



# CIVL HANDBOOK



2016-17



**University of Manitoba**  
Engineering Society



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## TABLE OF CONTENTS

DEPARTMENT INFORMATION

GLOSSARY

SECOND YEAR COURSE DESCRIPTION AND TIPS

THIRD YEAR COURSE DESCRIPTION AND TIPS

FOURTH YEAR COURSE DESCRIPTION AND TIPS

TECHNICAL ELECTIVE COURSE DESCRIPTION AND TIPS



## DEPARTMENT INFORMATION

### Civil Engineering

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Civil Engineering work addresses issues related to infrastructure and to the environment. More specifically, civil engineers design, manage, maintain, and supervise the implementation of various structures using advanced technologies and computer-aided engineering. Civil engineers serve as key players in areas such as urban redevelopment, meeting the challenges of sustainable development, environmental pollution control, public infrastructure renewal, and the preparation for, or recovery from, natural disasters.

In addition to the standard Civil Engineering program, the department offers an Environmental Option for students interested in this field. Students interested in this program should consult with the Civil Department Office to select an appropriate set of elective courses.





## GLOSSARY

These terms will help guide you through the Department Handbook and through your years in engineering!

- **CAD Lab:** This refers to one of the three computer labs that have the software you will need in your courses such as Solidworks.
- **Core Courses:** All of these courses must be taken and passed.
- **Co-Requisite:** Refers to a course which must be taken concurrently with another course.
- **Prerequisite:** Refers to a course that must be completed with a letter grade of D or higher before beginning a subsequent course.



## **SECOND YEAR COURSE DESCRIPTIONS**

### **Introduction to Physical Chemistry (CHEM 1310) 3CR**

Thermochemistry, chemical thermodynamics, and chemical kinetics. CHEM 1310 is a prerequisite.

**Difficulty: 3.5 Workload: 3**

### **Solid Mechanics (CIVL 2800) 4CR**

Analysis of deformable bodies; stress and strain in three dimensions; equilibrium equations and strain-displacement relations; constitutive relations and mechanical behaviour of materials; radially symmetric and plane problems in elasticity; relevant experimental demonstrations. MATH 1710/1700 and ENG 1440 are prerequisites.

### **Graphics for Civil Engineers (CIVL 2830) 2CR**

Orthographic Drawing: Object Orientation and Views, Space Dimensions, Surfaces, Lines, and Hidden Features. Computer-based Drawings. Applications: Steel and Reinforced Concrete Structures, Digital Terrain Models. Ethical, Legal and Professional Issues. CIVL 2840 is corequisite.

### **Engineering Communication (ENG 2030 or ENG 2040) 3CR**

Take only one of ENG 2030: Students work in a team-based environment to produce deliverables comparable to the engineering workplace. In-class tutorials focus on the sharpening of individual students' writing skills through an analytical, problem-solving and critical thinking approach. Students are exposed to a variety of communicative scenarios and emphasis is placed on development of a repertoire of skills necessary for effective communication in the engineering profession. OR ENG 2040: This team-based course focuses on a rhetorical approach, communication strategies and guided practice in the design of engineering communications. ENGL 1400/1310, ENG 1430 (or former ENG 2010) prerequisite.

**Difficulty: 3 Workload: 5**

**Tips:** Make sure to get started on your final report early to allow lots of time for editing. Wear business clothes for all presentations. Try to keep up with entries in your journal.

### **Civil Engineering Geomatics (CIVL 2840) 3CR**

Geomatics in civil engineering, map-making, map-reading, computerized maps; leveling; distance measurement angles, directions, traverses; coordinate geometry; electronic survey instruments; global positioning system; geographic information systems; digital photogrammetric methods and data; aspects of route surveying. MATH 1210 and CIVL 2030 are corequisites.



### **Math Analysis 1 (MATH 2130) 3CR**

Multivariable differential and integral calculus up to and including multiple integrals in cylindrical and spherical coordinates. For Engineering and Geophysics students only. MATH 1710 and MATH 1210 are prerequisites.

**Difficulty:** 3    **Workload:** 3

**Tips:** Make sure to review your notes from Calculus 2 before starting this class. The textbook has lots of practice problems, which are a great way to prepare for the tests. Make an effort to attend the tutorials, as the professors will go through practice problems.

### **Contemporary Statistics for Engineers (STAT 2220) 3CR**

Descriptive statistics, basic probability concepts, special statistical distributions, statistical inference-estimation and hypothesis testing, regression, reliability, statistical process control. MATH 1710/1700 is a prerequisite.

### **Civil Engineering Materials (CIVL 2770) 5CR**

Principles of testing; testing standards; instrumentation; data acquisition systems; mechanical properties of steel, iron, cement, concrete, asphalt, wood and composites; classification and particle size analysis of soils and aggregates. ENG 1440 and CIVL 2800 are prerequisites.

### **Civil Engineering Systems (CIVL 2780) 4CR**

Introduction to applied systems analysis approach. Use of applied systems analysis in Civil Engineering. Optimization techniques: linear programming; dynamic programming; other techniques. Evaluation: decision analysis. MATH 1710/1700 is a prerequisite.

**Difficulty:** 3    **Workload:** 3

### **Fluid Mechanics (CIVL 2790) 4CR**

Definition of fluid; fluid properties; variation of pressure in a fluid; hydrostatic forces; buoyancy; kinematics of flow; control volumes; continuity; Bernoulli's equation; momentum equation; energy equation; flow in closed conduits; open channel flow. ENG 1440 and MATH 1710 are prerequisites.

**Difficulty:** 4    **Workload:** 3.5



### **Numerical Methods (CIVL 3590) 4CR**

Variety of numerical techniques applicable to solutions of problems in civil engineering. COMP 1012 is a prerequisite and MATH 2132 is a corequisite.

**Difficulty:** 3.5 **Workload:** 3

### **Geology for Engineers (GEOL 2250) 4CR**

Principles of physical geology; materials in processes in geology; classification of igneous, metamorphic, and sedimentary rocks; elementary geological and geophysical surveying techniques; geological hazards, volcanism, earthquakes, landsliding, processes of weathering, transportation and geomorphology. no prerequisites.

### **Math Analysis 2 (MATH 2132) 3CR**

(Lab required) Infinite series, Taylor and Maclaurin Series; ordinary differential equations including Laplace transforms. For Engineering and Geophysics students only. MATH 1210 and MATH 1710 are prerequisites.

**Difficulty:** 4 **Workload:** 3

**Tips:** The best way to prepare for your midterms and final is to do lots of practice problems in the textbook. The tutorials are taught by the professor, so they are a great opportunity to go through additional practice problems and ask your questions.



## THIRD YEAR COURSE DESCRIPTIONS

### **Env Eng Analysis (CIVL 3690) 4 CR**

Introduction to environmental engineering analysis concept; risk assessment; colloidal dispersions; mass balances, reaction kinetics and reactor design principles. Water pollution and water quality in rivers and lakes. Physical, chemical and biological unit operations and processes applied in water and/or wastewater treatment. Meteorology and air pollution; atmospheric dispersion. Solid waste management issues. CHEM 1310/2560 are prerequisites.

### **Geo Mat Analysis (CIVL 3730) 4 CR**

Geotechnical Materials and Analysis (3-1.5T:0-0) 4 Soil and rock properties: laboratory and field techniques; in situ states of stress and consolidations; constitutive models; stress beneath loaded areas and around tunnels; analysis of simple retaining structures and slopes; stability and settlement of shallow and deep foundations in soil and rock. CIVL 2800 and GEOL 2250 are prerequisites.

### **Hydrology (CIVL 3750) 4CR**

Basic hydrological processes; precipitation; evapotranspiration; infiltration and runoff; analytical methods; hydrograph theory and application; application to reservoir design; project floods and flow forecasting; statistical analysis. STAT 2220 is a corequisite.

### **Structural Analysis (CIVL 3760) 4CR**

Different structural forms and load distribution, analysis of cables; statically determinate curved, beams and frames; influence lines; energy methods and deflections of structures; flexibility and stiffness methods; computer-aided structural analysis; introduction to structural dynamics. STAT 2220 is a pre- or corequisite.

### **Transportation Eng 1 (CIVL 3790) 4CR**

Introduction to transportation. Overview of Canada and U.S. transport systems. Fundamentals of transport systems analysis. Introduction to sequential demand modeling. Analysis and evaluation of uninterrupted flow on highways. Basics of geometric design of highways. Basics of design of at-grade intersections. Introduction to computer applications in transportation engineering. Basics of pavement engineering and design. CIVL 2770, 2780, 2840 STAT 2220 are prerequisites.

### **Environmental Eng Design (CIVL 3700) 4CR**

Design principles are developed for water, solid/soil and air pollution control. Application of the principles in design projects which may include surface and groundwater remediation, solid waste management, landfilling, soil remediation and site assessment;





municipal and industrial wastewater treatment; odour and air pollution abatement facilities. CIVL 3690 is a prerequisite.

**Difficulty: 3    Workload: 3**

**Hydraulics (CIVL 3740) 4CR**

Hydraulics of uniform and gradually varied flow; backwater computation and classification of surface water profiles; hydraulics jumps, spillways, and stilling basins; flow over weirs; hydraulic models; theory of turbo-machinery. CIVL 2790 is a prerequisite.

**Difficulty: 3    Workload: 3**

**Structural Design 1 (CIVL 3770) 4CR**

Introduction to design of steel structures; loading, structural configurations; design of simple members and connections; building code requirements. CIVL 2770 and 3760 are prerequisites.

**Difficulty: 4    Workload: 4**

**Eng Economics (CIVL 4050) 3CR**

Introduction to engineering economics. Time value of money and discounted cash flow calculations. Comparing alternatives. Replacement analysis and life-cycle costing. Public sector engineering economy studies. Private sector engineering economy studies. Before and after-tax analysis. Applications in cost-estimating. Applications in asset management systems. Basic accounting. Accommodating capital limitations. Dealing with inflation. Dealing with risk and uncertainty. STAT 2220 is a prerequisite.

**Difficulty: 3    Workload: 3**

**Environmental Ethics (PHIL 2750) 3CR [or a complementary elective]**

An examination of some important ethical issues connected with environmental pollution and resource depletion. Examples to be covered include: the ideal of liberty and environmental limits; scarcity and the ideal of justice; growth vs. steady-state economics; animal rights, and survival ethics vs welfare ethics. Students may not hold credit for PHIL 2750 and any of: PHIL 2751 or PHIL 2290 or PHIL 2531. Prerequisite: successful completion of 30 hours of university credit.



## **FOURTH YEAR COURSE DESCRIPTIONS**

### **Geotechnical Design (CIVL 4220) 4CR**

Site characterization; design and construction of surface footings, deep foundations, tunnels, earth and rock support systems; design and remediation of slopes; frozen soils and foundation design; geosynthetics and geofabrics in geotechnical construction; reinforced earth; geoenvironmental issues; tailing dams, clean-up, and remediation. CIVL 3730 is a prerequisite.

### **Infrastructure Engineering and Construction Management (CIVL 4380) 4CR**

Infrastructure engineering; drainage systems, maintenance engineering and management. Construction and project management; workplace health and safety, construction site field trips, construction equipment, temporary facilities, project management. Elements of law for civil engineers. CIVL 4050 is a prerequisite.

### **Structural Design 2 (CIVL 4390) 4CR**

Design in reinforced concrete; properties of materials; ultimate strength design; analysis and design of sections in bending; shear and development considerations; short- and long-term deflection; sections subjected to bending and axial stresses; design of simple floor systems; column footings. CIVL 2770, 2800, 3760, 3770 are prerequisites.

### **Transportation Engineering 2 (CIVL 4400) 4CR**

Fundamentals of traffic control for highways. Capacity and level of service analysis on urban streets. Urban supplement to geometric design guide for Canadian roads. Modelling vehicle performance. Elements of railway engineering. Design for trucks. Transportation systems management. Application of intelligent transportation systems. Basic pavement design methods. Introduction to pavement management systems. Highway accidents and design for safety. Legislative and policy framework for transportation engineering. CIVL 3790 is a prerequisite.

### **Technology, Society, and the Future (CIVL 4460) 3CR**

Impact of technology and technological change on society - past, present, future; specific technologies, e.g. construction, machine power, computers, communications, medical, military: the process of technological change; invisible effects of technology; technology and use; sustainable development, limits to growth and the role of technology. ENGL 1400/1310 is a prerequisite.

### **Design Project (CIVL 4590) 6CR**

An interdisciplinary project-based course involving engineering design, teamwork and delivered in studio format. Students are expected to work in pre-assigned teams under the guidance of professional engineers on a pre-determined project. Lecture material will cover



project management, construction, environmental and economic issues. Each team will be required to give an oral presentation of their design project. ENG 2010, CIVL 2840, 3700, 3740, 3750, 3770, 3790 are prerequisites.

**Difficulty: 4    Workload: 5**



## **TECHNICAL ELECTIVES COURSE DESCRIPTIONS**

### **Finite Element Analysis (CIVL 3710) 4CR**

One-dimensional analysis of fluid flow, seepage and heat transfer; truss, beam and frame elements; two-dimensional problems; isoparametric elements and Gauss quadrature; time-dependent problems, diffusion, consolidation, and time integration methods; introduction to commercial packages; solution of problems in civil engineering (seepage, dams, pavements). CIVL 2790, 2800, 3590 are prerequisites.

### **Masonry Design (CIVL 4020) 4CR**

Introduction to the building codes that govern masonry design. Advanced design procedures for masonry members and structures. Single-story and multi-story building design. CIVL 3760 is a prerequisite.

### **Design of Concrete Mix (CIVL 4022) 4CR**

Constituent materials (cement, admixtures, etc.) of concrete; performance-based design and control of concrete mixtures; fresh, hardened and durability properties of concrete. CIVL 2770 is a prerequisite.

### **Structural Design 3 (CIVL 4030) 4CR**

Prestressed concrete structures; fibre-reinforced concrete structures; bridge loading, analysis and design in steel and concrete; special topics in structural engineering. CIVL 2770, 2800, 3760, 3770, 4390 are prerequisites.

**Difficulty: 3    Workload: 3**

### **Eng Management and Environment (CIVL 4100) 4 CR**

Teams of students apply environmental management techniques, such as: impact assessment, site assessment, and auditing to selected engineering construction projects and operations; several oral and written reports are required. CIVL 3700 is a pre- or corequisite.

### **Structural Dynamics (CIVL 4040) 4CR**

Dynamic loads in civil engineering; overview of structural dynamics; single-degree-of-freedom systems; free-vibration, harmonic, periodic and impulsive loads; multi-degree-of-freedom systems; distributed systems; beam vibrations; steady-state vibrations of foundations; introduction to earthquake engineering; elastic waves in soils, response and design spectrums; wind vibrations. CIVL 3760 is a prerequisite.



### **Water Treatment Plant Design (CIVL 4120) 4CR**

Design of unit processes used in potable water treatment plants: solid/liquid separation, oxidation, coagulation, filtration, adsorption and disinfection. Determination of design parameters through laboratory studies. Water treatment plants design standards and guidelines. CIVL 3690 is a prerequisite.

### **Solid Waste (CIVL 4130) 4CR**

Engineering principles and the practice of integrated management of solid wastes, including characteristics, sorting, utilization and final disposal in landfill. Principles of leachate and hazardous waste management and disposal. CIVL 3700 is a pre- or corequisite.

### **Environmental Systems (CIVL 4180) 4CR**

Development of a river water quality model; waste allocation modelling; modelling of the sites selection process; analysis of environmental impact using technical and non-technical (i.e. sociological, ethical, aesthetic) parameters. CIVL 2780, 3690, 3750 are prerequisites.

### **Groundwater Contamination (CIVL 4200) 4CR**

Introduction to the principles of groundwater chemistry; chemical evolution of natural groundwater flow systems; sources of contamination; mass transport processes; hydrochemical behaviour of contaminants; nuclear waste disposal; non-aqueous phase organics; aquifer remediation. CIVL 4250, GEOL 2250 are prerequisites.

### **Geotechnical Engineering (CIVL 4230) 4CR**

Case-history approach to geotechnical engineering practice from civil and mining engineering; relationship between predicted and observed behaviour; surface and shallow footings; propped walls and bulkheads; rock and soft ground tunneling; deep foundations; rock and soil slopes; culverts; geoenvironmental problems. CIVL 3730 is a prerequisite.

**Difficulty: 3    Workload: 3**

### **Groundwater Hydrology (CIVL 4250) 4CR**

Introduction to theory of groundwater flow; flow nets; regional groundwater flow; well hydraulics; role of groundwater in geologic and engineering processes; multiphase flow. GEOL 2250, CIVL 2790 MATH 2130, 2132 (or 2110) are prerequisites.

### **Design of Urban Water Systems (CIVL 4300) 4CR**

Water supply and the design of water distribution systems. Urban hydrology and design of wastewater and stormwater collection systems. Manitoba specific applications will be discussed. CIVL 3750 is a prerequisite and CIVL 3740 is a pre- or corequisite.



### **Hazardous Waste (CIVL 4350) 4CR**

Sources and classification of hazardous and industrial wastes. Overview of the waste management problem. Theory and applications of various physical, chemical, and thermal, waste treatment processes. Waste elimination options and strategies. CIVL 3690 is a prerequisite.

### **Transportation Systems (CIVL 4410) 4CR**

Contemporary approaches to transportation planning. Data for transportation planning. Advanced demand analysis and modelling. Illustrative transport planning studies. Planning and design for public passenger transportation. Planning and design for barrier-free transportation and transport of disabled persons. Goods movement and trucking studies. Planning and design for motor carrier operations. Planning and design for grain handling and transportation. Transport planning in developing countries. Evaluating transport plans and projects. Transport and the environment. Transport and energy. Vehicle operating costs and engineering unit cost models. CIVL 3790 is a prerequisite.

### **Highway Pavement Design (CIVL 4420) 4CR**

Soil classification and properties; soil-moisture-density-strength relationships; earthwork operations and specifications; soil stabilization; granular bases; surface drainage; structural design of flexible and rigid pavements. CIVL 2770 and 3790 are prerequisites.

**Difficulty: 3    Workload: 3**

### **Watershed Processes (CIVL 4470) 4CR**

Rainfall-runoff processes, flood routing; characteristics and mechanics of flow in (natural) channels; computer modelling of watershed hydrology and hydraulics; influence of man-made structures; river morphology, sediment transport prediction, design of a stable channel; river ice processes. CIVL 3750 is a prerequisite and CIVL 3740 is a pre- or corequisite.

### **Air Pollution (BIOE 4460) 4CR**

Air pollutant sources and characteristics, their impact on the environment, their behaviour in the atmosphere. Methods of sampling and measurement and the basic technological alternatives available for separation/removal and control. Particular problems of regional interest are discussed. CIVL 2790 is a pre- or corequisite.

**Difficulty: 2    Workload: 2.5**

### **Remediation of Contaminated Soil (SOIL 4500) 3CR**

Physical, chemical and biological approaches to remediation of land including; nature of contaminants, procedures for assessing the extent of the impact, consequences to the environment, approaches to remediation and case studies of contaminant remediation.



**Structural Design in Wood (BIOE 4560) 4CR**

Design using wood as a structural material in light-frame buildings. Consideration of design constraints associated with sawn lumber as well as based composite materials. Emphasis on use of computer based design aids. CIVL 3770 is a prerequisite.

**Difficulty: 3    Workload: 3**