CIVL HANDBOOK

2017-18

University of Manitoba
Engineering Society

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Civil Engineering

Department Contacts

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Department Description

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.

Options

The Environmental Engineering Option provides an opportunity for students to focus on environmental engineering related courses. For other areas of study, students can choose their design and elective courses to be focused on a specific topic but they are not formal specializations designated on transcripts.

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Tips for Incoming Civil Students

These tips are from current civil students and students from other departments.

1. If they are available, old midterms and finals are one of the best ways to prepare for your exams. Pay attention to the style of questions your professor has given in the past and to the concepts that were emphasized in previous years' exams.
2. Make friends, you will have several group projects for which you get to choose your partners.
3. Don't leave all of your tech electives for your last year, they conflict with each other and you will not be able to get into the courses you want.
4. Consider taking your complementary electives in the evenings during the summer. They are less demanding and you can can lighten your course load during the school year.
5. Many of your courses will have weekly quizzes or assignments. Even though they aren't worth a large percentage of your grade, put in as much effort as you can. Your marks in these sections of the course can help boost your overall grade.
6. Take advantage of the professors' office hours, they can provide assistance on assignments and with studying for tests and exams.
7. Get your card encoded at the earliest opportunity, there are usually a few days it is done every fall term; it will be needed to access rooms such as the CAD lab.

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Course List

Second Year Courses

Introduction to Physical Chemistry (CHEM 1310) 3CR
Engineering Communication (ENG 2030 or ENG 2040) 3CR
Math Analysis 1 (MATH 2130) 3CR
Math Analysis 2 (MATH 2132) 3CR
Contemporary Statistics for Engineers (STAT 2220) 3CR
Geology for Engineers (GEOL 2250) 4CR
Civil Engineering Materials (CIVL 2770) 5CR
Civil Engineering Systems (CIVL 2780) 4CR
Fluid Mechanics (CIVL 2790) 4CR
Solid Mechanics (CIVL 2800) 4CR
Graphics for Civil Engineers (CIVL 2830) 2CR
Civil Engineering Geomatics (CIVL 2840) 3CR

Third Year Courses

Environmental Ethics (PHIL 2750) 3CR [or a complementary elective]
Engineering Economics (ENG 3000) 3CR
Numerical Methods (CIVL 3590) 4CR
Environmental Engineering Analysis (CIVL 3690) 4CR
Environmental Engineering Design (CIVL 3700) 4CR
Geotechnical Materials and Analysis (CIVL 3730) 4CR
Hydraulics (CIVL 3740) 4CR
Hydrology (CIVL 3750) 4CR
Structural Analysis (CIVL 3760) 4CR
Structural Design 1 (CIVL 3770) 4CR
Transportation Engineering 1 (CIVL 3790) 4CR

Fourth Year Courses

Geotechnical Design (CIVL 4220) 4CR
Infrastructure Engineering and Construction Management (CIVL 4380) 4CR
Structural Design 2 (CIVL 4390) 4CR
Transportation Engineering 2 (CIVL 4400) 4CR
Design Project (CIVL 4590) 6CR
Technology, Society, and the Future (CIVL 4460) 3CR

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Technical Electives

Finite Element Analysis (CIVL 3710) 4CR
Masonry Design (CIVL 4020) 4CR
Design of Concrete Mix (CIVL 4022) 4CR
Sustainable Building Design (CIVL 4024) 4CR
Structural Design 3 (CIVL 4030) 4CR
Structural Dynamics (CIVL 4040) 4CR
Engineering Management and Environment (CIVL 4100) 4CR
Water Treatment Plant Design (CIVL 4120) 4CR
Solid Waste (CIVL 4130) 4CR
Environmental Systems (CIVL 4180) 4CR
Groundwater Contamination (CIVL 4200) 4CR
Geotechnical Engineering (CIVL 4230) 4CR
Geotechnical Earthquake Engineering (CIVL 4232) 4CR
Groundwater Hydrology (CIVL 4250) 4CR
Design of Urban Water Systems (CIVL 4300) 4CR
Thesis Project (CIVL 4332) 4CR
Hazardous Waste (CIVL 4350) 4CR
Transportation Systems (CIVL 4410) 4CR
Highway Pavement Design (CIVL 4420) 4CR
Air Pollution (BIOE 4460) 4CR
Watershed Processes (CIVL 4470) 4CR
Remediation of Contaminated Soil (SOIL 4500) 3CR
Structural Design in Wood (BIOE 4560) 4CR

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Course Descriptions

SECOND YEAR COURSE DESCRIPTIONS

Introduction to Physical Chemistry (CHEM 1310) 3CR
Thermochemistry, chemical thermodynamics, and chemical kinetics. This course expands on topics covered in high school chemistry that were not included in CHEM 1300. This course is more math intensive than CHEM 1300, which some people have difficulty with. CHEM 1300 is a prerequisite.

Difficulty: 3 **Workload:** 3.5

Tips: Start your lab write ups early so that you have time to ask questions if needed and also to consult with other peers.

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.

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. Have fun with derivatives and integrals in 3D. MATH 1710 and MATH 1210 are prerequisites.

Difficulty: 3.5 **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.

Math Analysis 2 (MATH 2132) 3CR
Infinite series, Taylor and Maclaurin Series; ordinary differential equations including Laplace transforms. For Engineering and Geophysics students only. This class introduces many new concepts unlike Math 1, which mostly builds on first year Calculus. MATH 1210 and MATH 1710 are prerequisites. Note that Math 1 is not a prerequisite.

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.

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. Up to the midterm this class is pretty easy. After the midterm it becomes more difficult and you start doing some derivatives, but with a bit of practice it's manageable. MATH 1710/1700 is a prerequisite.

Difficulty: 2 **Workload:** 2

Tips: Make sure you keep up with the practice problems. Although the material is relatively straightforward, it can get a little overwhelming if you fall behind. Also, don't forget to study theory questions in addition to your normal numerical question practice.

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. The material in this course is straightforward but there is a lot of information to memorize. The huge amount of memorizing means you still have to study quite a bit to do well in this class. No prerequisites.

Difficulty: 2.5 **Workload:** 3

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.

Difficulty: 4 **Workload:** 5

Tips: Make sure to bring a phone to the labs because the lab facilitator writes a lot of helpful information on the whiteboard which will be indispensable when writing the lab reports. It also helps if you bring a surface to write on to the lab (such as a clipboard), since most of your notes are written while standing.

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. This course is all about solving optimization problems. Basically, you turn word problems into numerical problems and then solve them mathematically. Up to the midterm, you solve problems mostly by hand. After the midterm, you will mostly be using Microsoft Excel to solve problems. 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. This course has tutorials, labs, assignments and quizzes. Be prepared to put lots of work into this class. ENG 1440 and MATH 1710 are prerequisites.

Difficulty: 4 **Workload:** 3.5

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. This course is kind of a like a more advanced Statics course and it contains lots of math and equations. MATH 1710/1700 and ENG 1440 are prerequisites.

Difficulty: 3.5 **Workload:** 3.5

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. This course teachs Computer Aided Design (CAD) using the AutoCAD program. Be prepared to spend lots of time in the AutoCAD lab working on assignments. CIVL 2840 is corequisite.
Difficulty: 2.5 **Workload:** 3

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. This course teaches some basic surveying skills and it's a must-have course if you want to get a Civil engineering co-op position. MATH 1210 and CIVL 2030 are corequisites.

Difficulty: 3 **Workload:** 2

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THIRD YEAR COURSE DESCRIPTIONS

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.

Difficulty: 2 **Workload:** 2

Engineering Economics (ENG 3000) 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. Statistics is a prerequisite for this course, but it really has nothing to do with what you learned in it. This course covers basic economic analysis that is applicable to engineers. for STAT 2220 is a prerequisite.

Difficulty: 3 **Workload:** 3
Tips: Practice makes perfect!

Numerical Methods (CIVL 3590) 4CR
Variety of numerical techniques applicable to solutions of problems in civil engineering. This course is essentially a cross between a math course and a computer science course. You will use MATLAB to solve mathematical problems. COMP 1012 is a prerequisite and MATH 2132 is a corequisite.

Difficulty: 3.5 **Workload:** 3

Environmental Engineering 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. This class mostly focuses on treating drinking water to make to suitable for human consumption. Note that this class is involves a lot of chemistry and you will be using what you learned in CHEM 1310 quite a bit. CHEM 1310/2560 are prerequisites.

Difficulty: 3 **Workload:** 3

Environmental Engineering 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

Geotechnical Materials 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.

Difficulty: 4 **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. This course is essentially Fluid Mechanics 2.0 and you will expand on some of the topics covered in Fluid Mechanics. CIVL 2790 is a prerequisite.

Difficulty: 3 **Workload:** 3

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. This course covers a lot of content, but it mostly focuses on calculations involving flow in rivers. This course has tutorials, labs, assignments and quizzes. Be prepared to put lots of work into this class. STAT 2220 is a corequisite.

Difficulty: 4 **Workload:** 4

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.

Difficulty: 3.5 **Workload:** 4

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

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.

Difficulty: 2.5 **Workload:** 3.5

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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.

Difficulty: 3 **Workload:** 2

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.

Difficulty: 4 **Workload:** 4

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.

Difficulty: 2.5 **Workload:** 2.5

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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

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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.

Difficulty: 3.5 **Workload:** 3

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-storey 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.

Sustainable Building Design (CIVL 4024) 4CR
(Lab required) Best practices in sustainable design; current standards that govern building envelope components, cladding systems, membranes, interface details and indorr air quality. Industry challenges; presents fundamental principles of building science and demonstrates their application to the design, repair and maintenance of buildings; building systems; how environments affect material performance. May not be held with BIOE 4412 or BIOE 4700. Prerequisite: CIVL 3760, Pre or Corequisite: CIVL 3770.

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

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.

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.

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

Geotechnical Earthquake Engineering (CIVL 4232) 4CR
(Lab required) Introduction to soil dynamics and geotechnical earthquake engineering. Behavior of soil subjected to various types of dynamic or cyclic loadings; liquefaction and lateral spreading of soil; design of shallow and deep foundations. retaining structures, slopes and pavements subject to seismic loading; design code provisions. Prerequisite: CIVL 3730.

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.

Thesis Project (CIVL 4332) 4CR
The student will undertake an original study involving engineering design, procedure, or experimental investigation that emphasizes the student's initiative and judgement. The student must demonstrate an ability to plan, conduct and formally report on the study by written thesis and oral presentation. May not be held with CIVL 4330. Prerequisites: Completion of 120 credit hours, and [ENG 2030 or ENG 2040 (or the former ENG 2010).].

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

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

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.

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

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Summer Research Opportunities

For more information on…
U of M URA: Google University of Manitoba URA and visit the U of M website.
NSERC USRA: Google NSERC USRA and visit the NSERC website.
Either Award: Contact Sheila Lapinski in E1-284 or at sheila.smith@umanitoba.ca

1. Dr. Tricia Stadnyk: Hydrology, Tricia.Stadnyk@umanitoba.ca, E1-308.

a) Changing trends in pan-arctic discharge: analysis of observed trends in historical (1964-present) pan-arctic discharge that will be used as the basis for assessing future trends, simulated by the Arctic-HYPE hydrological model forced by global climate model scenarios.
b) Water supply projections for the Nelson River basin: assess the range in projected streamflow from various hydrological models under future climates from present day to the 2100s. The goal is to predict long-term water quantity for hydroelectric development and regulation in the Nelson River for Manitoba Hydro.
c) Integrated Water Management: assess Manitoba Hydro's regulation practices under future climate conditions using a water management model (WEAP). The goal is to develop practical parametric rule curves as the next generation of reservoir operation policies for the major control points in the Nelson system.

2. Dr. Pooneh Maghoul, Geotechnical, Pooneh.Maghoul@umanitoba.ca, E1-432.

a) Thermal Piles in Cold Region: Geothermal energy is energy extracted from the heat stored in the ground. The goal of this research is to study the load capacity of a thermal pile in cold region under thermal and mechanical loadings.
b) Soil-Pipeline Interaction in Landslide Zones: Buried pipeline infrastructures are a pre-eminent part of the gas and oil transportation across the country and their integrity has an important impact on the strength of Canada's economy. This research aims to study the effect of pore water pressure and the degree of saturation on the soil-pipeline interaction to present some guidelines to improve the soil-pipeline practice.

3. Dr. Ahmed Shalaby, Transportation, Ahmed.Shalaby@umanitoba.ca, E1-332.

Project no. 1: Nondestructive testing of the City of Winnipeg regional street network (Client: City of Winnipeg)
The student will assist a team that will use the University of Manitoba instrumented vehicle (Falling Weight Deflectometer) to measure deflection of road sections. Five City of Winnipeg projects will be tested both before and after rehabilitation. The analysis of FWD data and ground penetrating radar data will provide useful insights for infrastructure renewal projects. This work involves several field visits within the City of Winnipeg to collect data, inspect works,

and to monitor construction progress. Students interested in field work, surveying and data collection and analysis will find this project both interesting and challenging.
Project no. 2: Pavement Smoothness Specifications (joint project with Manitoba Infrastructure and City of Winnipeg)
Pavement profile and smoothness data is routinely collected using a laser profile mounted on a vehicle travelling at highway speed. This project aims to develop construction acceptance specifications based on smoothness. First a set of measurements will be collected and used to bench mark quality of construction. The student will analyze the impact of road features such as utility openings, grade, and intersections on smoothness. Familiarity with numerical methods and MATLAB will be helpful.
Project no. 3: Characterizing cold-mix pothole patching materials
Cold-mix asphalt is regularly used to fill potholes and to patch pavements. The project aims to characterize the materials used by Manitoba Infrastructure and the City of Winnipeg for this purpose. Four different mixes will be tested and compared. The laboratory tests will be performed in the Pavement Research Laboratory and include stiffness, workability, volumetric properties, and bond. The student will participate in laboratory tests and in field evaluation of the materials in a side-by-side experimental section. Interest in laboratory testing of materials is an asset for this work.

4. Dr. Qiuyan Yuan, Environmental, Qiuyan.Yuan@umanitoba.ca, E3-375.

a) Recycling drywall waste as bulking agent for composting.

5. Dr. James Blatz, Geotechnical, James.Blatz@umanitoba.ca, E1-328.

a) Evaluating the behavior of steel piles for bridge abutments.
b) Development of new soil property maps for the City of Winnipeg.

6. Dr. Jonathan Regehr, Transportation, Jonathan.Regehr@umanitoba.ca, E1-310.

a) Proactive monitoring and management of the wheel-rail interface for improved freight rail performance: Over the last 50 years, exponential growth in North American freight demand has motivated rail companies to improve productivity by adopting heavier rail cars, operating longer trains, and increasing network capacity. Heavier and more frequent axle loads impose greater rail contact stresses and necessitate expensive and carefully planned maintenance. In particular, the rail industry recognizes the benefits of proactive rail maintenance programs. This research analyzes freight rail performance trends using industry-standard metrics to assess the outcomes of preventive rail grinding programs.
b) Design of a traffic data visualization tool: Traffic data are common inputs for innumerable transportation engineering decisions. These data describe the magnitude of vehicles using a roadway system and their temporal, spatial, and vehicle classification characteristics. This research involves evaluating and testing existing tools used to visualize traffic data characteristics for use by practicing engineers and the public.

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Glossary

These are a few terms that may be helpful to know throughout your studies in our faculty.

- **APEGM:** The Association of Professional Engineers and Geoscientists of Manitoba. This organization governs the work of all Professional Engineers and Geoscientists in Manitoba.
- **CFES:** The Canadian Federation of Engineering Students (which includes U of M). This national organization provides a diverse range of services as they work to support a number of Canadian Engineering schools.
- **Co-Requisite:** Refers to a course which must be taken concurrently with another course.
- **EngO:** The U of M's Engineering Orientation, also known as the two funnest days of the year. Be sure to attend on September 8th and 9th!
- **Frosh:** Refers to a first-year student.
- **HIRED:** Helping Industry Reach Engineers Directly. These sessions are held every Monday evening and provide students the opportunity to interact with industry (there's free pizza!).
- **Lab:** Refers to the portion of a course involving hands-on experiments. Most labs also require the submission of an individual or group report.
- **Midterm:** Most courses include one or two midterm exams which cover a selected portion of the course content. Although they come up quickly, midterms serve as an effective tool to keep updated with course material.
- **Prerequisite:** Refers to a course which must be completed prior to registration for another course.
- **TA:** Teaching Assistant. TAs will usually be available to students during labs/tutorials and can be very helpful in answering questions.
- **Technical Societies:** Also called "Tech Socs", this term refers to the many engineering student groups associated with UMES. Tech Soc lounges are located on the fifth floor of E1.
- **The Window:** Opens onto the Engineering Atrium and is a great resource for all engineering students. Stop by The Window to purchase snacks, UMES merchandise and event tickets or to simply ask questions.
- **Tutorial:** Refers to the portion of a course involving practice problems. Some tutorials require these questions be submitted while others do not.
- **UMES:** The University of Manitoba Engineering Society. Refers to the faculty student council which coordinates many important events and services.
- **WESST:** The Western Engineering Students' Societies Team (which includes U of M). WESST provides a diverse range of services to its 10 Western Canadian member schools.

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Helpful Links

UMES Website: http://umes.mb.ca/

Important Dates and Deadlines: http://umanitoba.ca/student/records/deadlines/

Program Requirements and Timetables: https://goo.gl/d1pUV9

Complementary Electives: https://goo.gl/Cprbw1

Technical Electives: https://goo.gl/ymzYqH