CIVIL AND ENVIRONMENTAL ENGINEERING (CIV ENGR)

CIV ENGR 1 — COOPERATIVE EDUCATION PROGRAM
1 credit.
Work experience which combines classroom theory with practical knowledge of operations to provide students with a background upon which to base a professional career.
Requisites: So st
Course Designation: Workplace - Workplace Experience Course
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2017

CIV ENGR 251 — ENGINEERING SPATIAL MEASUREMENTS
2 credits.
Introduction to the fundamentals of engineering measurements; units of measurement; significant figures; errors in measurement; measuring devices and their calibration; measurements of distances, angles, elevations and other engineering quantities; construction measurements; reference coordinate systems for point positioning, datums; mapping.
Requisites: MATH 221, ME 170 or consent of instructor
Repeatable for Credit: No
Last Taught: Spring 2006

CIV ENGR 290 — CONSTRUCTION SYSTEMS
3 credits.
Course focuses upon the building construction industry. Buildings include many engineered systems, such as foundations, structural, and exterior cladding. Course addresses construction methods and techniques for sitework, excavation, paving, cast-in-place concrete, precast concrete, masonry, structural steel, and moisture protection. Course uses case examples of individual systems.
Requisites: So st
Repeatable for Credit: No
Last Taught: Spring 2017

CIV ENGR/G LE 291 — PROBLEM SOLVING USING COMPUTER TOOLS
3 credits.
Introduction to engineering computations with emphasis on computer tools and computer based measurement, data collection, and processing. Tools will include computer aided drafting, spreadsheets, other engineering computation tools, and hardware and software for laboratory and spatial measurements.
Requisites: EMA 202 or 304
Repeatable for Credit: No
Last Taught: Fall 2017

CIV ENGR 299 — INDEPENDENT STUDY
1-3 credits.
Requisites: Consent of instructor
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2016

CIV ENGR 310 — FLUID MECHANICS
3 credits.
Fluid statics and dynamics, dimensional analysis, flow of an ideal fluid, flow of a real fluid—including laminar and turbulent flow, applications to engineering problems.
Requisites: MATH 234 EMA 202 or equiv
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

CIV ENGR 311 — HYDROSCIENCE
3 credits.
Introduction to the water cycle, its relationship to the environment and human attempts to conserve, control, and utilize water judiciously. Fundamentals of hydrology, hydraulics, coastal engineering and water resources engineering.
Requisites: CIV ENGR 310
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

CIV ENGR 320 — ENVIRONMENTAL ENGINEERING
3 credits.
Fundamental sanitary aspects of environmental engineering. Role of the engineer in the control of the environment; water supply and wastewater problems; solid waste disposal; air pollution; and administration in environmental engineering.
Requisites: 1 year college chem
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

CIV ENGR 322 — ENVIRONMENTAL ENGINEERING PROCESSES
3 credits.
Combination of theory and laboratory practice to study basic unit operations and processes in environmental engineering. Emphasis on water and wastewater treatment processes, such as coagulation/flocculation, chemical precipitation, filtration, adsorption, activated sludge, anaerobic digestion, and substrate utilization kinetics.
Requisites: CIV ENGR 320
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017
CIV ENGR/GLE 330 — SOIL MECHANICS
4 credits.
Basic principles of soil mechanics and fundamentals of application in engineering practice; soil composition and texture; classification; permeability and seepage; consolidation; settlement; shear strength; lateral earth pressures; fundamentals of retaining structures, shallow and deep foundations, slope stability; sub-surface exploration; lab.
Requisites: EMA 303 or 304 or con reg
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

CIV ENGR 340 — STRUCTURAL ANALYSIS I
4 credits.
Analysis of statically determinate and indeterminate beams, trusses, and rigid frames; deflections by virtual-work, moment-area; influence lines; force methods; structural design loads, introduction to structural design, approximate methods.
Requisites: EMA 303 Mech Engr 307 or con reg
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

CIV ENGR 370 — TRANSPORTATION ENGINEERING
3 credits.
Characteristics of transportation supply and demand; measuring and estimating demand; social and environmental impacts; planning of transportation systems; characteristics of transportation modes; interaction between modes; mode interfaces; transportation technology; economics; public policy, implementation and management.
Requisites: STAT 311 or STAT 324
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

CIV ENGR/BSE/SOIL SCI 372 — ON-SITE WASTE WATER TREATMENT AND DISPERSAL
2 credits.
On-site treatment and dispersal of waste water from homes, commercial sources and small communities. Sources, pretreatment units, nutrient removal units, constructed wetlands, surface and soil dispersal systems, recycle and reuse systems, regulations, alternative collection systems.
Requisites: CHEM 103
Repeatable for Credit: No
Last Taught: Fall 2017

CIV ENGR/ENVIR ST/GEOG 377 — AN INTRODUCTION TO GEOGRAPHIC INFORMATION SYSTEMS
4 credits.
Design, implementation and use of automated procedures for storage, analysis and display of spatial information. Covers data bases, information manipulation and display techniques, software systems and management issues. Case studies. Meets with Civil Environmental Engineering 357.
Requisites: Sophomore standing
Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

CIV ENGR 392 — BUILDING INFORMATION MODELING (BIM)
3 credits.
Provides students with an introduction to the use of Building Information Modeling (BIM) technology in the construction industry. The course allows students to gain experience in using computer tools such as the Autodesk Revit Family to model building designs.
Requisites: M E 160 or M E 170
Course Designation: Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

CIV ENGR/E M A 395 — MATERIALS FOR CONSTRUCTED FACILITIES
3 credits.
Properties and tests of materials used in the initial construction or repair of facilities (including buildings, transportation systems, utility systems, and reinforced earth). Introduction to laboratory and field measurement techniques to assess material performance capabilities. Technical report preparation.
Requisites: EMA 303 307
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

CIV ENGR 410 — HYDRAULIC ENGINEERING
3 credits.
Engineering approaches to measurement, control and conveyance of water and wastewater flows, emphasizing analysis, design, characteristics and selection of: measurement devices, distribution and collection pipe systems, and pumps and turbines with consideration of plant, quality, economic, reliability, and security aspects.
Requisites: CIV ENGR 310 311 or consent of instructor
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2017
CIV ENGR 411 — OPEN CHANNEL HYDRAULICS
3 credits.
Analysis and characteristics of flow in open channels (natural and artificial); channel design considerations including uniform flow (rivers, sewers), flow measuring devices (weirs, flumes), gradually varied flow (backwater and other flow profiles, flood routing), rapidly varied flow (hydraulic jump, spillways), and channel design problems (geometric considerations, scour, channel stabilization, sediment transport).
Requisites: CIV ENGR 311
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2016

CIV ENGR 412 — GROUNDWATER HYDRAULICS
3 credits.
Engineering fundamentals of groundwater flow. Mass and momentum conservation, diffusion, and dispersion. Applications to wells, recharge, plumes, and convective transport. Physical models and elementary numerical methods, including flow nets. Some laboratory work.
Requisites: None
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2017

CIV ENGR 414 — HYDROLOGIC DESIGN
3 credits.
An introduction to the design of engineering structures which control and/or utilize runoff, emphasizing the sizing of structures to meet hydrologic uncertainty. Applies principles and techniques from several disciplines, including hydrology, hydraulics, probability and statistics. Specific techniques include flood frequency analysis; risk analysis; design storm and historic storm techniques; rainfall-runoff modeling.
Requisites: Civ Engr 315 or cons inst
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Summer 2016

CIV ENGR 415 — HYDROLOGY
3 credits.
Water cycle as related to air mass properties and movement, precipitation, evaporation, snowmelt, infiltration, streamflow, floods, and groundwater. Statistical hydrology, and hydrologic simulations—including runoff prediction, streamflow and reservoir routing, impoundment operation studies, and urban hydrology.
Requisites: (CIV ENGR/G L E/CIV ENGR 291 and CIV ENGR 311) or graduate standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

CIV ENGR 416 — WATER RESOURCES SYSTEMS ANALYSIS
3 credits.
Water supply and demand are increasingly stressed by climate, population, land-use, policy, etc. This course presents a variety of systems analysis techniques for water resources planning and management. Deterministic and stochastic optimization and simulation models will be developed and applied. Problems addressed include water supply, water quality, and river basin development.
Requisites: CIV ENGR 311 or consent of instructor
Repeatable for Credit: No
Last Taught: Spring 2017

CIV ENGR 421 — ENVIRONMENTAL SUSTAINABILITY ENGINEERING
3 credits.
This course utilizes the three paradigms of sustainability (environmental, social, and economic) in an engineering setting, in order to understand how to engineer for a sustainable future. The course will cover topics such as design for the environment, green chemistry, pollution prevention, total cost accounting, life cycle assessment, and industrial ecology. It will involve a community based learning term project, where the students will work in groups to address the sustainability implications of a project for a community partner.
Requisites: (MATH 217, 221, or 275) and CHEM 104 or 109
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

CIV ENGR 422 — ELEMENTS OF PUBLIC HEALTH ENGINEERING
3 credits.
Requisites: Consent of instructor
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2013

CIV ENGR 423 — AIR POLLUTION EFFECTS, MEASUREMENT AND CONTROL
3 credits.
The influence of man-caused pollution on the atmosphere, globally and locally. Evaluation of human health, economic, and aesthetic effects of air pollution. Techniques for measurement of atmosphere pollutant concentrations and determination of local and regional air quality. Detailed presentation of air pollution sources and methods for their control. The role of local, state and federal government in air pollution control.
Requisites: Senior standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2017
CIV ENGR 424 — ENVIRONMENTAL ENGINEERING LABORATORY
2 credits.
Basic chemistry and chemical calculations applied to environmental engineering, lab methods and interpretation of results for chemical and biological analyses of water and wastewater.
**Requisites:** CHEM 103 or equiv
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement
**Repeatable for Credit:** No
**Last Taught:** Fall 2014

CIV ENGR 426 — DESIGN OF WASTEWATER TREATMENT PLANTS
3 credits.
Unit operations in wastewater treatment; physical, chemical, and biological processes for treatment of wastewater; sludge treatment and disposal; design of a wastewater treatment plant; site visits to wastewater treatment plants.
**Requisites:** CIV ENGR 310 or 316, CIV ENGR 320, or cons inst
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement
**Repeatable for Credit:** No
**Last Taught:** Fall 2017

CIV ENGR 427 — SOLID AND HAZARDOUS WASTES ENGINEERING
3 credits.
Basic concepts in designing, evaluating, and operating solid wastes storage, collection, and disposal systems; waste reduction, resource recovery, incineration and land disposal methods; hazardous wastes engineering; legal, political, and administrative considerations.
**Requisites:** CIV ENGR 310 or cons inst
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement
**Repeatable for Credit:** No
**Last Taught:** Fall 2017

CIV ENGR 428 — WATER TREATMENT PLANT DESIGN
3 credits.
Preliminary studies and design of water treatment processes and subordinate plant facilities; project control of design project; unit operations in water treatment; groundwater treatment; preliminary cost estimates; introduction of computer-aided design concept; site visits to water treatment plants.
**Requisites:** CIV ENGR 310, 320
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement
**Repeatable for Credit:** No
**Last Taught:** Spring 2017

CIV ENGR 429 — ENVIRONMENTAL SYSTEMS OPTIMIZATION
3 credits.
Design and analysis of complex environmental systems to capture policy trade-off in managing water, land, air, and energy resources. Illustration of models that describe decision variables and constraints to capture the full range of alternative policy choices. Heuristic and formal solution procedures to select best project alternatives.
**Requisites:** Introductory calculus
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement
**Repeatable for Credit:** No
**Last Taught:** Spring 2016

CIV ENGR 440 — STRUCTURAL ANALYSIS II
3 credits.
**Requisites:** CIV ENGR 340
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement
**Repeatable for Credit:** No
**Last Taught:** Spring 2017

CIV ENGR 442 — WOOD STRUCTURES I
3 credits.
Properties of wood, basic concepts of structural design, design of wood structural members by LRFD including beams, columns and connections. Sawn, glued-laminated, sheathing and composite wood construction products. Concrete formwork.
**Requisites:** CIV ENGR 340
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement
**Repeatable for Credit:** No
**Last Taught:** Fall 2016

CIV ENGR/ENVIR ST/G L E/GEOSCI 444 — PRACTICAL APPLICATIONS OF GPS SURVEYING
2 credits.
**Requisites:** MATH 210, 211, 221 or equiv or cons inst
**Course Designation:** Breadth - Physical Sci. Counts toward the Natural Sci req
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
**Repeatable for Credit:** No
**Last Taught:** Spring 2017
CIV ENGR 445 — STEEL STRUCTURES I
3 credits.

Design loads, codes, specifications and standards; philosophies of design; load and resistance factor design (LRFD); allowable stress design (ASD); properties and types of structural steel; residual stresses; behavior and LRFD design criteria for tension members, compression, laterally braced and unbraced beams; essentials of bolted and welded connections.

Requisites: CIV ENGR 340
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

CIV ENGR 447 — CONCRETE STRUCTURES I
3 credits.

Behavior of reinforced concrete structural elements; concepts of design and proportioning sections for strength and serviceability; background of specification requirements; strength design applied to beams, columns, and members under combined axial load and bending; continuous beams.

Requisites: CIV ENGR 340
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2017

CIV ENGR/I SY E/N E 460 — UNCERTAINTY ANALYSIS FOR ENGINEERS
3 credits.

This course introduces undergraduates to approaches for quantifying uncertainty in engineering analyses. Both analytical and computational methods are demonstrated.

Requisites: Statistics 311, MATH/STAT 431, or consent of instructor
Repeatable for Credit: No
Last Taught: Spring 2017

CIV ENGR 489 — HONORS IN RESEARCH
1-3 credits.

Undergrad honors research projects supervised by faculty members. Not available for graduate credit.

Requisites: Consent of instructor
Course Designation: Honors - Honors Only Courses (H)
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2010

CIV ENGR/BSE 491 — LEGAL ASPECTS OF ENGINEERING
3 credits.

Legal principles and institutions germane to engineering practice; formation and performance of engineer-client and owner-contractor relationships; preparation of technical specifications; surety bonds and insurance; construction liens; contract administration; construction contract remedies; intellectual property of engineers; engineers' obligations to society and their fellow engineers.

Requisites: Sr st or cons inst
Repeatable for Credit: No
Last Taught: Fall 2017

CIV ENGR 492 — INTEGRATED PROJECT ESTIMATING AND SCHEDULING
3 credits.

Principles of estimating and scheduling for the construction industry, engineer’s preliminary and final estimates’ quantity take offs and cost and duration determinations for major items related to a construction project; use manual and computer techniques.

Requisites: Jr st
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2017

CIV ENGR 494 — CIVIL AND ENVIRONMENTAL ENGINEERING DECISION MAKING
3 credits.

Planning, designing, and managing civil engineering systems. Fundamentals of the systems approach; marginal analysis; optimization techniques; decision analysis; economic analysis; cost-effectiveness analysis. Case study applications.

Requisites: MATH 221 or cons inst
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2017

CIV ENGR 496 — ELECTRICAL SYSTEMS FOR CONSTRUCTION
3 credits.

Basic electricity, utility systems, standards and codes, electrical construction materials, branch circuit design, motor branch circuit design, feeder and service design, estimating and management concepts in electrical contracting, grounding, lighting, telecommunications.

Requisites: PHYSICS 202
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2017

CIV ENGR 497 — MECHANICAL SYSTEMS FOR CONSTRUCTION
3 credits.

Introduction to building mechanical systems. Plumbing, heating, ventilation, air conditioning, fire protection, automation/controls and process systems. Introduction to mechanical systems design and cost estimating. Mechanical system management.

Requisites: PHYSICS 202
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017
CIV ENGR 498 — CONSTRUCTION PROJECT MANAGEMENT
3 credits.

Characteristics of Construction Industry; project organizations; the design and construction process; labor, material, and equipment utilization; cost estimation; construction pricing and contracting; construction planning; cost control, monitoring accounting; and management systems construction.

Requisites: Junior standing or consent of instructor
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2017

CIV ENGR 500 — WATER CHEMISTRY
3 credits.

Elements of fresh and marine water chemistry; acid-base, precipitation, complexation, oxidation-reduction, adsorption, and biochemical reactions in natural waters and water treatment processes.

Requisites: CHEM 103, 104, 221 or equivalent or consent of instructor
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

CIV ENGR 501 — WATER ANALYSIS-INTERMEDIATE
3 credits.

Principles and applications of chemical and instrumental methods for the chemical analysis of water.

Requisites: CHEM 103
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2017

CIV ENGR 502 — ENVIRONMENTAL ORGANIC CHEMISTRY
3 credits.

Environmental behavior of anthropogenic organic compounds. Physical-chemical properties and compound specific reactivities. Environmental processes controlling transport and fate; air-water exchange, sorption, chemical and photochemical reactions and transformations. Environmental fate modeling. For graduate students in environmental science and engineering.

Requisites: CIV ENGR 500, CHEM 343 or equiv, or cons inst
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2011

CIV ENGR/EMA 508. — COMPOSITE MATERIALS
3 credits.

Physical properties and mechanical behavior of polymer, metal, ceramic, cementitious, cellulosic and biological composite systems; micro- and macro-mechanics; laminaton and strength analyses; static and transient loading; fabrication; recycling; design; analytical-experimental correlation; applications.

Requisites: M E 444 or M E/EMA 570 or EMA 506 or graduate standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2015

CIV ENGR 514 — COASTAL ENGINEERING
2-3 credits.

The effect of natural forces associated with storms, hurricanes, and water-level variations on the coastal zone, and efforts made to combat these forces. Wave and storm-surge prediction, the change of waves as they approach shore, and wave forces on the shore; shore erosion and littoral drift; nearshore pollution in lakes and oceans; harbor, breakwater, and revetment design.

Requisites: CIV ENGR 311 or consent of instructor
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

CIV ENGR 515 — HYDROCLIMATOLOGY FOR WATER RESOURCES MANAGEMENT
3 credits.

Students will be introduced to various strategies for integrating climate science into water resources, specifically addressing climatic influences on hydrologic variables, the prospects for prediction, and the implications on water management and development. Students will consider both space and time variability of hydrological processes in the context of sub-seasonal, seasonal, and climate change time-scales. The course format will include lectures, discussion, student presentations, and role-playing.

Requisites: CIV ENGR 315 and STAT 224
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No

CIV ENGR 522 — HAZARDOUS WASTE MANAGEMENT
3 credits.

Environmental regulations, remediation site characterization, contaminant characterization, detailed engineering and management considerations related to the design and operation of hazardous waste remediation systems involving water pollution, air pollution, solid waste, and groundwater pollution.

Requisites: CIV ENGR 320 or cons inst
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2017
CIV ENGR/GLE 530 — SEEPAGE AND SLOPES
3 credits.
Practical aspects of seepage effects and ground water flow. Stability of natural and man-made slopes under various loading conditions. Design and construction of earth dams and embankments. Flow net and its use; wells; filters; total and effective stress methods of slope analysis; selection of pertinent soil parameters.
Requisites: CIV ENGR/GLE 330
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

CIV ENGR/GLE 531 — RETAINING STRUCTURES
3 credits.
Rigid and flexible earth retaining structures. Analysis and design of retaining walls, anchored bulkheads, braced cuts, tie back cuts, mechanically stabilized earth, and slurry trench walls. Lateral earth pressure due to soil, water, surcharge loads, etc., local and overall stability and the design of anchorage and bracing systems.
Requisites: CIV ENGR/GLE 330; COMP SCI 310 or cons inst
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2010

CIV ENGR/GLE 532 — FOUNDATIONS
3 credits.
Shallow and deep foundations. Analysis and design of footings, mats, piers and piles, and related fill and excavation operations. Consolidation settlement, time rate of settlement, stress distribution, elastic (immediate) settlement, load bearing capacity; methods to reduce settlements and increase shear strength; the selection of a foundation system.
Requisites: CIV ENGR/GLE 330, COMP SCI 310 or cons inst
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2016

CIV ENGR 534 — FIELD METHODS IN GEOLOGICAL ENGINEERING
3 credits.
Methods of site investigations for the rational design of structures in rocks and soil. Field reconnaissance, exploratory drilling, in situ testing, and post-excavation monitoring.
Requisites: CIV ENGR/GLE 330, GLE 474, or consent of instructor
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2009

CIV ENGR 543 — PRECAST CONCRETE
3 credits.
Design of structural systems using precast concrete components, capacity of prestressed components, fire ratings, connections and construction of precast systems.
Requisites: CIV ENGR 447
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2012

CIV ENGR 545 — STEEL STRUCTURES II
3 credits.
Composite construction; composite vs. non-composite behavior; shored vs. unshored construction; stability of frames; elastic analysis of frames including second order effects; strength of members subject to combined flexure and axial compression; plate girders; vertical flange buckling; flexural and shear strength; flexure and shear interaction; stiffener requirements.
Requisites: CIV ENGR 445
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2016

CIV ENGR 547 — CONCRETE STRUCTURES II
3 credits.
Deflections under short duration and sustained loads; compression members with emphasis on stability and secondary bending moments; two-way slab systems; prestressed concrete including prestress losses; design of shear walls, special topics in strut and tie modelling, compression field theory and design for torsion may be covered; flexure analysis; design of sections; and shear strength.
Requisites: CIV ENGR 447
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

CIV ENGR ENVIR ST/LAND ARC 556 — REMOTE SENSING DIGITAL IMAGE PROCESSING
3 credits.
Techniques of enhancement and quantification of remote sensing imagery. Emphasis on processing and analyzing data gathered by airborne and satellite sensors. Techniques to quantitatively analyze data from photography, electro-optical scanners, satellite systems, and radar and passive microwave systems. A 5-week practicum with applications to: agriculture and forestry, geology and soils, water quality, and urban and regional planning.
Requisites: Civ Engr/Envir St/Forestry 303 or authorization
Course Designation: Level - Advanced
L&S Credit: Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2016
CIV ENGR/A A E/ENVIR ST/URB R PL 561 — ENERGY MARKETS
3 credits.

Energy resources are an essential element of the world's business, political, technical and environmental landscape. Analytic tools provided by the discipline of economics expands our understanding of this critical issue. Energy supply markets reviewed include both fossil fuels and renewable resources. Energy demand sectors include residential, commercial, industrial and transportation. Electricity represents an intermediate energy market. The interactions among these markets participants indicate how scarce resources are allocated among competing needs in the world economy.

Requisites: A A E 215, ECON 101, or ECON 111
Course Designation: Breadth - Social Science
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

CIV ENGR 570 — ENVIRONMENTAL IMPACT OF TRANSPORTATION SYSTEMS
3 credits.

Nature of the ecosystem and ecosystem modeling, the nature of transportation produced impacts on man's social, economic, physical and emotional well being, on wildlife, natural areas, agricultural areas; environmental economics; measuring and evaluating environmental quality, and citizen tactics in response to environmental issues.

Requisites: Jr st or cons inst
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Summer 2012

CIV ENGR 571 — URBAN TRANSPORTATION PLANNING
3 credits.

Principles of planning, evaluation, selection, adoption, financing, and implementation of alternative urban transportation systems; formulation of community goals and objectives, inventory of existing conditions; transportation modeling—trip generation, distribution, modal choice, assignment, technological characteristics and operation of modern transit and other movement systems.

Requisites: CIV ENGR 370 or consent of instructor
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

CIV ENGR 573 — GEOMETRIC DESIGN OF TRANSPORT FACILITIES
3 credits.

Problems in ground transportation facility design; generation, capacity, location and design; rural and urban at-grade intersection design; grade separations; interchanges; parking lots and terminals.

Requisites: CIV ENGR 370
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2017

CIV ENGR 574 — TRAFFIC CONTROL
3 credits.

Traffic data collection studies; measures of effectiveness and evaluation of traffic system performance; design and application of traffic control devices; design of traffic signal systems; operational controls and traffic management strategies.

Requisites: CIV ENGR 370 or consent of instructor
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

CIV ENGR 575 — ADVANCED HIGHWAY MATERIALS AND CONSTRUCTION
3 credits.

Soils, soil stabilization, aggregates, bituminous materials and mixtures, general highway materials and construction of rigid and flexible pavements.

Requisites: None
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2016

CIV ENGR 576 — ADVANCED PAVEMENT DESIGN
3 credits.

Covers the principles of stress and strain analyses in typical highway pavement structures due to loading from traffic and climate. Also covers the most commonly used analysis and design procedures/software to determine thickness of pavement layers and prediction of performance.

Requisites: CIV ENGR/E M A 395
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

CIV ENGR 578 — SENIOR CAPSTONE DESIGN
4 credits.

The application of theoretically and academically acquired knowledge to a civil and environmental engineering problem in as near "real-world" as possible.

Requisites: Completion of at least 1 crse which carries 3 cr of design
Repeatable for Credit: No
Last Taught: Fall 2017

CIV ENGR 579 — SEMINAR-TRANSPORTATION ENGINEERING
1 credit.

Current problems and research developments in transportation, highways, traffic engineering, and transportation planning and systems analysis.

Requisites: Sr st
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2017
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Description</th>
<th>Requisites</th>
<th>Course Designation</th>
<th>Repeatable for Credit</th>
<th>Last Taught</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIV ENGR 592</td>
<td>CONSTRUCTION LABOR PRODUCTIVITY MANAGEMENT</td>
<td>3</td>
<td>Comprehensive systems approach to construction labor productivity management and methods improvement. Productivity measurements including work sampling, crew balance charts, process charts, flow diagram and others. The course also includes external factors affecting labor productivity, such as change orders, overmanning, stacking of trades and weather. An integral part of this course is the impact of safety on productivity.</td>
<td>Requisites: None</td>
<td>Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement</td>
<td>No</td>
<td>Fall 2010</td>
</tr>
<tr>
<td>CIV ENGR 596</td>
<td>CONSTRUCTABILITY ANALYSIS</td>
<td>3</td>
<td>Project facility delivery process; conceptual planning, design, construction, operation and maintenance, construction knowledge and experience, analysis of facility design from a construction perspective, constructability concepts.</td>
<td>Requisites: Jr st</td>
<td>Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement</td>
<td>No</td>
<td>Summer 2011</td>
</tr>
<tr>
<td>CIV ENGR 609</td>
<td>SPECIAL TOPICS IN WATER CHEMISTRY</td>
<td>1-3</td>
<td>Given on demand.</td>
<td>Requisites: Cons inst</td>
<td>Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement</td>
<td>Yes, unlimited number of completions</td>
<td>Spring 2015</td>
</tr>
<tr>
<td>CIV ENGR 618</td>
<td>SPECIAL TOPICS IN HYDRAULICS AND FLUID MECHANICS</td>
<td>1-3</td>
<td>Given on demand.  Requisites: Prereq varies with topic</td>
<td>Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement</td>
<td>Repeatable for Credit: Yes, unlimited number of completions</td>
<td>No</td>
<td>Spring 2017</td>
</tr>
<tr>
<td>CIV ENGR 619</td>
<td>SPECIAL TOPICS IN HYDROLOGY</td>
<td>1-3</td>
<td>Given on demand.  Requisites: Cons inst</td>
<td>Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement</td>
<td>Repeatable for Credit: Yes, unlimited number of completions</td>
<td>No</td>
<td>Fall 2010</td>
</tr>
<tr>
<td>CIV ENGR/SOIL SCI 623</td>
<td>MICROBIOLOGY OF WATERBORNE PATHGENS AND INDICATOR ORGANISMS</td>
<td>3</td>
<td>Source, environmental fate and transport of major groups of waterborne pathogens, including epidemiology and testing of associated indicator organism. Management and treatment technologies for prevention of pathogen transmission.</td>
<td>Requisites: SOIL SCI/MICROBIO 523 or CIV ENGR 322 or consent of instructor</td>
<td>Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement</td>
<td>No</td>
<td>Spring 2017</td>
</tr>
<tr>
<td>CIV ENGR 629</td>
<td>SPECIAL TOPICS IN ENVIRONMENT ENGINEERING</td>
<td>1-3</td>
<td>Given on demand.</td>
<td>Requisites: Sr st</td>
<td>Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement</td>
<td>Yes, unlimited number of completions</td>
<td>Fall 2017</td>
</tr>
<tr>
<td>CIV ENGR/M&amp;ENVTOX/SOIL SCI 631</td>
<td>TOXICANTS IN THE ENVIRONMENT: SOURCES, DISTRIBUTION, FATE, &amp; EFFECTS</td>
<td>3</td>
<td>Nature, sources, distribution, and fate of contaminants in air, water, soil, and food and potential for harmful exposure.</td>
<td>Requisites: CHEM 343 345 or equiv; CHEM 561 or equiv; PHYSICS 103 104 or equiv; MATH 211; or cons inst</td>
<td>Course Designation: Breadth - Biological Sci. Counts toward the Natural Sci req</td>
<td>No</td>
<td>Spring 2017</td>
</tr>
<tr>
<td>CIV ENGR/G L E 633</td>
<td>WASTE GEOTECHNICS</td>
<td>3</td>
<td>The geotechnical aspects of waste disposal and storage. Critical aspects of geotechnical design, construction, and testing relevant to the performance of earthen structures used for the storage and disposal of wastes or the remediation of contaminated sites are discussed.</td>
<td>Requisites: CIV ENGR/G L E 330 320 or cons inst</td>
<td>Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement</td>
<td>No</td>
<td>Fall 2010</td>
</tr>
</tbody>
</table>
CIV ENGR/G L E 635 — REMEDIATION GEOTECHNICS
3 credits.

Geotechnical practice for remediation of sites containing contaminated soil and groundwater is discussed. Topics include non-invasive and invasive subsurface exploration techniques, methods to monitor for the presence of contaminants in the saturated and unsaturated zones, and geotechnically-oriented remedial action technologies.

Requisites: CIV ENGR 320 330
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2015

CIV ENGR 639 — SPECIAL TOPICS IN GEOTECHNICAL ENGINEERING
1-4 credits.

Given on demand.

Requisites: Cons inst
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2016

CIV ENGR 641 — HIGHWAY BRIDGES
3 credits.

Design applications in structural steel, reinforced and prestressed concrete to simple span and continuous highway bridges; AASHTO Specifications and loading applications; composite concrete-steel bridges; lateral and longitudinal forces on superstructure and substructure and substructures; pier design; multicell box culverts.

Requisites: CIV ENGR 445, 447
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2017

CIV ENGR 649 — SPECIAL TOPICS IN STRUCTURAL ENGINEERING
1-3 credits.

Given on demand.

Requisites: None
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2017

CIV ENGR 669 — SPECIAL TOPICS IN CONSTRUCTION ENGINEERING
AND MANAGEMENT
1-4 credits.

Advanced topics of special interest to seniors and grad students in construction engineering and management.

Requisites: None
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2017

CIV ENGR 679 — SPECIAL TOPICS IN TRANSPORTATION AND CITY PLANNING
3 credits.

Given on demand.

Requisites: Cons inst
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2017

CIV ENGR/PUB AFFR 694 — MANAGEMENT OF CIVIL INFRASTRUCTURE SYSTEMS
3 credits.

Comprehensive systems approach to civil infrastructure and asset management with emphasis on transportation facilities. Social, political, economic factors that influence transportation planning, design, construction, maintenance and operation. Needs assessment, information management, performance measurement, life cycle cost and benefits analysis, prioritization and optimization, budgeting and finance.

Requisites: Grad st or cons inst, CIV ENGR 494 or equiv
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No

Last Taught: Fall 2015

CIV ENGR 699 — INDEPENDENT STUDY
1-9 credits.

Requisites: So st
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2015

CIV ENGR 700 — CHEMISTRY OF NATURAL WATERS
3 credits.

Application of chemical principles to cycling of important elements in natural waters; mineral weathering, cycles of carbon, nitrogen, phosphorus, silicon, sulfur, and minor elements in natural waters; relationships of atmospheric chemistry to natural waters.

Requisites: CIV ENGR 500 or cons inst
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2015
CIV ENGR/ATM OCN 701 — THE CHEMISTRY OF AIR POLLUTION
2 credits.

The course will cover background and modern research methods for the application of chemical analysis tools to understanding of the origin, composition, and the chemical transformations of pollutants that occur in the atmosphere. Emphasis will be directed at the pollutants impacting human health, climate change, and ecosystem degradation. Approximately half of the course materials will be taken from the scientific literature and will provide the opportunity to advance skills in the critical reading of journal articles. The course is directed at graduate students conducting research and interested in air pollution and environmental chemistry. As part of the course, students will gain experience in presenting scientific research methods and results related to course materials.

Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2016

CIV ENGR 702 — GRADUATE COOPERATIVE EDUCATION PROGRAM
1-2 credits.

Work experience that combines classroom theory with practical knowledge of operations to provide students with a background on which to develop and enhance a professional career. The work experience is tailored for MS students from within the U.S. as well as eligible international students.

Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Summer 2017

CIV ENGR 703 — ENVIRONMENTAL GEOCHEMISTRY
3 credits.

This course will be a quantitative treatment of chemical and biological processes controlling the speciation and partitioning of inorganic compounds in natural waters. Particular attention will be paid to heterogeneous reaction mechanisms, and kinetics controlling inorganic compounds in aqueous environments. Additionally, we will discuss in-situ techniques for measurement of environmental reactions. This course is designed to appeal to graduate students who are interested in environmental chemistry, chemistry, limnology, geology, environmental microbiology, soil science, and environmental modeling.

Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2017

CIV ENGR 704 — ENVIRONMENTAL CHEMICAL KINETICS
3 credits.

This course examines the fundamental molecular processes that govern the fate and transformation of organic contaminants in natural environmental systems and engineered treatment processes. We will emphasize the kinetics describing these processes and focus on transformation mechanisms of organic contaminants in aquatic systems. Specific topics include partitioning between air, water, and solids; chemical kinetics; substitution, hydrolysis, and redox reactions; oxidation reactions encountered in ozone and chlorine-based disinfection systems; and photochemical and biological transformations.

Requisites: CIV ENGR 500; Graduate Standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2015

CIV ENGR 716 — STATISTICAL MODELLING OF HYDROLOGIC SYSTEMS
3 credits.

Real world applications of probability and statistics to the analysis and modeling of problems in surface and groundwater hydrology. Assumes basic knowledge of probability and statistics.

Requisites: STAT 311 or cons inst
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2017

CIV ENGR/ENVIR ST/URB R PL 717 — WATER RESOURCES MANAGEMENT PRACTICUM PLANNING SEMINAR I
1 credit.

This is the first of two seminars used for planning the activities of the Summer Session Water Resources Management Practicum (ENVIR ST/CIV ENGR/URB R PL 719).

Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

CIV ENGR/ENVIR ST/URB R PL 718 — WATER RESOURCES MANAGEMENT PRACTICUM PLANNING SEMINAR II
2 credits.

This seminar is used for planning the field work, analysis and reporting of the Summer Session Water Resources Management Practicum (ENVIR ST/CIV ENGR/URB R PL 719).

Requisites: Adv Grad standing or consent of instructor
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2017
CIV ENGR/ENVIR ST/URB R PL 719 — WATER RESOURCES MANAGEMENT SUMMER PRACTICUM
4 credits.

Interdisciplinary team of students and staff working with agency personnel, citizen groups, and/or private sector representatives on the analysis of a contemporary, problem-oriented water resource issue. Physical, biological, economic and social aspects of the issue analyzed. Comprehensive written report results, practicum's findings and management recommendations.

**Requisites:** Envir St/Civ Engr/URB R PL/CIV ENGR/ENVIR ST 718 or consent of instructor
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** Yes, unlimited number of completions

**Last Taught:** Summer 2017

CIV ENGR 721 — BIOLOGICAL PRINCIPLES OF ENVIRONMENTAL ENGINEERING
3 credits.

Biological principles important to diagnosing and controlling pollution through environmental engineering applications such as fate and transport of contaminants in the environment, eutrophication, water treatment for human consumption, biological waste treatment for pollution control and bioenergy generation.

**Requisites:** Students must be accepted into an online Master of Engineering degree program
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Fall 2017

CIV ENGR 722 — CHEMICAL PRINCIPLES OF ENVIRONMENTAL ENGINEERING
3 credits.

Principles of general, physical, equilibrium, colloid and biochemical applied to environmental engineering processes such as evaluating environmental quality and treating water, air and soil to meet environmental standards.

**Requisites:** Students must be accepted into an online Master of Engineering degree program
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Spring 2017

CIV ENGR 723 — ENERGY PRINCIPLES OF ENVIRONMENTAL ENGINEERING
3 credits.

Principles of energy applied to environmental engineering such as energy resources, sustainability concerns, work and power, thermodynamics, system and process efficiencies, energy production from waste, heat transfer, and heating and cooling of systems.

**Requisites:** Declared in masters program in Civil and Environmental Engineering - Environmental Engineering
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Fall 2016

CIV ENGR/G L E 730 — ENGINEERING PROPERTIES OF SOILS
3 credits.

Determination and interpretation of soil properties for engineering purposes; physio-chemical properties of soil-water systems, permeability and capillarity, compression characteristics of soils, measurement of soil properties in the triaxial test, properties of frozen soils and permafrost.

**Requisites:** CIV ENGR/G L E 330
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Fall 2017

CIV ENGR/G L E 731 — PROPERTIES OF GEOSYNTHETICS
3 credits.

Properties and behavior of geosynthetics (plastics sheets and geotextiles used in geotechnical and geo-environmental construction) are discussed and measured in a laboratory setting. Students learn how to measure and quantify geomechanical and hydraulic behavior of geosynthetics which are used in design.

**Requisites:** Grad st CIV ENGR/G L E 330, or cons inst
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Fall 2008

CIV ENGR/G L E 732 — UNSATURATED SOIL GEOENGINEERING
3 credits.

Engineering principles of unsaturated soils as they apply to geotechnical and geoenvironmental systems. Effect of soil water suction and stress on hydraulic conductivity, shear strength, and compressibility of soils in the context of geoenengineering problems of flow and stability.

**Requisites:** Grad st Civ Engr/GLE 330 or cons inst
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Spring 2017

CIV ENGR/G L E 733 — PHYSICOCHEMICAL BASIS OF SOIL BEHAVIOR
3 credits.

Applications of physiochemical, mineralogical and environmental considerations to the engineering behavior of soils. Soil composition, formation, fabric, pore fluid chemistry and interaction of phases. The particulate nature of soils and the fabric-engineering property (volume change, strength, deformation and conduction) relationships.

**Requisites:** CIV ENGR/G L E 330 or consent of instructor
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Spring 2016
CIV ENGR/GLE 735 — SOIL DYNAMICS
3 credits.

Geotechnical considerations of earthquake engineering and foundation vibrations. Seismic surveying; ground motion during earthquakes; determination of soil properties for ground response analysis; dynamic properties of soils; soil structure interaction effects; soil liquefaction; dynamic analysis of earth dams; settlements resulting from earthquakes, lateral earth pressures during earthquakes; foundation vibrations.
Requisites: Civ Engr/EMA 530, EMA 545 or cons inst
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2014

CIV ENGR 739 — SPECIAL TOPICS IN GEOTECHNICAL ENGINEERING
1-4 credits.

Advanced topics of special interest to graduate students in geotechnical engineering.
Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2009

CIV ENGR 740 — ADVANCED METHODS OF STRUCTURAL ANALYSIS
3 credits.

Advanced topics in modern structural analysis including development of stiffness matrices, modeling connections, nonlinear geometry, nonlinear materials.
Requisites: CIV ENGR 440
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2008

CIV ENGR 744 — STRUCTURAL DYNAMICS AND EARTHQUAKE ENGINEERING
3 credits.

Response of Single Degree of Freedom (SDOF) systems; numerical evaluation of dynamic response; earthquake response of SDOF systems; response spectra; Multi Degree of Freedom (MDOF) systems; natural frequencies and vibration modes; modal superposition; direct integration; damping of MDOF systems; earthquake response of MDOF systems; earthquake resistant design (basic principles).
Requisites: CIV ENGR 440 or cons inst
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2013

CIV ENGR 749 — SPECIAL TOPICS IN STRUCTURAL ENGINEERING
1-4 credits.

Advanced topics of special interest to graduate students in structural engineering.
Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2017

CIV ENGR/ENVIR ST 772 — PRACTICUM IN TRANSPORTATION MANAGEMENT AND POLICY
3 credits.

Integrative capstone course in transportation management and policy. Interdisciplinary team experience in the application of theoretical knowledge and analytical tools for developing policy and making management decisions on "real-world" problems.
Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2016

CIV ENGR 790 — MASTER'S RESEARCH OR THESIS
1-9 credits.

Requisites: Consent of instructor
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2017

CIV ENGR 795 — CHARACTERIZATION OF ASPHALT BINDERS
3 credits.

Fundamentals of asphalt production methods, refining practices, and modification techniques. Asphalt rheological testing, linear and nonlinear visco-elasticity, conventional and Superpave characterization techniques. The role of asphalt rheology in pavement response and pavement performance. Course includes hands-on training on using different rheometers used in binder grading systems.
Requisites: CIV ENGR/EMA 395 or 575
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2012

CIV ENGR 820 — HYDRAULICS AND APPLIED FLUID MECHANICS FOR ENVIRONMENTAL ENGINEERS
3 credits.

Principles of hydraulics and fluid mechanics applied to environmental engineering systems that convey, control, and measure the flow of liquids, solid-liquid slurries, and gases.
Requisites: Students must be accepted into an online Master of Engineering degree program
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Summer 2017
CIV ENGR 821 — ENVIRONMENTAL ENGINEERING: BIOLOGICAL TREATMENT PROCESSES
3-4 credits.

Advanced theory and applications of biological systems for the treatment of wastes; lab techniques to assess treatability and to provide design parameters.
Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2017

CIV ENGR 822 — ENVIRONMENTAL ENGINEERING: PHYSICAL/CHEMICAL TREATMENT PROCESS
3-4 credits.

Advanced theory and applications of chemical and physical-chemical processes for the treatment of water and wastewater; lab techniques to assess design requirements and treatability.
Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

CIV ENGR 823 — ENVIRONMENTAL ENGINEERING DESIGN PROJECT
3 credits.

Engineering design project applied to environmental engineering solutions involving environmental chemistry, environmental quality, physical-chemical treatment processes, biological treatment processes, solid and hazardous waste engineering, energy, resource recovery, economic analysis, hydrology, and/or hydraulics and applied fluid mechanics.
Requisites: Declared in Master of Science in Civil and Environmental Engineering or Environmental Chemistry and Technology, or Master of Engineering in Civil and Environmental Engineering-Environmental Engineering Option
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No

CIV ENGR/URB R PL 839 — LAND USE AND COMMUNICATION SYSTEMS PLANNING
3 credits.

Application of systems analysis to the planning of land use and transportation systems; system modeling; environmental impacts; value measurement; decision-making strategies.
Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2013

CIV ENGR 890 — PRE-DISSERTATOR’S RESEARCH
1-9 credits.

Requisites: Grad st, for post-master’s, pre-dissertation stdts only
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2017

CIV ENGR 909 — GRADUATE SEMINAR - ENVIRONMENTAL CHEMISTRY & TECHNOLOGY
1 credit.

Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2017

CIV ENGR/ATM OCN/BOTANY/ENVIR ST/GEOSCI/ZOOLOGY 911 — LIMNOLOGY AND MARINE SCIENCE SEMINAR
1 credit.

Sections in various fields of zoological research.
Requisites: Grad st in limnology marine sci grad prgm or cons inst
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2017

CIV ENGR 919 — SEMINAR-HYDRAULIC ENGINEERING AND FLUID MECHANICS
1 credit.

Current research and review of literature in theoretical and applied fluid mechanics and hydraulic engineering.
Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2017

CIV ENGR 929 — SEMINAR-ENVIRONMENTAL ENGINEERING
1 credit.

Current research and literature on water, wastewater, water pollution control, solid wastes engineering and management.
Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2017

CIV ENGR 939 — GEOTECHNICAL ENGINEERING SEMINAR
1 credit.

Geotechnical analysis, design, and construction.
Requisites: Graduate or professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2017
CIV ENGR 949 — SEMINAR-STRUCTURAL ENGINEERING
1 credit.

Structural analysis, design, and construction.

Requisites: Graduate or professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: Yes, unlimited number of completions

Last Taught: Spring 2003

CIV ENGR/ENVIR ST 950 — ENVIRONMENTAL MONITORING SEMINAR
1 credit.

Current research and literature dealing with environmental remote sensing and geographic information systems.

Requisites: Graduate or professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: Yes, unlimited number of completions

Last Taught: Spring 2006

CIV ENGR/ENVIR ST 970 — COLLOQUIUM IN TRANSPORTATION MANAGEMENT AND POLICY
1 credit.

Current issues, case studies, research, and literature dealing with transportation management and policy development.

Requisites: Graduate or professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: Yes, unlimited number of completions

Last Taught: Fall 2016

CIV ENGR 990 — THESIS
1-12 credits.

Required for some M.S. and all Ph.D. degrees.

Requisites: Dissertator status

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: Yes, unlimited number of completions

Last Taught: Fall 2017

CIV ENGR 999 — ADVANCED INDEPENDENT STUDY
1-9 credits.

Requisites: Consent of instructor

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: Yes, unlimited number of completions

Last Taught: Fall 2017