

## B.Sc. in Civil Engineering

### Course Descriptions

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CIVL 3501

#### Soil Mechanics

*Prerequisite: FES 270*

This class is concerned with the physical and mechanical properties of soils. It includes topics of soil chemistry and soil fabric, soil classification, compaction, hydraulic conductivity, one-dimensional and two-dimensional seepage, soil compressibility, time dependant deformation of soils, and shear strength behavior of soils. Laboratory sessions involve experimentally evaluating the engineering properties of several different soil types and the application of these results to engineering problems.

CIVL 3502

#### Hydraulics

*Prerequisite: FES 231*

Fluid mechanics principles are applied to practical hydraulic problems involving flow in closed conduits and in open channels. Topics in pipe flow include losses in pipes, pipes in series and parallel, and network analysis. Topics in open channel flow deal with classification of flows, open channels and their properties, energy and momentum principles, uniform flow, design of erodible and non-erodible channels, and gradually varied flow. These aspects are explained in lectures and validated by laboratory measurements and demonstrations.

CIVL 3503

#### Structural Systems I

*Prerequisite: FES 240*

This course covers the calculation of elastic deformations for statically determinate structures and various methods for analyzing statically indeterminate structures including the slope deflection method, the moment distribution method and the stiffness method with matrix analysis. The application of matrix analysis in computer modeling using a typical commercially available structural analysis program will be studied. Also, approximate methods for indeterminate structures and influence lines for moving loads will be introduced.

CIVL 3504

#### Mechanics of Structural Materials

*Prerequisite: FES 231*

The content is focused on the application of the principles of the mechanics of solids in the design and analysis of structural materials and components. Building on engineering skills gained in the first two years, the class will examine general stress analysis, failure criteria, flexure, shear, torsion, compression buckling and plasticity as these aspects apply to structural components constructed

of timber, steel, concrete and fibre-reinforced polymers.

CIVL 3505

#### Construction of materials

*Prerequisite: FES 231*

The purpose of this class is to provide students with knowledge of residential and commercial building techniques and materials. In it, the properties and applications of common construction materials, components, and systems that relate to wood, steel, and concrete-frame structures are examined.

CIVL 3506

#### Introduction to Geology for Engineers

*Prerequisite: 3<sup>rd</sup> year standing*

This class deals with the fundamental principles of geology. Topics include mineralogy, rock-forming processes, weathering, erosion, groundwater, glaciation, mass wasting, running water, deserts, shorelines, geologic structures, tectonism, and Earth's interior. The links between geology, engineering and the environment are explored through case studies. Laboratory exercises covering the identification and interpretation of minerals, rocks, landforms (using topographic maps and remote sensing images) and geologic map structures are an important part of the class.

CIVL 3601

#### Transportation Engineering

*Prerequisite: 3<sup>rd</sup> year standing*

This class commences with an introduction to Transportation Engineering in the context of planning, design and operations of urban and rural systems. The class also provides an introduction to route location with special emphasis on USA and Canadian standards and specifications. It also includes detailed study of road design elements, vehicle motion, vehicle/pavement interaction, and principles of roadway capacity.

CIVL 3602

#### Engineering Hydrology

*Prerequisite: CIVL 3502*

The emphasis in this class is on quantitatively describing the physical processes in the hydrologic cycle. Such processes include precipitation, evaporation, infiltration, groundwater movement, surface runoff, as well as lake/reservoir routing effects. A working rainfall-runoff model is developed, and by convolution is used to produce a design hydrograph, so as to determine the appropriate size of a detention pond. Statistical hydrology and snow hydrology are also discussed.

CIVL 3604

### **Structural Systems II**

*Prerequisite: CIVL 3503*

The objective of the class is to provide students with a solid background in the fundamentals of structural design used for typical civil engineering structures such as trusses, building frames and floor systems. The background and application of the National Building Code (USA and Canada) provisions for structural design will be emphasized. The student will be able to size basic tension, compression and flexural elements using steel, concrete and timber, for representative structures.

CIVL 3605

### **Computations and Systems Modeling**

*Prerequisite: CIVL 3503*

This class introduces the application of various computational methods for solving a range of practical problems in civil engineering. Basic numerical methods for solving algebraic equations, non-linear and eigen-value problems, as well as numerical differentiation and integration are introduced. Curve-fitting and non-linear regression techniques are presented. Computational tools such as MatLab, MathCad, Excel, and Mathematica are introduced and used to analyze structural stability, the behavior of space-frames, dynamics, vibrations, and other topics of interest in infrastructure systems.

CIVL 3606

### **Construction Planning**

*Prerequisite: 3<sup>rd</sup> year standing*

This class deals with construction administration, bidding procedures, cost controls, planning and execution of civil Engineering construction projects. The class also covers planning and scheduling techniques such as CPM and PERT. The class presents basic methods of estimating construction costs, with applications to buildings, bridges, foundations, highways and earthworks.

CIVL 3607

### **Heavy Construction Materials**

*Prerequisite: CIVL 3505*

This course deals with the functions and planning of heavy construction materials. Simulation. Equipment used in earth moving, bridge building, and heavy lifting, as applied in construction of buildings, bridges, high rise, and other applications will be studied in details. Local construction sites will be visited as part of the laboratory sessions. The field trips will form the basis of design and simulation work involved in heavy construction materials. Optimization of such resources will also be presented.

CIVL 4701

### **Geotechnical Engineering**

*Prerequisite: CIVL 3501*

This class is concerned with the geotechnical aspects of temporary and permanent retaining walls for infrastructure or environmental works, deep and shallow foundations, soil-pipeline interaction, and design/analysis of natural cuts, embankments, and earth dams. The application of these design/analyses to particular infrastructure and environmental structures are emphasized in the laboratory sessions.

CIVL 4702

### **Design of Steel Structure**

*Prerequisite: 3<sup>rd</sup> year standing*

This introductory design class emphasizes the behavior and design of steel members resisting tensile, compressive, and flexural loads and simple connections of these elements. Members subject to combined loading will also be studied. Upon class completion, the student will be able to design building elements to CSA-S16.1-01. Although most design examples will be based on framed buildings, many of the concepts apply equally to other types of structures; e.g. bridges, towers, and submarine hulls.

CIVL 4703

### **Energy, Environment and Communication I**

*Prerequisite: None*

This course introduces the history of engineering and develops understanding of the role of industrialization in the modern age in shaping the lifestyle of the society. Various traits of the information age are identified and the principal features of technology development are discussed in this course. The flaws and strengths of the currently practiced engineering approaches are highlighted in order to develop understanding of the role of an engineer in the society.

CIVL 4810

### **Reinforced Concrete Design**

*Prerequisite: 4<sup>th</sup> year standing*

This class will provide students with a basic understanding of the behavior and analysis of reinforced concrete as a structural material, elementary skills and concepts necessary for designing a variety of common structural elements, and appropriate analysis techniques and code approximations. Current design code provisions related to flexure, shear and compression members will be reviewed leading to practical design examples for one-way floor systems, columns, footings, and cantilever retaining walls.

CIVL 4811

**Senior Design**

*Prerequisite: CIVL 3505*

The class objective is to provide experience in the application of engineering principles to the solution of a specific civil engineering design problem. Students are required to select a topic, prepare a proposal, and prepare a work schedule. The project is executed under the supervision of the instructor and may focus on laboratory experiments, field work, a design problem, or a detailed review of the state-of-the art in a given field. Students are required to prepare a formal report and make an oral presentation of their project.

CIVL 4812

**Energy, Environment and Communication II**

*Prerequisite: CIVL 4703*

This course follows up on the previous course and further develops comprehensive skills among engineering students. In this, pro-nature (hence, sustainable) technology development is discussed. Many examples are provided.

**TECHNICAL ELECTIVES**

CIVL 4704

**Transportation Systems**

*Prerequisite: 3<sup>rd</sup> year standing*

This class covers urban transportation planning, transportation demand and supply, transportation management. The environmental impact of transportation systems such as noise and air pollution will be examined. Methods to measure, predict, and evaluate impact of transportation modes will be covered.

CIVL 4705

**Alluvial Channels and River Engineering**

*Prerequisite: 3<sup>rd</sup> year standing*

This class will consider various aspects of fluvial geomorphology from a civil engineering point-of-view. This will include discussion of hydraulic resistance based on quantitative estimates of channel roughness, regime concepts for artificial and natural rivers, uses of boundary shear stress and unit stream power in bed-load estimations, the hydraulics and statistics of suspended sediment, numerical versus physical modelling, and a review of case histories of responses of rivers to human activity. The hydraulics of fish habitat assessment is also considered. The application of HEC RAS to a brook is also part of the class.

CIVL 4706

**Engineering Hydrogeology**

*Prerequisite: 3<sup>rd</sup> year standing*

This is relatively quantitative introduction to hydrogeology beings with a review of key definitions

and hydraulic principles pertaining to flow through porous media. This is followed by consideration of well hydraulics in the context of the evaluation and management of groundwater resources. The theory and application of numerical methods are discussed in relation to simple groundwater systems, and this is followed by discussion of the chemistry of both natural and contaminated systems.

CIVL 4707

**Introduction to Finite Element Methods for Structural Systems**

*Prerequisite: 3<sup>rd</sup> year standing*

This class presents an introduction to the theory and application of the finite element method. The basic linear elasticity, principles of minimum work and energy methods will be used in developing the methodology. Students will gain practical experience, using a commercial software package, to treat a balance set of real-life two and three-dimensional stress deformation problem under static and dynamic loading systems that are of specific interest to structural engineers.

CIVL 4708

**Applied Geomatics**

*Prerequisite: 4<sup>th</sup> year standing*

The class covers principles of geomatics utilizing exercises to show applications of the use of Global Positioning Systems (GPS) and Geographical Information Systems (GIS) technologies in engineering projects. Concepts of GPS such as data collection, processing and integration are discussed. GIS tools are used to acquire existing data sets, to merge GPS observations with these data, and to produce maps and to perform common, as well as more complex, analyses on a prototype GIS.

CIVL 4709

**Risk Assessment and Management**

*Prerequisite: 4<sup>th</sup> year standing*

This class will consider various aspects of fluvial geomorphology from a civil engineering point-of-view. This will include discussion of hydraulic resistance based on quantitative estimates of channel roughness, regime concepts for artificial and natural rivers, uses of boundary shear stress and unit stream power in bed-load estimations, the hydraulics and statistics of suspended sediment, numerical versus physical modelling, and a review of case histories of responses of rivers to human activity. The hydraulics of fish habitat assessment is also considered. The application of HEC RAS to a brook is also part of the class.

CIVL 4813

**Highway Engineering**

*Prerequisite: None*

Fundamental features of road design will be discussed in this course. International standards for

highway design will be presented. A surveying workshop will be part of this course in order to familiarize students with surveying and monitoring devices that are used in highway construction and monitoring. Among others, vertical and horizontal curves, roadway design elements, drainage and earthwork operations, highway material and pavement design will be presented. The laboratory component will deal with survey as well as demonstration of fundamental principles of highway engineering.

CIVL 4814

### **Hydraulic Engineering**

*Prerequisite: None*

This course introduces design of hydraulic systems in civil engineering applications. Various applications ranging from culvert systems to various dams will be covered in this course. Various earth materials as well as machineries used in hydraulic engineering will be presented.

CIVL 4815

### **Water Distribution and Sewerage Systems**

*Prerequisite: CIVL 3602*

This course deals with the hydraulic and hydrologic basis for water-related urban infrastructure. Specifically, the design of potable water distribution systems, wastewater collection systems, and storm water management systems are presented. Students develop the pre-design of one of these

systems for an actual subdivision, and present their design to the class. The minimization of the environmental impacts associated with the construction of a subdivision is also presented, both qualitatively and quantitatively.

CIVL 4816

### **Water and Waste Water Treatment**

*Prerequisite: CIVL 3602*

The focus of the class is on design of water treatment and municipal pollution control plants. Lectures and laboratory periods are on physical chemical and microbiological qualities of water and municipal wastewater. Lectures include various unit operations and unit processes of water and domestic wastewater treatment. Field visits to local and water and wastewater treatment plants are included.

CIVL 4817

### **Petroleum Engineering**

*Prerequisite: 4<sup>th</sup> year standing*

This course deals with the relationships of geology, basic reservoir rock properties, surface and interfacial phenomena, the flow of fluids through porous media, classification of oil and natural gas reservoirs, and reserve estimation principles. This course is the first technical course for petroleum engineering majors, and a rigorous overlook for students of other engineering disciplines.

