Civil Engineering Graduate Courses

Structures Track

CVNG 405/505 – Advanced Structural Analysis (3 credits)
Direct stiffness method for the analysis of two-dimensional trusses and frames, equivalent nodal forces, thermal and settlement effect, principal of virtual work, space trusses, grid structures, static condensation, Lagrange multipliers, tapered elements. Prerequisite: CVNG 301 or equivalent.

CVNG 407/507 – Structural Dynamics (3 credits)
Single degree of freedom systems, lumped-mass multi-degree systems, and multi-degree of freedom systems. Numerical evaluation of system responses due to blasts, wind, and earthquake loading. Applications. Prerequisite: CVNG 301 or equivalent.

CVNG 409/509 – Advanced Reinforced Concrete (3 credits)
Advanced topics in flexural design; torsion in beams; behavior and design of slender columns; biaxial bending of columns; design of two way slabs; inelastic analysis of flexural members; use of strut and tie analysis; yield line analysis, design of mat foundations. Prerequisite: CVNG 315.

CVNG 411/511 – Advanced Steel Design (3 credits)
Interpretation of current codes as related to the physical behavior of steel structures. Design of structural steel members: tension, compression, flexural and beam-columns. Design of connections. Prerequisite: CVNG 315.

CVNG 413/513 – Bridge Engineering (3 credits)
Structural systems for bridges, loading, analysis by influence lines, slab and girder bridges, composite design, pre-stressed concrete, rating of existing bridges, specifications and economic factors. Prerequisite: CVNG 315.

CVNG 515 – Prestressed Concrete (3 credits).
Theory and analysis of prestressed concrete members by various methods of prestressing; design of simple and continuous beams and slabs; prestress losses; composite beams. Extensive study of materials used in prestressed concrete. Precast concrete systems. Prerequisite: CVNG 315.

CVNG 517 – Seismic Design (3 credits)
Theory, analysis, and design of building structures under earthquake loading. Application of current codes and standards related to steel, concrete, masonry, and wood structures. Prerequisites: CVNG 315.

Non-CVNG courses applicable to Structures Track

MENG 533 – Composite Materials for Structure and Design (3 credits)
MENG 534 – Finite Element Analysis I (3 credits)
MENG 535 – Finite Element Analysis II (3 credits)
MENG 536 – Multidisciplinary Optimization (3 credits)
MENG 537 – Structural Reliability (3 credits)
MENG 538 – Advanced Mechanics of Solids (3 credits)
MENG 539 – Fracture Mechanics and Plasticity (3 credits)
Environmental and Sustainable Engineering Track

CVNG 419/519 – Sustainable Land Development Engineering (3 credits)
Introduction to land development engineering and urban planning; site design and sediment control; transportation planning and roadway design; water resource and waste disposal issues; ecological impact analysis; application sustainable development principles to land development projects at local and regional scales. Prerequisite: CVNG 203.

CVNG 421/521 – Sustainable Water Management (3 credits)
Water supply assessment and stormwater management considering hydrologic, legal, political, and ecological issues. Determination and forecasting of water demand; stormwater analysis and application of best management practices. Management of flooding and water quality in small and large scale watersheds. Prerequisites: CVNG 203 and CVNG 313.

CVNG 423/523 – Biological Treatment Systems (3 credits)
General fundamentals of environmental microbiology and its application to drinking water treatment and distribution, wastewater treatment, water pollution control, and natural systems. Theory and design of basic biological operations and processes. Prerequisite: CVNG 203.

CVNG 425/525 – Physical/Chemical Treatment Systems (3 credits)
The applicability of water chemistry and physical processes on natural waters and water treatment systems. Theory and design of physical and chemical operations and processes. Prerequisite: CVNG 203.

CVNG 427/527 – Design of Wastewater Treatment Facilities (3 credits)
This course covers detailed analysis of physical and biological processes used in wastewater treatment. Class includes a wastewater treatment design project. Prerequisite: CVNG 423/523.

CVNG 429/529 – Design of Drinking Water Treatment Facilities (3 credits)
This course covers detailed analysis of physical and biological processes used in drinking water treatment. Class includes a drinking water treatment design project. Prerequisite: CVNG 425/525.

CVNG 431/531 – Air Pollution (3 credits)
Fundamentals of meteorology, air pollution health impacts, particulate control mechanisms and devices, and gaseous pollutant control mechanisms and devices. Course includes detailed design projects involving major air pollution control devices. Prerequisite: CVNG 203.

CVNG 433/533 – Solid and Hazardous Waste Regulation and Treatment (3 credits)
Solid and hazardous waste management, including characterization, collection system design, waste minimization, design of landfills and incinerators, and remediation principles. Major aspects of managing hazardous waste, including regulation, pollution prevention, treatment, disposal, spill clean-up, and site remediation. Prerequisite: CVNG 203.

CVNG 535 – Groundwater Analysis and Site Remediation (3 credits)
Introduction to hydrodynamics of flow through porous media. The primary emphasis is on the analysis of steady and unsteady flow in confined and unconfined aquifers. Biological and physical/chemical remediation technologies, including theory and application, for groundwater and hazardous wastes. Prerequisites: CVNG 313, CVNG 523.

Non-CVNG courses applicable to Environmental and Sustainable Engineering Track

MENG 534 – Finite Element Analysis I (3 credits)
MENG 536 – Multidisciplinary Optimization (3 credits)
BME 505 – Data Handling
**Geotechnical Engineering Track**

CVNG 437/537 — Slopes and Retaining Structures (3 credits)
Selected topics in soil response and technology needed in conventional geotechnical analysis and design; shearing behavior in clays; subsurface investigation; lateral earth pressures, retaining walls, and sheet pile walls; stability of slopes. Prerequisite: CVNG 403.

CVNG 439/539 — Advanced Geotechnical Engineering (3 credits)
Introduction to the nature and origin of soils, rocks, geomembranes, and geotextiles; engineering significance of geologic landforms and soil deposits on construction and structures; identification and engineering classification of soils as it relates to structures; engineering behavior and operational properties of soils; permeability, compressibility, shearing resistance of geotechnical materials. Prerequisite: CVNG 309.

CVNG 541 — Soil Dynamics (3 credits)
Vibration of elementary systems, foundation vibratory theory, foundation design for vibratory loads, foundation isolation, wave propagation theory, response of soils to dynamic loading, dynamic soil properties, dynamic behavior of waste materials, field and laboratory methods for evaluation of dynamic soil properties, liquefaction of sands, vibratory compaction of granular materials. Prerequisite: CVNG 403.

CVNG 543 — Foundation Engineering II (3 credits)
Advanced classical earth pressure theories. Design of shallow foundations (isolated, combined, and strip footings), with specific attention to issues of mutual concern and interest to geotechnical and structural engineers. Review of factors that serve as the basis for selection of foundation type. Interpretation of subsurface exploration results. Settlement analyses and limit bearing capacity analyses. Communications and interaction between geotechnical and structural engineers. Structure and contents of a geotechnical report. Detailed treatment of geotechnical/structural design criteria and methodologies for various types of shallow and deep foundations. Prerequisite: CVNG 403.

**Non-CVNG courses applicable to Geotechnical Track**

MENG 534 – Finite Element Analysis I (3 credits)
MENG 535 – Finite Element Analysis II (3 credits)
MENG 536 – Multidisciplinary Optimization (3 credits)

**Transportation Analysis and Planning Track**

CVNG 445/545 — Traffic Engineering (3 credits)
Design, analysis and use of traffic control devices. Traffic administration, traffic flow theory, and highway capacity. An introduction to computer and traffic engineering. Acquisition, evaluation, statistical analysis and reporting of traffic engineering data used to design, evaluate and operate transportation systems. Prerequisite: CVNG 311.

CVNG 447/547 — Urban Transportation Planning (3 credits)
Systems engineering for traffic generation, distribution assignment; analysis and traffic engineering procedures as applied to urban transportation planning and design. Emphasis on urban transportation planning, alternate road alignments and alternate evaluation. Legal aspects of transportation planning and engineering. Prerequisite: CVNG 311.

CVNG 449/549 — Data Management and Analysis (3 credits)
This course introduces important concepts of database design and application using popular database and analytical tools. The objective is to introduce modern algorithms and tools for large data set management and analysis. With the instructions, assignments, and projects in this course, students are
expected to learn database design theories; analytical methods for capacity and time series analyses; and skills on popular software tools for data management and analysis.

Non-CVNG courses applicable to Transportation Planning Track

PPS 530 – Planning the Metropolis
PPS 525 – Infrastructure Planning and Process
PPS 531 – Land Use Planning and Analysis
ASCI 501 - Analysis of Aviation Safety Data
ASCI 502 - Aviation Safety Data Analysis
ASCI 508 - Management of Avtn Safety Prog
ASCI 512 - Aviation Safety Quality Issues
ASCI 515 - Avtn Incident/ Accident Analys
ASCI 522 - Aviation Safety Programs

General Courses

CVNG 593 – Special Topics (1-3 credits per semester)
A one-time course on a particular topic or a trial course that is expected to become a standard course with its own unique course number.

CVNG 596 – Master’s Project (1-3 credits per semester)
Theoretical/computational/experimental work that leads to a Project Report and presentation of the Project.

CVNG 599 – Master’s Thesis Research (0-6 credits per semester)
Research that leads to a Master’s Thesis and final defense of the Thesis.

CVNG 699 – Doctoral Dissertation Research (0-6 credits) A non-classroom course in which a student explores a topic that is related to the student's doctoral work and career goals.