CIV

Civil Engineering

CIV 505: Transportation Network Analysis
Traffic flows on networks; Deterministic and user equilibrium traffic assignment problems; Transportation networks and optimality; Transportation network design and reliability; Vulnerability of transportation networks
3 credits, Letter graded (A, A-, B+, etc.) May be repeated for credit.

CIV 507: Transportation Economics
Microeconomics principles applied in the transportation field. Transportation demand and supply. Transportation costs (fixed costs, variable costs) and externalities. Economic and social benefits of transportation. Economic principles for transport pricing, e.g. toll pricing. Cost benefit analysis of a transportation project. History of government regulation of transportation.
3 credits, Letter graded (A, A-, B+, etc.)

CIV 509: Transportation Logistics Systems
This course provides a deep understanding of logistics systems by introducing the models and analytic techniques to evaluate their design and operation. Emphasis will be placed on the development of models to demonstrate the core concepts involved in network distribution strategies, discrete facility location design, vehicle routing and scheduling, and inventory management.
3 credits, Letter graded (A, A-, B+, etc.)

CIV 510: Advanced Foundation Engineering
The course is designed to provide students with the theory and experience-based knowledge necessary to evaluate and estimate soil properties and earth pressure for analysis and design of retaining walls, anchored bulkheads, and excavation bracing systems. Bearing capacity and settlement of shallow foundations are also covered. Semesters Offered: Fall
3 credits, Letter graded (A, A-, B+, etc.)

CIV 511: Advanced Shear Strength of Soils
This course covers topics related to advanced analysis for shear strength of soils including stress-path, shear strength of cohesive soils, and shear strength of granular soils.
3 credits, Letter graded (A, A-, B+, etc.)

CIV 513: Seepage and Slope Stability
This class will expose students to water flow in soils and the associated seepage forces applied on underground structures. Also included in this class is a detailed discussion about determining the soil hydraulic properties in the lab and in the field. Additionally, the course will discuss the stability of earth slopes forming natural and manmade slopes using various analysis methods.
3 credits, Letter graded (A, A-, B+, etc.)

CIV 514: Advanced Cons
This course introduces several emerging materials in construction, some of which are already in use and some of which are still in development. First, students are taught overall material properties of concrete which include cement manufacturing, hydration, and microstructure. For each new material discussed, students are taught about its properties, how those properties are derived, and its potential applications. In addition, principles and application of material characterization techniques of X-ray diffraction, X-ray fluorescence, scanning electron microscope, and isothermal calorimetry will be discussed. Examples of materials discussed are high performance steel, ultra high performance concrete, calcium aluminate cement concrete, calcium sulfoaluminate cement, and fiber-reinforced polymers. The students then take field trips as a group to concrete batch plant, construction sites, or LEED-certified building with innovative concrete use and have a presentation about their field trips. Semesters Offered: Spring
3 credits, Letter graded (A, A-, B+, etc.) May be repeated 1 times FOR credit.

CIV 515: Analysis of Deep Foundations
This course covers topics related to the analysis and design of deep foundations including the design of vertically loaded drilled shafts and driven piles, the analysis of laterally loaded piles, and in-situ pile load tests.
3 credits, Letter graded (A, A-, B+, etc.)

CIV 516: Soil and Site Improvement
This class will expose students to techniques currently used in practice to improve the properties of soils in-situ. These techniques will include shallow and deep compaction, overexcavation and replacement, deep replacement, drainage and dewatering, preloading, deep soil mixing, and fill reinforcement. At the end of the class, students will be able to perform preliminary analysis to select the most appropriate soil improvement technique for a given project and deliver a detailed design of the selected technique.
3 credits, Letter graded (A, A-, B+, etc.)

CIV 517: Engineering Geology
Engineering geology is a multidisciplinary field that views geology from a civil engineering perspective. In this course, students will first learn how to characterize rocks and sediments as natural and engineering materials. Then, they will have a review over structural geology, geologic and engineering description of rock masses (geologic mapping, joint surveys, brief description of exploration techniques). Through case studies on different terrains (glacial, shore, alluvial, etc), students will explore how geology influences the design and construction of civil engineering projects. Prevention and mitigation of geohazards will also be discussed, along with the characteristics of different terrains.
3 credits, Letter graded (A, A-, B+, etc.)

CIV 522: Introduction to Coastal Engineering
Basic hydrodynamics of water waves. Topics include linear wave theory, energy, power and energy propagation, wave refraction, shoaling and breaking in the nearshore, diffraction by breakwaters and gaps, reflection and basin oscillations, wave statistics and spectra, wind-wave hindcast/forecast, wave forces on piles and pipes. Some coastal processes due to nonlinearity, including wave set-up/set-down, nearshore circulations and storm surges. Physical interpretations of mathematical formulas are particularly emphasized. Semesters Offered: Spring
3 credits, Letter graded (A, A-, B+, etc.) May be repeated 1 times FOR credit.

CIV 523: Coastal Engineering Planning and Design
The basic principles involved in the planning and design of various types and functions of coastal structures and shore protective measures will be discussed. Topics will include review of linear wave theory, considerations of site conditions; design processes; design of sloping- and vertical-front coastal structures; scour and scour protection; coastal sediment transport; shore protection measures such as coastal armorings, beach restoration, and beach stabilization; and introduction to harbor and marina.
3 credits, Letter graded (A, A-, B+, etc.)

CIV 524: Coastal Processes and Sediment Transport
This course describes processes associated with water and sediment movements close to...
shoreline. The topics covered in this course includes: sediment characteristics; long-term processes, hydrodynamics of coastal zone; field measurement techniques and analysis, equilibrium beach profiles, sediment transport, modeling of beaches and shorelines, shoreline modification and analysis including soft and hard engineering approaches and tidal inlets.

3 credits, Letter graded (A, A-, B+, etc.)

**CIV 526: Environmental Biotechnology**

This graduate course covers the fundamental concepts of biological processes that are important in natural and engineered environmental systems. The course will incorporate basic fundamental microbiology into a quantifiable engineering context in order to describe, predict and control behavior of environmental biological system.

3 credits, Letter graded (A, A-, B+, etc.)

**CIV 530: Structural Mechanics**

This course deals with fundamentals of the theory of structures with the objective of providing proper understanding and knowledge on structural analysis methods and structural behavior. The subject treatment is in the context of truss, beam, frame, and plate structural elements. A key objective is to provide the necessary knowledge and skills for capturing structural behavior through simple models. The course will extend concepts in matrix structural analysis by presenting a general framework for analyzing complex structural systems. A brief introduction to the finite element method and nonlinear structural analysis is provided.

3 credits, Letter graded (A, A-, B+, etc.)

**CIV 531: Nonlinear Structural Mechanics**

The course is aimed at advanced MS students and PhD students, and will complement other core courses in the sub-discipline of Structural Engineering and Mechanics. The course is designed as a follow-up from an existing fundamental introductory course: CIV 530 (Structural Mechanics). A justification on the importance of the topic for the training of students in the area of structural engineering and mechanics is give below. While the behavior of most structures under service loads is adequately captured by linear elastic analyses, their response near ultimate conditions is most often nonlinear. These limit-state conditions include the effects of cumulative elastic deformations that may lead to system instability (i.e., buckling), the effect of material inelastic response (e.g., yielding, or crushing) near ultimate capacities, or the combination of both. The area dealing with the theory and methods to determine the response of structures through their nonlinear behavior is commonly termed nonlinear structural mechanics. This advanced subject matter has become more conventional as the increase in computer power and increasingly user-friendly software is allowing more engineers to make use of the advantages of non-linear analysis. These include load redistribution after plasticization, design of structural systems for specific performance levels (beyond linear-elastic state), design of reconfigurable and deployable structures, and the determination of collapse behavior under extreme events. The course will present relevant theory and analysis methods on geometric and material nonlinear behavior of structures. Concepts will be presented from first principles but their application will be focused on truss and beam/frame finite elements. Assignments include computer program development and use of existing commercial computer codes.

3 credits, Letter graded (A, A-, B+, etc.)

**CIV 532: Structural Dynamics**

Analysis of the dynamic response of structures and structural components to transient loads and foundation excitation; single-degree-of-freedom and multi-degree-of-freedom systems; response spectrum concepts; numerical methods for integration of the equations of motion; simple inelastic structural systems; simple models of collapse behavior under extreme events. Further study of analyses methods on geometric and material nonlinear behavior of structures with primary emphasis on slab systems; on time dependent problems, nonlinear behavior, and design of indeterminate reinforced concrete structures, with primary emphasis on slab systems; emphasis on the strength of slabs and on the available methods of design of slabs spanning in two directions, with or without supporting beams.

3 credits, Letter graded (A, A-, B+, etc.)

**CIV 533: Intermediate Steel Design**

Metal members under combined loads; connections, welded and bolted; moment-resistant connections; plate girders, conventional behavior, and tension field action.

3 credits, Letter graded (A, A-, B+, etc.)

**CIV 534: Intermediate Reinforced Concrete Design**

Strength, behavior, and design of indeterminate reinforced concrete structures, with primary emphasis on slab systems; emphasis on the strength of slabs and on the available methods of design of slabs spanning in two directions, with or without supporting beams.

3 credits, Letter graded (A, A-, B+, etc.)

**CIV 535: Earthquake Engineering**

Source mechanisms, stress waves, and site response of earthquake shaking; effect on the built environment; nature of earthquake actions on structures; fundamental structural response characteristics of stiness, strength, and ductility; representation of the earthquake input in static and dynamic structural analysis; modeling of steel and concrete structures under earthquake effects; outputs for safety assessment; comprehensive source-to-design actions project.

3 credits, Letter graded (A, A-, B+, etc.)

**CIV 540: Intermediate Computational Mechanics**

This course deals with some intermediate computational mechanics concepts and is a continuation of introductory finite element courses. The main objective is to provide proper understanding and knowledge on theoretical and practical aspects of finite element technology. Emphasis is placed on time dependent problems, nonlinear elasticity, stress update algorithms, mixed and penalty formulations, as well as computer implementation and programming concepts.

3 credits, Letter graded (A, A-, B+, etc.)

**CIV 544: Environmental Fluid Dynamics**

Free surface flows of water and air occurring in natural fluid systems and influencing environmental transport and mixing. Fundamental principles of fluids, covering the scales relevant to both engineering and geo-physical applications. Topics include waves, instability, stratification, turbulent boundary layers, jets and plumes, and river hydraulics.

3 credits, Letter graded (A, A-, B+, etc.)

**CIV 545: Computational Fluid Mechanics**


3 credits, Letter graded (A, A-, B+, etc.)

**CIV 546: Environmental Aquatic Chemistry**

This course introduces the application of physical chemistry to solve problems related to natural water systems (both freshwater and seawater) and anthropogenic impacts on these systems. We will cover thermodynamics and kinetics and how they can be used to understand the distribution and cycling of chemical species in natural waters and related processes, including dissolution and precipitation, oxidation and reduction, acid-base interactions, and complexation. We will also cover special topics related to current issues in water quality.
CIV 547: Environmental Physical-Chemical Processes

Physical-chemical processes that affect environmental quality in natural and engineered systems. The focus is on developing a qualitative understanding of mechanisms as well as quantitative tools to describe, predict, and control physical-chemical processes. Topics include reactor mixing and reaction kinetics, gas transfer, sorption, particle dynamics, filtration, membranes, and disinfection. Most of the applications are in the water quality sub-domain, but overlap exists with air quality, soil and sediment contamination, and even some applications to biological systems.

3 credits, Letter graded (A, A-, B+, etc.)

May be repeated for credit.

CIV 548: Organic Pollutants in Environmental Systems

This course covers topics in theoretical and applied environmental organic chemistry. We will focus on physical/chemical properties of organic pollutants and the processes that govern their fate and transport, particularly in air and water, as well as their interactions with soil and biota. Topics include equilibrium partitioning, molecular diffusion, air-water exchange, sorption, bioaccumulation and biomagnification, and transformation reactions. We will also touch on emerging issues involving novel organic contaminants.

3 credits, Letter graded (A, A-, B+, etc.)

CIV 549: Environmental Exposure and Risk Assessment

This course will introduce types of harmful pollutants, the pathways by which humans and ecological receptors are exposed to these pollutants, and the strategies used to monitor and measure exposure and to estimate risk. We will explore the mechanisms linking chemical exposure to biological effects and how these processes are measured and modeled to characterize risks, as well as concepts related to environmentally-relevant exposures involving multiple stressors. Methodologies to quantitatively estimate ecological and human health risk will be discussed and applied to case studies covering real-life pollutant exposure scenarios.

3 credits, Letter graded (A, A-, B+, etc.)

CIV 550: Introduction to Smart Infrastructure Systems

The course will include lectures that provide historical background of smart infrastructure systems, fundamental concepts of decision-making, data representation, sensing and actuation networks, and associated challenges specific to smart cities applications. Basics concepts of probability and statistics, optimization, and uncertainty and risk will be introduced to help students build a solid foundation for machine learning and engineering system modeling. The course includes assignments that will provide hands-on experience on applying what they have learned from lectures. The students will conduct a comprehensive independent research project on topics related to smart infrastructure systems to enhance their understanding of a specific topic of their interest. This course will cover topics including sensing systems, data visualization, probabilistic modeling, Bayesian updating, convex optimization, uncertainty and risks, as well as open-ended topics related to policy, economics, and information security challenges in infrastructure monitoring and decision-making.

3 credits, Letter graded (A, A-, B+, etc.)

CIV 551: Sensing and Learning for Smart Cities

An introductory course on practical applications and challenges of sensing, data analytics and machine learning in the context of physical urban systems. Background is provided on data analysis and associated challenges specific to smart cities applications, insights behind signal representation, statistical modeling, and machine learning, and critical interpretation of outcomes. The course is suitable for students without prior experience in probabilistic and statistical modeling, or working with data. Topics include data visualization, noise cleansing, frequency domain analysis, forward and inverse modeling, feature extraction, sampling bias, statistical modeling, machine learning, and error analysis.

3 credits, Letter graded (A, A-, B+, etc.)

CIV 555: Analytics for Engineering Systems

This course systematically introduces methods of analytics with an emphasis placed on solving civil engineering problems. The design, operation, and management of civil engineering systems are increasingly complex and uncertain. This course aims to help students build the ability to use analytics for understanding, modeling, and optimizing civil engineering systems, and system of systems. Topics of this course include data description and visualization, modeling uncertainty with probability distribution, descriptive mining, sampling and statistical inference, regression analysis, time series analysis, neural networks, simulation, mathematical optimization, decision analysis, and optimization under uncertainty.

3 credits, Letter graded (A, A-, B+, etc.)

CIV 595: Independent Study in Civil Engineering

Students can register this course in order to conduct research or participate in a project under the supervision of one or more members of the Civil Engineering faculty.

1-6 credits, Letter graded (A, A-, B+, etc.)

May be repeated 2 times FOR credit.

CIV 596: MS Project

This course is taken by M.S. students who select MS Project track. Conducted jointly by graduate students and one or more members of the faculty. A final project report must be submitted to the advisor as well as to the Graduate Program Director. Without the submitted report, credits from his course cannot be applied toward the MS degree.

0-6 credits, Letter graded (A, A-, B+, etc.)

May be repeated for credit.

CIV 599: M.S. Thesis Research

This course is taken by M.S. students for their thesis research work.

1-12 credits, S/U grading

May be repeated for credit.

CIV 680: Special Topics in Transportation Engineering

The subject matter of special topics course can vary semester to semester depending on the interests of the students and the faculty, and the contemporary topics in transportation field.

3 credits, Letter graded (A, A-, B+, etc.)

May be repeated for credit.

CIV 681: Special Topics In Geomechanics and Geotechnical Engineering

The subject matter of special topics course can vary semester to semester depending on the interests of the students and the faculty, and the contemporary topics in geotechnical engineering field.

3 credits, Letter graded (A, A-, B+, etc.)

May be repeated for credit.

CIV 682: Special Topics in Ocean and Coastal Engineering

The course is designed for the discussion of topics of special interest on demand that may not be covered in regularly scheduled courses. Varying topics from ocean wave mechanics, offshore structures, coastal processes, sediments and morphology to estuarine dynamics may be offered concurrently.
3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

**CIV 683: Special Topics in Structural Engineering**
The subject matter of special topics course can vary semester to semester depending on the interests of the students and the faculty, and the contemporary topics in structural engineering field.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

**CIV 684: Special Topics in Water Resources and Environmental Engineering**
The course is designed for the discussion of topics of special interest on demand that may not be covered in regularly scheduled courses. Varying topics from water treatment, solid waste management, urban and watershed hydrology, stormwater management, water quality modeling to environmental fluid mechanics may be offered concurrently.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

**CIV 685: Special Topics in Materials Engineering**
The subject matter of special topics course can vary semester to semester depending on the interests of the students and the faculty, and the contemporary topics in materials engineering field.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

**CIV 686: Special Topics in Smart Civil Infrastructure Systems**
The subject matter of special topics course can vary semester to semester depending on the interests of the students and the faculty, and the contemporary topics in transportation field.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

**CIV 691: Civil Engineering Seminar**
This course is designed to expose students to cutting-edge research and development activities in civil engineering. Speakers are invited from both on and off campus. Fall and spring.

0 credits, S/U grading. May be repeated.

**CIV 695: Civil Engineering Internship**
Participation in off-campus engineering practice in private corporations, public agencies, or non-profit institutions. Student will be required to have faculty coordinator as well as a contact in outside organizations, to participate with them in regular consultations on the project, and to submit a final report to both. A maximum of 3 credits can be accepted toward the M.S. degree.

1 credit, S/U grading
May be repeated 3 times FOR credit.

**CIV 697: Practicum in Teaching I**
Every TA must register for this course

Fall, S/U grading
May be repeated for credit.

**CIV 698: Practicum in Teaching II**
Practicum in teaching under faculty supervision

3 credits, S/U grading
May be repeated for credit.

**CIV 699: Dissertation Research On Campus**
Students have to register for this class during their dissertation research after advancement to candidacy. Major portion of research must take place on SBU campus, at Cold Spring Harbor, or at the Brookhaven National Lab.

0-9 credits, S/U grading
May be repeated for credit.

**CIV 700: Dissertation Research Off Campus-Domestic**
Students have to register for this class during their dissertation research after advancement to candidacy. Major portion of research will take place off-campus, but in the United States and/or U.S. provinces. All international students must enroll in one the graduate student insurance plans and should be advised by an international advisor.

1-9 credits, S/U grading
May be repeated for credit.

**CIV 701: Dissertation Research Off Campus-International**
Major Portion of research will take place outside of the United States and/or U.S. provinces. Domestic students have the option of the health plan and may also enroll in MEDEX. International students who are in their home country are not covered by mandatory health plan and must contact the Insurance Office for the insurance charge to be removed. International students who are not in their home country are charged for the mandatory health insurance. If they are to be covered by another insurance plan they must file a waiver be second week of classes. The charge will only be removed if other plan is deemed comparable. All international students must receive clearance for an International Advisor

1-9 credits, S/U grading