APSC 200 Engineering Design and Practice II

F/W K 4

In this course students will participate constructively on teams to create solutions to open-ended complex problems, using standard design methods and tools. This project-based course provides instruction primarily in the first 6 weeks of the semester focusing on problem scoping, creativity and idea generation, decision making incorporating technical, economic, societal, and environmental factors, safety, engineering codes and regulations, and engineering ethics. The final 6 weeks of the course centre around a design project delivered by each discipline. This course is integrated with $\frac{APSC-293}{APSC-293}$, and coordinated by the same instructor. $\frac{(0/0/12/0/36)}{APSC-293}$

PREREQUISITE: APSC 100 or permission of instructor

COREQUISITE: APSC 293 EXCLUSION: MECH 212

APSC 221 Economics and Business Practices in Engineering

F/W 3-0-0 3

This course will provide the student in the Engineering program with the ability to appropriately incorporate selected economic and business practices into the practice of engineering. The practices covered include: business planning for the enterprise, enterprise economic analysis, project management process, project economic analysis, risk analysis and management, quality management and change management. Assignments and examples are based on situations from engineering based industries. (0/0/42/0/0)

EXCLUSIONS: APSC 321, COMM 244

APSC 293 Engineering Communications

F/W K 1

This course provides an introduction to effective engineering writing and speaking skills with the emphasis on professional correspondence, engineering reports, oral briefings, and formal oral presentations. These skills are developed in lectures and small group tutorials. This course is integrated with APSC-200, and coordinated by the same instructor. (0/0/12/0/0)

PREREQUISITE: APSC 100 or permission of instructor COREQUISITE: APSC 200 or permission of instructor

EXCLUSIONS: APSC 292, CHEE 260, ELEC 291, ELEC 391, GEOL 291, GEOL 292, MECH 290

CIVL 200 Civil Week I - Professional Skills

F.5-1-12.5

Within a team structure 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. (0/0/14/7/7)

CIVL 201 Professional Skills F/W .5-1-1 2.5

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. (0/0/14/7/7) (This course may not be offered every year).

PREREQUISITE: Permission of the Department

EXCLUSION: CIVL 200

CIVL 210 Chemistry for Civil Engineers

F 3-1-.5 4.5

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) (0/20/0/20/15)

PREREQUISITES: APSC 132

CIVL 215 Materials for Civil Engineers

W 3-1-.5 4.5

The basic engineering properties, micro/macro structure, behaviour and applications of various civil engineering materials will be studied including materials used in structural engineering, hydrotechnincal 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) (0/12/0/32/10)

PREREQUISITE: APSC 151

CIVL 222 Numerical Methods for Civil Engineers

W 4-1-0 5

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. (45/0/0/15/0)

PREREQUISITES: MTHE 224 (MATH 224) or MTHE 225 (MATH 225) or MTHE 226 (MATH 226)

CIVL 230 Solid Mechanics I

F 3-.5-.75 4.25

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. PPE will be required for this course student's cost (see course materials for details) (0/0/0/50/0) PREREQUISITE: APSC 111, APSC 171

EXCLUSION: CIVL 220

CIVL 231 Solid Mechanics II

W 3-.5-1 4.5

Calculation of bending displacements using moment-area methods; introduction to statically indeterminate systems; combined loading; stress and strain transformations; columns; energy methods; non-linear material behaviour; two-dimensional elasticity; advanced torsion problems. (0/0/0/54/0)

PREREQUISITE: CIVL 230

CIVL 250 Hydraulics I

W 3-.5-.5 4

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 student's cost (see course materials for details) (0/4/0/22/22) PREREQUISITE: APSC 172, APSC 174

MTHE 224 Applied Mathematics for Civil Engineers

F 3-.4-.8 4.2

The course will discuss the application of linear differential equations with constant coefficients, and systems of linear equations within the realm of civil engineering. Additionally, the course will explore relevant data analysis techniques including: graphical and statistical analysis and presentation of experimental data, random sampling, estimation using confidence intervals, linear regression, residuals and correlation. (50/0/0/0)

PREREQUISITES: APSC 142, APSC 172, APSC 174

EXCLUSIONS: MTHE 225 (MATH 225), MATH 226, MTHE 235 (MATH 235), MTHE 237 (MATH 237), STAT 267

CIVL 300 Civil Week - Professional Skills

F .5-1-1 2.5

Within a team structure 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. (0/0/14/7/7)

PREREQUISITE: CIVL 200

CIVL 330 Structural Analysis

F 3-.5-.25 3.75

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. (0/0/0/44/0)

PREREQUISITES: CIVL 230, CIVL 231

CIVL 331 Structural Steel Design

W 3-.5-.5 4

Introduction to Limit States Design, load paths. Dead and live loads for design as specified in the National Building Code of Canada. Design assumptions regarding material properties of structural steel. Design of tension members; bolted connections; design of simple columns; design of beams (laterally supported and laterally unsupported) for flexure and shear; design of bearing stiffeners; design of steel-concrete composite beams; stability analysis; design of beam-columns. Sustainability for building materials; introduction to LEED. (0/0/0/12/36)

PREREQUISITES: CIVL330

CIVL 340 Geotechnical Engineering I

F 3-.5-.25 3.75

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 student's cost (see course materials for details)(0/0/0/32/12)

PREREQUISITES: CIVL 215 or GEOE 281 (GEOL 281), CIVL 230

CIVL 341 Geotechnical Engineering II

W 3-.5-.5 4

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 student's cost (see course materials for details) (0/0/0/12/36)

PREREQUISITE: CIVL 340

CIVL 350 Hydraulics II

F 3-.5-.25 3.75

Topics in open channel flow including friction, specific energy, free-surface profiles, culverts and hydraulic-jump energy dissipaters. Lake dynamics and environmental hydraulics will be introduced. The basic underlying concepts of water resources and hydrology will be discussed. (0/0/0/14/30) PREREQUISITE: CIVL 250

CIVL 360 Civil Engineering Design and Practice III

W K4

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 defendable 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.(0/0/12/0/36) Prerequisite: APSC 200

CIVL 371 Groundwater Engineering

F 3-.5-.25 3.75

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. (0/0/0/30/14)

PREREQUISITE: MTHE224 or MTHE225 or MTHE 232

CIVL 372 Water and Wastewater Engineering

W 3-.5-.5

This course introduces general concepts of water/wastewater engineering for the protection of human and ecosystem health, and focuses on the fundamental design and operation of unit operations and processes for provision of safe drinking water and the treatment and disposal of wastewaters and accumulated solids to meet source water protection regulations and requirements. Topics include water quality problems; reactors and reactions; the quality of water supplies and the characteristics of wastewater; the chemical, physical and/or biological treatment of drinking water and wastewater; and biosolids stabilization and management. Alternative and innovative urban water management strategies will be discussed and emerging issues for water managers will be introduced. The laboratories will illustrate standard and advanced analytical methods and data analysis for design of some of these systems. PPE will be required for this course at the student's cost. (0/12/0/20/16) PREREQUISITE: CIVL 210

CIVL 400 Civil Week - Professional Skills

F .5-1-1 2.5

Within a team structure 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. (0/0/14/7/7) * APSC 480 will be considered as a substitute for CIVL 400 and CIVL 460

PREREQUISITE: CIVL 300 COREQUISITE: CIVL 460

CIVL 430 Reinforced Concrete Design

F 3-.25-.5 3.75

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) (0/0/0/11/33) PREREQUISITES: CIVL 215, CIVL 330, CIVL 331

CIVL 431 Infrastructure Rehabilitation

W 3-.5-.5 4

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) (0/0/0/32/16)

PREREQUISITES:CIVL 430

CIVL 436 Prestressed Concrete

W 3-0-1 4

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. (0/0/0/24/24)

PREREQUISITES:CIVL 430

CIVL 442 Geotechnical Design (new course)

F 3-0-.75

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. (0/0/0/10/35) PREREQUISITES: CIVL 341

CIVL 443 Geoenvironmental Design

W 3-1-0 4

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. (0/0/0/12/36) PREREQUISITES: CIVL 340 or permission of the department

CIVL 450 Hydraulics III

F 3-.5-.75 3.75

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. (12/0/0/20/12) Prerequisite: CIVL 350.

CIVL 451 Lake, Reservoir, and Coastal Engineering

F3-.5-.25 3.75

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. (0/0/0/24/24)

PREREQUISITES: CIVL 350, or permission of the department

CIVL 460 Civil Engineering Design II

FW K6

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) (0/0/10/31/31)* APSC 480 will be considered as a substitute for CIVL 400 and CIVL 460 PREREQUISITE: APSC 200, APSC 293 COREQUISITE: CIVL 400

CIVL 471 ENV TE I: Subsurface Contamination

W 3-0-1 4

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 apsects, remediation technologies, and selected case histories. (0/0/0/34/14)

PREREQUISITES: CIVL 371, or GEOE 343 (GEOL 343), or permission of the department

CIVL 473 Water Resources Systems

F 3-.0-.75 3.75

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 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. (12/0/0/20/12) Prerequisite: CIVL 350.

CIVL 500 Civil Engineering Thesis

FW 0-0-4 4

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 analysing 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). (0/0/24/24/0)

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