

# CIVIL ENGINEERING

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## Courses

### **CIVL 200 Professional Skills I Units: 2.50**

This intensive short-course serves as a kickoff to Civil Engineering at Queen's. Students will be engaged in a design challenge where they are to conceive, design, implement and operate a system to achieve some specified function bounded by constraints. Focus will be placed on development of decision making, team building, communication and engineering design skills.

K2.5(Lec: 0, Lab: 0, Tut: 0)

**Requirements:** Prerequisites: Must be registered in BSCE or BASC program. Corequisites: Exclusions:

**Offering Term:** F

#### **CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 8

Engineering Science 0

Engineering Design 20

**Offering Faculty:** Smith Engineering

### **CIVL 201 Professional Skills Units: 2.50**

Within a team structure potentially involving second, third, and fourth year Civil Engineering students and a faculty advisor, students will engage in a range of exercises designed to promote written and verbal communication, decision making, team building and engineering design skills. Lectures, workshops, design charettes and both individual and team assignments will be utilized to enhance learning. This course is available only to select students, under exceptional or extenuating circumstances, at the discretion of the Head of the Department and the Undergraduate Chair. (This course may not be offered every year).

(Lec: 0.5, Lab: 1, Tut: 1)

**Requirements:** Prerequisites: Permission of the Department

Corequisites: Exclusions: CIVL 200

**Offering Term:** FW

#### **CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 14

Engineering Science 7

Engineering Design 7

**Offering Faculty:** Smith Engineering

### **CIVL 210 Chemistry For Civil Engineers Units: 4.50**

Application of fundamental chemistry principles with respect to their sources, reactions, effects and fates in civil and environmental engineering systems. Topics will include chemical equilibria, stoichiometry and reaction kinetics; electrochemistry and corrosion; adsorption and ion exchange; solubility and precipitation; coagulation; microbiological reactions and kinetics; biochemical, chemical and theoretical oxygen demand; acidity, alkalinity and hardness; as well as biogeochemical cycles. These concepts will be further developed and applied in tutorial and laboratory modules. A design-based laboratory is conducted as part of this course. Personal Protective Equipment (PPE) will be required for this course at student's cost (see course materials for details)

(Lec: 3, Lab: 1, Tut: 0.5)

**Requirements:** Prerequisites: APSC 132 Corequisites:

Exclusions:

**Offering Term:** F

#### **CEAB Units:**

Mathematics 0

Natural Sciences 20

Complementary Studies 0

Engineering Science 20

Engineering Design 15

**Offering Faculty:** Smith Engineering

### **CIVL 215 Materials For Civil Engineers Units: 4.50**

The basic engineering properties, micro/macro structure, behaviour and applications of various civil engineering materials will be studied including materials used in structural engineering, hydrotechnical engineering, geotechnical engineering and environmental engineering. This will include concrete, steel, timber, polymers, composites and soil. Interaction between materials will be examined. Laboratory experiments will be used to demonstrate material behaviour. PPE will be required for this course student's cost (see course materials for details)

(Lec: 3, Lab: 1, Tut: 0.5)

**Requirements:** Prerequisites: APSC 151 Corequisites:

Exclusions:

**Offering Term:** W

#### **CEAB Units:**

Mathematics 0

Natural Sciences 12

Complementary Studies 0

Engineering Science 32

Engineering Design 10

**Offering Faculty:** Smith Engineering

**CIVL 220 Statics And Solid Mechanics Units: 4.00**

Review of statics, forces and equilibrium, internal forces in simple structures; axial, torsion, shear and moment diagrams; concepts of stress and strain; mechanical properties of materials; centroids and moments of areas; axial stress; flexural stress; shear stress in shafts and beams; calculation of displacement by integration; introduction to combined loading; introduction to column buckling. This course is designed primarily for mechanical engineering students.

COURSE DELETED

(Lec: 3, Lab: 0.25, Tut: 0.75)

**Requirements:** Prerequisites: APSC 111, APSC 171.

Permission of the department for students not registered in Mechanical Engine Corequisites: Exclusions:

**Offering Term:** F

**CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 0

Engineering Science 48

Engineering Design 0

**Offering Faculty:** Smith Engineering

**CIVL 222 Numerical Methods Units: 5.00**

This course introduces the basics of numerical analysis and the use of computer software (MATLAB) for civil engineering analysis. Error analysis, numerical differentiation and integration, root finding, derivation and numerical solution of partial differential equations using finite difference methods, and optimization are among the topics covered. All problems emphasize engineering applications.

(Lec: 4, Lab: 1, Tut: 0)

**Requirements:** Prerequisites: MTHE 224 (MATH 224) or MTHE 225 (MATH 225) or MTHE 226 (MATH 226) Corequisites:

Exclusions:

**Offering Term:** W

**CEAB Units:**

Mathematics 45

Natural Sciences 0

Complementary Studies 0

Engineering Science 15

Engineering Design 0

**Offering Faculty:** Smith Engineering

**CIVL 230 Solid Mechanics I Units: 4.25**

Graphic Statics; Definitions of Stress and Strain; Hooke's Law; Axial Member Analysis and Design; Analysis and Design of Shafts Subjected to Torsion; Analysis and Design of Beams; Columns; Inelastic Bending; Introduction to Work and Energy and the Principle of Virtual Work

(Lec: 3, Lab: 0.5, Tut: 0.75)

**Requirements:** Prerequisites: APSC 111, APSC 171, APSC 182

Corequisites: Exclusions: MECH 221

**Offering Term:** F

**CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 0

Engineering Science 50

Engineering Design 0

**Offering Faculty:** Smith Engineering

**CIVL 231 Solid Mechanics II Units: 4.50**

Shear and bending moment diagrams; Moment-area method; Introduction to statically indeterminate structures; Virtual work for beams and frames (determinate and indeterminate); Stress review, transformed sections, and combined loading; Stress-strain transformation (including Mohr's circle); Failure theories.

(Lec: 3, Lab: 0.5, Tut: 1)

**Requirements:** Prerequisites: CIVL 230 Corequisites:

Exclusions:

**Offering Term:** W

**CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 0

Engineering Science 54

Engineering Design 0

**Offering Faculty:** Smith Engineering

**CIVL 250 Hydraulics I Units: 4.00**

Fluid properties, fluid statics, basic equations of fluid flow: Continuity, Momentum, Euler's Equation of Motion, Linear Momentum Equation and Bernoulli's Equation. Flow of real fluid in closed conduits: friction losses and local energy losses. Pipeline flows in engineering practice. PPE will be required for this course at student's cost (see course materials for details)

(Lec: 3, Lab: 0.5, Tut: 0.5)

**Requirements:** Prerequisites: APSC 172, APSC 174

Corequisites: Exclusions:

**Offering Term:** W

**CEAB Units:**

Mathematics 0

Natural Sciences 4

Complementary Studies 0

Engineering Science 22

Engineering Design 22

**Offering Faculty:** Smith Engineering

**CIVL 300 Professional Skills II Units: 2.50**

Professional skills relating to how engineers interact with, communicate with, and consider the implications of their actions on a wide range of potential stakeholders, ranging from colleagues to clients to society as a whole, will be developed. Students will improve their technical writing and verbal communication skills as they work through case studies intended to: deepen an understanding of the roles and responsibilities of a Professional Engineer; strengthen an ability to apply professional ethics, accountability and equity; and enhance an appreciation of the potential social and environmental impacts of engineering activities. Class discussions will normally occur every second week.

K2.5(Lec: 0.5, Lab: 1, Tut: 1)

**Requirements:** Prerequisites: CIVL 200 Corequisites:

Exclusions:

**Offering Term:** F

**CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 28

Engineering Science 0

Engineering Design 0

**Offering Faculty:** Smith Engineering

**CIVL 330 Structural Analysis Units: 4.00**

Analysis of statically determinate structures such as trusses and plane frames, calculation of deflections by virtual work. Flexibility and stiffness methods for analyzing statically indeterminate structures. Computer applications of the above methods.

(Lec: 3, Lab: 0.5, Tut: 0.5)

**Requirements:** Prerequisites: CIVL 230, CIVL 231

Corequisites: Exclusions:

**Offering Term:** F

**CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 0

Engineering Science 48

Engineering Design 0

**Offering Faculty:** Smith Engineering

**CIVL 331 Structural Steel and Timber Design Units: 4.00**

The objective of this course is to develop an understanding of the fundamentals in the design of steel and timber structures. To develop this understanding, the course focuses in-depth on the behaviour of steel and timber at the material, element, and system levels with specific reference to standards/codes practicing engineers use when designing with steel and timber in Canada, including CSA S16 and CSA O86. Students will learn how to design and analyze steel and timber tension members, columns, beams (laterally supported and laterally unsupported), beam-columns, and connections.

(Lec: 3, Lab: 0, Tut: 1)

**Requirements:** Prerequisites: CIVL 330 Corequisites:

Exclusions:

**Offering Term:** W

**CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 0

Engineering Science 12

Engineering Design 36

**Offering Faculty:** Smith Engineering

**CIVL 336 Structural Steel/Concrete Des Units: 4.00**

Introduction to limit states design, load paths, sustainability, and life-cycle analysis. Dead and live loads for design as specified in the National Building Code of Canada. Design assumptions regarding material properties of structural steel, concrete, and reinforcing steel. Flexural design of reinforced concrete beams including singly reinforced sections, doubly reinforced sections, T-sections, and one-way slabs. Control of cracking in reinforced concrete beams as specified for design. Flexural design of laterally supported and laterally unsupported structural steel beams. Shear design of structural steel and reinforced concrete beams. Design of tension members in structural steel. Design of axially loaded columns in structural steel and reinforced concrete. (0/0/0/8/40) ~ COURSE DELETED IN 2008/09 ~

**Requirements:** CIVL226 OR CIVL228 OR CIVL226

**Offering Term:** F

**CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 0

Engineering Science 8

Engineering Design 40

**Offering Faculty:** Smith Engineering

**CIVL 340 Geotechnical Engineering 1 Units: 4.00**

An introductory course focussing on the fundamental mechanics of soil materials (gravel, sand, silt and clay) applied to geotechnical engineering problems. Topics studied include: phase relationships; index properties of coarse and fine grained soils; one-dimensional steady state seepage; effective stress; one-dimensional compression and consolidation; drained and undrained shear strength; and lateral earth pressure. Theoretical material is applied to examine real engineering issues with a particular focus on developing design skills and engineering judgement. Students will conduct physical experiments to explore soil behaviour. The important role of geology on the mechanics of geotechnical materials is emphasized through classroom discussions and problem sets. PPE will be required for this course at student's cost (see course materials for details).

(Lec: 3, Lab: 0.5, Tut: 0.5)

**Requirements:** Prerequisites: CIVL 215 or GEOE 281 (GEOL 281), CIVL 230 Corequisites: Exclusions:

**Offering Term:** F

**CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 0

Engineering Science 36

Engineering Design 12

**Offering Faculty:** Smith Engineering

**CIVL 341 Geotechnical Engineering 2 Units: 4.00**

A course focusing on design issues and methods of analysis for practical geotechnical engineering problems. Topics studied include: site investigation; capacity and settlement of shallow and deep foundations; two-dimensional steady state seepage; landslides and slope stability. Commercial software will be introduced to perform stability, deformation and seepage analyses. Students will conduct physical experiments to explore how design methods compare with real soil behaviour. The important role of geology in geotechnical design is emphasized through classroom discussions and problem sets. PPE will be required for this course at student's cost (see course materials for details)

(Lec: 3, Lab: 0.5, Tut: 0.5)

**Requirements:** Prerequisites: CIVL 340 Corequisites:

Exclusions:

**Offering Term:** W

**CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 0

Engineering Science 12

Engineering Design 36

**Offering Faculty:** Smith Engineering

**CIVL 342 Geotechnical Design Units: 4.00**

A study of foundation design methods including stress distribution, slope stability, lateral earth pressure, retaining walls, braced walls, anchors, ultimate bearing capacity, foundation design, and piles. (0/0/0/12/36)~ COURSE DELETED IN 2008/09 ~

**Requirements:** CIVL340

**Offering Term:** W

**CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 0

Engineering Science 12

Engineering Design 36

**Offering Faculty:** Smith Engineering

**CIVL 350 Hydraulics 2 Units: 4.00**

Topics in open channel flow including friction, specific energy, free-surface profiles, culverts and hydraulic-jump energy dissipators. Lake dynamics and environmental hydraulics will be introduced. The basic underlying concepts of water resources and hydrology will be discussed.

(Lec: 3, Lab: 0.5, Tut: 0.5)

**Requirements:** Prerequisites: CIVL 250 Corequisites:

Exclusions:

**Offering Term:** F

**CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 0

Engineering Science 18

Engineering Design 30

**Offering Faculty:** Smith Engineering

**CIVL 355 Introd. Hydraulic Engineering Units: 4.00**

Topics in open channel flow including friction, specific energy, free-surface profiles, culverts and hydraulic-jump energy dissipators. Turbomachinery including pump characteristics, pump selection and analysis of combinations of pumps and piping systems. Fluid measurement, lift and drag, cavitation and water hammer, dispersion and diffusion are also discussed. (0/5/0/10/33) ~ COURSE DELETED IN 2008/09

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**Requirements:** CIVL354

**Offering Term:** W

**CEAB Units:**

Mathematics 0

Natural Sciences 5

Complementary Studies 0

Engineering Science 10

Engineering Design 33

**Offering Faculty:** Smith Engineering

**CIVL 360 Civil Engineering Design and Practice III Units: 4.00**

Students will develop and employ Engineering Design and Practice skills to resolve a complex, open-ended design task. This will involve the iterative application of Civil Engineering technical knowledge to identify and evaluate design options. The economic, environmental and societal implications of the preferred solution(s) will be assessed. Students will select, detail and communicate their final design in a logical, traceable and defensible manner. Ethical, legal and other relevant professional issues will be studied and discussed through case studies. Students will also develop and enhance written, graphical and oral communications skills.

K4(Lec: Yes, Lab: No, Tut: Yes)

**Requirements:** Prerequisites: APSC 200 Corequisites:

Exclusions:

**Offering Term:** W

**CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 12

Engineering Science 0

Engineering Design 36

**Offering Faculty:** Smith Engineering

**CIVL 371 Groundwater Engineering Units: 4.00**

This course introduces students to the fundamentals of groundwater systems with an emphasis on the engineering design of extraction systems for water supply, site dewatering, and parameter estimation tests. Source water protection methods will be discussed. Equations governing the flow of groundwater, flownets, and capture zones are presented. Detailed case histories are presented. Laboratories make extensive use of commercial grade software for surface and groundwater flow simulation. (Lec: 3, Lab: 0.5, Tut: 0.5)

**Requirements:** Prerequisites: MTHE 224 or MTHE 225 or MTHE 232 Corequisites: Exclusions:

**Offering Term:** F

**CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 0

Engineering Science 34

Engineering Design 14

**Offering Faculty:** Smith Engineering

**CIVL 372 Water and Wastewater Units: 4.00**

The focus of this course is to introduce water and wastewater engineering systems through active learning strategies and hands-on lab experiences. Students will have the opportunity to learn about environmental indicators/measurements/guidelines, reactors, engineered and natural systems, biological and chemical reactions, mass and energy balances, risk assessment, life cycle assessment, and environmental and human health impact assessment. These concepts will allow students to assess a variety of aspects of environmental engineering and design.

(Lec: 3, Lab: 1, Tut: 0)

**Requirements:** Prerequisites: CIVL 210 Corequisites:

Exclusions:

**Offering Term:** W

**CEAB Units:**

Mathematics 0

Natural Sciences 12

Complementary Studies 0

Engineering Science 20

Engineering Design 16

**Offering Faculty:** Smith Engineering

**CIVL 400 Professional Skills III Units: 2.50**

Professional skills relating to how engineers interact with, communicate with, and consider the implications of their actions on a wide range of potential stakeholders, ranging from colleagues to clients to society as a whole, will be developed. Students will improve their technical writing and verbal communication skills as they work through case studies intended to: deepen an understanding of the roles and responsibilities of a Professional Engineer; strengthen an ability to apply professional ethics, accountability and equity; and enhance an appreciation of the potential social and environmental impacts of engineering activities. Class discussions will normally occur every second week.

K2.5(Lec: 0.5, Lab: 1, Tut: 1)

**Requirements:** Prerequisites: CIVL 300 Corequisites: CIVL 460

Exclusions:

**Offering Term:** F

**CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 28

Engineering Science 0

Engineering Design 0

**Offering Faculty:** Smith Engineering

**CIVL 430 Reinforced Concrete Design Units: 4.00**

Flexural design of reinforced concrete beams including singly reinforced sections, doubly reinforced sections, T-sections, and one-way slabs. Control of cracking in reinforced concrete beams as specified for design. Design of continuous beams and one-way slabs; short and slender columns; footings deflections; development of reinforcement. A laboratory design project is undertaken in this course. PPE will be required for this course at student's cost (see course materials for details).

(Lec: 3, Lab: 0.5, Tut: 0.5)

**Requirements:** Prerequisites: CIVL 215, CIVL 330, CIVL 331

Corequisites: Exclusions:

**Offering Term:** F

**CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 0

Engineering Science 12

Engineering Design 36

**Offering Faculty:** Smith Engineering

**CIVL 431 Infrastructure Rehabilitation Units: 4.00**

This course deals with evaluation of the deterioration of the infrastructure and the design of rehabilitation measures. Items discussed include corrosion of reinforcement in concrete, microbiological corrosion of buried pipelines, asphalt deterioration and repair, deterioration of timber in buildings, and issues of sustainability of infrastructure. Design techniques to reduce deterioration in new construction are also discussed. The laboratory portion involves some of the test methods used to evaluate deterioration and field trips to observe some common forms of deterioration. PPE will be required for this course at student's cost (see course materials for details)

(Lec: 3, Lab: 0.5, Tut: 0.5)

**Requirements:** Prerequisites: CIVL 430 Corequisites:

Exclusions:

**Offering Term:** W

**CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 0

Engineering Science 32

Engineering Design 16

**Offering Faculty:** Smith Engineering

**CIVL 436 Prestressed Concrete Units: 4.00**

Behaviour, analysis and design of pretensioned and post-tensioned concrete systems including simply-supported and continuous beams, and two-way slabs. Considerations of prestress losses, cracking and deflection. A design project is undertaken in this course. Three term-hours, winter; lectures and tutorials.

(Lec: 3, Lab: 0, Tut: 1)

**Requirements:** Prerequisites: CIVL 430 Corequisites:

Exclusions:

**Offering Term:** W

**CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 0

Engineering Science 24

Engineering Design 24

**Offering Faculty:** Smith Engineering

**CIVL 442 Geotechnical Design Units: 4.00**

A design-based course where geotechnical principles are applied to study the design of a variety of geotechnical engineering structures. Topics studied include: design of a site investigation program, interpretation of site stratigraphy, estimation of soil parameters, design of shallow and/or deep foundations, design of earth retaining structures, and construction issues such as dewatering schemes or temporary excavations. Students will conduct practical design tasks to experience a range of aspects of the geotechnical design process, to utilize common models used in geotechnical design, and to communicate with project partners such as structural consultants, site investigation companies, and construction contractors. The important role of geology in geotechnical problems is emphasized through classroom discussions, planning a site investigation and constructing a geologic model.

(Lec: 3, Lab: 0, Tut: 1)

**Requirements:** Prerequisites: CIVL 341 Corequisites:

Exclusions:

**Offering Term:** F

**CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 0

Engineering Science 12

Engineering Design 36

**Offering Faculty:** Smith Engineering

**CIVL 443 Geoenvironmental Design Units: 4.00**

A design-based course where geotechnical and hydrogeologic principles are applied to study environmentally sustainable disposal of solid waste. Topics studied include: source and nature of waste: disposal options; environmental legislation and regulations; public impact and perception; contaminant transport; use of geosynthetic materials; and design issues and tradeoffs. Students will conduct practical design tasks to investigate the planning, design, construction, operation and post-closure of phases of an engineered waste disposal facility. The important role of geology in geoenvironmental problems is emphasized through classroom discussions, planning a site investigation and constructing a geologic model.

(Lec: 3, Lab: 1, Tut: 0)

**Requirements:** Prerequisites: CIVL 340 or permission of the

department Corequisites: Exclusions:

**Offering Term:** W

**CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 0

Engineering Science 12

Engineering Design 36

**Offering Faculty:** Smith Engineering



#### **CIVL 450 Municipal Hydraulics Units: 4.00**

The course will present concepts and tools to analyze and design water services, including storm sewers, sanitary sewers, and water mains, at the site- and sub-division level. Many of the concepts and tools are used in the fields of land-development engineering and municipal engineering. The course will provide an introduction to hydrological processes, design rainfall prediction with intensity-duration-frequency curves, estimation of time of concentration, peak runoff prediction in small drainage areas with the Rational Method and the unit hydrograph method, reservoir routing and storm water management tank and pond design, storm sewer analysis and design with Manning's equation, wastewater flow prediction, sanitary sewer analysis and design, water demand prediction, steady-state analysis of pressurized pipes, water main design, and designing water services according to municipal design standards.

(Lec: 3, Lab: 0, Tut: 1)

**Requirements:** Prerequisites: CIVL 350 Corequisites:

Exclusions:

**Offering Term:** F

**CEAB Units:**

Mathematics 12

Natural Sciences 0

Complementary Studies 0

Engineering Science 24

Engineering Design 12

**Offering Faculty:** Smith Engineering

#### **CIVL 451 Lake, Reservoir and Coastal Units: 4.00**

The fundamental hydraulic processes affecting coastal engineering and water reservoir operation are discussed. Topics include wave theory, wave measurement, wave record analysis, wave transformation, seiches, tides, storm surges, turbulent mixing and transport of pollutants. Student projects are assigned on computational water reservoir modelling, analysis of field data and reservoir operation as well as the design of breakwaters and ocean structures and the use of hydraulic and numerical coastal models.

(Lec: 3, Lab: 0.5, Tut: 0.5)

**Requirements:** Prerequisites: CIVL 350, or permission of the department Corequisites: Exclusions:

**Offering Term:** F

**CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 0

Engineering Science 26

Engineering Design 22

**Offering Faculty:** Smith Engineering

#### **CIVL 455 River Engineering Units: 4.00**

A course in the basics of river engineering including the study of alluvial processes, the prediction and consequences of sediment transport, the design of measures to control erosion and accretion, and the design of dams, spillways and diversions. Critical aspects in the design of river engineering structures and assessment of environment impact of river engineering projects are discussed. The use of physical and numerical models in the practice of river engineering is illustrated. The principles of natural channel design, stream restoration, and bioengineering in river environments are also addressed.

(Lec: 3, Lab: 0.5, Tut: 0.5)

**Requirements:** Prerequisites: CIVL 350 Corequisites:

Exclusions:

**Offering Term:** W

**CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 0

Engineering Science 24

Engineering Design 24

**Offering Faculty:** Smith Engineering

#### **CIVL 460 Civil Engineering Design and Practice IV Units: 6.00**

This fourth year design capstone course has student teams undertake a comprehensive engineering design project which involves the creative, interactive process of designing a structure/system to meet a specified need subject to economic, health, safety and environmental constraints. The teams will work in collaboration with an industry partner. Each team will submit an engineering report and make an oral presentation PPE will be required for this course at student's cost (see course materials for details)

K6(Lec: Yes, Lab: No, Tut: Yes)

**Requirements:** Prerequisites: APSC 200, APSC 293, CIVL 360, CIVL 330, CIVL 340, CIVL 350, CIVL 371 or in final 16 months of CIVL program. Corequisites: Exclusions:

**Offering Term:** FW

**CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 12

Engineering Science 0

Engineering Design 60

**Offering Faculty:** Smith Engineering



**CIVL 471 Subsurface Contamination Units: 4.00**

This course deals with subsurface contamination by hazardous industrial liquids such as PCB oils, gasoline, jet fuel, chlorinated solvents and coal tars. The fundamentals of multiphase/multicomponent flow and transport in soil and groundwater are outlined followed by specific treatment of both dense and light non-aqueous phase liquids. The course will examine the subsurface distribution of these liquids, site characterization methods, indoor air intrusion, regulatory aspects, remediation technologies, and selected case histories.

(Lec: 3, Lab: 0, Tut: 1)

**Requirements:** Prerequisites: CIVL 371, or GEOE 343 (GEOE 343), or permission of the department

**Exclusions:**

**Offering Term:** F

**CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 0

Engineering Science 34

Engineering Design 14

**Offering Faculty:** Smith Engineering

**CIVL 472 Water Treatment Units: 4.00**

This course describes the physical-chemical treatment processes for water treatment. Students in this course will learn about the chemical and microbiological constituents in source water that determine downstream treatment requirements. Students will explore the fundamental physical, chemical and biological principles that govern unit operations (e.g. coagulation and flocculation; screening, sedimentation, and floatation; filtration; disinfection) and their applications in water treatment plants. Students will learn about plant optimization and apply systems thinking to analyze and design water treatment scenarios. The responsibilities of a professional engineer in ensuring safe drinking water will also be discussed.

(Lec: 3, Lab: 0.5, Tut: 0.5)

**Requirements:** Prerequisites: CIVL 372

**Exclusions:**

**Offering Term:** W

**CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 0

Engineering Science 36

Engineering Design 12

**Offering Faculty:** Smith Engineering

**CIVL 473 Water Resources Systems Units: 4.00**

This course will present concepts and tools for designing and modelling large-scale water resources systems in urban catchments. Focus will be placed on the design and analysis of urban drainage systems and urban water supply/distribution systems at the catchment level. Hydrologic, hydraulic, and statistical modelling tools used in industry will be used to evaluate the performance of water resources systems. Topics will include: the urban water cycle, environmental considerations in master planning of drainage and water supply systems, climate change impacts on water resources systems, floodplain analysis and flood control, statistical analysis of rainfall and stochastic hydrology, continuous simulation modelling, planning and modelling of large-scale urban drainage systems, planning and modelling of large-scale water distribution systems, reliability analysis and water quality analysis of water distribution systems, and the master planning process for urban drainage and drinking water systems.

(Lec: 3, Lab: 0, Tut: 1)

**Requirements:** Prerequisites: CIVL 350

**Exclusions:**

**Offering Term:** W

**CEAB Units:**

Mathematics 12

Natural Sciences 0

Complementary Studies 0

Engineering Science 24

Engineering Design 12

**Offering Faculty:** Smith Engineering

**CIVL 490 Selected Topics in Civil Engineering Units: 4.00**

Providing advanced study and application of selected topics in Civil Engineering, this course will be offered periodically by visiting faculty and professionals. Consult the department homepage for opportunities.

(Lec: 3, Lab: 0, Tut: 1)

**Requirements:** Prerequisites: Successful completion of 3rd year Civil Engineering and permission of the Department.

**Corequisites:** **Exclusions:**

**Offering Term:** F

**CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 0

Engineering Science 48

Engineering Design 0

**Offering Faculty:** Smith Engineering



**CIVL 491 Selected Topics in Civil Engineering Units: 4.00**

Providing advanced study and application of selected topics in Civil Engineering, this course will be offered periodically by visiting faculty and professionals. Consult the department homepage for opportunities.

(Lec: 3, Lab: 0, Tut: 1)

**Requirements:** Prerequisites: Successful completion of 3rd year Civil Engineering and permission of the Department.

Corequisites: Exclusions:

**Offering Term:** W

**CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 0

Engineering Science 48

Engineering Design 0

**Offering Faculty:** Smith Engineering

**CIVL 500 Civil Engineering Thesis Units: 4.00**

Working closely with a faculty member, students will conduct research on a civil engineering or related applied science topic. Students will: identify a problem; formulate a research question; and devise and implement a research plan. The nature of the research may involve obtaining experimental measurements, performing field testing and/or numerical analysis, and analyzing and interpreting research results. Students will prepare a comprehensive, written technical report and will defend their research in an oral examination. Registration is limited to a maximum of twenty (20) students. PPE will be required for this course at student's cost (see course materials for details).

K4(Lec: Yes, Lab: Yes, Tut: Yes)

**Requirements:** Prerequisites: successful completion of 3rd year civil engineering with a minimum sessional average of 70%

Corequisites: Exclusions:

**Offering Term:** FW

**CEAB Units:**

Mathematics 0

Natural Sciences 0

Complementary Studies 24

Engineering Science 24

Engineering Design 0

**Offering Faculty:** Smith Engineering