continuity, momentum; energy principles are applied to special problems from various branches of hydraulic engineering. (Cross-listed with CIVE854)
Prerequisite(s)/Corequisite(s): CIVE352

CIVE 455 NONPOINT POLLUTION (3 credits)
Identification, characterization, and assessment of nonpoint source pollutants; transport mechanisms and remediation technologies; design methodologies and case studies. (Cross-listed with CIVE855)
Prerequisite(s)/Corequisite(s): CIVE326 and CIVE352

CIVE 456 SURFACE WATER HYDRO (3 credits)
Advanced topics in surface water hydrology including parametric and stochastic processes and systems analysis of hydrologic problems with particular emphasis on the application of techniques in the design of engineering particles. (Cross-listed with CIVE856)
Prerequisite(s)/Corequisite(s): CIVE352

CIVE 458 GROUND WATER ENGINEERING (3 credits)
The application of engineering principles to the movement of ground water. The influence of the physical and geologic environment on ground water hydraulics, water well hydraulics and aquifer evaluation. Emphasis is placed on practical ground water engineering problems. (Cross-listed with CIVE858)
Prerequisite(s)/Corequisite(s): CIVE352.
CIVE 459 RELIABILITY OF STRUCTURES (3 credits)
Fundamental concepts related to structural reliability, safety measures, load models, resistance models, system reliability, optimum safety levels, and optimization of design codes. 
Prerequisite(s)/Corequisite(s): CIVE 341. Not open to nondegree students.

CIVE 461 URBAN TRANS PLANNING (3 credits)
Development of urban transportation planning objectives and goals. Data collection procedures, land use and travel forecasting techniques, trip generation, trip distribution, modal choice analysis, and traffic assignment. Site development and traffic impact analysis. (Cross-listed with CIVE861)
Prerequisite(s)/Corequisite(s): CIVE361

CIVE 462 HIGHWAY DESIGN (3 credits)
Design of roadways, interchanges, intersections, parking facilities, and land development site access and circulation. Emphasis on design projects. (Cross-listed with CIVE862)
Prerequisite(s)/Corequisite(s): CIVE361

CIVE 463 TRAFFIC ENGINEERING (3 credits)
Design of signalized intersections, arterial street and network signal systems, and freeway control systems. Emphasis on design projects. (Cross-listed with CIVE863)
Prerequisite(s)/Corequisite(s): CIVE361

CIVE 468 AIRPORT PLANNING AND DESIGN (3 credits)
Planning and design of general aviation and air-carrier airports. Land-side components include vehicle ground access systems, vehicle circulation parking and terminal buildings. Air-side components include aircraft apron-gate area, taxiway system, runway system and air traffic control facilities and airspace. Emphasis on design projects. (Cross-listed with CIVE868)
Prerequisite(s)/Corequisite(s): CIVE361

CIVE 469 COMPUTER-AIDED INTERCHANGE DESIGN (3 credits)
Principles of high-speed traffic operations, safety, and decision making related to critical design parameters used for optimal interchange geometric design through development of an interchange design project using graphical and civil engineering software. (Cross-listed with CIVE869)
Prerequisite(s)/Corequisite(s): CIVE 462; not open to non-degree graduate students.

CIVE 471 BITUMINOUS MATERIALS AND MIXTURES (3 credits)
Understanding of the physical, chemical, geometrical, and mechanical characteristics and practical applications of bituminous materials and mixtures. Fundamental mechanics for elastic and inelastic materials and basic theories associated with mechanical data analyses and designs. Recent advances and significant research outcomes for further discussions. Applications of theories to laboratory and field testing. (Cross-listed with CIVE 871)
Prerequisite(s)/Corequisite(s): CIVE 378. Not open to non-degree graduate students.

CIVE 472 PAVEMENT DESIGN&EVALUATION (3 credits)
Thickness design of flexible and rigid pavement systems for highways and airports; design of paving materials; evaluation and strengthening of existing pavements. (Cross-listed with CIVE872)
Prerequisite(s)/Corequisite(s): CIVE 334

CIVE 475 WATER QUALITY STRATEGY (3 credits)
Holistic approach to the selection and analysis of planning strategies for protecting water quality from nonpoint sources of contamination. Introduction to the use of methods of analyzing the impact of strategies on whole systems and subsystems for selecting strategies; and for evaluating present strategies.
Prerequisite(s)/Corequisite(s): Senior standing, not open to nondegree students

CIVE 476 CONSTRUCTION COST CONTROLS (3 credits)
Development of cost accounting principles and financial controls appropriate for construction contractors. Includes purchasing policies and procedure, labor and equipment cost reporting techniques, accounting procedures for control of materials and supplies, billing methods, principles of financial reporting and analysis. 
Prerequisite(s)/Corequisite(s): ACCT 2010 and ACCT 2020.

CIVE 481 COMPUTATIONAL PROBLEM SOLVING IN CIVIL ENGINEERING (3 credits)
Introduction of numerical methods to solve problems in civil engineering, including finding roots of equations, solving linear algebra equations, optimization, curve fitting, numerical differentiation and integration, and finite difference method. Computational methods in numerical integration, matrix operations and ordinary differential equations as they apply to civil engineering problems. (Cross-listed with CIVE 881)
Prerequisite(s)/Corequisite(s): Not open to non-degree graduate students.

CIVE 489 SENIOR DESIGN PROJECT (3 credits)
Requires the formulation and completion of a civil engineering design project. Course provides senior civil engineering students with the opportunity to apply engineering concepts and principles to a comprehensive design project of multiple sub-disciplinary nature. The principal objectives are for students to develop an understanding of the entire life-cycle of civil engineering projects with emphasis on the development of a unified and sustainable design that addresses the client’s needs; project team work; strong engineer-client relationships; and effective project communications.
Prerequisite(s)/Corequisite(s): Senior standing and CIVE 385

CIVE 498 SPEC TOPICS IN CIVIL ENGR (1-6 credits)
Special problems, topics, or research in civil engineering. (Cross-listed with CIVE898)

CIVE 801 CIVIL ENGINEERING SYSTEMS (3 credits)
Systems analysis approach to civil engineering problems. System model elements and principles of systems theory with applications to civil engineering. (Cross-listed with CIVE401)
Prerequisite(s)/Corequisite(s): MATH3350

CIVE 819 FLOW SYSTEMS DESIGN (3 credits)
Application of hydraulic principles to the design of water distribution systems, wastewater and stormwater collection systems, channelized flow systems and treatment facilities. (Cross-listed with CIVE 419)
Prerequisite(s)/Corequisite(s): CIVE 326 or CIVE 327; Corequisite: CIVE 352

CIVE 821 HAZARDOUS WASTE MANAGEMENT AND TREATMENT (3 credits)
Survey of the hazardous waste management system in the USA. State and federal hazardous waste regulations. Chemical characteristics of hazardous waste and unit operations and processes used for treatment of soil, water, and air. (Cross-listed with CIVE 421)
Prerequisite(s)/Corequisite(s): CIVE326; not open to non-degree graduate students

CIVE 822 POLLUTION PREVENTN:PRINC/PRACT (3 credits)
Introduction to pollution prevention (P2) and waste minimization methods. Practical applications to small businesses and industries. Legislative and historical development of P2 systems analysis, waste estimation, P2 methods, P2 economics, and sources of P2 information. (Cross-listed with CIVE 422)

CIVE 823 PHYS/CHEM TRMT PROC ENV ENGR (3 credits)
Evaluation and analysis of physical and chemical unit operations and processes applied to the treatment of water, wastewater, and hazardous wastes.
Prerequisite(s)/Corequisite(s): CIVE326 and CIVE425
CIVE 824 SOLID WASTE MGT ENGR (3 credits)
Planning design and operation of solid waste collection processing, treatment, and disposal systems including materials, resources and energy recovery systems. (Cross-listed with CIVE424)
Prerequisite(s)/Corequisite(s): CIVE326 and CIVE334

CIVE 826 DSGN WATER TREAT FAC (3 credits)
Analyses of water supplies and design of water treatment and distribution systems. (Cross-listed with CIVE426)
Prerequisite(s)/Corequisite(s): CIVE425

CIVE 827 DSGN WASTEWATER TRT & DISP FAC (3 credits)
Analysis of systems for wastewater treatment and disposal. (Cross-listed with CIVE427)
Prerequisite(s)/Corequisite(s): CIVE425

CIVE 828 ENVIRONMENTAL ENGINEERING CHEMISTRY (3 credits)
Basic concepts from general chemistry. Thermodynamic and kinetic basis for the composition of aquatic systems. Equilibrium chemistry, including acid-base reactions, reduction-oxidation reactions, metal speciation and precipitation, and gas/liquid partitioning.
Prerequisite(s)/Corequisite(s): CIVE 326. Not open to non-degree graduate students.

CIVE 829 BIOLOGICAL WASTE TREATMENT (3 credits)
Principles of biological processes and their application in the design of waste treatment systems.
Prerequisite(s)/Corequisite(s): CIVE 326 or equivalent.

CIVE 830 FUND WATR QUAL MODEL (3 credits)
A comprehensive study of water quality and the effects of various water pollutants on the aquatic environment; modeling of water quality variables. (Cross-listed with CIVE430)
Prerequisite(s)/Corequisite(s): CIVE326

CIVE 831 SMALL TREATMENT SYSTEMS (3 credits)
Design of small and decentralized waste water management systems. (Cross-listed with CIVE 431.)
Prerequisite(s)/Corequisite(s): Coreq: CIVE 425. Not open to non-degree graduate students.

CIVE 834 SOIL MECHANICS II (3 credits)
(Lecture 3, option Lab 3) Application of the effective stress principle to shear strength of cohesive soils; analysis of stability of slopes. Development of continuum relationships for soils; solutions for stresses and displacements for an elastic continuum, solution of the consolidation equation for various initial and boundary conditions. (Cross-listed with CIVE434)
Prerequisite(s)/Corequisite(s): CIVE334

CIVE 836 FOUNDATION ENGINEER (3-4 credits)
(Lecture 3, Optional Lab 3) Subsoil exploration and interpretation; selection of foundation systems; determination of allowable bearing capacity and settlement; design of deep foundations; pile driving analysis; control of groundwater. (Cross-listed with CIVE436)
Prerequisite(s)/Corequisite(s): CIVE334

CIVE 839 INTRODUCTION TO BRIDGE ENGINEERING (3 credits)
Structural types, bridge loads, design of bridge slabs, steel girder bridges, and prestressed concrete girder bridges. Evaluation of existing bridges. Problems related to fatigue and corrosion. Field testing of bridges. (Cross-listed with CIVE439)
Prerequisite(s)/Corequisite(s): CIVE440 or CIVE441 or CIVE840

CIVE 840 REINFORCED CONCRETE DESIGN I (3 credits)
Introduction to the design of reinforced concrete building components. Emphasis is placed on the design of flexural and compression members, simple walls, foundations, and floor systems using the latest ACI design requirements. (Cross-listed with CIVE440)
Prerequisite(s)/Corequisite(s): CIVE341

CIVE 842 STRUCTURAL DYNAMICS (3 credits)
Prerequisite(s)/Corequisite(s): CIVE341

CIVE 843 ADVANCED STRUCTURAL ANALYSIS (3 credits)
Matrix analysis methods and computer solutions for indeterminate structures. Additional topics: static condensation, shear deformation, and non-prismatic members in matrix-based analyses, moment distribution method, load cases and load combinations for buildings and bridges, and influence lines and analysis for moving loads.
Prerequisite(s)/Corequisite(s): CIVE 341. Not open to non-degree graduate students.

CIVE 844 STR DESIGN & PLANNING (3 credits)
(Lect 2, Lab 2) Principles of design of steel and reinforced concrete structural building systems, planning of building vertical and horizontal load resisting systems, and bridge systems. Several design projects involve indeterminate analysis and design concepts for both steel and reinforced concrete. (Cross-listed with CIVE444)
Prerequisite(s)/Corequisite(s): CIVE440 and CIVE441

CIVE 846 STEEL DESIGN II (3 credits)
A continuation of CIVE 441. The principles and procedures used in design of steel buildings, design of plate girders, design and analysis of building systems, design and analysis of composite steel-concrete building systems, innovative building systems, and introduction to seismic design of steel buildings. Plate buckling, beam, column, and beam-column design. Frame stability. Introduction to connection design. (Cross-listed with CIVE446)
Prerequisite(s)/Corequisite(s): CIVE441

CIVE 847 REINFORC CONCRETE II (3 credits)
Shear friction theory, strut-and-tie modeling, anchorage, deflection, slider and bi-axially loaded members, torsion, two-way action and punching shear, and footing design. Excel spreadsheets are developed and used for various designs. (Continuation of topics covered in CIVE 440/840.) (Cross-listed with CIVE447)
Prerequisite(s)/Corequisite(s): CIVE440 or CIVE840

CIVE 849 INTRODUCTORY FINITE ELEMENT ANALYSIS IN SOLID MECHANICS (3 credits)
Matrix methods of analysis. The finite element stiffness method with a focus on solid mechanics. Isoparametric elements formulation based on energy principles. Perform finite element analyses using commercial software.
Prerequisite(s)/Corequisite(s): CIVE 443 or 843

CIVE 850 PRESTRESSED CONCRETE (3 credits)
Analysis and design of prestressed concrete members. Axial force, bending, shear, torsion, prestress losses, initial and long-term deflection, partial prestressing, statically indeterminate structures.
Prerequisite(s)/Corequisite(s): CIVE341 and CIVE440

CIVE 851 INTRODUCTION TO FINITE ELEMENT ANALYSIS (3 credits)
Matrix methods of analysis. The finite element stiffness method. Computer programs. Applications to structures and soils. Introduction to finite element analysis of fluid flow. (Cross-listed with CIVE 451)
Prerequisite(s)/Corequisite(s): MENG 3250 or EMEC 3250; and MENG 4800 or EMEC 4800.

CIVE 852 WATER RESOURCES DEVIL (3 credits)
Theory and application of systems engineering with emphasis on optimization and simulation techniques for evaluating alternatives in water resources developments related to water supply, flood control, hydroelectric power, drainage, water quality, water distribution, irrigation and water measurement. (Cross-listed with CIVE452)
Prerequisite(s)/Corequisite(s): CIVE352
CIVE 853 GIS IN WATER RESOURCES (3 credits)

CIVE 854 HYDRAULIC ENGR (3-4 credits)
(Lecture 2-3, Lab 0-3) Fundamentals of hydraulics with applications of mechanics of solids, mechanics of fluids; engineering economics to the design of hydraulic structures, continuity, momentum; energy principles are applied to special problems from various branches of hydraulic engineering. (Cross-listed with CIVE454)
Prerequisite(s)/Corequisite(s): CIVE352

CIVE 855 NONPOINT POLLUTION (3 credits)
Identification, characterization, and assessment of nonpoint source pollutants; transport mechanins and remediation technologies; design methodologies and case studies. (Cross-listed with CIVE455)
Prerequisite(s)/Corequisite(s): CIVE326 and CIVE352

CIVE 856 SURFACE WATER HYDRO (3 credits)
Advanced topics in surface water hydrology including parametric and stochastic processes and systems analysis of hydrologic problems with particular emphasis on the application of techniques in the design of engineering particles. (Cross-listed with CIVE456)
Prerequisite(s)/Corequisite(s): CIVE352

CIVE 857 APPLIED STRUCTURAL ANALYSIS (3 credits)
Prerequisite(s)/Corequisite(s): CIVE851

CIVE 858 GROUND WATER ENGINEERING (3 credits)
The application of engineering principles to the movement of ground water. The influence of the physical and geologic environment on ground water hydraulics, water well hydraulics and aquifer evaluation. Emphasis is placed on practical ground water engineering problems. (Cross-listed with CIVE458)
Prerequisite(s)/Corequisite(s): CIVE352.

CIVE 859 RELIABILITY OF STRUCTURES (3 credits)
Fundamental concepts related to structural reliability, safety measures, load models, resistance models, system reliability, optimum safety levels, and optimization of design codes.
Prerequisite(s)/Corequisite(s): CIVE341, not open to nondegree students

CIVE 861 URBAN TRANS PLANNING (3 credits)
Development of urban transportation planning objectives and goals. Data collection procedures, land use and travel forecasting techniques, trip generation, trip distribution, modal choice analysis, and traffic assignment. Site development and traffic impact analysis. (Cross-listed with CIVE461.)
Prerequisite(s)/Corequisite(s): CIVE361

CIVE 862 HIGHWAY DESIGN (3 credits)
Design of roads, intersections, interchanges, parking facilities, and land development site access and circulation. Emphasis on design projects. (Cross-listed with CIVE462)

CIVE 863 TRAFFIC ENGINEERING (3 credits)
Design of signalized intersections, arterial street and network signal systems, and freeway control systems. Emphasis on design projects. (Cross-listed with CIVE463)
Prerequisite(s)/Corequisite(s): CIVE361

CIVE 864 ANALYSIS AND ESTIMATION OF TRANSPORTATION DEMAND (3 credits)
Introduction to conceptual, methodological and mathematical foundations of analysis and design of transportation services; review of probabilistic modeling; application of discrete choice models to demand analysis.
Prerequisite(s)/Corequisite(s): CIVE461 or CIVE861 or equivalent

CIVE 865 HIGHWAY GEOMETRICS (3 credits)
Principles of highway geometrics. Sight distances, design vehicles, vehicle characteristics, horizontal and vertical alignment, cross section elements, and at-grade intersections and interchanges.
Prerequisite(s)/Corequisite(s): (CIVE462 or CIVE652), not open to nondegree students

CIVE 866 TRAFFIC CHARACTERISTICS (3 credits)
Use of the concepts of volume, speed, density, and capacity to describe the characteristics and performance of surface, air, and water transportation systems.
Prerequisite(s)/Corequisite(s): (CIVE463 or CIVE863) and (STAT3800 or MATH3800)

CIVE 867 TRANS SAFETY ENGR (3 credits)
Safety criteria in the planning, design and operation phases of highway, rail, airport, mass transit, pipeline, and waterway transportation systems. Background of safety legislation and funding requirements. Identification of high accident locations and methods to determine cost/effectiveness of improvements.

CIVE 868 AIRPORT PLANNING AND DESIGN (3 credits)
Planning and design of general aviation and air-carrier airports. Land-side components include vehicle ground access systems, vehicle circulation parking and terminal buildings. Air-side components include aircraft apron-gate area, taxiway system, runway system and air traffic control facilities and airspace. Emphasis on design projects. (Cross-listed with CIVE468)
Prerequisite(s)/Corequisite(s): CIVE361

CIVE 869 COMPUTER-AIDED INTERCHANGE DESIGN (3 credits)
Principles of high-speed traffic operations, safety, and decision making related to critical design parameters used for optimal interchange geometric design through development of an interchange design project using graphical and civil engineering software. (Cross-listed with CIVE469)
Prerequisite(s)/Corequisite(s): CIVE 862. Not open to non-degree graduate students.

CIVE 871 BITUMINOUS MATERIALS AND MIXTURES (3 credits)
Understanding of the physical, chemical, geometrical, and mechanical characteristics and practical applications of bituminous materials and mixtures. Fundamental mechanics for elastic and inelastic materials and basic theories associated with mechanical data analyses and designs. Recent advances and significant research outcomes for further discussions. Applications of theories to laboratory and field testing. (Cross-listed with CIVE 471)
Prerequisite(s)/Corequisite(s): CIVE 378. Not open to non degree graduate students.

CIVE 872 PAVEMENT DESIGN & EVALUATION (3 credits)
Thickness design of flexible and rigid pavement systems for highways and airports; design of paving materials; evaluation and strengthening of existing pavements. (Cross-listed with CIVE472)
Prerequisite(s)/Corequisite(s): CIVE334

CIVE 875 WATER QUALITY STRATEGY (3 credits)
A holistic approach to the selection and analysis of planning strategies for protecting water quality from nonpoint sources of contamination. An introduction to the use of methods of analyzing the impact of strategies on whole systems and subsystem for selecting strategies; and for evaluating present strategies.
CIVE 881 COMPUTATIONAL PROBLEM SOLVING IN CIVIL ENGINEERING (3 credits)
Introduction of numerical methods to solve problems in civil engineering, including finding roots of equations, solving linear algebra equations, optimization, curve fitting, numerical differentiation and integration, and finite difference method. Computational methods in numerical integration, matrix operations and ordinary differential equations as they apply to civil engineering problems. (Cross-listed with CIVE 481)
Prerequisite(s)/Corequisite(s): Not open to non-degree graduate students.

CIVE 898 SPECIAL TOPICS (1-6 credits)
Special problems, topics, or research in civil engineering. (Cross-listed with CIVE498)

CIVE 899 MASTERS THESIS (1-10 credits)
Master’s Thesis.
Prerequisite(s)/Corequisite(s): Admission to masters degree program and permission of major adviser, Not open to nondegree students.

CIVE 916 ENVIRONMENTAL LAW AND WATER RESOURCE MANAGEMENT SEMINAR (3 credits)
An interdisciplinary seminar with the Department of Civil Engineering. Contemporary environmental issues and water resource Management.
Prerequisite(s)/Corequisite(s): Permission. Not open to non-degree graduate students.

CIVE 940 BEHAVIOR OF STRUCTURAL MEMBERS (3 credits)
Behavior and/or design of structural steel members and their connections. Torsion effects on open and closed thin walled members. Frame buckling and stability considerations in structural steel frames. Dynamic analysis and seismic design considerations.
Prerequisite(s)/Corequisite(s): CIVE 446/CIVE 846. Not open to non-degree graduate students.

CIVE 945 STRUCTURAL ANALYSIS AND DESIGN FOR DYNAMIC LOADS (3 credits)
Behavior of structural materials and systems under dynamic loads. Analysis and design for dynamic loads. Computational techniques. Selected laboratory demonstrations of the dynamic behavior of structural systems.
Prerequisite(s)/Corequisite(s): CIVE 443 or 843, and CIVE 842; or permission, not open to non-degree graduate students.

CIVE 948 BLAST-RESISTANT STRUCTURAL DSGN (3 credits)
Prerequisite(s)/Corequisite(s): CIVE842

CIVE 949 STEEL BRIDGE DESIGN (3-6 credits)
Prerequisite(s)/Corequisite(s): (CIVE436 or CIVE836) and (CIVE446 or CIVE846), not open to non-degree graduate students.

CIVE 954 ADVANCED HYDRAULICS (3 credits)
Advanced studies involving pipe and culvert hydraulics, rapidly-varied flow in open channels, sediment transport, river mechanics, control, and design.
Prerequisite(s)/Corequisite(s): CIVE854, not open to non-degree graduate students.

CIVE 958 CONTAMINANT TRANSPORT IN POROUS MEDIA (3 credits)
Theory of flow and contaminant transport in porous media including groundwater flow, multiphase flow, equilibrium contaminant distribution, reactive transport of contaminants, and colloid transport in porous media.
Prerequisite(s)/Corequisite(s): Permission, not open to non-degree graduate students.

CIVE 961 MASS TRANSIT SYSTEMS (3 credits)
The place of mass transit in solving urban transportation problems: transit system and terminal characteristics and planning criteria. Speed, capacity, accessibility, and operation of mass transit systems. Future prospects in transit technology and case studies of existing systems.
Prerequisite(s)/Corequisite(s): Not open to nondegree students

CIVE 962 APPLICATION OF GEOGRAPHIC INFORMATION SYSTEMS (GIS) TO TRANSPORTATION (3 credits)
Geographic Information Systems (GIS) structure, function, and concepts such as spatial data models, relational databases, and spatial analyses. GIS project planning, management, and applications to transportation-related issues.
Prerequisite(s)/Corequisite(s): Not open to nondegree students

CIVE 963 HIGHWAY SAFETY DATA ANALYSIS (3 credits)
Highway safety issues and appropriate accident data analysis. Quantify changes in safety when modifications are made to highways in an effort to enhance safety. Judge reported safety improvements and carry out appropriate analysis for assessing the effectiveness of safety improvements.
Prerequisite(s)/Corequisite(s): STAT8805, not open to nondegree students

CIVE 964 THEORY TRAFFIC FLOW (3 credits)
Analysis of traffic characteristics as applied to traffic engineering facility design and flow optimization. Capacity of expressways, ramps, weaving sections, and intersections. Analytical approaches to flow analysis, queueing theory, flow density relationships, and traffic simulation.
Prerequisite(s)/Corequisite(s): CIVE 866 and (STAT 3800 or STAT 8805), not open to non-degree graduate students

CIVE 965 TRAFFIC CONTROL SYSTEMS (3 credits)
Principles of traffic control. Design and analysis of intersection, arterial street, network, and freeway control systems. Traffic surveillance and driver information systems.
Prerequisite(s)/Corequisite(s): CIVE966 and permission, not open to non-degree graduate students.

CIVE 966 TRANSPORTATION PNLG & ECONOMCS (3 credits)
Community growth and development based on planning decisions regarding land use whereby transportation facilities are fitted to land use. Economic studies that consider the consequences to transportation agencies, users, and nonusers. Agency expenditures, capital outlay and annual expenses for maintenance and operations. User consequences such as vehicle operating costs; commercial time costs; accident costs; discomfort and inconvenience costs; and assignment of money valuations to pleasure, recreation, and culture. Nonusers consequences items such as cost reductions or increases in public services; increases in value of crops and natural resources where areas become more readily accessible; changes in business and industrial activities; and increase or decrease of residential property values.

CIVE 967 ANALYSIS AND DESIGN OF TRANSPORTATION SAFETY SYSTEMS (3 credits)
Operations research techniques for modeling system performance and design of transportation services. Routing and scheduling problems. Network equilibrium and partially distributed queuing systems.
Prerequisite(s)/Corequisite(s): Not open to nondegree students

CIVE 969 SEMINAR IN CIVIL ENGINEERING (1-6 credits)
Current topics, research projects, and review of current literature in the various areas of civil engineering.
Prerequisite(s)/Corequisite(s): Permission. Not open to non-degree graduate students.

CIVE 998 SP PRBLMS CIVIL ENGR (1-6 credits)
Reading and evaluation of technical publications concerned with theory and/or experimental data. Subsequent assignments are coordinated with the student’s particular interests in his/her field of specialization.
Prerequisite(s)/Corequisite(s): Not open to nondegree students
CIVE 999 DOCTORAL DISSERTATION (1-24 credits)

Doctoral Dissertation.

**Prerequisite(s)/Corequisite(s):** Admission to doctoral degree program and permission of supervisory committee chair. Not open to nondegree students.