4.2 School of Architecture

Macdonald-Harrington Building, Room 201
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http://www.mcgill.ca/arch

Director
David Covo; B.Sc.(Arch.), B.Arch.(McG.), F.R.A.I.C., O.A.Q.

Emeritus Professors
John Bland; B.Arch.(McG.), A.A. Dipl., D.Sc.(Carleton), R.C.A., F.R.A.I.C., O.A.Q. *(William C. Macdonald Emeritus Professor of Architecture)*
Norbert Schoenauer; B.Arch.(Bud.), M.Arch.(McG.), R.C.A., F.R.A.I.C., O.A.Q., C.P.U.Q., M.C.I.P. *(William C. Macdonald Emeritus Professor of Architecture)*
Harold Spence-Sales; A.A.Dipl., M.R.T.P.I., F.C.I.P.

Professors
Bruce Anderson; B.Arch.(McG.), M.Arch.(Harv.), F.R.A.I.C., O.A.Q.
Vikram Bhatt; N.Dip.Arch.(Ahmedabad), M.Arch.(McG.), M.R.A.I.C.
Derek Drummond; B.Arch.(McG.), F.R.A.I.C., O.A.A. *(William C. Macdonald Professor of Architecture)*
Alberto Pérez-Gómez; Dipl.Eng.(Nat.Pol.Inst.Mexico), M.A., Ph.D.(Essex) *(Saidye Rosner Bronfman Professor of Architectural History)*
Adrian Sheppard; B.Arch.(McG.), M.Arch.(Yale), F.R.A.I.C., O.A.Q., A.A.P.P.Q.
Radoslav Zuk; B.Arch.(McG.), M.Arch.(M.I.T.), D.Sc. (Ukr.Acad.Art), F.R.A.I.C., F.R.S.A., F.A.R.C., O.A.Q., O.A.A.

Associate Professors
Annmarie Adams; B.A.(McG.), M.Arch., Ph.D.(Berkeley), M.R.A.I.C.
Ricardo Castro; B.Arch.(Los Andes), M.Arch., M.A.(Art History) (Ore.) M.R.A.I.C.
David Covo; B.Sc.(Arch.), B.Arch.(McG.), F.R.A.I.C., O.A.Q.
Avi Friedman; B.Arch.(Technion), M.Arch.(McG.), Ph.D. (Montr.), O.A.Q., I.A.A.
Robert Mellin; B.Arch., M.Sc.(Arch.)(Penn.State), M.Arch.(McG.), M.Sc., Ph.D.(U.Penn.), M.R.A.I.C., N.A.A.
Pieter Sijpkes; B.Sc.(Arch.), B.Arch.(McG.)

Faculty Lecturer
Rhona Kenneally

Adjunct Professors
Manon Asselin, Julia Bourke, Joseph Baker, Nathalie David, Howard Davies, François Dufaux, Gordon Edwards, François Émond, Julia Gersovitz, Dan Hanganu, Alka Jain, Phyllis Lambert, Seymour Levine, Harry Mayerovitch, Serge Melanson, Joanna Nash, Daniel Pearl, Mark Poddubiuk, Daniella Rohan, Jacques Rousseau, Richard Russell, Robert Stanley, Robert Thibodeau, Catherine Vezina, Fred Weiser, Samson Yip, Jozef Zorko

Research Associates
Jim Donaldson, Terrance Galvin, David Krawitz, Rafik Salama

Associate Members
Clarence Epstein, Tania Martin, Irena Murray, Howard Schubert

Visiting Critics and Lecturers
Each year visitors are involved in the teaching of certain courses as lecturers and critics. These visitors change from year to year; in 1999, they were:

James Aitken, Cheryl Atkinson, Cecile Baird, William Barker, Ken Bedford, Barry Bell, Borkur Bergman, Torben Berns, Patrick Bernier, Philip Bobrow, Jonathan Bordo, Raouf Boutros, Louis Brillant, Greg Caicco, Eugene Carrelli, Michael Carroll, Charles Charlebois, Randy Cohen, Cynthia Cooper, Hugh Cullum, Georges Copur, Dirk de Meyer, Georges Drolet, Philippe Drolet, Marie-Danielle Faucher, Susan Fisher, Kurt Forster, Marco Frascari, Stan Fung, Deborah Gans, Pierre Gendron, Jean-Pierre Genereux, Jason Gilliland, Marc Glaudemans, Nan Griffiths, Ken Hayes, Edward Hercun, Tanis Hinchcliffe, Andrew Hoffman, Hal Ingberg, Christopher Ives, Raphael Justewicz, Brigitte Knowles, Andrew Kozina, Hava Low Yon, Hubert Low Yon, Barbara Lawson, David Leatherbarrow, Annie Lebel, Marie-Claude Leblond, Pierre Lefebvre, Janna Levitt, Mark London, Marie-Paule Macdonald, Frank McMahon, Eric Marosi, Rudi Meyer, Desmond Morton, Richard Murphy, Bernard Olivier, David Owen, Stephen Parcell, Louise Pelletier, Pamela Plumb-Dhindsa, Stephane Pratt, Claude Provencher, Roger Bruno Richard, Bernard Saint-Denis, Tom Schweitzer, Donald Sherefkin, Yves Sherrif, Daniel Smith, Frances Stober, David Theodore, Vladimir Topouzanov, Eva Vecsei, William Weima, Andrea Wolff, George Yu.

ARCHITECTURAL CERTIFICATION IN CANADA

In Canada, all provincial associations recommend a degree from an accredited professional degree program as a prerequisite for licensure. The Canadian Architectural Certification Board (CACB), which is the sole agency authorized to accredit Canadian professional degree programs in architecture, recognizes two types of accredited degrees: the Bachelor of Architecture and the Master of Architecture. A program may be granted a five-year, three-year, or two-year term of accreditation, depending on its degree of conformance with established educational standards.

Masters degree programs may consist of a pre-professional undergraduate degree and a professional graduate degree, which, when earned sequentially, comprise an accredited professional education. However, the pre-professional degree is not, by itself, recognized as an accredited degree.

Since all provincial associations in Canada recommend any applicant for licensure to have graduated from a CACB-accredited program, obtaining such a degree is an essential aspect of preparing for the professional practice of architecture. While graduation from a CACB-accredited program does not assure registration, the accrediting process is intended to verify that each accredited program substantially meets those standards that, as a whole, comprise an appropriate education for an architect.

PROGRAMS OF STUDY

McGill's professional program in architecture is structured as a four and a half year, or nine semester, course of study divided into two parts.

The first part, for students entering with the Diploma of Collegial Studies in Pure and Applied Science or the equivalent, is a six-semester design program leading to a non-professional degree, Bachelor of Science (Architecture). [Most students from outside Quebec are admitted to an eight-semester B.Sc.(Arch.) program and enter a first year which includes courses outlined in section 3.1.3.

The second part, for students with the B.Sc.(Arch.) degree, is a one and a half year, or three-semester, program leading to the professional Master of Architecture I degree.

The professional M.Arch.I replaces the present Bachelor of Architecture which is the degree accredited by the CACB for a five-year period to December 31, 2000 and recognized as accredited by the National Architectural Accrediting Board (NAAB) in the USA.

Students in the B.Sc.(Arch.) program who intend to proceed to the professional degree must satisfy certain minimum requirements including:

1. completion of the B.Sc.(Arch.) degree, including the series of required and complementary courses stipulated for professional studies, with a minimum CGPA of 3.00;
2. completion of the sequence of six design studios, with a minimum average GPA of 2.70;
3. completion of six months relevant work experience.

Further information on the professional M.Arch.I program is available on the web at http://www.mcgill.ca/arch.

Student Exchanges

A limited number of qualified students may participate in an exchange with Schools of Architecture at other universities which have agreements with the McGill School of Architecture, for a maximum of one semester in the second year of the B.Sc.(Arch.) program. These include: Facultad de Arquitectura, Universidad de Los Andes, Bogotá, Colombia; Istituto Universitario di Architettura di Venezia, Venice, Italy; Fakultät für Raumplanung und Architektur, Technische Universität Wien, Vienna, Austria; The Technion - Israel Institute of Technology, Haifa, Israel; Institut Supérieur d'Architecture, Saint-Luc Bruxelles, Brussels, Belgium; École d'architecture de Grenoble, Grenoble, France; École d'architecture Clermont-Ferrand, Clermont-Ferrand, France.

ANCILLARY ACADEMIC FACILITIES

Laboratories and Workshops
Architectural Workshops – Jonathan Rousham, Technician.

Communications Laboratory, including Photo Lab – Professor Ricardo Castro and Dr. Donald Chan.

Computers in Architecture Laboratory and the Apple Design and Modeling Centre – Dr. Donald Chan, System Manager.

The Building Science Resource Centre – Dr. Avi Friedman.

Library
The Blackader-Lauterman Library of Architecture and Art, located in the Redpath Library – Marilyn Berger.

Collections
The Visual Resources Collection, including slides, film, video and other materials – Dr. Annmarie Adams.

The Canadian Architecture Collection, housed in the Blackader-Lauterman Library – Irena Murray.

The Orson Wheeler Architectural Model Collection – Professor Pieter Sijpkes.

CURRICULUM FOR THE B.Sc.(Arch.) DEGREE

REQUIRED COURSES		COURSE CREDIT	
Non-Departmental Subjects			
303-205A,B	Statics	3	
303-220A	Law for Architects and Engineers	3	
303-229A	Surveying for Architects	2	
303-283B	Strength of Materials	4	
† 303-384A	Soil Mechanics and Foundations	2	
† 303-385A	Structural Steel and Timber Design	3	
† 303-388B	Reinforced Concrete Design	2	
† 303-492A	Structures	2	
306-310A,B	Engineering Economy	3	**24**

† Candidates intending not to proceed to the M.Arch.I degree may substitute other courses of equal total weight for any of these.

Architectural Subjects			
301-201A	Communication, Behaviour & Arch.	6	
301-202B	Arch. Graphics and Design Elements	6	
301-217A	Freehand Drawing I	1	
301-218B	Freehand Drawing II	1	
301-240B	Organization of Materials in Building	3	
301-250A	Architectural History I	3	
301-251B	Architectural History II	3	
301-303A	Design and Construction I	6	
301-304B	Design and Construction II	6	
301-321A	Freehand Drawing III	1	
301-322B	Freehand Drawing IV	1	
301-324T	Sketching School I	1	
301-327T	Summer Project I	1	
301-375A	Landscape	2	
301-405A	Design and Construction III	6	
301-406B	Design and Construction IV	6	
301-428T	Summer Project II	1	
301-447B	Electrical Services	2	
301-451B	Building Regulations & Safety	2	**58**

COMPLEMENTARY COURSES **12**

Students must complete 12 credits of architectural complementaries which must include at least one course from each of the areas of concentration listed below in order to qualify for the B.Sc.(Arch.) degree.

A. History	B. Theory	C. Environmental Design	D. Technics
301-372A	301-352B	301-350A	301-364B
301-388A	301-363A	301-378B	301-377B
301-522A	301-383B	301-520B	301-461B
301-528A	301-523B	301-521B	301-471A,B
301-531A	301-524A	301-527B	301-526B
301-532B	301-525A	580-442B	
301-533B	301-529B		

Students may also satisfy the remaining architectural complementary credit requirements by taking one or more of the summer courses listed below:

301-317C	301-318C	301-319C	301-379L

OUTSIDE ELECTIVES: **6**

6 credits must be completed outside the School of Architecture, subject to School approval.

TOTAL CREDITS, B.Sc.(Arch.): **100**

Architectural Complementaries

301-252A	(3)	intro. to Architectural History I
301-253B	(3)	Intro. to Architectural History II
301-317C	(4)	Avant-Garde Art and Design
301-318C	(4)	Design Sketching
301-319C	(4)	The Camera and Perception
301-350A	(3)	The Material Culture of Canada
301-352B	(3)	Art and Theory of House Design
301-364B	(2)	Architectural Modeling
301-372A	(2)	History of Architecture in Canada
301-377B	(2)	Energy, Environment and Buildings
301-378A	(3)	Site Usage
301-379L	(4)	Summer Course Abroad
301-383B	(2)	Geometry, Architecture and Environment
301-388A	(2)	Introduction to Historic Preservation
301-461B	(1)	Freehand Drawing & Sketching
301-471A,B	(2)	Computer-Aided Building Design
301-490A,B	(2)	Selected Topics in Design
301-520B	(3)	Montreal: Urban Morphology
301-521B	(3)	Structure of Cities
301-522A	(3)	History of Domestic Arch. in Quebec
301-523B	(3)	Significant Texts and Buildings
301-524B	(3)	Seminar on Architectural Criticism
301-525A	(3)	Seminar on Analysis and Theory
301-526B	(3)	Philosophy of Structure
301-527B	(3)	Civic Design
301-528A	(3)	History of Housing
301-529B	(3)	Housing Theory
301-531A	(3)	Arch. Intentions from Vitruvius to the Renaissance
301-532B	(3)	Origins of Modern Architecture
301-533B	(3)	New Approaches to Architectural History
301-540A,B	(3)	Selected Topics in Architecture I
301-541A,B	(3)	Selected Topics in Architecture II
580-442B	(2)	Enabling Environments

COURSES OFFERED BY THE SCHOOL

● Denotes courses not offered in 2000-01.
▭ Denotes limited enrolment.
★ Denotes courses offered only in alternate years.

Unless otherwise indicated, students not registered in the B.Sc.(Arch.) who wish to take courses offered by the School must obtain a password card from the Student Advisor.

301-201A COMMUNICATION, BEHAVIOUR & ARCH. 6(2-10-6)
Introduction to design; development of design judgement and

communication skills in a series of exercises addressing light, scale, space, form and colour in the built environment; introduction to techniques of oral and graphic presentation, including model making, photography, sketching and architectural drawing. The course is based in the studio and includes lectures, seminars and field trips. **Professor Covo and Adjunct Faculty**

301-202B ARCH. GRAPHICS & ELEMENTS OF DESIGN. 6(2-10-6) (Prerequisite: 301-201A) Introduction to architectural design; consideration of building form in relation to program, structural system, material selection, site and climate; further development of skills in model making, conventional architectural drawing, axonometric and perspective drawing, sketching and architectural rendering. The course is based in the studio and includes lectures, seminars and field trips. **Professor Zuk and Adjunct Faculty**

301-217A FREEHAND DRAWING I. 1(0-3-0) Drawing in pencil and charcoal. Limited enrolment, password card required.
Professor Nash
Section 01:reserved for Architecture students.
Section 02:reserved for others.

301-218B FREEHAND DRAWING II. 1(0-3-0) (Prerequisite: 301-217A) A continuation of course 301-217A Limited enrolment, password card required. **Professor Nash**
Section 01:reserved for Architecture students.
Section 02:reserved for others.

301-240B ORGANIZATION OF MATERIALS IN BLDGS. 3(2-3-4) The characteristics of basic building materials: wood, steel, masonry and concrete. How building materials are shaped into building components, and how these components are integrated into the building envelope. Problems, laboratory projects and field trips to illustrate principles. **Professor Friedman**

301-250A ARCHITECTURAL HISTORY I. 2(2-0-4) The study of architecture and cities in their social, political and cultural contexts from the earliest settlements to the end of the Middle Ages.
Professor Castro

301-251B ARCHITECTURAL HISTORY II. 2(2-0-4) (Prerequisite: 301-250B) The study of architecture and cities in their social, political and cultural contexts from the Renaissance to the present. In-depth study of the language of architectural history.
Rhona Kenneally

▭ **301-252A INTRO. TO ARCHITECTURAL HISTORY I.** 3(3-0-6) The study of architecture and cities in their social, political and cultural contexts from the earliest settlements to the end of the Middle Ages. Introduction to the language of architectural history. Open only to students outside the School of Architecture. Limited enrolment, password card required. **Professor Castro**

▭ **301-253B INTRO. TO ARCHITECTURAL HISTORY II.** 3(3-0-6) The study of architecture and cities in their social, political and cultural contexts from the Renaissance to the present. In-depth study of the language of architectural history. Open only to students outside the School of Architecture. Limited enrolment, password card required. **Rhona Kenneally**

301-303A DESIGN AND CONSTRUCTION I. 6(2-10-6) (Prerequisite: 301-202B) An exploration of the design of buildings. Projects emphasize the major social, technological, environmental, and symbolic aspects of the design process. Introduction to specific modelling, presentation, and documentation techniques. Discussions, readings, field trips and practical exercises.
Professors Castro, Mellin and Sijpkes

301-304B DESIGN AND CONSTRUCTION II. 6(2-10-6) (Prerequisite: 301-303A) Continuation of Design and Construction I with projects of increasing complexity. Projects deal with particular aspects of architectural design and/or explore approaches to design methodology. Discussions, readings, field trips and practical exercises.
Professors Castro and Sijpkes

▭ **301-318C DESIGN SKETCHING.** 4(2-5-5) (Prerequisite: 301-202B) Pictorial drawing in the design process; relationship of drawing type to design intention; strategies for visualization and representation based on perspective sketching, axonometric and oblique projection in selected media; studio work based on design exercises and problems varying in length from several minutes to several days. Limited enrolment; password card required.
Professor Covo

▭ **301-319C THE CAMERA AND PERCEPTION.** 4(2-5-5) (Prerequisite: 301-202B) An intensive study of man and the urban environment. Through the use of still photography, the relationship of time, motion, space, place and light are explored in order to gain insights into the urban environment. Topics include: "photographic seeing", light, survey of masters, history of photography, camera and darkroom techniques, tonal control, composition, etc. Limited enrolment; password card required. **Staff**

301-321A FREEHAND DRAWING III. 1(0-3-0) (Prerequisite: 301-218B) A continuation of course 301-218B. Limited enrolment, password card required.
Section 01:reserved for Architecture students.
Section 02:reserved for others. **Professor Nash**

301-322B FREEHAND DRAWING IV. 1(0-3-0) (Prerequisite: 301-321A) A continuation of course 301-321A.Limited enrolment, password card required. **Professor Nash**
Section 01:reserved for Architecture students.
Section 02:reserved for others.

301-324T SKETCHING SCHOOL I. 1(0-0-3) (Prerequisite: 301-218B) An eight-day supervised field trip in the late summer to sketch places or things having specific visual characteristics. Students are required to include Sketching School I in the B.Sc.(Arch.) program. **Professors Castro and Covo**

301-327T SUMMER PROJECT I. 1(0-0-3) (Prerequisite: 301-202B) These projects are assigned by staff members before the end of the session to be submitted at registration for the fall semester.
Professors Castro and Sijpkes

301-350A THE MATERIAL CULTURE OF CANADA. 3(2-1-6) A study of Material Culture in Canada, the "stuff" of our lives; using a multidisciplinary approach to the interpretation of the non-textual materials which have shaped the lives of past and present Canadians, using the resources of the McCord Museum and other Montreal museums, galleries and collections.
Rhona Kenneally and visitors
Section 01:reserved for Architecture students.
Section 02:reserved for Canadian Studies.
Section 03:reserved for others.

▭ **301-352B ART AND THEORY OF HOUSE DESIGN.** 3(2-2-5) (Prerequisite: 301-202B or permission of instructor.) An examination of the art and theory of the design of houses by architects who developed the form to perfection. Lectures and field trips will focus on the work of selected house architects from antiquity to the present.
Professor Bruce Anderson
Section 01:reserved for Architecture students.
Section 02:reserved for others.

▭ **301-364B ARCHITECTURAL MODELING.** 3(2-1-6) (Prerequisite: 301-202B and 301-471B) Architectural modeling using digital media. Topics include: advanced 3-D modeling and rendering techniques; raster and vector image editing; digital animation; hypertext and the World Wide Web; issues of representation and methodology; comparison of various publishing media. Limited enrolment. **Professor Yip**

▭ ★ **301-372A HISTORY OF ARCHITECTURE IN CANADA.** 2(2-0-4) (Prerequisite: 301-202B) (Given alternate years, alternating with 301-388A.) French, British and American influences in the Maritime Provinces, Quebec and Ontario. Limited enrolment; password card required. **Professor Gersovitz**

301-375A LANDSCAPE. 2(2-2-2) (Prerequisite: 301-202B) Land form, plant life, microclimate; land use and land preservation; elements and methods of landscape design. **Professor Émond**

301-377B ENERGY, ENVIRONMENT AND BUILDINGS. 2(2-0-4) (Prerequisite: 301-202B or permission of instructor) Energy consumption in the built environment; architectural means to conserve energy; the potential and limitations of unconventional sources of energy; a comparative study of energy conserving buildings and

their long-term environmental impact; effects of legislation and financing. Limited enrolment; password card required.

Professor Thibodeau

Section 01:reserved for Architecture students.

Section 02:reserved for others.

301-378A SITE USAGE. 3(2-0-7) (Prerequisite: 301-202B or permission of instructor) The study of the creation, form and usage of the exterior space generated in various patterns of low-rise housing. Socio-cultural aspects of patterns; exterior space as a logical extension of the living unit; social control of the use of urban and suburban land; comparative model for low-rise housing patterns. Limited enrolment; password card required.

Professor Drummond

Section 01:reserved for Architecture students.

Section 02:reserved for others.

▭ **301-379L SUMMER COURSE ABROAD.** (4 credits) (Prerequisite: 301-202B or permission of instructor) Study of a distinct urban environment and its key buildings; graphic recording and analysis of physical configuration, constructional peculiarities and present use. Excursions to neighbouring sites of special architectural interest. Limited enrolment; password card required.

Professors Castro and Zuk

301-383B GEOMETRY, ARCHITECTURE AND ENVIRONMENT. 2(2-0-4) (Prerequisite: 301-202B or permission of instructor) Geometry in the formal structure of design. Grids, lattices, polygons and polyhedra; proportional systems. Evidence of these figures and structures in natural objects and phenomena. Graphical and physical models. Application to architecture and the human environment.

Professor Zuk

● ★**301-388A INTRODUCTION TO HISTORIC PRESERVATION.** 2(2-2-2) (Prerequisite: 301-303A) (Given alternate years, alternating with 301-372A.) Historic attitudes and terminologies of conservation; historic research techniques. Restoration technology of building materials and principles of interior design in the 19th and 20th centuries; current preservation planning.

Professor Gersovitz

301-405A DESIGN AND CONSTRUCTION III. 6(2-10-6) (Prerequisites: 301-304B and 301-428T) A structured investigation of architectural concepts; program interpretation with respect to relevant cultural, social and environmental contexts; applications of appropriate formal languages and building technologies in integrated proposals for a variety of building forms.

Professors Anderson, Sheppard and Zuk and Adjunct Faculty

301-406B DESIGN AND CONSTRUCTION IV. 6(2-10-6) (Prerequisite: 301-405A) A detailed study and comprehensive development of architectural proposals for complex building types and site conditions; the exploration of coherent initial concepts with respect to programmatic requirements, image and form; subsequent elaboration leading to meaningful and technologically viable designs for the built environment. **Professors Anderson, Davies, Sheppard and Adjunct Faculty**

301-428T SUMMER PROJECT II. 1(0-0-3) (Prerequisite: 301-304B) See course 301-327T. **Professors Anderson, Sheppard and Zuk**

301-447B ELECTRICAL SERVICES. 2(2-2-2) (Prerequisite: 301-304B) Production, measurement and control of light; design of lighting systems; electrical distribution in residential and commercial buildings; Canadian Electrical Code. Limited enrolment, password card required. **Professor Edwards**

Section 01:reserved for Architecture students.

Section 02:reserved for others.

301-451B BUILDING REGULATIONS AND SAFETY. 2(2-2-2) (Prerequisite: 301-406B) The study of building codes with specific emphasis on the National Building and National Fire Codes of Canada. Examples of existing buildings with assignments to illustrate regulations. Development of a systematic approach to the implementation of codes during the preliminary design stage of an architectural project. Limited enrolment, password card required.

Professor Zorko

Section 01:reserved for Architecture students.

Section 02:reserved for others.

301-461B FREEHAND DRAWING AND SKETCHING. 1(0-3-0) (Prerequisite: 301-324C) Drawing and sketching in pencil, charcoal and other media both in the studio and out-of-doors. **Professor Covo**

▭ **301-471A,B COMPUTER-AIDED BUILDING DESIGN.** 2(2-2-2) (Prerequisite: 301-202B or equivalent) An introduction to selected applications of interactive computing in architecture; emphasis on development of simple algorithms in graphic, as well as non-graphic, modes in hands-on situations in the lab; field trips to several in use installations. Limited enrolment; password card required. **Staff**

301-490A,B SELECTED TOPICS IN DESIGN. 2(2-0-4) (Prerequisite: 301-202B or permission of instructor.) A course to allow the introduction of special topics in related areas of design. **Staff**

301-520B MONTREAL: URBAN MORPHOLOGY. 3(2-1-6) (Prerequisite: 301-251B) Historical, geographical, demographical, and regional evolution of the metropolis of Montreal. Topics include: important *quartiers*, the Montreal urban grid, industrialization, reform movements, geographical diversity, urban culture, local building techniques and materials. Basic concepts of urban morphology and their relationships to the contemporary urban context will be explored. Limited enrolment. **Professor Rohan**

Section 01:reserved for Architecture students.

Section 02:reserved for others.

● **301-521B STRUCTURE OF CITIES.** 3(2-0-7) (Prerequisite: 301-202B or permission of instructor) Nature, pattern and life of modern cities. Urban networks, special areas, problems and prosects. Limited enrolment, password card required.

Professor Anderson

Section 01:reserved for Architecture students.

Section 02:reserved for others.

▭ **301-522A HISTORY OF DOMESTIC ARCH. IN QUEBEC.** 3(2-0-7) (Prerequisite: 301-251A) The architecture of houses in Quebec from 1650 to the present. Distinguished buildings are reviewed from the point of view of form, style, siting and material, as influenced by climate, culture and architectural antecedents in France, England and the United States. The course material is presented through alternating bi-weekly lectures and seminars. Limited enrolment; password card required. **Professor Anderson**

● ▭ ★ **301-523B SIGNIFICANT TEXTS & BUILDINGS.** 3(2-0-7) (Prerequisite: 301-251A) (Alternating with 301-524B.) Critical study of significant architectural thought since 1750 as it has been expressed in buildings and texts (treatises, manifestos, criticisms). A specific theme will be addressed every year to allow in-depth interpretations of the material presented and discussed. Limited enrolment; password card required. **Professor Castro**

▭ ★**301-524B SEMINAR ON ARCHITECTURAL CRITICISM.** 3(2-0-7) (Prerequisite: 301-251A) (Alternating with 301-523B.) The development and current role of architectural criticism with particular reference to its affinities with art and literary criticism. Limited enrolment; password card required. **Professor Castro**

▭ **301-525A SEMINAR ON ANALYSIS AND THEORY.** 3(2-0-7) (Prerequisite: 301-202B or permission of instructor) Analysis and evaluation of significant architectural projects with reference to contemporary architectural theories. Limited enrolment; password card required. **Professor Zuk**

301-526B PHILOSOPHY OF STRUCTURE. 3(2-0-7) (Prerequisite: 301-202B or permission of Instructor) (Not open to students who have taken 301-374B.) Philosophy of Structure aims to investigate structure in its broadest sense. The course is divided in two halves; the first one gives an overview of the development of theoretical structural frameworks such as mathematics and geometry, while the second one highlights physical structures constructed by na-

ture (geology, turbulence), man or animals. Password card required. **Professor Sijpkes**
Section 01:reserved for Architecture students.
Section 02:reserved for others.

301-527B CIVIC DESIGN. 3(2-0-7) (Prerequisite: 301-378A) The elements of form in buildings and their siting design in the urban setting. Password card required, limited enrolment.
Professor Drummond
Section 01:reserved for Architecture students.
Section 02:reserved for others.

▭ **301-528A HISTORY OF HOUSING.** 3(2-0-7) (Prerequisite: 301-251A or permission of instructor) Indigenous housing both transient and permanent, from the standpoint of individual structure and pattern of settlements. The principal historic examples of houses including housing in the age of industrial revolution and contemporary housing. Limited enrolment. Enrolment Cap is placed on each section. **Professor Sijpkes**
Section 01:reserved for Architecture students.
Section 02:reserved for Masters of Architecture students.
Section 03:reserved for Urban Planning students.
Section 04:reserved for Urban Systems Students.
Section 05:reserved for Engineering Students.

301-529B HOUSING THEORY. 3(2-0-7) (Prerequisite: 301-528A or permission of instructor) A review of environmental alternatives in housing; contemporary housing and the physical and sociological determinants that shape it; Canadian housing. Limited enrolment, password card required. **Professor Schoenauer**
Section 01:reserved for Architecture students.
Section 02:reserved for others.

301-531A ARCH. INTENTIONS FROM VITRUVIUS TO THE RENAISSANCE. 3(2-0-7) (Prerequisite: 301-251A) Architectural intentions embodied in buildings and writings of architects from antiquity to the Renaissance. Special emphasis is placed on the cultural connections of architecture to science and philosophy. Limited enrolment, password card required. **Professor Pérez-Gómez**
Section 01:reserved for Architecture students.
Section 02:reserved for others.

301-532B ORIGINS OF MODERN ARCHITECTURE. 3(2-0-7) (Prerequisite: 301-251A) Examination of architectural intentions (theory and practice) in the European context (especially France, Italy and England), during the crucial period that marks the beginning of the modern era. Limited enrolment, password card required.
Professor Pérez-Gómez
Section 01:reserved for Architecture students.
Section 02:reserved for others.

▭ **301-533B NEW APPROACHES TO ARCHITECTURAL HISTORY.** 3(2-0-7) (Prerequisite: 301-251A or permission of instructor) An exploration of the aims, tools, and methods of Architectural History as a discipline; the use of primary sources from the Canadian Centre for Architecture and other archives. Limited enrolment; password card required. **Professor Adams**

301-540A,B SELECTED TOPICS IN ARCHITECTURE I. 3(2-0-7)
A course to allow the introduction of new topics in Architecture as needs arise, by regular and visiting staff. **Staff**

301-541A,B SELECTED TOPICS IN ARCHITECTURE II. 3(2-0-7)
A course to allow the introduction of new topics in Architecture as needs arise, by regular and visiting staff. **Staff**

301-550B URBAN PLANNING I. 3(2-0-7) (Prerequisite: B.Sc.(Arch.) or permission of instructor.) (Not normally open to Urban Planning students.) Theory and practice. An examination of different basic approaches to urban planning with special reference to Quebec. Limited enrolment, password card required. **Staff**
Section 01:reserved for Architecture students.
Section 02:reserved for others.

301-551A URBAN PLANNING II. 3(2-1-6) (Prerequisite: 301-550B) Urban design and project development, theory and practice. Detailed analysis of selected examples of the development process and of current techniques in urban design. Limited enrolment, password card required. **Professor Fischler**
Section 01:reserved for Architecture students.
Section 02:reserved for others.

301-554A MECHANICAL SERVICES IN BUILDINGS. 2(2-0-4) (Prerequisite: 301-405A or permission of instructor.) Problems encountered in providing mechanical services in buildings. Physiological and environmental aspects of heat, ventilation and air conditions, estimation of heating and cooling loads and selection and specification of equipment. Sprinkler systems and plumbing. Construction problems produced by installation of this equipment. Limited enrolment, password card required. **Professor Levine**
Section 01:reserved for Architecture students.
Section 02:reserved for others.

301-555B ENVIRONMENTAL ACOUSTICS. 2(2-0-4) (Prerequisite: 301-405A or permission of instructor.) Acoustics in architectural design, and in environmental control of buildings. Acoustical requirements in the design of auditoria such as theatres, lecture halls, opera houses, concert halls, churches, motion picture theatres, studios. Principles of noise and vibration control, sound insulating in building construction. Practical noise control in various types of buildings. Limited enrolment, password card required.
Professor Melanson
Section 01:reserved for Architecture students.
Section 02:reserved for others.

● ▭ **580-442B ENABLING ENVIRONMENTS.** 2(1-2-3) (Prerequisite: 301-303A for Architecture students; 580-326D for Occupational Therapy students) Students work in multi-disciplinary teams under the supervision of faculty and visitors on projects in the design and construction of environments for the disabled drawn from case histories of selected institutions. Course work may include group and individual field trips to hospitals, clinics or specific project sites. Limited enrolment. **Professors Gisel, Covo and visitors**

4.3 Department of Chemical Engineering

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McGill University
3610 University Street, Montreal, QC, H3A 2B2
Telephone: (514) 398-4494 Fax: (514) 398-6678
http://www.engineering.mcgill.ca/chem/index.htm

Chair
Richard J. Munz; B.A.Sc., M.A.Sc.(Wat.), Ph.D.(McG.), Eng.

Professors
David G. Cooper; B.Sc., Ph.D.(Tor.)
John M. Dealy; B.S.(Kansas), M.S.E., Ph.D.(Mich.), Eng.
W.J. Murray Douglas; B.Sc.(Qu.), M.S.E., Ph.D.(Mich.)
Musa R. Kamal; B.S.(Ill.) M.S., Ph.D.(Carnegie-Mellon), Eng.
Arun S. Mujumdar; B.Ch.E.(Bombay), M.Eng., Ph.D.(McG.)
Alejandro D. Rey; B.Ch.Eng.(CCNY), Ph.D.(Berkeley)
Juan H. Vera; B.Mat.(Chile), Ing.Quim.(U.T.E.), M.S.(Berkeley), Dr.Ing.(Santa Maria), Ing.
Bohumil Volesky; M.Sc.(Czech. Tech. Univ.), Ph.D.(W.Ont.)
Martin E. Weber; B.S.E.(Prin.), Sc.D.(M.I.T.), P.Eng.

Associate Professors
Dimitrios Berk; B.Sc.(Bosphorus), M.E.Sc.(W.Ont.), Ph.D.(Calg.), P.Eng.
Jean-Michel Charrier; Dipl. Ing., E.N.S.A.M.(Paris), M.S., Ph.D.(Akron), Ing.
Jean-Luc Meunier; Dipl. Ing., EPFL(Lausanne), M.Sc., Ph.D., INRS(Varennes), Ing.
Jana Simandl; B.Eng.(McG.), Ph.D.(Calg.), P.Eng.

Assistant Professor
Wayne A. Brown; B.Eng., M.Eng., Ph.D.(McG.)

Assistant Professor (Special Category)
Paula Wood-Adams; B.Sc.(Alta), M.Eng, Ph.D.(McG.)

Associate Members
Thomas M.S. Chang; B.Sc., M.D., Ph.D.(McG.), F.R.C.P.(C)
Reinhold H. Crotogino; B.A.Sc.(U.B.C.), Ph.D.(McG.)

Harry L. Goldsmith; B.Sc., M.A.(Oxon.), Ph.D.(McG.)
(Experimental Medicine)

PAPRICAN Adjunct Professors

George J. Kubes; B.Eng., M.Eng.(Prague), Ph.D.(Bratislava)

Gil B. Garnier; B.Appl.Sc., M.Appl.Sc.(Sherbrooke), Ph.D.(Virginia Polytechnic Institute and State University)

Adjunct Professors

Bohumil Alince, Manon Bérubé, Pierre Bisaillon, Richard Campeau, Lionel Chartier, Earl J. Chin, Norman E. Cooke, Gordon Cooper, Mireille Cote, Peter Csakany, Eric Denman, Pierre Duhaime, Kenneth Frei, Andrés Garcia-Rejon, Sylvain Gendron, Robert W. Gooding, Serge Guiot, Norayr Gurnagul, Bing Huang, R. Bruce Kerr, Tadeusz Kudra, Caroline Ladanowski, Pascale Lagacé, Norman Liebergott, David J. McKeagan, Monica Nasmyth, Raman Nayar, Ky T. Nguyen, Jean R. Paris, Michel Perrier, Norman Peters, Ivan I. Pikulik, Alain A. Roche, John Sarlis, Paul Stuart, Khoa Tran, Roger C. Urquhart, Leszek A. Utracki.

The central purpose of engineering is to pursue solutions to technological problems in order to satisfy the needs and desires of society. Chemical engineers are trained to solve the kinds of problems that are typically found in the "chemical process industries", which include the chemical manufacturing, plastics, water treatment, pulp and paper, petroleum refining, ceramics, and paint industries as well as substantial portions of the food processing, textile, nuclear energy, biochemical and pharmaceutical industries. The technological problems and opportunities in these industries are often closely linked to social and economic questions. For this reason, practitioners of chemical engineering often deal with these questions when they are working in management, pollution abatement, product development, marketing and equipment design.

The discipline of chemical engineering is distinctive in being based equally on physics, mathematics and chemistry. Application of these three fundamental sciences is basic to a quantitative understanding of the process industries. Those with an interest in the fourth major science, biology, will find several courses in the chemical engineering curriculum which integrate aspects of the biological sciences relevant to process industries such as food processing, fermentation and water pollution control. Courses on the technical operations and economics of the process industries are added to this foundation. The core curriculum concludes with process design courses taught by practicing design engineers. Problem-solving, experimenting, planning and communication skills are emphasized in courses throughout the core curriculum.

By means of complementary courses, students can also obtain further depth in technical areas and breadth in non-technical subjects. Some students elect to complete a minor in biotechnology, management, materials engineering, computer science, environmental engineering or chemistry.

The solution to many environmental problems requires an understanding of technological principles. A chemical engineering degree provides an ideal background. In addition to relevant material learned in the core program, a selection of environmental complementary courses and minor programs is available. The involvement of many chemical engineering staff members in environmental research provides the opportunity for undergraduate students to carry out research projects in this area.

The curriculum also provides the preparation necessary to undertake postgraduate studies leading to the M.Eng. or Ph.D. degrees in chemical engineering. Students completing this curriculum acquire a broad, balanced education in the natural sciences with the accent on application. Thus, for those who do not continue in chemical engineering, it provides an exceptionally balanced education in applied science. For others, it will form the basis of an educational program that may continue with a variety of studies such as business administration, medicine or law. Versatility is, then, one of the most valuable characteristics of the graduate of the chemical engineering program.

ACADEMIC PROGRAM

For those who have completed the Quebec CEGEP level program in Pure and Applied Sciences, the Chemical Engineering Program comprises 110 credits as outlined below. Certain students who take advantage of summer session courses can complete the departmental programs in three calendar years. Students who have passed Chemistry 202 or 302 at the CEGEP level are exempt from course 180-212 or 234, respectively (Introductory Organic Chemistry I and Selected Topics in Organic Chemistry), the corresponding courses are transferred from required courses to electives. CEGEP students who have the appropriate calculus background may write Advanced Credit Placement Examinations at a time and place to be announced by the Faculty. Successful completion will give 3 credits for course 189-260 Intermediate Calculus.

For appropriately qualified high school graduates from outside Quebec, an extended credit program is available, as described in section 3.1.2.

In some cases students from university science disciplines have sufficient credits to complete the requirements for the B.Eng. (Chemical) program in two years. Those concerned should discuss this with their advisor.

Students must obtain a C grade or better in all core courses. For the Department of Chemical Engineering core courses include all required courses (departmental and non-departmental) as well as complementary courses (departmental). A grade of "D" is a passing grade in other complementary courses and in any elective courses taken.

CURRICULUM FOR THE B.ENG. DEGREE IN CHEMICAL ENGINEERING

REQUIRED COURSES		COURSE CREDIT	
Non-Departmental Courses			
180-212A,B	Introductory Organic Chemistry I	4	
180-233B	Sel. Topics in Phys. Chemistry	3	
180-234A,B	Sel. Topics in Org. Chemistry	3	
189-260A,B	Intermediate Calculus	3	
189-261A,B	Differential Equations	3	
189-265A,B	Advanced Calculus	3	
306-221A,B	Engineering Professional Practice	1	
306-310A,B	Engineering Economy	3	
308-208A,B	Computers in Engineering	3	**26**
Chemical Engineering Courses			
302-200A	Intro. to Chemical Eng.	4	
302-204B	Chemical Manuf. Processes	3	
302-220B	Chem. Eng.Thermodynamics	3	
302-291A	Instr. Measurements Lab.	4	
302-314A	Fluid Mechanics	4	
302-315B	Heat and Mass Transfer	4	
302-340B	Process Modelling	3	
302-351B	Separation Processes	3	
302-360A,B	Technical Paper I	1	
302-370A	Elements of Biotechnology	3	
302-380A	Materials Science	3	
302-392A	Project Laboratory I	4	
302-393B	Project Laboratory II	5	
302-423A	Chemical Reaction Engineering	4	
302-453A	Process Design	4	
302-456A,B	Design Project I	1	
302-457A,B	Design Project II	5	
302-455B	Process Control	4	
302-462A,B	Technical Paper II	1	
302-474A	Biochemical Engineering	3	
302-484B	Materials Engineering	3	**69**
COMPLEMENTARY COURSES			
Courses to be selected from those approved by the Department (see list of technical complementaries below)			**9**

See section 3.3. The Chemical Engineering program requires 6 credits selected from categories (i) and (ii) of section 3.3.		**6**
TOTAL		**110**

If advanced credit is obtained for 189-260 Intermediate Calculus (see section 2.3), the total number of credits is reduced by three.

For students starting their B.Eng. studies in September who have completed the Quebec Diploma of Collegial Studies, a program for the first two semesters of study is given below:

Semester 1		**Credits**	
180-212A	Organic Chemistry I	4	
189-260A	Intermediate Calculus	3	
302-200A	Intro. to Chemical Eng.	4	
302-291A	Instr. Meas. Lab.	4	
306-221A,B	Engineering Professional Practice	1	**16**
Semester 2			
180-234B	Organic Chemistry II	3	
189-261B	Differential Equations	3	
302-204B	Chemical Manuf. Processes	3	
302-220B	Chem. Eng. Thermodynamics	3	
308-208B	Computers in Engineering	3	**15**

Students entering their second year of study or who are starting in January must plan their program of studies in consultation with their departmental adviser.

For students admitted to the 8-semester program (see section 3.1.2), the additional courses are specified in the "Welcome" book, and can also be found on the Faculty website (http://www.engineering.mcgill.ca).

TECHNICAL COMPLEMENTARIES

A minimum of 9 credits of complementary courses must be chosen from a list of technical complementaries approved by the Department. The purpose of this requirement is to provide students with an area of specialization within the broad field of chemical engineering. Alternatively, some students use the technical complementaries to increase the breadth of their chemical engineering training.

At least two (2) technical complementary courses are to be selected from those offered by the Department (list below). Permission is given to take the third complementary course from other suitable undergraduate courses in the Faculty of Engineering (see for example the Faculty list of courses in section 4.1.1).

The technical complementary courses currently approved by the Department are as follows:

302-363A,B	Projects in Chemical Engineering I
302-438B	Eng. Princ. of Pulp & Paper Processes
302-452B	Particulate Systems
302-458A	Computer Applications
302-464A,B	Projects in Chemical Engineering II
302-471A	Industrial Water Pollution Control (or 303-430A)
302-472B	Industrial Air Pollution Control (or 305-534B)
302-481A	Polymer Engineering
302-487A	Chemical Processing in the Electronics Industry
302-494A,B	Research Project and Seminar
302-495A,B	Research Project and Seminar
302-571B	Small Computer Applications in Chemical Engineering
302-581B	Polymer Composites Engineering
202-505B	Selected Topics in Biotechnology (Biotechnology Minor students only)

Courses 481A and 581B comprise a Polymeric Materials sequence. Additional courses in this area are available in the Chemistry Department (e.g. 180-455A) or at the graduate level (302-681 to 684). The Department has considerable expertise in the polymer area.

Courses 370A and 474A make up a sequence in Biochemical Engineering-Biotechnology. Students interested in this area may take additional courses, particularly those offered by the Department of Food Science and Agricultural Chemistry, Faculty of Agricultural and Environmental Sciences, and courses in biochemistry and microbiology. The food, beverage and pharmaceutical industries are large industries in the Montreal area and these courses are relevant to these industries and to the new high technology applications of biotechnology.

The third area in which there is a sequence of courses is Pollution Control. The Department offers two courses in this area: 302-471A and 302-472B. As some water pollution control problems are solved by microbial processes, course 302-474B is also relevant to the pollution control area. Likewise as the solution to pollution problems frequently involves removal of particulate matter from gaseous or liquid streams, course 302-452B is also relevant. Additional courses in this area are listed under section 5.7.

A Minor in Biotechnology is also offered in the Faculties of Engineering and of Science with emphasis on Molecular Biology and Chemical Engineering Processes. A full description of the Minor program appears in section 5.2.

Note that many of the technical complementaries are offered only in alternate years. Students should, therefore, plan their complementaries as far ahead as possible. With the approval of the instructor and academic adviser, students may also take graduate (302-5XX level) courses as technical complementaries.

ELECTIVE COURSES

Students who have obtained exemptions for courses, i.e. for CEGEP courses equivalent to 180-212 or 180-234, or who take more than the minimum requirements for the degree, may choose university level courses in any field. Approval of an elective course requires only that no timetable conflicts are created and that it not be a repetition of material already covered in the curriculum or already mastered by the student.

CURRICULUM COMMITTEE

The Curriculum Committee is composed of three students, elected by their classes, and two staff members. This Committee provides a forum for all matters involving undergraduate student/staff interactions. While the primary concern is with matters of curriculum and courses (their content, evaluation, scheduling, etc.), the Committee has also taken up a number of other matters in recent years, e.g. working space, facilities (equipment and libraries), etc.

CANADIAN SOCIETY FOR CHEMICAL ENGINEERING

The Chemical Engineering Student Society has for many years been affiliated both with the CSChE (Canadian Society for Chemical Engineering) and with the AIChE (American Institute of Chemical Engineers). For a nominal fee students receive "Canadian Chemical News", a monthly publication, and the AIChE Student Members Bulletin as well as other privileges of student membership in the two societies. The student chapter also organizes a series of local social, educational and sporting events. For example, recent events have included student-professor banquets and Christmas parties, dances, speakers, broomball games and joint meetings with the Montreal Section of the CSChE. The latter gives students a chance to mix with practising chemical engineers.

COURSES OFFERED BY THE DEPARTMENT

- ● Denotes courses not offered in 2000-01
- ◎ Complementary courses
- ▭ Courses with Limited Enrolment

* a D grade is acceptable for prerequisite purposes only

302-200A INTRODUCTION TO CHEMICAL ENGINEERING. 4(3-2-8) (Restrictions: students with DCS in PAS, HS or equivalent.) Introduction to the design of industrial processes. Survey of unit operations, and systems of units. Elementary material balances, first and second laws of thermodynamics, use of property tables and charts, steady flow processes, heat engines, refrigeration cycles. Relationships between thermodynamic properties, property estimation techniques. Laboratory and design exercise.

Professors Dealy and Vera

302-204B CHEMICAL MANUFACTURING PROCESSES. 3(2-3-4) (Prerequisite: 302-200A) Introduction to degrees of freedom. Problem solving in the design of simple processes (mixing, washing, decantation) and separation processes (evaporation, binary distillation). Elements of reaction engineering and process control and design. **Professor Berk**

302-220B CHEMICAL ENGINEERING THERMODYNAMICS. 3(3-1-8) (Prerequisite: 302-200A) Application of thermodynamic equilibrium; free energy and equilibrium; phase rule; chemical reaction equilibrium for homogenous and multicomponent/multiphase systems. Application to the design of binary distillation. Laboratory exercise. **Professor Cooper**

◎ ▭ **302-230B ENVIRONMENTAL ASPECTS OF TECHNOLOGY.** 3(3-0-6) The impact of urbanization and technology on the environment. Topics include urbanization: causes, effects, land use regulations; transportation technology and environmental implications; environmental impact of energy conversions; energy policy alternatives; formulation of energy and environmental policy; air pollution: sources, effects, control; water pollution: sources, effects, control. MARS passwords distributed after the first class. **Professor Volesky**

302-291A INSTRUMENTAL MEASUREMENT LABORATORY. 4(2-5-5) Elements of statistical analysis associated with instrumental measurements. Principles of operation and calibration of selected measuring instruments. Principles of modern data acquisition and processing. Introduction to instrument system selection in chemical engineering. **Professor Cooper**

302-314A FLUID MECHANICS. 4(3-3-6) (Prerequisite: 302-204B. Corequisite: 189-265A.) Fluid properties; dimensional analysis; drag; packed/fluidized beds; macroscopic energy balances, Bernoulli's equation and linear momentum theorem; flowmeters, pipeline systems, non-Newtonian fluids, microscopic balances leading to continuity and Navier-Stokes equations; boundary layer approximation; turbulence. Laboratory exercises. **Professor Mujumdar**

302-315B HEAT AND MASS TRANSFER. 4(3-2-7) (Prerequisite: 302-314A) Transport of heat and mass by diffusion and convection; transport of heat by radiation; diffusion; convective mass transfer; drying; gas-liquid separations; absorption; mathematical formulation of problems and equipment design for heat and mass transfer; laboratory exercises. **Professor Brown**

302-340B PROCESS MODELLING. 3(3-1-5) (Prerequisites: 189-261A,B; 189-265A,B; 302-314A) Principles of mathematical modelling in chemical engineering: problem formulation, solution, discrete systems; difference and difference-differential equations, methods of solution; understanding system behaviour, optimization. **Professor Rey**

302-351B SEPARATION PROCESSES. 3(3-0-6) (Prerequisites: 302-204B; 308-208A,B; 302-220B. Corequisites: 302-315B.) Concepts underlying separation processes. Equilibrium-based processes with staging and continuous contacting, distillation, evaporation, liquid-liquid extraction, leaching. Introduction to membrane based separations. **Professor Simandl**

302-360A,B TECHNICAL PAPER I. 1(0-0-3) A technical paper prepared according to instructions issued by the Department. **Mr. Denman**

◎ **302-363A,B PROJECTS IN CHEMICAL ENGINEERING I.** 2(1-0-5) (Prerequisite: 302-200A*) Projects on social or technical aspects of chemical engineering practice. Students must suggest their own projects to be approved and supervised by a member of the staff. Students may work in groups. **Staff**

302-370A ELEMENTS OF BIOTECHNOLOGY. 3(3-0-6) (Prerequisite: 180-234A,B) Industrially important proteins, carbohydrates and other biochemicals, industrially significant microbes; cell structure and metabolism; laboratory exercises. **Professor Brown**

302-380A MATERIALS SCIENCE. 3(3-1-5) (Prerequisite: 302-220B) Structure/property relationship. Atomic and molecular structure, bonds, electronic band structure. Order in solids: crystal structure, disorders, solid phases. Mechanical properties and fracture, physico-chemical properties, design. **Professors Munz and Volesky**

302-392A PROJECT LABORATORY I. 4(3-3-6) (Prerequisites: 302-291B) Planning for the solution of experimental problems; design of experiments for logical and statistical interpretation; statistical analysis of experimental data; effective work in groups; selected laboratory exercises. **Professor Weber**

302-393B PROJECT LABORATORY II. 5(2-10-4) (Prerequisite: 302-392A) Student groups execute and report on experimental projects. **Professor Weber and Staff**

302-423A CHEMICAL REACTION ENGINEERING. 4(3-1-8) (Prerequisites: 180-233B; 302-315B) Review of fundamental concepts in chemical reaction thermodynamics and kinetics. Mass and energy balances for homogenous ideal reactors. Batch, semi-batch and continuous operation. Heterogenous reactions, effect of heat and mass transfer on the global rate, introduction to catalytic and non-catalytic reactions and multiphase reactors. Laboratory exercises. **Professor Berk**

● ◎ ▭ **302-430A TECHNOLOGY IMPACT ASSESSMENT.** 3(3-1-5) (Restricted to final year students by permission of instructor.) The power of technology to shape man's physical, economic and social environment: effects of technological transitions on culture and ecology; TIA methodologies, public participation, engineering contributions, regulations; implications of TIA on social and economic development. Limited enrolment. **Ms Ladanowski**

◎ **302-438B ENGRG PRINCIPLES IN PULP & PAPER PROCESSES.** 3(3-0-6) (Corequisites: 302-423A) Characterization of wood, pulp and paper. Flowsheets of basic pulping processes. Applications of thermodynamics, fluid mechanics, heat and mass transfer, and reaction engineering principles in the pulp and paper processes. **Dr. Kubes**

◎ **302-452B PARTICULATE SYSTEMS.** 3(3-0-6) (Prerequisites: 302-201A, 302-210B*) Study of operations involving multiphase systems with one of the phases finely sub-divided as bubbles, drops or particles. Applications in grinding, agglomeration, settling, fluidization etc. **Professor Munz**

302-453A PROCESS DESIGN. 4(4-1-7) (Prerequisites: 302-315B; 306-310A,B. Corequisite: 302-351B) Analysis of design alternatives. Structure of process design systems, degrees of freedom, information flow. Computer-aided process and plant design programs, physical properties, specifications, recycle convergence, optimization, applications, economics. Safety, environmental control in plant design. **Professor Simandl**

302-455B PROCESS CONTROL. 4(3-1-8) (Prerequisites: 302-315B; 302-351B; 302-423A) Dynamic modelling of processes, transfer functions, first and higher-order systems, dead-time, open and closed loop responses, empirical models, stability, feedback control, controller tuning, transient response, frequency response, feedforward and ratio control, introduction to computer control, sampling, discrete models, Z-transform, introduction to multivariable control. Laboratory exercises. **Professor Wood-Adams**

302-456A/B DESIGN PROJECT I. 1(1-0-2) (Prerequisite: 302-393B. Corequisite: 302-453A. Must be taken in the semester preceding 302-547.) Introduction to a process design and economic evaluation project for a major industrial operation. Students work in small group under an experienced plant design supervisor. **Professors Kamal and Simandl**

302-457A/B DESIGN PROJECT II. 5(1-2-12) (Prerequisite: 302-456A/B. Must be taken in the semester following 302-456.) A process plant design and economic evaluation for a major industrial operation. Students work in small groups, under an experienced plant design supervisor. Plant visit. **Professors Kamal and Simandl**

◎ **302-458A COMPUTER APPLICATIONS.** 3(2-3-4) (Prerequisites: 308-208A,B and 302-393B) Use of computers and software as problem solving aids in chemical engineering. Lectures on software engineering, computer architectures, and multitasking. In laboratory work, groups of students will produce software to be used and maintained by others. **Professor Wood-Adams**

302-462A,B TECHNICAL PAPER II. 1(0-0-3) (Prerequisite: 302-360A) A technical paper prepared according to instructions issued by the Department. **Mr. Bisaillon**

◎ **302-464A,B PROJECTS IN CHEMICAL ENGINEERING II.** 2(1-0-5) (Prerequisite: 302-363A,B) Projects on social or technical aspects of chemical engineering practice. Students must suggest their own projects to be approved and supervised by a member of the staff. Students may work in groups. **Staff**

◎ **302-471B INDUSTRIAL WATER POLLUTION CONTROL.** 3(3-0-6) (Prerequisite: 302-314A or equivalent) Effect of wastes on streams, water quality and standard analyses, waste water sampling techniques, waste water treatment technology and processes; design of treatment operations and equipment; physical, chemical and biological methods; specific industrial applications with emphasis on Canadian case studies; industrial effluent treatability studies. **Professor Volesky**

● ◎ **302-472B INDUSTRIAL AIR POLLUTION CONTROL.** 3(2-0-7) (Prerequisite: 302-314A or equivalent) Air quality standards, air surveys, process design considerations, dispersion theory and stack design; dust cleaning methods, design of scrubbers, case studies in the Canadian context. **Professor Munz**

302-474A BIOCHEMICAL ENGINEERING. 3(3-0-6) (Prerequisites: 302-370A, 302-423A) Microbial growth kinetics; biological reactors, application of transport phenomena; instrumentation and control; selected topics in downstream processing; novel bioreactor systems. Laboratory exercises. **Professor Volesky**

◎ **302-481A POLYMER ENGINEERING.** 3(3-0-6) (Prerequisites: 180-212A,B) The application of engineering fundamentals to the preparation and processing of polymers. Classification and characterization of polymers, reaction media and kinetics of polymerization, reactor design, mechanical behaviour of polymers, visco-elasticity and rheology, processing techniques; extrusion, molding, etc. **Professor Charrier**

302-484B MATERIALS ENGINEERING. 3(3-0-6) (Prerequisites: 302-315B, 302-380A) Processes for forming and producing engineering materials such as amorphous, semicrystalline, textured and crystal-oriented substances, short and long fibre-reinforced polymers, ceramics and ceramic composites. Effect of processing variables on the properties of the finished article. Process of blending and alloying. Shaping, bonding and joining operations. **Professors Rey and Vera**

◎ **302-487A CHEM. PROCESSING IN THE ELECTRONICS INDUSTRY.** 3(3-0-6) (Prerequisite: 180-233B) Chemical processes and unit operations in the manufacture of microelectronic components and their supports. Fabrication of silicon wafers, purification, crystal growth. Imaging processes, deposition of semiconductive materials, plasma and chemical etching. Reclamation of reagents from waste streams. Safety and environmental concerns. **Professor Cooper**

◎ **302-494A,B,D RESEARCH PROJECT & SEMINAR.** 3(1-6-2) (Prerequisite: 302-393B) Independent study and experimental work on a topic chosen by consultation between the student and Departmental Staff. **Staff**

◎ **302-495A,B,D RESEARCH PROJECT & SEMINAR.** 4(1-9-2) (Prerequisite: 302-393B) Independent study and experimental work on a topic chosen by consultation between the student and the Departmental staff. **Staff**

◎ **302-571B SMALL COMPUTER APPLICATIONS IN CHEM. ENG.** 3(2-0-7) (Prerequisite: 302-458 or permission of the instructor.) The use of small computers employing a high level language for data acquisition and the control of chemical processes. Real-time system characteristics and requirements, analog to digital, digital to analog conversions and computer control loops are examined. Block level simulation. **Dr. Huang**

◎ **302-581B POLYMER COMPOSITES ENGINEERING.** 3(3-0-6) (Prerequisite: 302-481 or permission of instructor.) Characteristics of thermoplastic and thermosetting polymeric matrices and particulate/fiber dispersed elements. Associated structure characterization. Processing techniques. Quantitative engineering analyses to correlate structure with properties and processing. Product/process design. Applications in chemical process equipment, construction, transportation (land, marine, aerospace), general industrial and consumer goods. **Professor Charrier**

◎ **302-591B ENVIRONMENTAL BIOREMEDIATION.** 3(3-0-6) The presence and role of microorganisms in the environment, the role of microbes in environmental remediation either through natural or human-mediated processes, the application of microbes in pollution control and the monitoring of environmental pollutants. **Dr. Guiot**

4.4 Department of Civil Engineering and Applied Mechanics

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http://www.mcgill.ca/civil

Chair
Denis Mitchell; B.A.Sc., M.A.Sc., Ph.D.(Tor.), F.A.C.I., Eng.

Emeritus Professors
Louis J. Arcand; B.Sc., M.Eng.(McG.) Q.L.S., M.C.I.S., M.A.S.P.
Philip J. Harris; B.Sc.(Man.), M.Eng., Ph.D.(McG.), F.E.I.C., F.C.S.C.E., Eng.
Stuart B. Savage; B.Eng.(McG.), M.S.Eng.(Cal.Tech.), Ph.d.(McG.), F.R.S.C.

Professors
Vincent H. Chu; B.S.Eng.(Taiwan), M.A.Sc.(Tor.), Ph.D.(M.I.T.), Eng.
M. Saeed Mirza; B.Eng.(Karachi), M.Eng., Ph.D.(McG.), F.A.C.I., F.E.I.C., F.C.S.C.E., Hon. F.I.E.P., Eng.
Denis Mitchell; B.A.Sc., M.A.Sc., Ph.D.(Tor.), F.A.C.I., Eng.
Van-Thanh-Van Nguyen; B.M.E.(Vietnam), M.C.E.(A.I.T.), D.A.Sc.(Montr.), Eng.
Ronald G. Rice; B.A.Sc.(Tor.), S.M.(M.I.T.), Dipl. U.&R.Pl., Ph.D.(Tor.), Eng.
A. Patrick S. Selvadurai; M.S.(Stan.), Ph.D., D.Sc.(Nottingham), F.E.I.C., F.I.M.A., F.C.S.C.E., P.Eng.
Suresh C. Shrivastava; B.Sc.(Eng.) (Vikram), M.C.E.(Del.), Sc.D.(Col.), Eng.

Associate Professors
Luc E. Chouinard; B.Ing., M.Ing.(Montr.), B.C.L.(McG.), Sc.D.(M.I.T.), Eng.
Ronald Gehr; B.Sc.(Eng.)(Rand), M.A.Sc.,Ph.D.(Tor.), P.Eng.
Robert D. Japp; B.Eng., M.Eng., Ph.D.(McG.), Eng.
Ghyslaine McClure; B.Ing.(Montr.), S.M.C.E.(M.I.T.), Ph.D.(Montr.), Eng.
James Nicell; B.A.Sc., M.A.Sc., Ph.D.(Windsor), P.Eng.

Assistant Professors
Susan J. Gaskin; B.Sc.(Queen's), Ph.D. (Canterbury)
Subhasis Ghoshal; B.C.E. (India), M.S.(Missouri), Ph.D. (Carnegie Mellon)
Colin Rogers; B.A.Sc.(Waterloo), M.A.Sc., Ph.D.(Sydney), P.Eng.
Yixin Shao; B.S., M.S.(Tongji), Ph.D.(Northwestern)

Adjunct Professors
James Byrns, Diane Girard, Serge Guiot, Jalal Hawari, Lionel Hervieux, Catherine Hirou, Graham Holder, Robert D. Japp, Kenneth MacKenzie, John C. Osler, Richard G. Redwood, Sandro Scola, David Stringer, William Taylor, Pierre Trottier, Jan Vrana, Ronald Zaloum

Civil engineers have traditionally applied scientific and engineering knowledge to the task of providing the built environment, from its conception and planning to its design and construction, maintenance and rehabilitation. Examples include buildings, bridges, roads, railways, dams, and facilities for water supply and treatment, and waste disposal. With the aging and deterioration of an already vast infrastructure, its maintenance and rehabilitation has become an increasingly important role of the civil engineering profession. Also, with worldwide concern about the detrimental impact of human activities on the environment, civil engineers are now in the forefront of developing and providing the means for both prevention and remediation of many aspects of environmental pollution.

The program in Civil Engineering is comprehensive in providing the fundamentals in mechanics and engineering associated with the diverse fields of the profession, in offering choices of specialization, and in fully reflecting the advances in science, mathematics, engineering and computing that have transformed all fields of engineering in recent years. The resulting knowledge and training enables graduates to not only enter the profession thoroughly well prepared, but also to adapt to further change.

The required courses ensure a sound scientific and analytical basis for professional studies through courses in solid mechanics, fluid mechanics, soil mechanics, environmental engineering, water resources management, structural analysis, systems analysis and mathematics. Fundamental concepts are applied to various fields of practice in both required and complementary courses.

By a suitable choice of complementary courses, students can attain advanced levels of technical knowledge in the specialized areas mentioned above. Alternatively, students may choose to develop their interests in a more general way by combining complementary courses within the Department with several from other departments or faculties.

Students who wish to extend their knowledge in certain areas beyond the range that the program complementary courses allow, can also take a Minor program. Minors are available in fields such as Arts, Economics, Management, Environmental Engineering, and Construction Engineering and Management. These require additional credits to be taken from a specified list of topics relating to the chosen field. Further information on the various Minor programs may be found in section 5. Details of how the Minors can be accommodated within the Civil Engineering program will be made available at the time of preregistration counselling.

Experience has shown that graduates of the program who choose to pursue advanced studies elsewhere receive favourable consideration by all the leading universities in North America and abroad.

ACADEMIC PROGRAMS

Considerable freedom exists for students to influence the nature of the program of study which they follow in the Department of Civil Engineering and Applied Mechanics. A variety of advanced complementary courses is offered in five main groupings: Environmental Engineering, Geotechnical Engineering, Hydrotechnical Engineering, Structural Engineering, and Transportation Engineering.

Guidance on the sequence in which required core courses should be taken is provided for students in the form of a sample program which covers the entire period of study. The technical complementary courses selected, usually in the last two semesters of the program, will depend upon the student's interests. U0 and U1 students should consult the "Welcome" book for the prescribed courses for the first two semesters. All students must meet with their advisor to confirm the courses for which they are registered.

Courses taken in Semester 3 or later will depend on a student's interests and ability. Information and advice concerning different possibilities are made available in the Department prior to registration. All programs require the approval of a staff adviser. Programs for students transferring into the Department with advanced standing will be dependent upon the academic credit previously achieved, and such a program will be established only after consultation with a staff adviser.

CURRICULUM FOR THE B.ENG. DEGREE IN CIVIL ENGINEERING

REQUIRED COURSES		COURSE CREDIT	
Non-departmental courses			
186-221A	General Geology	3	
189-260A,B	Intermediate Calculus	3	
189-261A,B	Differential Equations	3	
189-265A,B	Advanced Calculus	3	
305-261B,C	Measurement Laboratory	2	
305-290A	Graphics	3	
306-221A,B	Engineering Professional Practice	1	
306-310A,B	Engineering Economy	3	
308-208A,B	Computers in Engineering	3	
465-206B	Communiction in Engineering	3	**27**
Departmental courses			
303-202B	Construction Materials	4	
303-205A,B	Statics	3	
303-206B	Dynamics	3	
303-207A,B	Solid Mechanics	4	
303-208A	Civil Engrg Systems Analysis	3	
303-210C	Surveying	2	
303-225B	Environmental Engineering	4	
303-290A	Thermodynamics & Heat Transfer	3	
303-302B	Probabilistic Systems	3	
303-311A	Geotechnical Mechanics	4	
303-317A	Structural Engineering I	3	
303-318B	Structural Engineering II	3	
303-319B	Transportation Engineering	3	
303-320A	Numerical Methods	4	
303-323A	Hydrology & Water Resources	3	
303-324B	Construction Project Management	3	
303-327B	Fluid Mechanics & Hydraulics I	4	
303-418A,B	Project	3	
303-432A,B	Technical Paper	1	**60**

COMPLEMENTARY COURSES **15**

Fifteen credits to be selected from those listed below or from other suitable undergraduate or 500-level graduate courses. In exceptional cases, and with the Chair's approval, 600-level graduate courses may be taken as complementary courses. Not all of these courses are offered annually. A list of those to be given will be available prior to the commencement of lectures.

Up to two technical complementary courses may be taken outside the Department, subject to approval by the student's advisor prior to registration (see list of Faculty technical complementaries in section 4.1.1).

Permission of the Depart-ment Chair is required to take more than two. No course that is similar to one available in the Department of Civil Engineering and Applied Mechanics may be taken outside, unless prior arrangements have been made, such as to accommodate courses given in alternate years.

303-416B	(3)	Geotechnical Engineering
303-421B	(3)	Municipal Systems
303-428A	(3)	Fluid Mechanics & Hydraulics II
303-430A	(3)	Water Treatment & Pollut Control
303-433B	(3)	Urban Planning
303-440A	(3)	Traffic Engineering
303-446A	(3)	Construction Engineering
303-451A	(3)	Geoenvironmental Engineering
303-460A	(3)	Matrix Structural Analysis
303-462A	(3)	Design of Steel Structures
303-463B	(3)	Design of Concrete Structures
303-470A,B	(3)	Research Project
303-512B	(3)	Advanced Civil Engrg Materials
303-514A	(3)	Structural Mechanics
303-526B	(3)	Solid Waste Management
303-527A	(3)	Renov & Preserv of Infrastructure
303-540A	(3)	Urban Transportation Planning
303-541B	(3)	Rail Engineering
303-550B	(3)	Water Resources Management
303-553A	(3)	Stream Pollution and Control
303-555B	(3)	Environmental Data Analysis
303-572A	(3)	Computational Hydraulics
303-573A	(3)	Hydraulic Structures
303-574B	(3)	Fluid Mech of Water Pollution
303-575B	(3)	Fluid Mechanics of Air Pollution
303-576B	(3)	Hydrodynamics
303-577A	(3)	River Engineering

303-579B (3) Water Power Engineering
303-585B (3) Groundwater Hydrology
303-586A (3) Earthwork Engineering
303-587A (3) Pavement Design

Two courses (6 credits) to be selected in consultation with academic advisor as prescribed by section 3.3. **6**

TOTAL CREDITS 108

If advanced credit given for 189-260A,B, Intermediate Calculus (see section 2.3)

TOTAL CREDITS 105

COURSES OFFERED BY THE DEPARTMENT

● Denotes courses not offered in 2000-01

Where asterisks appear with a prerequisite, they have the following significance:

* a D grade is acceptable for prerequisite purposes.

** under special circumstances, the Department may permit this course to be taken as a co-requisite.

303-202B CONSTRUCTION MATERIALS. 4(4-2-6) (Prerequisite: 303-290A) Classification of materials; atomic bonds; phase diagrams; elementary crystallography, imperfections and their relationship to mechanical behaviour; engineering properties and uses of ferrous and non-ferrous metals, ceramics, cement, concrete, timber and timber products, polymers, composites; smart materials and systems; electrochemical reactions and corrosion, prevention and protection; environmental influences; group laboratory projects. **Professor Mirza**

303-205A,B STATICS. 3(3-2-4) Systems of forces and couples, resultants, equilibrium. Trusses, frames and beams, reactions, shear forces, bending moments. Centroids, centres of gravity, distributed forces, moments of inertia. Friction, limiting equilibrium, screws, belts. **Professors Chouinard and Shrivastava**

303-206B DYNAMICS. 3(3-2-4) (Prerequisite: 303-205A,B. Co-requisites: 189-260A,B and 189-261A,B.) Kinematics and kinetics of particles, systems, and rigid bodies; mass-acceleration, work-energy, impulse-momentum. Moving coordinate systems. Lagrange's equations. Vibrations and waves. **Professor Gaskin**

303-207A,B SOLID MECHANICS. 4(3-2-7) (Prerequisites: 303-205A,B*, 305-290A** or equivalent) Stress-strain relationships; elastic and inelastic behaviour; performance criteria. Elementary and compound stress states, Mohr's circle. Shear strains, torsion. Bending and shear stresses in flexural members. Deflections of beams. Statically indeterminate systems under flexural and axial loads. Columns. Dynamic loading. (Two-hour laboratory periods, alternate weeks. Weekly tutorials.) **Professors McClure and Shao**

303-208A CIVIL ENGRG SYSTEMS ANALYSIS. 3(3-1-5) (Prerequisites: 189-265A,B and 308-208A,B) Introduction to civil engineering systems; system modelling process; systems approach and optimization techniques; application of linear programming; simplex method; duality theory; sensitivity analysis; transportation problem; assignment problem; network analysis including critical path method; integer linear programming method. **Professor Nguyen**

303-210C SURVEYING 2(*). (Prerequisite: 308-208A,B) The construction and use of modern survey instruments; transit, level, etc.; linear and angular measurements and errors; horizontal and vertical curves; error analysis, significance of figures; use of computers and software; recent developments. **Mr. Scola**
** Two weeks after winter session examination period.*

303-225B ENVIRONMENTAL ENGINEERING. 4(4-2-6) (Prerequisite: 303-290A. Co-requisite: 189-261A,B) Principles of ecology, ecosystems and environmental chemistry and physics, cycles of elements; mass balance analyses; sources and characteristics of pollution; pollution problems and engineered solutions as applied to air, water and soil media; environmental law, policy and impact. **Professor Ghoshal**

303-229A SURVEYING FOR ARCHITECTS. 2(2-3-1) Measurement of elevations, directions and distances using engineer's level, transit and tape; development of plot plans and topographic maps; volumetric calculations of cuts and fills; area measurements using planimeter; traverse computations; architectural applications. **Mr. Scola**

303-281A ANALYTICAL MECHANICS. 3(3-1-5) (Co-requisites: 189-260A,B and 189-261A,B) Kinematics of particles, dynamics of particles. Work, conservative forces, potential energy. Relative motion and general moving frames of reference. Central force fields and orbits. Dynamics of a system of particles. General motion of rigid bodies, angular momentum and kinetic energy of rigid bodies. Generalized coordinates and forces, Lagrange's equations. **Professor Chu and Dr. Babarutsi**

303-283B STRENGTH OF MATERIALS. 4(4-1-7) (Prerequisite: 303-205A,B*) Structural behaviour, trusses, statically determinate beams, frames, and arches; moments of inertia, stress, strain, properties of materials; bending and shearing stresses; torsion; fixed and continuous beams; reinforced concrete beams; columns; combined stresses; Mohr's circle. **Dr. Babarutsi**

303-290A THERMODYNAMICS & HEAT TRANSFER. 3(3-2-4) Macroscopic vs. microscopic viewpoint; states and processes; energy conservation and transformation. Phase equilibrium; equations of state; thermodynamic properties; work; heat; First Law of thermodynamics; internal energy; enthalpy; specific heat; thermodynamic processes: reversibility, polytrophic processes, applications of First Law; Second Law; entropy; introduction to heat transfer. **Professor Nicell**

303-302B PROBABILISTIC SYSTEMS. 3(3-1-5) (Prerequisites: 189-260A,B and 308-208A,B*) An introduction to probability and statistics with applications to Civil Engineering design. Descriptive statistics, common probability models, statistical estimation, regression and correlation, acceptance sampling. **Professor MacKenzie**

303-311A GEOTECHNICAL MECHANICS. 4(3-3-6) (Prerequisite: 303-207A,B) Identification and classification of soils; physical and engineering properties; principle of effective stress; permeability, compressibility, shear strength, stress-strain characteristics; groundwater flow and seepage; earth pressure and retaining structures; stress distributions in soils; settlement; bearing capacity of shallow foundations. **Professor Selvadurai**

303-317A STRUCTURAL ENGINEERING I. 3(3-1-5) (Prerequisites: 303-202B and 303-207A,B) The design process; loads, sources, classifications, load factors, combinations; limit states design; structural systems and foundations; choice of materials; virtual work and energy methods; statical and kinematic indeterminacy; slope deflection method, introduction to matrix methods; analysis of indeterminate systems; force envelopes. **Professor McClure**

303-318B STRUCTURAL ENGINEERING II. 3(3-1-5) (Prerequisite: 303-317A) Durability and service life; fire resistance and protection; steel, reinforced concrete and timber; behaviour and design of components in tension, compression, bending and shear; slenderness, global and local instability; axial load and moment interaction; curvature, deflection, ductility; connections; bond and anchorage of reinforcement; simple footings. **Professor Rogers**

303-319B TRANSPORTATION ENGINEERING. 3(3-1-5) (Prerequisites: 303-208A and 308-208A,B. Co-requisite: 303-302B) Introduction to design and operating principles and procedures for surface transportation systems, including vehicle motion and performance, pavements, geometric design of roadbeds, vehicle flow and capacity, traffic control, demand, supply and cost concepts. **Professor Rice and Ms. Hirou**

303-320A NUMERICAL METHODS. 4(3-3-6) (Prerequisites: 308-208A,B and 189-265A,B) Numerical procedures applicable to civil engineering problems: integration, differentiation, solution of initial-value problems, solving linear and non-linear systems of equations, boundary-value problems for ordinary-differential equations, and for partial-differential equations. **Professor Chouinard**

303-323A HYDROLOGY AND WATER RESOURCES. 3(3-2-4) (Prerequisite: 303-302B) Precipitation, evaporation and transpiration.

Streamflow, storage reservoirs. Groundwater hydrology. Morphology of river basins. Statistical analysis in hydrology, stochastic modelling and simulation. Case studies in hydroelectric power development, flood damage mitigation, irrigation and drainage.
Professor Nguyen

303-324B CONSTRUCTION PROJECT MANAGEMENT. 3(3-1-5) (Prerequisites: 306-310A,B and 303-208A) Construction fundamentals; procedures and responsibilities; tender documents, specifications, proposals, contracts; construction project organization, estimating, planning, scheduling, control; liability, claims procedures, arbitration; job safety; security and loss control; case histories, site visits. **Mr. Taylor**

303-327B FLUID MECHANICS & HYDRAULICS I. 4(3-6-3) (Prerequisites: 303-206B and 189-265A,B) Fluid properties, statics and kinematics; forces due to fluids in motion, Bernoulli's equation, analysis of experiments, streamline curvature, boundary layers, pipe flow, hydraulic machinery and introduction to open channel flow. **Professor Chu**

303-382B PARTIAL DIFF. EQUATIONS IN ENGINEERING. 3(3-1-5) (Prerequisites: 189-261A,B, 189-265A,B and 303-281A*) Classifications of PDEs; Laplace's Equation, steady fluid flow. Diffusion Equation; pressure transients in porous media, moisture and chemical diffusion, heat conduction; Wave Equation; waves and vibrations in strings, membranes and bars. Uniqueness of solution; variables separable solutions in rectangular and cylindrical coordinates; product solutions, elementary applications of integral transforms. **Professor Selvadurai**

303-384A SOIL MECHANICS & FOUNDATIONS. 2(2-3-1) (Prerequisites: 303-207A,B* or 303-283B*) Nature of soils, identification and classification. Physical properties of soils, permeability, compressibility, shear strength, principle of effective stresses, stress strain behaviour. Seepage, frost action. Field exploration of soil conditions. Foundations, shallow and deep. Earth pressures and retaining structures, stability of earth masses. **Professor Japp**

303-385A STRUCTURAL STEEL & TIMBER DESIGN. 3(3-1-5) (Prerequisite: 303-283B. Corequisite: 301-240B) Structural loadings, load factors, code requirements and design procedures. Characteristics of structural steel and structural timber in building construction. Structural design of axially loaded tension and compression members, joists, beams, girders, trusses and framing systems. **Mr. Vrana**

303-388B REINFORCED CONCRETE DESIGN. 2(2-2-2) (Prerequisite: 303-283B) Physical properties of concrete; behaviour and design of reinforced concrete members in compression, tension, bending, shear and combined loadings; bond and anchorage; reinforced concrete slabs and precast concrete elements; structural framing systems. **Mr. Vrana**

303-416B GEOTECHNICAL ENGINEERING. 3(3-1.5-4.5) (Prerequisite: 303-311A) Site investigation, in-situ measurement of engineering properties of soils; braced excavations; bearing capacity of shallow foundations; upper bound solutions; soil structure interaction; design aspects of footing and rafts, coefficient of subgrade reaction; deep foundations; bearing capacity of piles, pile settlement; stability of slopes; infinite slopes; frost action in soils.
Professor Japp

303-418A,B PROJECT. 3(0-4-5) (Prerequisite: Completion of an approved set of required and complementary courses.) A study or design topic in any of the branches of Civil Engineering or their combination. Project may be analytical or experimental. Chosen in consultation with a staff member, whose approval is necessary. Guidance provided by Department staff and by practising engineers. Project normally carried out in a student's last semester.
Professors Shao, Shrivastava and Staff

303-421B MUNICIPAL SYSTEMS. 3(3-2-4) (Prerequisite: 303-327B) Design of water-related municipal services; sources of water and intake design; estimation of water demand and wastewater production rates; design, construction and maintenance of water distribution, wastewater and stormwater collection systems; pumps and pumping stations; pipe materials, network analysis and optimization; storage; treatment objectives for water and wastewater.
Professor Nicell

303-428A FLUID MECHANICS & HYDRAULICS II. (3-3-3) (Prerequisite: 303-327B) Open channel flow, internal hydraulics, hydraulic transient in pipes. **Professor Gaskin**

● **303-430A WATER TREATMENT & POLLUTION CONTROL.** 3(3-3-3) (Prerequisites: 303-225B and 303-327B) Principles of water and sewage treatment. Water and sewage characteristics; design of conventional unit operations and processes; laboratory analyses of potable and waste waters. **Professor Gehr**

303-432A,B TECHNICAL PAPER. 1(0-0-3) (Prerequisite: 455-206B) A technical paper, on a suitable topic, is to be prepared in accordance with detailed instructions which are provided by the Department. This paper will normally be written in the U3 year and may be submitted in September or January. **Staff**

303-433B URBAN PLANNING. 3(3-1-5) (Prerequisites: 303-421A and 306-310A,B. Co-requisite: 303-319B) The City in History. The planning profession, evolution of planning in North America, Canada and Quebec. Planning theories, the general or master plan, planning processes and techniques, planning and design of residential subdivisions. Local planning issues, housing policies, planning laws. **Professor Wolfe**

303-440A TRAFFIC ENGINEERING. 3(3-1-5) (Prerequisite: 303-319B*) Driver, vehicle and traffic flow characteristics; origin-destination studies, traffic studies and analysis, accident studies, queuing theory applications, gap acceptance, simulation, highway capacity, traffic regulations and control measures, intersection control. **Mr. Byrns**

303-446A CONSTRUCTION ENGINEERING. 3(3-1-5) (Prerequisite: 303-324B) Project management principles; construction equipment economics, selection, operation; characteristics of building, heavy, marine, underground and route construction projects; international projects. **Mr. Taylor**

303-451A GEOENVIRONMENTAL ENGINEERING. 3(3-1.5-4.5) (Prerequisites: 303-225B and 303-311A) Geoenvironmental hazards; land management of waste; regulatory overview, waste characterization; soil-waste interaction; geosynthetics; low permeability clay barriers; contaminant transport; containment systems; collection and removal systems; design aspects; strategies for remediation; rehabilitation technologies. **Professor Ghoshal**

303-460A MATRIX STRUCTURAL ANALYSIS. 3(3-2-4) (Prerequisites: 303-206B and 303-317A) Computer structural analysis, direct stiffness applied to two and three dimensional frames and trusses, matrix force method, nonlinear problems, buckling of trusses and frames, introduction to finite element analysis.
Professor Chouinard

303-462A DESIGN OF STEEL STRUCTURES. 3(3-3-3) (Prerequisite: 303-318B) Design of structural steel elements: plate girders, members under combined loadings, eccentrically loaded connections, structural systems. Design of structural steel systems: composite floor systems, braced frames, moment resisting frames. **TBA**

303-463B DESIGN OF CONCRETE STRUCTURES. 3(3-3-3) (Prerequisite: 303-318B) Design of continuous beams and slabs, columns under biaxial bending, retaining and structural walls, two-way and flat slabs, and combined footings. Slenderness effects in columns. Introduction to masonry structures. **Professor Mitchell**

303-469A INFRASTRUCTURE & SOCIETY. 3(3-2-4) (Prerequisite: 306-310A,B) Infrastructure systems; planning, organization, communication and decision support systems; budgeting and management; operations, maintenance, rehabilitation and replacement issues; public and private sectors, privatization and governments; infrastructure crisis and new technologies; legal, environmental, socio-economic and political aspects of infrastructure issues; professional ethics and responsibilities; case studies.
Professor Mirza

303-470A,B RESEARCH PROJECT. 3(0-1-8) (Prerequisite: 60 credits in the Civil Engineering and Applied Mechanics program) Open to students with a high CGPA. A research project must be carried out and a technical paper prepared under the supervision of a member of staff. The project must be established with the consent of the Staff Supervisor, and must be approved by the Department before registration. May be taken in conjunction with the required

course 303-418A,B and the project therefore can be carried out through two semesters. **Staff**

303-492A STRUCTURES. 2(2-2-2) (Prerequisites: 303-385A and 303-388B) A study of structural systems in concrete, steel, timber; a philosophy of structure; choice of structure; economic factors in design; recent developments and trends in structure; lateral stability by frame action, bracing shear walls; mechanics of certain structural forms. **Professor Mitchell**

303-512B ADVANCED CIVIL ENGRG MATERIALS. 3(3-3-3) (Prerequisite: 303-202B) Production, structure and properties of engineering materials; ferrous alloys, treatments, welding, special steels, cast iron; ceramic materials; polymers; composite materials; concrete, admixtures, structure, creep, shrinkage; asphalt and asphaltic materials; clay materials and bricks; impact of environment on material response, durability, quality assessment and control, industrial specifications; recent advances. **Professor Shao**

303-514A STRUCTURAL MECHANICS. 3(3-1-5) Stress, strain, and basic equations of linear elasticity. General and particular solutions of plane and axisymmetric problems. Stress concentration and failure criteria. Unsymmetrical bending of beams; shear centres; torsion of thin-walled structural members. Curved beams. Formulation and applications of energy principles, and their connection to finite-element method. **Professor Shrivastava**

303-526B SOLID WASTE MANAGEMENT. 3(3-2-4) (Prerequisite: 303-225B) Characterization of municipal and industrial solid wastes. Review of solid and hazardous waste impacts, regulations and treatment options. Collection and transportation of solid wastes. Methods of reclamation and disposal. Introduction to the design of landfill sites and incinerators. **Professor Nicell**

303-527A RENOV. & PRESERV. OF INFRASTRUCTURE. 3(3-2-4) (Prerequisites: 303-202B and 303-318B) Maintenance, rehabilitation, renovation and preservation of infrastructure; infrastructure degradation mechanisms; mechanical, chemical and biological degradation; corrosion of steel; condition surveys and evaluation of buildings and bridges; repair and preservation materials, techniques and strategies; codes and guidelines; case studies. **Professor Mirza**

303-528A REHABILITATION CASE STUDIES. 3(0-0-9) Topical case studies from industrial and governmental experience in rehabilitation of infrastructure. Course conducted in collaboration with the other four institutions. Each student is required to submit a technical report. **TBA**

303-540A URBAN TRANSPORTATION PLANNING. 3(3-1-5) (Prerequisite: 303-319B or permission of instructor.) Process and techniques of urban transportation engineering and planning, including demand analysis framework, data collection procedures, travel demand modelling and forecasting, and cost-effectiveness framework for evaluation of project and system alternatives. **Professor Rice and Mr. Trottier**

303-541B RAIL ENGINEERING. 3(3-1-5) Principles of rail system design, including vehicle motion calculations, supporting way design, and rail vehicle design. Planning and operational characteristics for rail freight systems and urban rail systems, with an assessment of operational and technological developments. **TBA**

303-546A,B SELECTED TOPICS IN CIVIL ENG. I. 3(3-0-6. (Prerequisite: Permission of instructor.) Special topics related to Civil Engineering will be presented by staff and visiting lecturers.

303-547A,B SELECTED TOPICS IN CIVIL ENG. II. 3(3-0-6) (Prerequisite: Permission of instructor.) Special topics related to Civil Engineering will be presented by staff and visiting lecturers.

303-548A,B SELECTED TOPICS IN CIVIL ENG. III. 3(3-0-6) (Prerequisite: Permission of instructor.) Special topics related to Civil Engineering will be presented by staff and visiting lecturers.

303-550B WATER RESOURCES MANAGEMENT. 3(3-0-6) (Prerequisite: 303-323A or equivalent.) State-of-the-art water resources management techniques; case studies of their application to Canadian situations; identification of major issues and problem areas; interprovincial and international river basins; implications of development alternatives; institutional arrangements for planning and development of water resources; and, legal and economic aspects. **Professor Nguyen**

303-553A STREAM POLLUTION AND CONTROL. 3(3-2-4) (Prerequisite: 303-225B) Water quality standards; physical, chemical, and bacterial contamination of surface waters; effects of specific types of pollution such as thermal, point and non-point sources; stream self-purification; effects on lake eutrophication; pollution surveys and methods of control; laboratory tests. **Professor Gehr**

303-554A ENVIRONMENTAL ENGINEERING SEMINAR 3(3-0-6)9 (Prerequisite: Permission of instructor.) The course will expose the students to various environmental engineering issues. Lectures will be given by faculty and invited speakers from industry. Each student is required to prepare a written technical paper and make an oral presentation. **Professor Gehr**

● **303-555B ENVIRONMENTAL DATA ANALYSIS.** 3(3-0-6) (Prerequisite: 303-302B or permission of instructor.) Application of statistical principles to design of measurement systems and sampling programs. Introduction to experimental design. Graphical data analysis. Description of uncertainty. Hypothesis tests. Model parameter estimation methods: linear and nonlinear regression methods. Trend analysis. Statistical analysis of censored data. Statistics of extremes. **Professor Nguyen**

303-570A WAVES AND COASTAL ENGINEERING. (3) (3-0-6) (Prerequisite: 303-327B) Waves: wave transformation and prediction, waterlevels; coastal geomorphology: geology, sediment transport, coastal processes; coastal engineering: shore protection, harbours, dredging, coastal management. **S. Gaskin**

● **303-572A COMPUTATIONAL HYDRAULICS.** 3(3-0-6) (Prerequisite: 303-327B or equivalent.) Computation of unsteady flows in open channels; abrupt waves, flood waves, tidal propogations; method of characteristics; mathematical modelling of river and coastal currents. **Professor Chu**

303-573A HYDRAULIC STRUCTURES. 3(3-0-6) (Prerequisites: 303-323A and 303-327B) Hydraulic aspects of the theory and design of hydraulic structures. Storage dams, spillways, outlet works, diversion works, drop structures, stone structures, conveyance and control structures, flow measurement and culverts. **Mr. Holder**

303-574B FLUID MECHANICS OF WATER POLLUTION. 3(3-0-6) (Prerequisite: 303-327B or equivalent.) Mixing, dilution and dispersion of pollutants discharged into lakes, rivers, estuaries and oceans; salinity intrusion in estuaries and its effects on dispersion; biochemical oxygen demand and dissolved oxygen as water quality indicators; thermal pollution; oil pollution. **Professor Chu**

● **303-575B FLUID MECHANICS OF AIR POLLUTION.** 3(3-0-6) (Prerequisite: 303-327B or equivalent.) Fundamentals of fluid mechanics; properties and sources of air pollution; the atmospheric boundary layer; atmospheric diffusion; atmospheric stability; aerodynamics of plumes; coagulation and settling of particles; molecular diffusions. **TBA**

● **303-576B HYDRODYNAMICS.** 3(3-0-6) (Prerequisite: 303-327B or equivalent.) Equations of motion, Bernoulli, Cauchy and Bjerknes' theorems, virtual mass, complex variables and conformal mapping. Free surface flows, dynamic and kinematic boundary conditions. Shallow water flows, waves of finite amplitude. Flows on a geophysical scale, Ekman layers, homogeneous lake circulation, seiches. Linear waves, refraction and diffraction around breakwaters. **TBA**

303-577A RIVER ENGINEERING. 3(3-0-6) (Prerequisite: 303-327B) Mechanics of the entrainment, transportation and deposition of solids by fluids; sediment properties; threshold of movement; ripples, dunes and antidunes; suspended load; bed load; stable channel design; meandering of rivers; wave-induced transport; turbidity currents; transport of solids in pipelines; aeolian transport. **Professor Gaskin**

● **303-579B WATER POWER ENGINEERING.** 3(3-0-6) (Prerequisites: 303-323A and 306-310A,B) A practical approach to the planning and design of hydro-electric power installations. Fundamental theory of water availability and demand; flow, power and load duration curves; classification of power sources; project planning;

economic analysis including costs and benefits; special features of hydro plants; and appurtenances for hydro plants. **TBA**

303-585B GROUNDWATER HYDROLOGY. 3(3-0-6) (Prerequisite: Permission of instructor.) Groundwater geology; steady-state and transient-state regional groundwater; infiltration and recharge; hydrological cycle; chemical constituents; adsorption/desorption processes; Groundwater exploration techniques; pumping tests; groundwater pollution; diffusion and dispersion; thermal processes; groundwater resource management. **Professor Selvadurai**

● **303-586A EARTHWORK ENGINEERING.** 3(3-0-6) (Prerequisite: Permission of instructor.) Stability of natural slopes and cuts, stability analysis; design of earth and rock fills, dykes and dams; techniques to improve stability; compaction of soil, compaction control; soil improvement by in-situ processes; reinforced earth. **TBA**

● **303-587A PAVEMENT DESIGN.** 3(3-0-6) (Prerequisite: Permission of instructor.) Properties of bituminous materials, design of bituminous concrete mixes, construction control; evaluation of design parameters, factors controlling their variability; soil stabilization; frost effects; stresses and displacements in layered systems, analysis of rigid and flexible pavement systems; design of highway and airport pavements; pavement evaluation and strengthening; recycling. **TBA**

4.5 Department of Electrical and Computer Engineering

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Gerry W. Farnell; B.A.Sc.(Tor.), S.M.(M.I.T.), Ph.D.(McG.), F.I.E.E.E., Eng.
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Frank D. Galiana; B.Eng.(McG.), S.M., Ph.D.(M.I.T.), F.I.E.E.E., Eng.
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Boon-Teck Ooi; B.E.(Adel.), S.M.(M.I.T.), Ph.D.(McG.), Eng.
Nicholas C. Rumin; B.Eng., M.Sc., Ph.D.(McG.), Eng.
Jonathan Webb; B.A., Ph.D.(Cantab.)

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Frank Ferrie; B.Eng., Ph.D.(McG.)
Vincent Hayward; Dip.d'Ing.(ENSM, Nantes), Doc.Ing.(Orsay), Eng.
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Benoit Champagne; B.Eng., M.Eng.(Montr.), Ph.D.(Tor.)
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Mourad El-Gamal; B.Sc.(Cairo), M.Sc.(Nashville), Ph.D.(McG.)
Karim Khordoc; B.Eng., M.Eng., Ph.D. (McG.)
Andrew Kirk; B.Sc.(Brist.), Ph.D.(London)
Radu Negulescu; M.Sc.(Romania), M.Sc.(France), Ph.D.(Wat.)
Zilic Zeljko; B.Eng.(Zagreb), M.S.c, Ph.D.(Tor.)

Visiting Professors
Michael Kaplan; M.Sc., Ph.D.(Cornell)
Birendra Prasada; M.Sc.(Ban.), Ph.D.(Lond.)
Jean Regnier; B.Eng., M.Eng.(Montr.), Ph.D.(M.I.T.)

Lecturers
Kenneth L. Fraser; B.Eng., M.Eng.(McG.), Eng.
Florence Danilo; M.Eng.(McG.)
Dennis Giannacopoulos; M.Eng., Ph.D.(McG.)

Associate Members
Martin Buehler; M.Sc., Ph.D.(Yale)
Gregory Dudek; B.Sc.(Queen's), M.Sc., Ph.D.(Tor.)
Alan C. Evans; M.Sc.(Surrey), Ph.D.(Leeds)
William R. Funnell; M.Eng., Ph.D.(McG.)
Henrietta L. Galiana; M.Eng., Ph.D.(McG.)
Jean Gotman; M.E.(Dartmouth, N.S.), Ph.D.(McG.)
Robert E. Kearney; M.Eng., Ph.D.(McG.)
Bruce Pike; M.Eng., Ph.D.(McG.)

Adjunct Professors
Vinod K. Agarwal, Eduard Cerny, Danny Grant, Paul Freedman, M. Gavrilovic, Jeremiah F. Hayes, Cheng K. Jen, Geza Joos, Stanley Kubina, Irene Leszkowicz, Lin Lin, Miguel Marin, Donald McGillis, Douglas O'Shaughnessy, Januz Rajski, Fazlollah M. Reza, Farouk Rizk, Mohamad A. Sawan, Mohammad R. Soleymani, Oryal Tanir, Lucjan A. Wegrowicz.

General Information on Programs

The Department of Electrical and Computer Engineering offers undergraduate degree programs in Electrical Engineering, Electrical Engineering (Honours), and Computer Engineering. All programs provide students with a strong background in mathematics, basic sciences, engineering science, engineering design and complementary studies, in conformity with the requirements of the Canadian Engineering Accreditation Board (CEAB).

The program in Electrical Engineering gives students a broad understanding of the key principles that are responsible for the extraordinary advances in the technology of computers, microelectronics, automation and robotics, telecommunications and power systems. These areas are critical to the development of our industries and, more generally, to our economy. A graduate of this program is exposed to all basic elements of electrical engineering and can function in any of our client industries. This breadth is what distinguishes an engineer from, say, a computer scientist or physicist.

The program in Electrical Engineering (Honours) is designed for students who wish to pursue postgraduate work and look to a career in advanced research and development. The technical complementaries are selected from graduate courses, facilitating the transition to postgraduate studies. Students in this curriculum benefit from smaller classes and have more contact with professorial staff and graduate students. However, the program is quite demanding. Students are expected to register for at least 14 credits per semester; they may register for a smaller number only with the permission of the Chair of this Department. Students in the Honours program must maintain a minimum GPA of 3.00. Those who fail to maintain this standard are transferred to the regular program.

The program in Computer Engineering provides students with greater depth and breadth of knowledge in the hardware and software aspects of computers. Students are exposed to both theoretical and practical issues of both hardware and software in well-equipped laboratories. Although the program is designed to meet the growing demands by industry for engineers with a strong back-