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1 The Faculty

1.1 Location
Macdonald Engineering Building
817 Sherbrooke Street West
Montreal, QC H3A 2K6
Canada
Website: http://www.mcgill.ca/engineering
Faculty of Engineering Student Affairs Office:
Macdonald Engineering Building, Room 378
Telephone: (514) 398-7257

1.2 Administrative Officers
JOHN E. GRUZLESKI, B.Sc., M.Sc.(Queen’s), Ph.D.(Toronto), Eng.
Dean
JIM NICELL, B.A.Sc., M.A.Sc., Ph.D.(Windsor), P.Eng.
Associate Dean (Student Affairs)
DAVID L. FROST, B.A.Sc.(U.B.C.), M.S., Ph.D.(Caltech), P.Eng.
Associate Dean (Academic)
JUAN H. VERA, B.Math.(Chile), Ing.Quim.(U.T.E.), M.S.(Berkeley), Dr. Ing.(Santa Maria), Ing.
Associate Dean (Research)
DAVID COVO, B.Sc.(Arch.), B.Arch.(McG.), M.R.A.I.C., O.A.Q.
Director, School of Architecture
DAVID F. BROWN, B.A.(Bishop’s), M.U.P.(McG.), Ph.D.(Sheffield)
Director, School of Urban Planning
RICHARD J. MUNZ, B.A.Sc., M.A.Sc.(Wat.), Ph.D.(McG.), Eng.
Chair, Department of Chemical Engineering
Chair, Department of Civil Engineering and Applied Mechanics
Chair, Department of Electrical and Computer Engineering
Chair, Department of Mechanical Engineering
ROBIN A.L. DREW, B.Tech.(Bradford), Ph.D.(Newcastle)
Chair, Department of Mining, Metals and Materials Engineering
JONATHAN ROUSHAM Building Administrator
STEVE YUE, B.Sc., Ph.D.(Leeds) Secretary of Faculty
IDA GODEFROY Assistant to the Dean
JUDY PHARO Faculty Student Advisor

1.3 Historical Note
The Faculty of Engineering began in 1871 as the Department of Practical and Applied Science in the Faculty of Arts with degree programs in Civil Engineering and Surveying, Mining Engineering and Assaying, and Practical Chemistry. Diploma courses had been offered from 1859, and by 1871 the staff and enrolments had increased sufficiently to justify the creation of the Department. Continued growth led to the formation of the Faculty of Applied Science in 1878. By 1910 there were ten degree programs offered, including Architecture and Railroad Engineering. Subsequent changes in the overall pattern of the University led to the creation of the Faculty of Engineering in 1931 with a departmental structure very similar in name to that which exists at present.
1.4 The Faculty Today
The Faculty currently includes five engineering departments and two schools:

The Departments
- Chemical Engineering
- Civil Engineering and Applied Mechanics
- Electrical and Computer Engineering
- Mechanical Engineering
- Mining, Metals and Materials Engineering

The Schools
- Architecture
- Urban Planning

The Faculty serves approximately 2200 undergraduate students and 700 graduate students in a wide variety of academic programs.

Undergraduate programs leading to professional bachelor degrees are offered in all Engineering Departments. These programs are designed to qualify the graduates for immediate employment in a wide range of industries and for membership in the appropriate professional bodies. Additionally, a non-professional undergraduate degree is offered in the School of Architecture for those who plan to work in related fields not requiring professional qualification. The curricula are structured to provide suitable preparation for those who plan to continue their education in post-graduate studies either at McGill or elsewhere.

The professional degrees in Architecture and Urban Planning are offered at the Master’s level and are described in the Graduate Studies Calendar.

The academic programs, which are described in detail in section 4, are divided into required and complementary sections. The required courses emphasize those basic principles which permit graduates to keep abreast of progress in technology throughout their careers. Exposure to current technology is provided by the wide variety of complementary courses which allow students to pursue in depth a particular interest.

An internship program involving a paid 8 to 16 month industrial work experience is available to Engineering and Science students. Generally students will enter the internship program before starting their final year of undergraduate studies. Details can be found in section 2.9. In addition, CO-OP programs are offered in Mining Engineering and in Metals and Materials Engineering.

Post-graduate programs leading to Master’s and Doctoral degrees are offered in all sectors of the Faculty. Numerous areas of specialization are available in each of the departments and schools. All post-graduate programs including the professional degree programs in Architecture and in Urban Planning are described in the Graduate Studies Calendar.

1.5 Special Facilities and Related Programs
1.5.1 Engineering Microcomputing Facility
In addition to the services provided by the Computing Center, the Faculty, in conjunction with its departments and schools, maintains specialized computing and information resources in support of teaching and research. These vary from desktop PCs distributed throughout the Engineering complex to very high performance scientific workstations found in the research laboratories. Each unit organizes and maintains facilities that are designed around specific roles, e.g. CAD/CAM, microelectronic design, software engineering, circuit simulation, process control, polymers, structural mechanics, metal processing, etc., in addition to systems dedicated to administrative support.

The role of the Faculty is to provide access to computing resources on a 24-hour basis and to provide services that are not covered by individual units. The Faculty works in close cooperation with the McGill Computing Centre which provides remote access to the Faculty network.

1.5.2 Agricultural and Biosystems Engineering
The Faculty of Engineering cooperates with the Faculty of Agricultural and Environmental Sciences in providing courses of instruction for a curriculum in agricultural and biosystems engineering to meet requirements for a professional degree awarded in the Faculty of Agricultural and Environmental Sciences. The second semester of the penultimate year of the program is given by the Faculty of Engineering on the Downtown Campus. Details of the curriculum are given on page 456 in the Agricultural and Environmental Sciences section.

Some of the courses offered by the Department of Agricultural and Biosystems Engineering may be of interest to students in the Faculty of Engineering.

1.5.3 Department of Biomedical Engineering
Lyman Duff Medical Sciences Building
3775 University Street
Montreal, QC H3A 2B4
Telephone: (514) 398-8278

Engineering undergraduates who are interested in the biomedical applications of engineering techniques should contact the Chair of their department or the graduate Chair of Biomedical Engineering. Some of the courses offered by the BME Department may be of interest to Engineering students, and may be approved as complementary courses. A partial list follows (see the Graduate Studies Calendar, accessible at http://www.mcgill.ca, for more details):

- BMDE 501 SELECTED TOPICS IN BIOMEDICAL ENGINEERING. (3) (3-0-6)
- BMED 503 BIOMEDICAL INSTRUMENTATION. (3) (2-1-6)
- BMED 519 BIOMEDICAL SIGNALS AND SYSTEMS. (3) (2-0-8)

1.6 Library Facilities

2 General Information
2.1 Admission Requirements
The Faculty of Engineering offers programs leading to the degrees of B.Eng. and B.Sc. (Arch.). Enrolment in some programs is limited.

Specific information on admissions requirements for Quebec students, students from provinces of Canada other than Quebec and applicants from outside of Canada can be found in section 2 of the Application Procedures, Admission Requirements chapter.

2.2 Exchange Programs
The Faculty of Engineering participates in a number of exchange programs that provide undergraduates with an opportunity to study at Ecole Polytechnique and other Quebec universities, and at selected colleges and universities in the United States, Mexico and Europe. Applicants must have completed at least one year of study and have maintained an average of 3.00 or better. Further information may be obtained from the Faculty of Engineering Student Affairs Office, or the Exchange Officer, Admissions, Recruitment and Registrar's Office.

2.3 Transfer Credits
In certain cases, credit may be granted for courses passed with a grade of C or better at other universities, up to a maximum of 45 credits for Engineering and 42 credits for Architecture. For further information, please see section 6.7 of the General Information and Regulations section.
2.4 Advanced Credit Examinations
Prior to their first registration, the Faculty of Engineering offers the opportunity for students entering the Faculty from a Quebec CEGEP program to receive advanced credit in MATH 260 Intermediate Calculus upon successful completion of the Advanced Credit Examination. The MATH 260 Intermediate Calculus examination covers material that has a similarity to the syllabus of the CEGEP Calculus III course.

In all engineering programs, students who are successful in the MATH 260 Intermediate Calculus examination will automatically have the number of credits required for the completion of their program reduced by three.

2.5 Registration
Students who are currently registered and intend to return to the same degree program in the following academic session are required to register following procedures outlined in this Calendar, General University Information and Regulations section 3. It is mandatory for all returning students to see a Departmental Academic Advisor in their Department for course confirmation during the first two weeks of the fall semester and, if changes are being made, during the first two weeks of the winter semester.

Information regarding course registration is sent to new students at the time of admission. All new students must see a Departmental Academic Advisor during the advising period. Non-Engineering students should obtain permission from the Associate Dean of their Faculty, and the Faculty Student Advisor in the Faculty of Engineering Student Affairs Office, to register for Engineering courses listed in section 4.

2.5.1 Registration for Continuing Education Courses
Students wishing to take a language course(s) via the Centre of Continuing Education for credit must register through the Student Affairs Office. A complete Course Authorization Form will be required. Students must refer to the Centre of Continuing Education Calendar and Timetable for course information and deadlines. For further information, contact the Student Affairs Office.

2.5.2 Course Withdrawal
Students may withdraw from a course without academic penalty provided they do so before the end of the seventh week of the semester. Beyond this time their names will appear on the mark reports and, in the event that they do not take the examination, they will be given a J grade.

2.6 Advising
All students are required to seek academic advising about their programs from the Department in which they study. Additional information may be obtained by calling:

- General Information (514) 398-7257
- Architecture (514) 398-6702
- Chemical Engineering (514) 398-4494
- Civil Engineering (514) 398-6860
- Electrical and Computer Engineering (514) 398-7344
- Mechanical Engineering (514) 398-8070
- Materials and Materials Engineering (514) 398-4755 ext. 4365
- Mining Engineering (514) 398-4755 ext. 0573
- Urban Planning (514) 398-4075

2.7 Student Activities
The campus offers a wide variety of extra-curricular activities for students. All are encouraged to participate. Many of these are organized within the Faculty under the auspices of the Engineering Undergraduate Society (EUS), or the Architectural Student Association (ASA). Both of these organizations publish handbooks describing their operations and the activities of various Faculty clubs and societies. All undergraduate students automatically become members of the EUS or the ASA, as appropriate.

2.8 Scholarships and Bursaries
Scholarships, bursaries and loans are open to students in the Faculty of Engineering. Students should consult the Undergraduate Scholarships and Awards Calendar available on the Web at http://www.mcgill.ca or from the Admissions, Recruitment and Registrar's Office. Specific information concerning these awards may be obtained from the Faculty Student Advisor, Faculty of Engineering Student Affairs Office.

2.9 IYES: Internship Year for Engineering and Science
Employers value experience. The IYES Program allows students to gain professional work experience during the course of their undergraduate studies while at the same time earning a salary within the average range of those for entry-level professional positions. Other benefits include:

- improved chance of obtaining a job upon graduation and at a higher starting salary;
- the opportunity to test a choice of career and assess the pertinence of post-graduate study before making a long-term commitment;
- the opportunity to develop communication skills and to acquire a business perspective that cannot be learned in school and is unlikely to be gained from a summer job.

Employment through the IYES Program typically begins in January or May and continues for 8, 12 or 16 months, including a 4-month probationary training period. Employers choose the most suitable students for their organization through the application, interview and ranking process. While employed by the participating companies, students work on assignments related to their field of study. Students switch to the Internship Program from the regular program when they accept an Internship placement. Successful completion of an 8 to 16-month internships will qualify the student to graduate with the Internship Program designation, which will be noted on the student's permanent record.

STUDENT ELIGIBILITY
All students participating in this program must:

- have a good academic record (satisfactory standing),
- be registered full time in their program,
- have between 15 and 45 credits remaining to complete their undergraduate studies in the following areas of Engineering or Science:
  - Atmospheric Science
  - Biotechnology
  - Chemical Engineering
  - Civil Engineering
  - Computer Engineering
  - Electrical Engineering
  - Environmental Studies
  - Mathematics and Statistics
  - Mechanical Engineering
  - Physics
- remain a degree candidate while on internship,
- return to complete studies at McGill (internship students will receive an automatic extension for the completion of their studies). Students are not allowed to complete their undergraduate degree during the internship period.

In addition, it is recommended that the student be able to demonstrate strong leadership and communication skills.

COST
- There is no application fee.
- Every student hired through the Program will be assessed a fee of $700. Students will be billed this amount approximately one month after starting their internship.
- Participating companies are invited to match the student's contribution in the form of a tax deductible donation to IYES.

Further information can be obtained from the Internet http://www.mecc.mcgill.ca or by sending an email to info@mecc.mcgill.ca
2.10 Calculators in Faculty Tests and Examinations
The use of calculators during tests and examinations is at the discretion of the course instructor. If a calculator is permitted in the examination, the Faculty requires that the students use a Faculty Standard Calculator, i.e. the CASIO fx-991 or the Sharp EL-546. These calculators are non-programmable, inexpensive, available through local dealers, e.g. EUS General Store in McConnell Engineering Building, and have many features of interest to Engineering students. Any model fx-991 or EL-546 is acceptable, regardless of the letter suffix which appears after the model number. All Engineering students are expected to own one of the two Faculty Standard Calculators.

3 Academic Requirements

3.1 Degree Requirements
In order to obtain a Bachelor's degree, students must complete one of the departmental programs described in section 4.

3.1.1 Entrance Requirements
The degree programs in the Faculty of Engineering are designed for students who have completed a general and basic science program. This basic science requirement consists of two semesters of calculus, chemistry, physics, one semester of vectors, matrices and analytical geometry and one semester of humanities or social sciences.

Students entering the Faculty of Engineering from Quebec complete these courses at the CEGEP and enter a seven-semester program.

Students entering from outside Quebec with a high school diploma generally enter an eight-semester program and complete the basic science requirements at McGill.

Students who have completed Advanced Placement Exams, Advanced Levels, the International Baccalaureate, the French Baccalaureate, or McGill placement and/or advanced credit examinations may receive exemptions and/or credits for all or part of the basic science requirements. Similarly, students who have completed courses at other universities or colleges may receive exemptions and/or credits.

3.1.2 Basic Science Requirements for Students Entering from Outside Quebec (8-semester program)
Generally, students admitted to Engineering from outside Quebec are required to complete the basic science requirements outlined below, in addition to the departmental programs described in section 4.

CHEM 110 (4 credits) General Chemistry 1
CHEM 120 (4 credits) General Chemistry 2
MATH 140 (3 credits) Calculus 1
or MATH 139 (3 credits) Calculus
or MATH 150 (4 credits) Calculus A
MATH 141 (4 credits) Calculus 2
or MATH 151 (4 credits) Calculus B
MATH 133 (3 credits) Vectors, Matrices & Geometry
PHYS 131 (4 credits) Mechanics and Waves
PHYS 142 (4 credits) Electromagnetism & Optics
xxx-xxx (3 credits) Humanities/Social Sciences course

Calculus courses MATH 150/MATH 151 are designed for students who have completed a course in high school calculus. Students who complete the Calculus sequence MATH 150/ MATH 151 will receive exemption with credit from MATH 260 (Intermediate Calculus), in the regular Engineering program.

In the event that the student has some prior calculus, but is not sufficiently confident to proceed with MATH 150/MATH 151, the appropriate sequence is MATH 140/MATH 141.

If a student has no previous calculus exposure, MATH 150/ MATH 151 may be replaced with MATH 139/MATH 141.

Students who are uncertain as to which calculus course sequence is appropriate for them should contact Ms. Pharo, Faculty Student Advisor in the Faculty of Engineering Student Affairs Office (514) 398-7256.

The Humanities/Social Science course may be selected from a list outlined in Welcome to McGill. A copy of the booklet is mailed to all students admitted to the Engineering program at McGill. A Humanities/Social Sciences course is not required of students admitted to Electrical/Computer Engineering.

Students may write McGill Placement Tests to obtain credit for CHEM 110, CHEM 120, MATH 140, MATH 141, MATH 133, PHYS 131 and PHYS 142, in the event that they have studied similar material previously. Details on the advanced placement examinations are provided in Welcome to McGill.

Students entering with advanced standing credits (Advanced Placements, Advanced Levels, International Baccalaureate examinations, McGill Placement Tests) are required to meet with the Faculty Student Advisor, Faculty of Engineering Student Affairs Office, to finalize their program of studies. (This must be done prior to meeting with the Departmental Advisor.) An information session will be held prior to the advising sessions to process these advanced credits. Please refer to the Welcome to McGill section "Advising Engineering" for more information.

3.1.3 Architecture – Basic Science Requirements for Students Entering from Outside Quebec (8-semester program)
Generally, students admitted to Architecture from outside Quebec are required to complete the following courses:

CHEM 110 (4 credits) General Chemistry 1
CHEM 120 (4 credits) General Chemistry 2
MATH 139 (4 credits) Calculus
or MATH 140 (3 credits) Calculus 1
MATH 141 (4 credits) Calculus 2
MATH 133 (3 credits) Vectors, Matrices & Geometry
PHYS 131 (4 credits) Mechanics and Waves
PHYS 142 (4 credits) Electromagnetism & Optics

Students may write McGill Placement Tests to obtain credit for CHEM 110, CHEM 120, MATH 140, MATH 141, MATH 133, PHYS 131 and PHYS 142, in the event that they have studied similar material previously. Details on the advanced placement examinations are provided in Welcome to McGill.

3.2 Degrees and Requirements for Professional Registration
Non-Professional:
Bachelor of Science (Architecture)

The first professional degree in architecture is the Master of Architecture I. The description of the M.Arch. I program can be found in the Graduate Studies Calendar.

Professional:
Bachelor of Engineering
Bachelor of Engineering (Honours)
Bachelor of Software Engineering

The B.Eng. programs are accredited by the Accreditation Board of the Canadian Council of Professional Engineers and fulfill the academic requirements for admission to the provincial engineering professional organizations. All students are encouraged to seek professional registration after graduation. To become a Professional Engineer, a graduate must pass an examination on legal aspects as well as on the principles of professional practice, and acquire two to four years of engineering experience, depending on the province. Only persons duly registered may use the title of "engineer" and perform the professional activities reserved for engineers by the provincial laws and regulations.

Graduates of the Bachelor of Software Engineering program should be eligible for accreditation (once accreditation standards for Software Engineers have been adopted).

In Quebec, the professional engineering body is the Ordre des ingénieurs du Québec (OIQ). In order to better prepare new graduates for the practice of their profession, McGill organizes seminars in cooperation with the Ordre on various aspects of the
profession. The OIQ also has a student section. As soon as students have accumulated 60 credits in a B.Eng. Program, they can join the Student Section of the OIQ. Registration is free.

For more information, visit the websites of the Ordre des ingénieurs du Québec (http://www.oiq.qc.ca) and of the Canadian Council of Professional Engineers (http://www.ccape.ca).

3.3 Prerequisites

Prerequisites must be completed prior to course registration, if applicable. If a student has registered for a course and did not satisfy the prerequisite, the course may be dropped from his/her record by the Faculty. Written notification will be forwarded to the student and he/she will be permitted to revise his/her course selection.

Those students who have received advance credits/exemptions or passed a placement exam, and are blocked from registration into a course due to a prerequisite block, must complete a Course Authorization Form and submit it to the Faculty of Engineering Student Affairs Office. A Departmental advisor must sign and make a notation on the Course Authorization Form indicating that the prerequisite has been satisfied.

Further information may be obtained from the Faculty of Engineering Student Affairs Office.

3.4 Complementary Studies

Engineering students must complete 6 credits (9 credits in Electrical and Computer Engineering) of additional complementary courses as follows:

(i) One 3-credit course on the impact of technology on society
(ii) One 3-credit course (6 credits in Electrical and Computer Engineering, of which a minimum of 3 credits must be from category A described below) in the humanities and social sciences, administrative studies and law.

The three credits under (i) are to be chosen from the following list of courses which relate to the impact of technology on society.

CHEE 230 Environmental Aspects of Technology
CHEE 430 Technology Impact Assessment
CIVE 469 Infrastructure & Society
ECON 225 Economics of the Environment
ENVR 201 Society and Environment
GEOG 200 Geographical Perspectives: World Environmental Problems
GEOG 203 Introduction to Environmental Studies
GEOG 205 Global Change: Past, Present and Future
GEOG 302 Environmental Management 1
MIME 308 Social Impact of Technology
PHIL 343 Biomedical Ethics
SOCI 235 Technology and Society
SOCI 312 Industrial Sociology

The course(s) under (ii) are to be chosen from the following:

Electrical and Computer Engineering students must select at least one 3-credit course from Category A (Humanities and Social Sciences).

A. Humanities and Social Sciences

Any course at the 200 level or above from the departments of:

- Anthropology
- Economics (any 200 or 300 level course excluding ECON 208, ECON 217, ECON 227, ECON 259 and ECON 337)
- History
- Philosophy (excluding PHIL 210)
- Political Science
- Psychology (excluding PSYC 204, PSYC 305 and PSYC 435 but including PSYC 100)
- Religious Studies
- School of Social Work
- Sociology (excluding SOCI 350)
or ARCH 350 The Material Culture of Canada
or ENVR 203 Knowledge, Ethics and Environment
or ENVR 400 Environmental Thought
or MATH 338 History and Philosophy of Mathematics

B. Administrative Studies and Law

Faculty of Engineering

FACC 220 Law for Architects and Engineers

Faculty of Management

INDR 294 Introduction to Labour-Management Relations
MGCR 222 Organizational Behaviour
MGCR 320 Managing Human Resources
MGCR 352 Marketing Management I
MGCR 360 Social Context of Business
MRKT 360 Marketing of Technology
ORGB 321 Leadership

C. Language Courses

Any language course which is deemed by the academic advisor to have a sufficient cultural component or, in the case of a student who was not already proficient in a specific language, program credit will be given for the second of two successfully completed, academically approved 3-credit language courses.

3.5 Student Progress

The B.Eng. programs may be completed in seven semesters. The B.Sc. (Arch.) program may be completed in six or eight semesters, depending upon point of entry.

A student must successfully complete the B.Eng. or B.Sc. (Arch.) programs within six years of entry. Candidates admitted to a lengthened program, or to a shortened program because of advanced standing, or who are participating in the IYES program, will have a correspondingly greater or lesser period in which to complete their program. Extensions may be granted by the Committee on Standing in cases of serious medical problems or where other similarly uncontrollable factors have affected a student’s progress.

3.5.1 Letter Grades

In the Faculty of Engineering, letter grades are assigned according to the grading scheme adopted by the professor in charge of a particular course. They have the designations:

A, A- Very Good J Unexcused Absence
B+, B, B- Good K Incomplete
C+, C Satisfactory KF Incomplete Failed
D Conditional Pass L Deferred
F Failed T Credit by examination only

Grades A, B and C indicate satisfactory results. Grade D indicates marginal results which may be acceptable for peripheral courses but not for core courses required by the program. The classification of a course as core or peripheral depends on the individual student's program and will be decided by the department concerned. Grade F is a permanent grade indicating unsatisfactory results. Grade J indicates an unexcused failure to submit assignments or an unexcused absence from an examination. It is equivalent to an F grade.

3.5.2 Incomplete Course Deadlines

Those students with a K grade (incomplete), MUST complete the course within three (3) months, after which the student will be given a grade of KF (incomplete/failed). The deadline for Fall term courses is March 31st (January 15th for Winter graduation); for Winter term courses it is August 15th (May 15th for Spring graduation) and for Summer term courses it is December 1st (October 1st for Fall graduation).

If the student is unable to complete the course within the given deadlines, a request for an extension must be forwarded to the Associate Dean (Student Affairs). If an extension has already been permitted, the Faculty will make the necessary corrections.

3.5.3 Satisfactory/Unsatisfactory Option

The Satisfactory/Unsatisfactory Option (S/U) may be used for elective courses only.

Students must specify courses as S/U at the time of registration. The option will not be added manually to a student’s record after the Drop/Add deadline or once a mark has been submitted by
the Faculty. Once a mark has been submitted, this option will not be reversed.

1. "Elective" refers to that category of the complementary studies component of the program involving a Social Science/Humanities course, or a course dealing with the impact of technology on society; or to elective courses taken outside the School of Architecture by architecture students. It does not apply to the "technical complementarities" or "architectural complementarities", or to any other category of the Engineering or Architecture programs.

2. A C grade is considered a pass under the University Satisfactory/Unsatisfactory option. (Students should note that the Faculty of Engineering accepts a D grade as a pass when courses eligible for the S/U option are taken in the conventional manner.)

3. Only students in satisfactory standing will be permitted to take a course under the Satisfactory/Unsatisfactory option. Only one course (3 credits) per term, to a maximum of 10% of a student's credits taken at McGill may be taken this way. Grades will be reported in the normal fashion by the instructor and the grades of C and above will be converted to Satisfactory (S) and grades of D and F will be converted to Unsatisfactory (U).

4. The courses taken under this option will be excluded from the GPA, but will be included in the number of credits.

NOTE: To be considered for scholarships/renewal of awards, students must complete at least 27 credits in the regular academic session exclusive of courses completed under this option.

3.5.4 Course Credits

The credit assigned to a particular course reflects the amount of effort it demands of the student. One credit normally represents three hours total work per week. This is, in general, a combination of lecture hours and other contact hours such as laboratory periods, tutorials and problem periods as well as personal study hours. As a guide, the average division of time for a course is indicated in hours in the course listing after the course credit. For example, (3) (3-0-6) indicates a three-credit course consisting of three lecture hours per week, no other contact hours and six hours of personal study per week.

3.5.5 Grade Point Averages and Extra Courses

The Faculty calculates a semestral grade point average (SGPA). Any courses taken which lie outside the program are classified as extra, are indicated by an "X" on transcripts and do not affect the grade point average. Students must receive departmental approval for such courses, and the course must be identified and recorded prior to writing the final examination.

3.5.6 Academic Standing Decisions

In the Faculty of Engineering, a decision on the student's academic standing is based on the CGPA (Cumulative Grade Point Average) according to the criteria listed below.

- Satisfactory standing - CGPA equal to 2.00 or greater.
- Probationary standing - CGPA less than or equal to 1.99 or equal to or greater than 1.20.
- Unsatisfactory standing - CGPA less than 1.20 (if this is the student's first semester, the student is normally readmitted to Probationary Standing by Faculty decision).

Note: The Faculty makes academic standing decisions after the completion of each semester (Fall, Winter, Summer) based on academic results to-date. Thus, if a student has been granted permission to defer one or more examinations, the standing decision will be made regardless of such deferrals. Please see below for further information about academic standing decisions.

Satisfactory Standing

Students in satisfactory standing may proceed, with the following conditions:

All core courses in which D or F grades were obtained must either be repeated successfully (grade C or better) or be replaced by an alternative approved course which is completed successfully.

All other courses in which F grades were obtained must either be repeated successfully at some point before graduation or be replaced by some alternative approved course which is completed successfully before graduation.

Students in poor academic standing are strongly urged to contact the Student Affairs Office to discuss their situation. Office staff are available to help guide students and to provide useful advice to help students achieve their goals. Helpful workshops are provided by Student Services, e.g., study skills, stress management, test anxiety. Students who are experiencing difficulties are encouraged to explore these avenues.

Probationary Standing

Students placed on Probationary Standing may proceed with their studies under the following conditions.

Students must reduce their credit load to a maximum of 13 credits per semester and must achieve at the end of the semester either a CGPA of 2.00 or better, or a semesteral GPA (SGPA) of 2.50 or better in order to continue.

A student whose SGPA is 2.50 or better, but whose CGPA is less than 2.00, may continue on with his/her studies but will remain on Probationary Standing.

Failure to achieve either the SGPA or CGPA requirements noted above will result in the student being placed on "Unsatisfactory Standing" (see below). Students will remain on probationary standing until they achieve a CGPA equal to or exceeding 2.00, at which time their standing will be changed to "satisfactory".

Students placed on Probationary Standing who need to reduce their credit load but are unable to drop course(s) must complete a Course Authorization Form and submit it to the Student Affairs Office. The course(s) will then be deleted manually from the student's record.

Unsatisfactory Standing

Students who have been placed on Unsatisfactory Standing will be asked to withdraw from the Faculty of Engineering for a minimum of one semester. Courses for which the student is currently registered will be deleted automatically from the student's record by the Faculty.

After a minimum of one semester away, the student can apply for readmission. A request for readmission must be made in writing in a letter addressed to the Associate Dean, Student Affairs in the Student Affairs Office. If readmitted, the student will be placed back on Probationary Standing. Students will remain on probationary standing until they achieve a CGPA greater or equal to 2.00, at which time their standing will be changed to "satisfactory".

While on probation during that semester and subsequent semesters, the student must reduce his/her credit load to a maximum of 13 credits per semester, and must meet or exceed the minimum SGPA specified by the department or a CGPA greater or equal to 2.00. The minimum SGPA requirement for each department is as follows:

- Department of Chemical Engineering: SGPA greater than or equal to 2.50
- Department of Civil Engineering and Applied Mechanics: SGPA greater than or equal to 2.50
- Department of Electrical and Computer Engineering: SGPA greater than or equal to 3.00
- Department of Mechanical Engineering: SGPA greater than or equal to 2.50
- Department of Mining, Metals and Materials Engineering: SGPA greater than or equal to 2.50
- School of Architecture: SGPA greater than or equal to 2.50

Students who fail to achieve the minimum SGPA required by their department will be required to permanently withdraw from the pro-
gram with no chance of readmission. In addition, students who have returned to satisfactory standing, but whose CGPA falls below 2.00 in a subsequent semester, will be required to permanently withdraw from the program with no chance of readmission.

3.5.7 Repeated Courses

Students who fail to achieve the required results in a course must either repeat it successfully or complete a substitute course approved by their department. For students who fail prerequisite courses which are offered only in the Fall or Winter, the department responsible may, in appropriate cases, arrange “reading courses” during the other semester or during the Summer months. Such courses taken during a Fall or Winter semester constitute a normal part of the candidate’s work load. If the student is on probation, these courses must be included in the workload reduction.

3.5.8 Reassessment and Reread of a Grade

In accordance with the Charter of Student Rights, and subject to the conditions stated therein, students have the right to consult any written submission for which they have received a mark and the right to discuss this submission with the examiner. If, after discussion with the instructor, a student decides to request a formal reread of a final exam, the student must apply in writing, complete the Reread form and submit it to the Faculty of Engineering Student Affairs Office.

The following conditions apply:

- requests for rereads in more than one course per term will not be accepted, unless permission is given by the Faculty of Engineering;
- grades may be either raised or lowered as the result of a reread;
- rereads in courses not in the Faculty of Engineering are subject to the deadlines, rules and regulations of the relevant faculty;
- any request to have term work re-evaluated must be made directly to the instructor concerned.

The deadlines to make an application for a formal reread of a final exam are:
- the last working day of March for fall courses,
- the last working day of July for winter courses, and
- the last working day of November for summer courses.

A $35 fee for each reread will be assessed directly to the student’s McGill account if the result remains the same or is lowered. If the grade is increased, no charge is made.

For further information, students may consult the Faculty of Engineering Student Affairs Office.

3.5.9 Examination Regulations

For information regarding examination regulations and procedures in the Faculty of Engineering, please refer to the Engineering web site, http://www.mcgill.ca/engineering.

3.5.10 Supplemental Examinations

Courses administered by the Faculty of Engineering do not have supplemental examinations; however, Engineering students may be eligible to write supplemental examinations in courses administered by the Faculties of Arts and Science (typically Humanities and Social Science courses and pre-engineering courses). When the following conditions apply:

- students must be in satisfactory or probationary standing; those with an unsatisfactory standing are not permitted to write supplemental;
- students are permitted to write a supplemental for courses in which they have received a mark of D, F, J or U;
- students must write the supplemental exam at the time of the next supplemental examination period;
- special permission of the Associate Dean (Student Affairs), Engineering, is required if a student wishes to write supplemental exams totaling more than seven (7) credits;
- only one supplemental examination is allowed in a course;

- the supplemental result may or may not include the same proportion of class work as did the original grade. The instructor will announce the arrangements to be used for the course by the end of the course change period;
- the supplemental result will not erase the grade originally obtained; both the original mark and the supplemental result will be calculated in the CGPA;
- additional credit will not be given for a supplemental exam where the original grade for the course was a D and the student already received credit for the course.

The supplemental examination period for Fall courses is during the months of April and May, and for Winter courses and courses spanning Fall/Winter during the last week of August. It is the student’s responsibility to find out the date and time of the supplemental exam. Supplemental exam applications are available from the Faculty of Engineering Student Affairs Office. Alternately, students may print out the Supplemental Examination Request Form from the Faculty web site and return it by mail or submit it to the Student Affairs Office.

The deadline for submission of applications is March 1st for Fall courses and July 15th for Winter courses and courses spanning Fall/Winter courses. There is a $35 non-refundable fee per each supplemental exam, which is charged directly to the student’s McGill student account. Students should consult the Faculty of Engineering Student Affairs Office for more information.

3.5.11 Deferred Examinations

Students who have missed a final examination due to illness or family affliction, must submit the following documentation to the Faculty of Engineering Student Affairs Office, Room 378 Macdonald Building:

- an original medical certificate or other documentation that covers the date of the missed examination, and the nature and duration of the illness;
- a completed Deferral Request Form;
- a detailed letter justifying the request for a deferral.

Students must also attest that they have completed all course work up-to-date, which will be verified with the instructor(s). The Student Affairs Office must be informed of the reasons for absences from final examination no later than one week after the date of the final examination that was missed.

A student’s signature on the Deferral Request form will allow the Faculty to verify the authenticity of the medical certificate and the nature of the illness, or any other documentation provided. If the form is not signed, it will result in the assignment of a J grade in the course.

If a student becomes ill during a formal examination, he/she must inform the invigilator as soon as possible. If necessary, the student will be escorted to the Health Services. As stated above, the student must return to the Faculty of Engineering Student Affairs Office with medical certification within one week of the exam. IMPORTANT: If a student completes the exam in routine fashion, the grade received CANNOT be changed.

Students are advised that deferrals are granted ONLY for compelling reasons. If the request for deferral is denied by the Associate Dean (Student Affairs) the student will receive a “J” grade (absent) in the course. For the purpose of calculating GPAs and CGPAs, the grade of “J” is treated as an “F” (failed, 0%). Students will be contacted regarding the approval of a deferral initially via email approximately two weeks after the end of examination period. A formal letter will be mailed at a later date.

Students granted a deferral will be given an “L” grade which will be replaced by a “J” should the students miss the next deferred or regular examination in the course, whichever occurs first. Students are to ONLY write the final examination but NOT re-do or re-submit course material. If they wish to resubmit assignments and/or rewrite quizzes, class tests and/or midterms, they must appeal to the Associate Dean, Student Affairs.
If a deferral is granted, the maximum number of courses that a student may register for will be limited to ensure that no more than 18 credits of coursework are to be satisfied in a single semester or no more than 6 exams are to be written, whichever is greater. This will provide a student with sufficient time during the semester and the exam period to properly prepare for deferred examinations.

For Engineering and Management courses, students granted a deferral MUST write the final exam the NEXT time it is offered. Students should be aware that a deferred examination might not be available until the next time the course is given (one year or longer).

For Arts and Science courses, students MUST write the supplemental examination offered during either May (for Fall courses) or August (for Winter courses). Consult the Calendar of Dates for the dates set for supplemental exams, and the supplemental examination schedule posted on the Web for the exact date and time of a specific exam. Please note deferrals are not permitted forsummer courses. Students may be permitted to withdraw from a course without refund instead.

For Continuing Education courses, students granted a deferral should contact the Centre for Continuing Education directly for more information.

Further information on Deferred Examinations can be found in section 5.2.2 of the General University Information chapter.

4 Academic Programs
The curricula and courses described in the following pages have been approved for the 2002-03 session, but the Faculty reserves the right to introduce changes as may be deemed necessary or desirable.

4.1 Faculty Courses
The following two courses are administered by the Faculty of Engineering.

FACC 220 LAW FOR ARCHITECTS AND ENGINEERS. (3) (3-0-6)
Aspects of the law which affect architects and engineers. Definition and branches of law; Federal and Provincial jurisdiction, civil and criminal law and civil and common law; relevance of statutes; partnerships and companies; agreements; types of property, rights of ownership; successions and wills; expropriation; responsibility for negligence; servitudes/easements, privileges/lien, hypothec/mortgages; statutes of limitations; strict liability of architect, engineer and builder; patents; trade marks; industrial design and copyright; bankruptcy; labour law; general and expert evidence; court procedure and arbitration.

FACC 480 TECHNOLOGICAL ENTREPRENEURSHIP PROJECT. (3)
(0-4-5) (Prerequisite: at least 6 credits from the Minor in Technological Entrepreneurship) (Open to Minor in MTE students only) Students will work with an existing "knowledge-based" or technology-based company and will define, plan and complete an in-depth study of a particular aspect of technological entrepreneurship that interests them. This project will be under the supervision of the instructor of the course and an employee of the company concerned.

4.2 School of Architecture
Macdonald-Harrington Building, Room 201
815 Sherbrooke Street West
Montreal, QC H3A 2K6
Telephone: (514) 398-6700
Fax: (514) 398-7372
http://www.mcgill.ca/arch

Director — David Covo
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)

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.
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) (Sidney Rosner Bronfman Professor of Architectural History)
Adrian Sheppard; B.Arch.(McG.), M.Arch.(Yale), F.R.A.I.C., O.A.A., A.A.P.P.Q.
Radoslav Zuk; B.Arch.(McG.), M.Arch.(M.I.T.), D.Sc.

Associate Professors
Annmarie Adams; B.A.(McG.), M.Arch., Ph.D.(Berkeley), M.R.A.I.C. (William Dawson Scholar)
Martin Bressani; B.Sc.(Arch.), B.Arch.(McG.), M.Sc.Arch., Diplomes des études approfondies, Docteur de l’Université de Paris-Sorbonne (Paris IV)
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.
Pieter Sijpkes; B.Sc.(Arch.), B.Arch.(McG.)

Course Lecturers
Manon Asselin, Jean D’Aragon, David Theodore, Roland Ulfig

Adjunct Professors

Research Associates
Jim Donaldson, Rafik Salama

Associate Members
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 2001, they were:
Gavin Affleck, Bruce Allen, Cathy Ann Barr, Barry Bell, Denis Bloudeau, Michel Broz, Ella Chmielewska, Paul Coollan, Anne Cormier, Richard De La Riva, Rene Daoust, Alexandra Dubois, Rodolphe El-Khoury, Imma Franco, Ben Gianni, Mitchell Hall, Jean-Paul Herby, Sheila Kennedy, Marie-Claude Leblond, Ellen Leibovich, Eric Marosi, Gilles Marty, Patrick Quinn, Stephen Parcell, Pierina Saia, Barry Sampson, John A. Schweitzer, Carol Sheffer, Mohamed Talaat.

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 must 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 accreditting 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 is accredited by the Canadian Architectural Certification Board (CACB), and is recognized as accredited by the National Council of Architectural Registration Boards (NCARB) 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 – David Speller, Technician.
Communications Laboratory, including Photo Lab – Professor Ricardo Castro.

Library

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

Canadian Architecture Collection, housed in the Blackader-Lauterman Library – Irena Murray.
Orson Wheeler Architectural Model Collection – Professor Pieter Sijpkes.
Materials Resource Centre – Dr. Avi Friedman.

CURRICULUM FOR THE B.Sc.(Arch.) DEGREE
[Program revisions are under consideration for September 2002. Go to http://www.mcgill.ca (Course Calendars) in July for details.]

REQUIRED COURSES

<table>
<thead>
<tr>
<th>COURSE</th>
<th>CREDIT</th>
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<tbody>
<tr>
<td>CIVE 205 Statics</td>
<td>3</td>
</tr>
<tr>
<td>CIVE 229 Surveying for Architects</td>
<td>2</td>
</tr>
<tr>
<td>CIVE 283 Strength of Materials</td>
<td>4</td>
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<tr>
<td>CIVE 385* Structural Steel and Timber Design</td>
<td>3</td>
</tr>
<tr>
<td>CIVE 388* Foundations &amp; Concrete Design</td>
<td>3</td>
</tr>
<tr>
<td>CIVE 492* Structures</td>
<td>2</td>
</tr>
<tr>
<td>FACC 220 Law for Architects and Engineers</td>
<td>3</td>
</tr>
<tr>
<td>MIME 310 Engineering Economy</td>
<td>3</td>
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</tbody>
</table>

* 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

ARCH 201 Communication, Behaviour & Architecture 6
ARCH 202 Arch. Graphics and Design Elements 6
ARCH 217 Freehand Drawing 1 1
ARCH 218 Freehand Drawing 2 1
ARCH 240 Organization of Materials in Building 3
ARCH 250 Architectural History 1 3
ARCH 251 Architectural History 2 3
ARCH 303 Design and Construction 1 6
ARCH 304 Design and Construction 2 6
ARCH 321 Freehand Drawing 3 1
ARCH 322 Freehand Drawing 4 1
ARCH 324 Sketching School 1 1
ARCH 375 Landscape 2
ARCH 405 Design and Construction 3 6
ARCH 406 Design and Construction 4 6
ARCH 447 Electrical Services 2
ARCH 451 Building Regulations & Safety 56

COMPLEMENTARY COURSES

Students must complete 12 credits of architectural complementary subjects 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

ARCH 372 ARCH 352 ARCH 350 ARCH 318
ARCH 379 ARCH 363 ARCH 378 ARCH 319
ARCH 388 ARCH 383 ARCH 379 ARCH 364
ARCH 522 ARCH 524 ARCH 520 ARCH 377
ARCH 523 ARCH 525 ARCH 521 ARCH 461
ARCH 528 ARCH 529 ARCH 527 ARCH 471
ARCH 531 OCC1 442 ARCH 526
ARCH 532
ARCH 533

OUTSIDE ELECTIVES: 6
6 credits must be completed outside the School of Architecture, subject to approval by the Student Advisor.

TOTAL CREDITS, B.Sc.(Arch.): 97

Architectural Complements

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

COURSES OFFERED BY THE SCHOOL
For the Term (Fall and/or Winter), days, and times when courses will be offered, please refer to the 2002-2003 Class Schedule on the Web, http://www.mcgill.ca/students/. Class locations and names of instructors are also provided.

Students preparing to register are advised to consult the Class Schedule website for the most up-to-date list of courses available. New courses may have been added or courses rescheduled after this Calendar went to press.
The schedule of courses to be offered in Summer 2003 will be available on the website in January.

A limited number of courses are open to students not registered in the School of Architecture. These courses are divided into two sections. Section 01 is reserved for students in Architecture; Section 02 is reserved on a limited enrolment basis, for students not registered in the School of Architecture. Please refer to individual course descriptions.

ARCH has replaced 301 as the prefix for Architecture courses.
The course credit weight is given in parentheses after the title.

• Denotes courses not offered in 2002-03.
★ Denotes courses taught only in alternate years.
☐ Denotes courses with limited enrolment.

ARCH 201 COMMUNICATION, BEHAVIOUR AND ARCHITECTURE, (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.

ARCH 202 ARCHITECTURAL GRAPHICS AND ELEMENTS OF DESIGN, (6) (2-10-6) (Prerequisite: ARCH 201) 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.

ARCH 217 FREEHAND DRAWING 1, (1) (0-3-0) Drawing in pencil and charcoal.

ARCH 218 FREEHAND DRAWING 2, (1) (0-3-0) (Prerequisite: ARCH 217) A continuation of course ARCH 217.

ARCH 240 ORGANIZATION OF MATERIALS IN BUILDINGS, (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.

ARCH 250 ARCHITECTURAL HISTORY 1, (3) (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.

ARCH 251 ARCHITECTURAL HISTORY 2, (3) (2-0-4) (Prerequisite: ARCH 250) 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.

ARCH 252 INTRODUCTION TO ARCHITECTURAL HISTORY 1, (3) (3-0-6) (Open only to students outside the School of Architecture) 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.

ARCH 253 INTRODUCTION TO ARCHITECTURAL HISTORY 2, (3) (3-0-6) (Open only to students outside the School of Architecture) 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.

ARCH 303 DESIGN AND CONSTRUCTION 1, (6) (2-10-6) (Prerequisite: ARCH 202) 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.

ARCH 304 DESIGN AND CONSTRUCTION 2, (6) (2-10-6) (Prerequisite: ARCH 303) 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.

ARCH 318 DESIGN SKETCHING, (3) (2-4-3) (Prerequisite: ARCH 202) (Departmental permission required)

ARCH 319 THE CAMERA AND PERCEPTION, (3) (2-4-3) (Prerequisite: ARCH 202) (Departmental permission required) 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.

ARCH 321 FREEHAND DRAWING 3, (1) (0-3-0) (Prerequisite: ARCH 218) A continuation of course ARCH 218.

ARCH 322 FREEHAND DRAWING 4, (1) (0-3-0) (Prerequisite: ARCH 321) A continuation of course ARCH 321.

ARCH 324 SKETCHING SCHOOL 1, (1) (0-0-3) (Prerequisite: ARCH 218) 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.

ARCH 350 THE MATERIAL CULTURE OF CANADA, (3) (2-1-6) (Section 01: Architecture students) (Section 02: Canadian Studies) (Section 03: others) A study of Material Culture in Canada, the "stuff" of our lives; using a multi-disciplinary 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.

ARCH 352 ART AND THEORY OF HOUSE DESIGN, (3) (2-2-5) (Prerequisite: ARCH 202 or permission of instructor) (Section 01: 2002-2003 Undergraduate Programs, McGill University
ARCH 346 ARCHITECTURAL MODELLING. (3) (2-1-6) (Prerequisite: ARCH 202 and ARCH 471) 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.

ARCH 375 LANDSCAPE. (2) (2-2-2) (Prerequisite: ARCH 202) Land form, plant life, microclimate; land use and land preservation; elements and methods of landscape design.

ARCH 377 ENERGY, ENVIRONMENT AND BUILDINGS. (2) (2-0-4) (Prerequisite: ARCH 202 or permission of instructor) (Section 01: Architecture students) (Section 02: others; limited enrolment.) 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.

ARCH 378 SITE USAGE. (3) (2-0-7) (Prerequisite: ARCH 202 or permission of instructor) (Section 01: Architecture students) (Section 02: others; limited enrolment.) The study of the creation, form and usage of the exterior space generated in various patterns: 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.

ARCH 379 SUMMER COURSE ABROAD. (3) (0-0-9) (Prerequisite: ARCH 202 or permission of instructor) (Departmental permission required) 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.

ARCH 383 GEOMETRY/ARCHITECTURE/ENVIRONMENT. (2) (2-0-4) (Prerequisite: ARCH 202 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.

ARCH 405 DESIGN AND CONSTRUCTION 3. (6) (2-10-6) (Prerequisite: ARCH 304) 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.

ARCH 406 DESIGN AND CONSTRUCTION 4. (6) (2-10-6) (Prerequisite: ARCH 405) 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.

ARCH 410 DESIGN AND CONSTRUCTION 5. (6)

ARCH 447 ELECTRICAL SERVICES. (2) (2-2-2) (Prerequisite: ARCH 304) (Section 01: Architecture students) (Section 02: others; limited enrolment.) Production, measurement and control of light; design of lighting systems; electrical distribution in residential and commercial buildings; Canadian Electrical Code.

ARCH 451 BUILDING REGULATIONS AND SAFETY. (2) (2-2-2) (Prerequisite: ARCH 405) (Section 01: Architecture students) (Section 02: others; limited enrolment.) 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.

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

ARCH 471 COMPUTER-AIDED BUILDING DESIGN. (2) (2-2-2) (Prerequisite: ARCH 202 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.

ARCH 490 SELECTED TOPICS IN DESIGN. (2) (2-0-4) (Prerequisite: ARCH 202 or permission of instructor) A course to allow the introduction of special topics in the architectural curriculum.

ARCH 520 MONTRÉAL: URBAN MORPHOLOGY. (3) (2-1-6) (Prerequisite: ARCH 251) (Section 01: Architecture students) (Section 02: others; limited enrolment.) Historical, geographical, demographic, and regional evolution of the metropolis of Montreal. Topics include: important quarters, 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.

ARCH 521 STRUCTURE OF CITIES. (3) (2-0-7) (Prerequisite: ARCH 202 or permission of instructor) (Section 01: Architecture students) (Section 02: others; limited enrolment.)

ARCH 522 HISTORY OF DOMESTIC ARCHITECTURE IN QUEBEC. (3) (2-0-7) (Prerequisite: ARCH 251) (Departmental permission required)

ARCH 523 SIGNIFICANT TEXTS AND BUILDINGS. (3) (2-0-7) (Prerequisite: ARCH 251) (Alternating with ARCH 524) (Departmental permission required) 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 areas of design.

ARCH 524 SEMINAR ON ARCHITECTURAL CRITICISM. (3) (2-2-7) (Prerequisite: ARCH 251) (Alternating with ARCH 525) (Departmental permission required)

ARCH 525 SEMINAR ON ANALYSIS AND THEORY. (3) (2-0-7) (Prerequisite: ARCH 202 or permission of instructor) (Departmental permission required)

ARCH 526 PHILOSOPHY OF STRUCTURE. (3) (2-0-7) (Prerequisite: ARCH 202 or permission of Instructor) (Not open to students who have taken ARCH 374) (Section 01: Architecture students) (Section 02: others; limited enrolment.) Philosophy of Structure aims to investigate structure in its broadest sense. The course is divided into 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 nature (geology, turbulence), man or animals.

ARCH 527 CIVIC DESIGN. (3) (2-0-7) (Prerequisite: ARCH 378) (Section 01: Architecture students) (Section 02: others; limited enrolment.) The elements of form in buildings and their siting design in the urban setting.

ARCH 528 HISTORY OF HOUSING. (3) (2-0-7) (Prerequisite: ARCH 251 or permission of instructor) (Section 01: Architecture students) (Section 02: others) 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.
ARCH 529 HOUSING THEORY. (3) (2-0-7) (Prerequisite: ARCH 528 or permission of instructor) (Section 01: Architecture students) (Section 02: others; limited enrolment.) A review of environmental alternatives in housing; contemporary housing and the physical and sociological determinants that shape it; Canadian housing.

ARCH 531 ARCHITECTURAL INTENTIONS VITRUVIUS - RENAISSANCE. (3) (2-0-7) (Prerequisite: ARCH 251) (Section 01: Architecture students) (Section 02: others; limited enrolment.) Examination of architectural intentions and theory in the Renaissance (especially France, Italy and England), during the crucial period that marks the beginning of the modern era.

ARCH 532 ORIGINS OF MODERN ARCHITECTURE. (3) (2-0-7) (Prerequisite: ARCH 251 or permission of instructor) (Departmental permission required)

ARCH 540 SELECTED TOPICS IN ARCHITECTURE 1. (3) (2-0-7) A course to introduce students to new ideas in architecture as needs arise, by regular and visiting staff.

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

ARCH 550 URBAN PLANNING 1. (3) (2-0-7) (Prerequisite: B.Sc.(Arch.) or permission of instructor) (Not normally open to Urban Planning students) (Section 01: Architecture students) (Section 02: others; limited enrolment.) Theory and practice. An examination of different basic approaches to urban planning with special reference to Quebec.

ARCH 551 URBAN PLANNING 2. (3) (2-1-6) (Prerequisite: ARCH 550) (Section 01: Architecture students) (Section 02: others; limited enrolment.) Urban design and project development, theory and practice. Detailed analysis of selected examples of the development process and of current techniques in urban design. Includes case studies from Quebec and elsewhere.

ARCH 554 MECHANICAL SERVICES. (2) (2-0-4) (Prerequisite: ARCH 405 or permission of instructor) (Section 01: Architecture students) (Section 02: others; limited enrolment.) Problems encountered in providing mechanical services in buildings. Physical 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.

ARCH 555 ENVIRONMENTAL ACOUSTICS. (2) (2-0-4) (Prerequisite: ARCH 405 or permission of instructor) (Section 01: Architecture students) (Section 02: others; limited enrolment.) 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.

OCC1 442 ENVIRONMENTS FOR THE DISABLED. (2) (1-2-3) (Prerequisite: ARCH 303 for Architecture students; OCC1 326 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.

4.3 Department of Chemical Engineering

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Montreal, QC H3A 2B2
Telephone: (514) 398-4494
Fax: (514) 398-8678
http://www.mcgill.ca/chemeng

Chair — Richard J. Munz

Post-Retirement
J.-M. Charrier; Dipl.Ing., E.N. S.A.M. (Paris), M.S., Ph.D.(Akon), Ing.
W.J. Murray Douglas; B.Sc.(Qu.), M.S.E., Ph.D.(Mich.)

Professors
David G. Cooper; B.Sc., Ph.D.(Tor.)
John M. Dealy; B.S.(Kansas), M.S.E., Ph.D.(Mich.), Eng.
Musa R. Kamal; B.S.(Ill.), M.S., Ph.D.(Carnegie-Mellon), Eng.
Richard J. Munz; B.A.Sc., M.A.Sc.(Wat.), Ph.D.(McG.), Eng.
Alejandro D. Rey; B.Ch.Eng.(CCNY), Ph.D.(Berkeley) (James McGill Professor)
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.)

Associate Professors
Dimitrios Berk; B.Sc.(Bosphorus), M.E.Sc.(W.Ont.), Ph.D.(Calg.), P.Eng.
Jean-Luc Meunier; Dipl. Ing., EPFL(Lausanne), M.Sc., Ph.D., INRS(Varennes), Ing.
Jana Simandi; B.Eng(McG.), Ph.D.(Calg.), P.Eng.

Assistant Professors
Wayne A. Brown; B.Eng., M.Eng., Ph.D.(McG.)
Sylvain Coulombe; B.Sc., M.Eng.(Sherb.), Ph.D.(McG.)
Richard L. Leask; B.A.Sc., M.A.Sc. (Wat.), Ph.D.(Tor.)
Sasha Omanovic; B.Sc., Ph.D. (Zagreb)
PAPRICAN Adjunct Professor
George J. Kubis; B.Eng., M.Eng.(Prague), Ph.D.(Bratislava)

Adjunct Professors

The central purpose of engineering is to solve problems of technology 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, economic and environmental concerns. 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

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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 may be exempt from course CHEM 212 or CHEM 234, respectively (Introductory Organic Chemistry 1 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 MATH 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

<table>
<thead>
<tr>
<th>COURSE</th>
<th>CREDIT</th>
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<tbody>
<tr>
<td>CHEM 212 Introductory Organic Chemistry 1</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 233 Sel. Topics in Phys. Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 234 Sel. Topics in Org. Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>COMP 208 Computers in Engineering</td>
<td>3</td>
</tr>
<tr>
<td>MATH 260 Intermediate Calculus</td>
<td>3</td>
</tr>
<tr>
<td>MATH 261 Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>MATH 265 Advanced Calculus</td>
<td>3</td>
</tr>
<tr>
<td>MIME 221 Engineering Professional Practice</td>
<td>1</td>
</tr>
<tr>
<td>MIME 310 Engineering Economy</td>
<td>3</td>
</tr>
</tbody>
</table>

CHEMICAL ENGINEERING COURSES

<table>
<thead>
<tr>
<th>COURSE</th>
<th>CREDIT</th>
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<tbody>
<tr>
<td>CHEE 200 Intro. to Chemical Eng.</td>
<td>4</td>
</tr>
<tr>
<td>CHEE 204 Chemical Manuf. Processes</td>
<td>3</td>
</tr>
<tr>
<td>CHEE 220 Chem. Eng. Thermodynamics</td>
<td>3</td>
</tr>
<tr>
<td>CHEE 291 Instr. Measurements Lab.</td>
<td>4</td>
</tr>
<tr>
<td>CHEE 314 Fluid Mechanics</td>
<td>4</td>
</tr>
<tr>
<td>CHEE 315 Heat and Mass Transfer</td>
<td>4</td>
</tr>
<tr>
<td>CHEE 340 Process Modelling</td>
<td>3</td>
</tr>
<tr>
<td>CHEE 351 Separation Processes</td>
<td>3</td>
</tr>
<tr>
<td>CHEE 360 Technical Paper 1</td>
<td>1</td>
</tr>
<tr>
<td>CHEE 370 Elements of Biotechnology</td>
<td>3</td>
</tr>
<tr>
<td>CHEE 380 Materials Science</td>
<td>3</td>
</tr>
<tr>
<td>CHEE 392 Project Laboratory 1</td>
<td>4</td>
</tr>
<tr>
<td>CHEE 393 Project Laboratory 2</td>
<td>5</td>
</tr>
<tr>
<td>CHEE 423 Chemical Reaction Engineering</td>
<td>4</td>
</tr>
<tr>
<td>CHEE 453 Process Design</td>
<td>4</td>
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<tr>
<td>CHEE 455 Process Control</td>
<td>4</td>
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<tr>
<td>CHEE 456 Design Project 1</td>
<td>1</td>
</tr>
<tr>
<td>CHEE 457 Design Project 2</td>
<td>5</td>
</tr>
<tr>
<td>CHEE 462 Technical Paper 2</td>
<td>1</td>
</tr>
<tr>
<td>CHEE 474 Biochemical Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CHEE 484 Materials Engineering</td>
<td>3</td>
</tr>
</tbody>
</table>

COMPLEMENTARY COURSES

Courses to be selected from those approved by the Department (see list of technical complements below)

See section 3.4. The Chemical Engineering program requires 6 credits selected from categories (i) and (ii) of section 3.4.

TOTAL 110

If advanced credit is obtained for MATH 260 Intermediate Calculus (see section 2.4), 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

<table>
<thead>
<tr>
<th>COURSE</th>
<th>CREDIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEE 200 Intro. to Chemical Eng.</td>
<td>4</td>
</tr>
<tr>
<td>CHEE 291 Instr. Meas. Lab.</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 212 Organic Chemistry 1</td>
<td>4</td>
</tr>
<tr>
<td>MATH 260 Intermediate Calculus</td>
<td>3</td>
</tr>
<tr>
<td>MIME 221 Engineering Professional Practice</td>
<td>1 16</td>
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</tbody>
</table>

Semester 2

<table>
<thead>
<tr>
<th>COURSE</th>
<th>CREDIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEE 204 Chemical Manuf. Processes</td>
<td>3</td>
</tr>
<tr>
<td>CHEE 220 Chem. Eng. Thermodynamics</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 234 Organic Chemistry 2</td>
<td>3</td>
</tr>
<tr>
<td>COMP 208 Computers in Engineering</td>
<td>3</td>
</tr>
<tr>
<td>MATH 261 Differential Equations</td>
<td>3</td>
</tr>
</tbody>
</table>

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

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

TECHNICAL COMPLEMENTARIES

A minimum of 9 credits of complementary courses must be chosen from a list of technical complements 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 complements 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.
The Technical Complementary courses currently approved by the Department are as follows:

- BIOT 505 Selected Topics in Biotechnology (Biotechnology Minor students only)
- CHEE 363 Projects in Chemical Engineering 1
- CHEE 438 Eng. Princ. of Pulp & Paper Processes
- CHEE 452 Particulate Systems
- CHEE 458 Computer Applications
- CHEE 464 Projects in Chemical Engineering 2
- CHEE 471 Industrial Water Pollution Control (or CIVE 430)
- CHEE 472 Industrial Air Pollution Control (or MECH 534)
- CHEE 481 Polymer Engineering
- CHEE 487 Chemical Processing in the Electronics Industry
- CHEE 494 Research Project and Seminar
- CHEE 495 Research Project and Seminar
- CHEE 571 Small Computer Applications in Chemical Engineering
- CHEE 581 Polymer Composites Engineering

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

Courses CHEE 370 and CHEE 474 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: CHEE 471 and CHEE 472. As some water pollution control problems are quite technical in nature, the course CHEE 474 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 CHEE 452 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 complementary courses are offered only in alternate years. Students should, therefore, plan their complementsaries as far ahead as possible. With the approval of the instructor and academic advisor, students may also take graduate (CHEE 500- level) courses as technical complementsaries.

**ELECTIVE COURSES**

Students who have obtained exemptions for courses, i.e. for CEGEP courses equivalent to CHEM 212 or CHEM 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**

For the Term (Fall and/or Winter), days, and times when courses will be offered, please refer to the 2002-2003 Class Schedule on the Web, http://www.mcgill.ca/students/. Class locations and names of instructors are also provided.

Students preparing to register are advised to consult the Class Schedule website for the most up-to-date list of courses available. New courses may have been added or courses rescheduled after this Calendar went to press.

The schedule of courses to be offered in Summer 2003 will be available on the website in January.

CHEE has replaced 302 as the prefix for Chemical Engineering courses.

The course credit weight is given in parentheses after the title.

- Denotes courses not offered in 2002-03.
- Denotes courses with limited enrolment.

**CHEE 200 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.

**CHEE 204 CHEMICAL MANUFACTURING PROCESSES.** (3) (2-3-4) (Prerequisite: CHEE 200) Material and energy balances in chemical processes. Problem solving in the design of separation processes (evaporation, crystallization), reactor design, process control, and environmental applications. Reactor design and environmental

**CHEE 220 CHEMICAL ENGINEERING THERMODYNAMICS.** (3) (3-1-8) (Prerequisite: CHEE 200) 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.

- **CHEE 230 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.


**CHEE 314 FLUID MECHANICS.** (4) (3-3-6) (Prerequisite: CHEE 204. Corequisite: MATH 265.) 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.

**CHEE 315 HEAT AND MASS TRANSFER.** (4) (3-2-7) (Prerequisite: CHEE 314) Transport of heat and mass by diffusion and convection; transport of heat by radiation; diffusion; convective mass transfer; drying; absorption; mathematical formulation of prob-
lems and equipment design for heat and mass transfer; laboratory exercises.

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

CHEE 351 SEPARATION PROCESSES. (3) (3-0-6) (Prerequisites: CHEE 204, CHEE 220. Corequisites: CHEE 315) Concepts underlying separation processes. Equilibrium-based processes with staging and continuous contacting, distillation, evaporation, liquid-liquid extraction, leaching. Introduction to membrane based separations.

CHEE 360 TECHNICAL PAPER 1. (1) (0-0-3) A technical paper prepared according to instructions issued by the Department.

CHEE 363 PROJECTS CHEMICAL ENGINEERING 1. (2) (1-0-5) (Prerequisite: CHEE 200 (A D grade is acceptable for prerequisite purposes only)) 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.

CHEE 370 ELEMENTS OF BIOTECHNOLOGY. (3) (3-0-6) (Prerequisite: CHEE 234) Enzyme kinetics; proteins, carbohydrates and other biochemicals; industrially significant microbes; introduction to genetic engineering, cell structure and metabolism; laboratory exercises.

CHEE 380 MATERIALS SCIENCE. (3) (3-1-5) (Prerequisite: CHEE 220) 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.

CHEE 392 PROJECT LABORATORY 1. (4) (3-3-6) (Prerequisite: CHEE 291) 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.

CHEE 393 PROJECT LABORATORY 2. (5) (2-10-4) (Prerequisite: CHEE 392) Student groups execute and report on experimental projects.


CHEE 430 TECHNOLOGY IMPACT ASSESSMENT. (3) (3-1-5) (Restricted to final year students by permission of instructor) CHEE 438 ENERGY PRINCIPLES IN PULP AND PAPER PROCESSES. (3) (3-0-6) (Corequisite: CHEE 423) 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.

CHEE 452 PARTICULATE SYSTEMS. (3) (3-0-6) (Prerequisites: CHEE 200, CHEE 314) (A D grade is acceptable for prerequisite purposes only.) Study of operations involving multiphase systems with one of the phases finely sub-divided as bubbles, drops or particles. Applications in environmental engineering, grinding, agglomeration, settling, fluidization.

CHEE 453 PROCESS DESIGN. (4) (4-1-7) (Prerequisites: CHEE 315; MIME 310. Corequisite: CHEE 351) 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.

CHEE 455 PROCESS CONTROL. (4) (3-1-8) (Prerequisites: CHEE 315, CHEE 351, CHEE 423) 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.

CHEE 456 DESIGN PROJECT 1. (1) (1-0-2) (Prerequisite: CHEE 393. Corequisite: CHEE 456. Must be taken in the semester preceding CHEE 547.) Introduction to a process design and economic evaluation project, including environmental and safety aspects, for a major industrial operation. Students work in small groups under an experienced plant design supervisor.

CHEE 457 DESIGN PROJECT 2. (5) (1-2-12) (Prerequisite: CHEE 456. Must be taken in the semester following CHEE 456.) A process plant design and economic evaluation, including environmental and safety aspects, for a major industrial operation. Students work in small groups, under an experienced plant design supervisor. Plant visit.

CHEE 458 COMPUTER APPLICATIONS. (3) (2-3-4) (Prerequisites: COMP 208 and CHEE 393) 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.

CHEE 462 TECHNICAL PAPER 2. (1) (0-0-3) (Prerequisite: CHEE 360) A technical paper prepared according to instructions issued by the Department.

CHEE 464 PROJECTS CHEMICAL ENGINEERING 2. (2) (1-0-5) (Prerequisite: CHEE 363) 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.

CHEE 471 INDUSTRIAL WATER POLLUTION CONTROL. (3) (3-0-6) (Prerequisite: CHEE 314 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.

CHEE 472 INDUSTRIAL AIR POLLUTION CONTROL. (3) (2-0-7) (Prerequisite: CHEE 314 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.

CHEE 474 BIOCHEMICAL ENGINEERING. (3) (3-0-6) (Prerequisites: CHEE 370, CHEE 423) Bioreactor design for biotechnology and environmental applications; microbial growth kinetics; application of transport phenomena and selected chemical engineering unit operations. Bioreactor instrumentation and performance optimization. Air and media sterilization processes. Selected operations of downstream processing and product recovery.

CHEE 481 POLYMER ENGINEERING. (3) (3-0-6) (Prerequisite: CHEE 212) 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, viscoelasticity and rheology, processing techniques; extrusion, molding, etc.

CHEE 484 MATERIALS ENGINEERING. (3) (3-0-6) (Prerequisites: CHEE 315, CHEE 380) 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.
CHEE 487 CHEMICAL PROCESSING: ELECTRONICS INDUSTRY. (3) (3-0-6) (Prerequisite: CHEM 233) 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.

CHEE 494 RESEARCH PROJECT AND SEMINAR. (3) (1-6-2) (Prerequisite: CHEE 393) Independent study and experimental work on a topic chosen by consultation between the student and Departmental Staff.

CHEE 494D1 RESEARCH PROJECT AND SEMINAR. (1.5) (Students must also register for CHEE 494D2) (No credit will be given for this course unless both CHEE 494D1 and CHEE 494D2 are completed successfully in consecutive terms) (CHEE 494D1 and CHEE 494D2 together are equivalent to CHEE 494) See CHEE 494 for course description.

CHEE 494D2 RESEARCH PROJECT AND SEMINAR. (1.5) (Prerequisite: CHEE 494D1) (No credit will be given for this course unless both CHEE 494D1 and CHEE 494D2 are successfully completed in consecutive terms) (CHEE 494D1 and CHEE 494D2 together are equivalent to CHEE 494) See CHEE 494 for course description.

CHEE 495 RESEARCH PROJECT AND SEMINAR. (4) (1-9-2) (Prerequisite: CHEE 393) Independent study and experimental work on a topic chosen by consultation between the student and the Departmental Staff.

CHEE 495D1 RESEARCH PROJECT AND SEMINAR. (2) (Students must also register for CHEE 495D2) (No credit will be given for this course unless both CHEE 495D1 and CHEE 495D2 are successfully completed in consecutive terms) (CHEE 495D1 and CHEE 495D2 together are equivalent to CHEE 495) See CHEE 495 for course description.

CHEE 495D2 RESEARCH PROJECT AND SEMINAR. (2) (Prerequisite: CHEE 495D1) (No credit will be given for this course unless both CHEE 495D1 and CHEE 495D2 are successfully completed in consecutive terms) (CHEE 495D1 and CHEE 495D2 together are equivalent to CHEE 495) See CHEE 495 for course description.

CHEE 496 ENVIRONMENTAL RESEARCH PROJECT. (3) (1-6-2) (Prerequisite: CHEE 393 or permission of instructor) Independent study and experimental work on an environmental topic chosen by consultation between the student and Departmental Staff.

CHEE 496D1 ENVIRONMENTAL RESEARCH PROJECT. (1.5) (Students must also register for CHEE 496D2) (No credit will be given for this course unless both CHEE 496D1 and CHEE 496D2 are successfully completed in consecutive terms) (CHEE 496D1 and CHEE 496D2 together are equivalent to CHEE 496) See CHEE 496 for course description.

CHEE 496D2 ENVIRONMENTAL RESEARCH PROJECT. (1.5) (Prerequisite: CHEE 496D1) (No credit will be given for this course unless both CHEE 496D1 and CHEE 496D2 are successfully completed in consecutive terms) (CHEE 496D1 and CHEE 496D2 together are equivalent to CHEE 496) See CHEE 496 for course description.

CHEE 571 SMALL COMPUTER APPLICATIONS: CHEMICAL ENGINEERING. (3) (2-0-7) (Prerequisite: CHEE 458 or permission of the instructor) Undergraduate program: complementary course) 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.

CHEE 581 POLYMER COMPOSITES ENGINEERING. (3) (3-0-6) (Prerequisite: CHEE 481 or permission of instructor) Undergraduate program: complementary course) 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.

CHEE 591 ENVIRONMENTAL BIOREMediation. (3) (3-0-6) (Undergraduate program: complementary course)
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:


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 Welcome to McGill for the prescribed courses for the first two semesters. All students must meet with their advisor each semester 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 advisor. 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 advisor.

CURRICULUM FOR THE B.ENG. DEGREE IN CIVIL ENGINEERING

<table>
<thead>
<tr>
<th>REQUIRED COURSES</th>
<th>COURSE</th>
<th>CREDIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-departmental courses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMP 208 Computers in Engineering</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>EDEC 206 Communication in Engineering</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>EPSC 221 General Geology</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MATH 260 Intermediate Calculus</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MATH 261 Differential Equations</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MATH 265 Advanced Calculus</td>
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<tr>
<td>MECH 261 Measurement Laboratory</td>
<td>2</td>
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<tr>
<td>MECH 290 Graphics</td>
<td>3</td>
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</tr>
<tr>
<td>MIME 221 Engineering Professional Practice</td>
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<td></td>
</tr>
<tr>
<td>MIME 310 Engineering Economy</td>
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</tbody>
</table>

Two courses (6 credits) to be selected in consultation with academic advisor as prescribed by section 3.4. 6

TOTAL CREDITS 108

If advanced credit given for MATH 260, Intermediate Calculus (see section 2.4)

TOTAL CREDITS 105

Departmental courses

<table>
<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
<td>CIVE 202</td>
<td>Construction Materials</td>
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</tr>
<tr>
<td>CIVE 205</td>
<td>Statics</td>
<td>3</td>
</tr>
<tr>
<td>CIVE 206</td>
<td>Dynamics</td>
<td>3</td>
</tr>
<tr>
<td>CIVE 207</td>
<td>Solid Mechanics</td>
<td>4</td>
</tr>
<tr>
<td>CIVE 208</td>
<td>Civil Eng Systems Analysis</td>
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<tr>
<td>CIVE 210</td>
<td>Surveying</td>
<td>2</td>
</tr>
<tr>
<td>CIVE 225</td>
<td>Environmental Engineering</td>
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</tr>
<tr>
<td>CIVE 290</td>
<td>Thermodynamics &amp; Heat Transfer</td>
<td>3</td>
</tr>
<tr>
<td>CIVE 302</td>
<td>Probabilistic Systems</td>
<td>3</td>
</tr>
<tr>
<td>CIVE 311</td>
<td>Geotechnical Mechanics</td>
<td>4</td>
</tr>
<tr>
<td>CIVE 317</td>
<td>Structural Engineering 1</td>
<td>3</td>
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<td>CIVE 318</td>
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<td>Transportation Engineering</td>
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<tr>
<td>CIVE 320</td>
<td>Numerical Methods</td>
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<tr>
<td>CIVE 323</td>
<td>Hydrology &amp; Water Resources</td>
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<td>CIVE 324</td>
<td>Construction Project Management</td>
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<tr>
<td>CIVE 327</td>
<td>Fluid Mechanics and Hydraulics</td>
<td>4</td>
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<tr>
<td>CIVE 418</td>
<td>Design Project</td>
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<tr>
<td>CIVE 432</td>
<td>Technical Paper</td>
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</table>

COMPLEMENTARY COURSES

A minimum of six credits to be selected from list (a) and the remaining nine credits to be selected from lists (a) or (b) or from other suitable undergraduate or 500-level courses.

(a) Design Technical Complementary

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit</th>
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<tbody>
<tr>
<td>CIVE 416</td>
<td>Geotechnical Engineering</td>
<td>(3)</td>
</tr>
<tr>
<td>CIVE 421</td>
<td>Municipal Systems</td>
<td>(3)</td>
</tr>
<tr>
<td>CIVE 428</td>
<td>Water Resources &amp; Hydraulic Engineering</td>
<td>(3)</td>
</tr>
<tr>
<td>CIVE 462</td>
<td>Design of Steel Structures</td>
<td>(3)</td>
</tr>
<tr>
<td>CIVE 463</td>
<td>Design of Concrete Structures</td>
<td>(3)</td>
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</table>

(b) General Technical Complementary

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit</th>
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</thead>
<tbody>
<tr>
<td>CIVE 430</td>
<td>Water Treatment &amp; Pollut Control</td>
<td>(3)</td>
</tr>
<tr>
<td>CIVE 433</td>
<td>Urban Planning</td>
<td>(3)</td>
</tr>
<tr>
<td>CIVE 440</td>
<td>Traffic Engineering</td>
<td>(3)</td>
</tr>
<tr>
<td>CIVE 446</td>
<td>Construction Engineering</td>
<td>(3)</td>
</tr>
<tr>
<td>CIVE 451</td>
<td>Geoenvironmental Engineering</td>
<td>(3)</td>
</tr>
<tr>
<td>CIVE 460</td>
<td>Matrix Structural Analysis</td>
<td>(3)</td>
</tr>
<tr>
<td>CIVE 470</td>
<td>Research Project</td>
<td>(3)</td>
</tr>
<tr>
<td>CIVE 512</td>
<td>Advanced Civil Engrg Materials</td>
<td>(3)</td>
</tr>
<tr>
<td>CIVE 514</td>
<td>Structural Mechanics</td>
<td>(3)</td>
</tr>
<tr>
<td>CIVE 526</td>
<td>Solid Waste Management</td>
<td>(3)</td>
</tr>
<tr>
<td>CIVE 527</td>
<td>Renov &amp; Preserv of Infrastructure</td>
<td>(3)</td>
</tr>
<tr>
<td>CIVE 540</td>
<td>Urban Transportation Planning</td>
<td>(3)</td>
</tr>
<tr>
<td>CIVE 541</td>
<td>Rail Engineering</td>
<td>(3)</td>
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<tr>
<td>CIVE 550</td>
<td>Water Resources Management</td>
<td>(3)</td>
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<tr>
<td>CIVE 553</td>
<td>Stream Pollution and Control</td>
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<td>CIVE 555</td>
<td>Environmental Data Analysis</td>
<td>(3)</td>
</tr>
<tr>
<td>CIVE 570</td>
<td>Waves and Costal Engineering</td>
<td>(3)</td>
</tr>
<tr>
<td>CIVE 572</td>
<td>Computational Hydraulics</td>
<td>(3)</td>
</tr>
<tr>
<td>CIVE 573</td>
<td>Hydraulic Structures</td>
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<td>CIVE 574</td>
<td>Fluid Mech of Water Pollution</td>
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<td>CIVE 576</td>
<td>Hydrodynamics</td>
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<td>CIVE 577</td>
<td>River Engineering</td>
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<td>CIVE 579</td>
<td>Water Power Engineering</td>
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<td>CIVE 585</td>
<td>Groundwater Hydrology</td>
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<tr>
<td>CIVE 586</td>
<td>Earthwork Engineering</td>
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<tr>
<td>CIVE 587</td>
<td>Pavement Design</td>
<td>(3)</td>
</tr>
</tbody>
</table>

TOTAL CREDITS 105
COURSES OFFERED BY THE DEPARTMENT

For the Term (Fall and/or Winter), days, and times when courses will be offered, please refer to the 2002-2003 Class Schedule on the Web, http://www.mcgill.ca/students/. Class locations and names of instructors are also provided.

Students preparing to register are advised to consult the Class Schedule website for the most up-to-date list of courses available. New courses may have been added or courses rescheduled after this Calendar went to press.

The schedule of courses to be offered in Summer 2003 will be available on the website in January.

CIVE has replaced 303 as the prefix for Civil and Applied Mechanics Engineering courses.

The course credit weight is given in parentheses after the title.

- Denotes courses not offered in 2002-03.
- Denotes courses with limited enrolment.

CIVE 202 CONSTRUCTION MATERIALS. (4) (4-2-6) (Prerequisite: CIVE 290) 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, cements, concrete, timber and timber products, polymers, composites; smart materials and systems; electrochemical reactions and corrosion, prevention and protection; environmental influences; group laboratory projects.

CIVE 203 SOLID MECHANICS LABORATORY. (1)

CIVE 205 STATICS. (3) (3-2-4) Systems of forces and couples, resultant, equilibrium. Trusses, frames and beams, reactions, shear forces, bending moments. Centroids, centres of gravity, distributed forces, moments of inertia. Friction, limiting equilibrium, screws, belts.

CIVE 206 DYNAMICS. (3) (3-2-4) (Prerequisite: CIVE 205. Corequisites: MATH 260 and MATH 261) Kinematics and kinetics of particles, systems, and rigid bodies; mass-acceleration, work-energy, impulse-momentum. Moving coordinate systems. Lagrange’s equations. Vibrations and waves.

CIVE 207 SOLID MECHANICS. (4) (3-2-T) (Prerequisites: CIVE 205 (a D grade is acceptable for prerequisite purposes), MECH 290 (under special circumstances, the Department may permit this course to be taken as a corequisite) or equivalent) (Two-hour laboratory periods, alternate weeks. Weekly tutorials) 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.

CIVE 208 CIVIL ENGINEERING SYSTEMS ANALYSIS. (3) (3-1-5) (Prerequisites: COMP 208 and Corequisite: MATH 265) 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.

CIVE 210 SURVEYING. (2) (Two weeks after winter session examination period) (Prerequisite: COMP 208) 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.

CIVE 225 ENVIRONMENTAL ENGINEERING. (4)(4-2-6) (Prerequisite: CIVE 290. Corequisite: MATH 261) 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.

CIVE 229 SURVEYING FOR ARCHITECTS. (2) (2-3-1)


CIVE 283 STRENGTH OF MATERIALS. (4) (4-1-7) (Prerequisite: CIVE 205 (a D grade is acceptable for prerequisite purposes)) 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.

CIVE 290 THERMODYNAMICS AND 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.

CIVE 302 PROBABILISTIC SYSTEMS. (3) (3-1-5) (Prerequisite: MATH 260 and COMP 208 (a D grade is acceptable for prerequisite purposes)) An introduction to probability and statistics with applications to Civil Engineering design. Descriptive statistics, common probability models, statistical estimation, regression and correlation, acceptance sampling.

CIVE 311 GEOTECHNICAL MECHANICS. (4) (3-3-6) (Prerequisite: CIVE 207) 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.

CIVE 317 STRUCTURAL ENGINEERING 1. (3) (3-1-5) (Prerequisites: CIVE 202 and CIVE 207) 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.

CIVE 318 STRUCTURAL ENGINEERING 2. (3) (3-1-5) (Prerequisite: CIVE 317) Durability and service life; fire resistance; 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.

CIVE 319 TRANSPORTATION ENGINEERING. (3) (3-1-5) (Prerequisites: CIVE 208 and COMP 208. Corequisite: CIVE 302) 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.

CIVE 320 NUMERICAL METHODS. (4) (3-3-6) (Prerequisites: COMP 208 and MATH 265) 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.


CIVE 324 CONSTRUCTION PROJECT MANAGEMENT. (3) (3-1-5) (Prerequisites: MIME 310 and CIVE 208) Construction fundamen-
CIVE 440 TRAFFIC ENGINEERING. (3) (3-1-5) (Prerequisite: CIVE 319 (a D grade is acceptable for prerequisite purposes)) 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.

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

CIVE 451 GEOMATERIALS ENGINEERING. (3) (3-1.5-4.5) (Prerequisites: CIVE 225 and CIVE 311) 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.

CIVE 465 MATRIX STRUCTURAL ANALYSIS. (3) (3-2-4) (Prerequisites: CIVE 206 and CIVE 317) 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.

CIVE 467 DESIGN OF STEEL STRUCTURES. (3) (3-3-3) (Prerequisite: CIVE 318) 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.

CIVE 468 DESIGN OF CONCRETE STRUCTURES. (3) (3-3-3) (Prerequisite: CIVE 318) Review of flexural behavior and design concepts. Design of flexural members, columns, two-way slab systems, retaining walls, disturbed regions, and shear walls. Introduction to prestressed concrete design.

CIVE 469 INFRASTRUCTURE AND SOCIETY. (3) (3-2-4) (Prerequisite: MISE 310)
CIVE 540 URBAN TRANSPORTATION PLANNING. (3) (3-1-5) (Prerequisite: CIVE 319 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.

- CIVE 541 RAIL ENGINEERING. (3) (3-1-5)

- CIVE 546 SELECTED TOPICS IN CIVIL ENGINEERING. (3) (3-0-6)

CIVE 550 WATER RESOURCES MANAGEMENT. (3) (3-0-6) (Prerequisite: CIVE 323 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.

CIVE 553 STREAM POLLUTION AND CONTROL. (3) (3-2-4) (Prerequisite: CIVE 225) Water quality standards. Physical and chemical pollution, 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.


- CIVE 570 WAVES AND COASTAL ENGINEERING. (3) (3-0-6) (Prerequisite: CIVE 327)

- CIVE 572 COMPUTATIONAL HYDRAULICS. (3) (3-0-6) (Prerequisite: CIVE 327 or equivalent)

CIVE 573 HYDRAULIC STRUCTURES. (3) (3-0-6) (Prerequisites: CIVE 323 and CIVE 327) 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.

CIVE 574 FLUID MECHANICS OF WATER POLLUTION. (3) (Prerequisite: CIVE 327 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.

- CIVE 576 HYDRODYNAMICS. (3) (3-0-6) (Prerequisite: CIVE 327 or equivalent)

CIVE 577 RIVER ENGINEERING. (3) (3-0-6) (Prerequisite: CIVE 327) Fluvial geomorphology; sediment properties; river turbulence; mechanics of the entrainment, transportation and deposition of solids by fluids; trend of movement; bed forms; suspended load, bed load and total load equations; stable channel design and regime rivers; river modeling; river engineering and river management.

- CIVE 579 WATER POWER ENGINEERING. (3) (3-0-6) (Prerequisites: CIVE 323 and MME 310)

- CIVE 585 GROUNDWATER HYDROLOGY. (3) (3-0-6)

- CIVE 586 EARTHWORK ENGINEERING. (3) (3-0-6)

- CIVE 587 PAVEMENT DESIGN. (3) (3-0-6)

4.5 Department of Electrical and Computer Engineering

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Fax: (514) 398-4470

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Chair — David A. Lowther
Associate Chair — Jonathan P. Webb

Emeritus Professors
Eric L. Adler; B.Sc.(Lond.), M.A.Sc.(Tor.), Ph.D.(McG.), F.I.E.E.E., Eng.


Post-Retirement

Clifford H. Champness; M.Sc.(Lond.), Ph.D.(McG).


Professors


Geza Joos; B.Sc.(C’dia), M.Eng. Ph.D.(McG).

Peter Kabal; B.A.Sc., M.A.Sc., Ph.D.(Tor.)

Tho Le-Ngoc; M.Eng.(McG.), Ph.D.(Ott.), F.I.E.E.E.

Harry Leib; B.Sc.(Technion), Ph.D.(Tor.)


David A. Lowther; B.Sc.(Lond.), Ph.D.(C.N.A.A.), F.C.A.E., Eng.


Gordon Roberts; B.A.Sc.(Wat.), M.A.Sc., Ph.D.(Tor.), Eng.

(William Dawson Scholar)

Jonathan Webb; B.A., Ph.D.(Ott., Can.

Assistants

Benoit Chamagne; B.Eng., M.Eng.(Montr.), Ph.D.(Tor.)

James Clark; B.Sc., Ph.D.(Br.Col.)

Frank Ferrie; B.Eng., Ph.D.(McG.)


Steve McFee; B.Eng., Ph.D.(McG.)

Hanna Michalska; B.Sc., M.Sc.(Warsaw), Ph.D.(Lond.)

David V. Plant; M.S., Ph.D.(Brown) (James McGill Professor)

Ishiang Shih; M.Eng., Ph.D.(McG.)

Assistant Professors

Tal Arbel; M.Eng., Ph.D.(McG.)

Jan Bacsky; B.Sc.(Harv.), M.Eng., Ph.D.(Prin.)

Benoit Boulet; B.Sc.(Laval), M.Eng.(McG.), Ph.D.(Tor.)

Lawrence Chen; B.Eng.(McG.), M.A.Sc., Ph.D.(Tor.)

Mark Coates; B.Eng.(Australia), Ph.D.(Cambridge)

Jeremy R. Cooperstock; A.Sc.(U.B.C.), M.Sc., Ph.D.(Tor.)

Mourad El-Gamal; B.Sc.(Cairo), M.Sc.(Nashville), Ph.D.(McG.)

Dennis Giannacopoulos; M.Eng., Ph.D.(McG.)

Andrew Kirk; B.Sc.(Brist.), Ph.D.(London) (William Dawson Scholar)

Fabrice Labeau; M.S., Ph.D.(Louvain)

Radu Negulescu; M.Sc.(Romania), M.Sc.(France), Ph.D.(Waterloo)

Milica Popovich; B.Sc.(Colo.), M.Sc., Ph.D.(Northwestern)

Ioannis Psaromiligos; B.Sc.(Patras), M.Sc., Ph.D.(Buffalo)

Zilic Zeljko; B.Eng.(Zagreb), M.S.C., Ph.D.(Tor.)

Visiting Professor

Nathan Ida; B.Sc., M.Sc.(Israel), Ph.D.(Colo.)

Birendra Prasad; M.Sc.(Ban.), Ph.D.(Lond.)
Lecturer
Kenneth L. Fraser, B.Eng., M.Eng.(McG.), Eng.

Associate Members
Martin Buehler; M.Sc., Ph.D.(Yale)
Philipe Depalle; D.E.A.(Le Mans & ENS Cachan, Ph.D.(Le Mans & IRCAM)
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.)
Bernard Segal; B.Sc., B.Eng., M.Eng., Ph.D.(McG.)

Adjunct Professors
Vinod Agarwal, Ray Barthikas, Maier Blostein,
Jean Luc Bouchard, Eduard Cerny, Simon Chamlian,
Charalambo Charalambous, Danny Grant, Cedric Guss, Maurice
Huneault, Cheng K. Jen, Michael Kaplan, Karim Khordoc,
Irene Leszkowicz, Lin Lin, Miguel Marin, Donald McGillis,
Douglas O’Shaughnessy, Norbert Puetz, Katarzyna Radecka,
Jean Regnier, Farouk Rizk, Mohammad R. Soleymani, 
Richard Vickers, Lucjan Wegrowicz.

General Information on Programs
The Department of Electrical and Computer Engineering offers undergraduate degree programs in Electrical Engineering, Electrical Engineering (Honours), Computer Engineering, and Software 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 complementsaries 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 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 background in modern computer technology, it also provides the underlying depth for graduate studies in all fields of Computer Engineering.

The Department, jointly with the School of Computer Science, will offer a Bachelor of Software Engineering program (subject to Ministry of Education approval)*. Graduates of this program should be eligible for accreditation (once accreditation standards for Software Engineers have been adopted). This new program offers students the opportunity to focus their studies on the skills needed to design and develop complex software systems. This emerging field of engineering is a major component of the growing Information Technology (IT) sector of the economy, in which the demand for qualified personnel continues to outstrip supply. Graduates of this program will have a solid foundation for careers in the software industry. [*The School of Computer Science will also offer a B.Sc. Major program in Software Engineering (subject to Ministry of Education approval). The B.Sc. program will not lead to accreditation. For further information on the Major in Software, refer to the School of Computer Science entry in the Faculty of Science section, page 394.]

In addition to technical complementary courses, students in all three programs take general complementary courses in social sciences, administrative studies and humanities. These courses allow students to develop specific interests in areas such as psychology, economics, management or political science.

Entrance Requirements and Advanced Standing
The curricula for the various programs offered by the Department are outlined below. Students entering Electrical or Computer Engineering from CEGEP may obtain advanced credit for MATH 260 Intermediate Calculus by passing the Advanced Credit Examination described in section 2.4.

Entry into the Honours Program
The Honours Program is a limited enrollment program and entry is highly competitive. There is no direct entry to the Honours program in the first year. Students may enter the Honours Program in the following ways:

- Students from CEGEP (7 semester) will be admitted, on the basis of their grades, at the start of the third semester.
- Students from outside Quebec (8 semester) will be admitted, at the start of the fifth semester, on the basis of their grades.

Though not required to do so, students in the Honours Program or wishing to enter the Honours Program are encouraged to take the following advanced math and physics courses:

- MATH 325 Ordinary Differential Eqs instead of MATH 261
- MATH 247 Linear Algebra instead of MATH 270
- MATH 248 Advanced Calculus 1 instead of MATH 265
- MATH 249 Advanced Calculus 2 instead of MATH 381
- PHYS 251 Mechanics instead of CIVE 281

To remain in the Honours program and to be awarded the Honours Degree, a student must have completed at least 14 credits in each semester since entering Electrical Engineering and maintained a CGPA of at least 3.00 since entering Electrical Engineering. For more information, please contact the Departmental office at (514) 398-7344.

CURRICULUM FOR THE B.ENG. DEGREE IN ELECTRICAL ENGINEERING (HONOURS)

<table>
<thead>
<tr>
<th>REQUIRED COURSES</th>
<th>COURSE CREDIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMP 202 Intro. to Computer Science</td>
<td>3</td>
</tr>
<tr>
<td>EDEC 206 Communication in Engineering</td>
<td>3</td>
</tr>
<tr>
<td>MATH 260 Intermediate Calculus</td>
<td>3</td>
</tr>
<tr>
<td>MATH 247* Linear Algebra</td>
<td>3</td>
</tr>
<tr>
<td>or MATH 270 Applied Linear Algebra (3)</td>
<td></td>
</tr>
<tr>
<td>MATH 248* Advanced Calculus 1</td>
<td>3</td>
</tr>
<tr>
<td>or MATH 265 Advanced Calculus (3)</td>
<td></td>
</tr>
<tr>
<td>MATH 249 Advanced Calculus 2</td>
<td>3</td>
</tr>
<tr>
<td>or MATH 381 Complex Variables &amp; Transforms (3)</td>
<td></td>
</tr>
<tr>
<td>MATH 325 Ordinary Differential Eqs</td>
<td>3</td>
</tr>
<tr>
<td>or MATH 261 Differential Equations (3)</td>
<td></td>
</tr>
<tr>
<td>MIME 221 Engineering Professional Practice</td>
<td>1</td>
</tr>
<tr>
<td>MIME 310 Engineering Economy</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 251 Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>or CIVE 281 Analytical Mechanics (3)</td>
<td></td>
</tr>
<tr>
<td>PHYS 271 Quantum Physics</td>
<td>3</td>
</tr>
</tbody>
</table>

* CGPA of 3.30 is required to register for MATH 247 and MATH 248.
**Departmental Courses**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECSE 200</td>
<td>Fundamentals of Electrical Engineering</td>
<td>3</td>
</tr>
<tr>
<td>ECSE 210</td>
<td>Circuit Analysis</td>
<td>3</td>
</tr>
<tr>
<td>ECSE 221</td>
<td>Introduction to Computer Engineering</td>
<td>3</td>
</tr>
<tr>
<td>ECSE 291</td>
<td>Electrical Measurements Lab</td>
<td>2</td>
</tr>
<tr>
<td>ECSE 303</td>
<td>Signals &amp; Systems 1</td>
<td>3</td>
</tr>
<tr>
<td>ECSE 304</td>
<td>Signals &amp; Systems 2</td>
<td>3</td>
</tr>
<tr>
<td>ECSE 305</td>
<td>Probability &amp; Random Sig. 1</td>
<td>3</td>
</tr>
<tr>
<td>ECSE 322</td>
<td>Computer Engineering</td>
<td>3</td>
</tr>
<tr>
<td>ECSE 323</td>
<td>Digital System Design</td>
<td>3</td>
</tr>
<tr>
<td>ECSE 330</td>
<td>Electronic Circuits 1</td>
<td>3</td>
</tr>
<tr>
<td>ECSE 334</td>
<td>Electronic Circuits 2</td>
<td>5</td>
</tr>
<tr>
<td>ECSE 351</td>
<td>Electromagnetic Fields</td>
<td>3</td>
</tr>
<tr>
<td>ECSE 352</td>
<td>EM Waves and Optics</td>
<td>3</td>
</tr>
<tr>
<td>ECSE 361</td>
<td>Power Engineering</td>
<td>3</td>
</tr>
<tr>
<td>ECSE 498</td>
<td>Honours Thesis 1</td>
<td>3</td>
</tr>
<tr>
<td>ECSE 499</td>
<td>Honours Thesis 2</td>
<td>2</td>
</tr>
</tbody>
</table>

**COMPLEMENTARY COURSES**

**Technical Complementary Courses**

Five technical complementary courses (15 credits), which must be Electrical Engineering Courses at the 500 level (or ECSE 427, ECSE 451). Students must choose their technical complementary courses so that they complete at least 9 credits in one of the following concentrations. However, with Departmental approval, the Honours Thesis 1 and 2 (ECSE 498 and ECSE 499) can count as 6 of the 9 credits. The remaining courses may be any at the 500 level offered by the Department. The choice is not restricted.

**Computer Systems Technology**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECSE 427</td>
<td>Operating Systems</td>
</tr>
<tr>
<td>ECSE 525</td>
<td>Computer Architecture</td>
</tr>
<tr>
<td>ECSE 532</td>
<td>Computer Graphics</td>
</tr>
<tr>
<td>ECSE 548</td>
<td>Introduction to VLSI</td>
</tr>
</tbody>
</table>

**Control and Automation**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECSE 501</td>
<td>Linear Systems</td>
</tr>
<tr>
<td>ECSE 502</td>
<td>Control Engineering</td>
</tr>
<tr>
<td>ECSE 503</td>
<td>Linear Stochastic Systems 1</td>
</tr>
<tr>
<td>ECSE 504</td>
<td>Computer Control</td>
</tr>
<tr>
<td>ECSE 505</td>
<td>Nonlinear Control Systems</td>
</tr>
<tr>
<td>ECSE 507</td>
<td>Optimization and Optimal Control</td>
</tr>
<tr>
<td>ECSE 509</td>
<td>Probability and Random Sig. 2</td>
</tr>
<tr>
<td>ECSE 512</td>
<td>Digital Signal Processing 1</td>
</tr>
<tr>
<td>ECSE 529</td>
<td>Image Processing &amp; Communication</td>
</tr>
<tr>
<td>ECSE 531</td>
<td>Real Time Systems</td>
</tr>
</tbody>
</table>

**Integrated Circuits and Electronics**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECSE 522</td>
<td>Asynchronous Circuits and Systems</td>
</tr>
<tr>
<td>ECSE 527</td>
<td>Optical Engineering</td>
</tr>
<tr>
<td>ECSE 530</td>
<td>Logic Synthesis</td>
</tr>
<tr>
<td>ECSE 533</td>
<td>Physical Basis of Semiconductors</td>
</tr>
<tr>
<td>ECSE 534</td>
<td>Analog Microelectronics</td>
</tr>
<tr>
<td>ECSE 545</td>
<td>Microelectronics Technology</td>
</tr>
<tr>
<td>ECSE 548</td>
<td>Introduction to VLSI</td>
</tr>
<tr>
<td>ECSE 571</td>
<td>Optoelectronic Devices</td>
</tr>
<tr>
<td>ECSE 573</td>
<td>Microwave Electronics</td>
</tr>
</tbody>
</table>

**Power Engineering**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECSE 502</td>
<td>Control Engineering</td>
</tr>
<tr>
<td>ECSE 549</td>
<td>Expert Systems in Electrical Design</td>
</tr>
<tr>
<td>ECSE 559</td>
<td>Flexible AC Transmission Systems</td>
</tr>
<tr>
<td>ECSE 560</td>
<td>Power Systems 2</td>
</tr>
<tr>
<td>ECSE 563</td>
<td>Power Systems Operation and Planning</td>
</tr>
<tr>
<td>ECSE 565</td>
<td>Power Electronics</td>
</tr>
</tbody>
</table>

**Telecommunications**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECSE 451</td>
<td>EM Transmission and Radiation</td>
</tr>
<tr>
<td>ECSE 509</td>
<td>Probability and Random Sig. 2</td>
</tr>
<tr>
<td>ECSE 511</td>
<td>Intro. to Digital Comm.</td>
</tr>
<tr>
<td>ECSE 512</td>
<td>Digital Signal Processing 1</td>
</tr>
<tr>
<td>ECSE 521</td>
<td>Digital Communications 1</td>
</tr>
<tr>
<td>ECSE 523</td>
<td>Speech Communications</td>
</tr>
<tr>
<td>ECSE 527</td>
<td>Optical Engineering</td>
</tr>
<tr>
<td>ECSE 528</td>
<td>Telecom. Network Architecture</td>
</tr>
</tbody>
</table>

**Laboratory Complementary Courses**

ECSE 571 Optoelectronic Devices
ECSE 596 Optical Waveguides

**General Complementary Courses**

Two 400-level laboratory courses in Electrical Engineering.

**Course Credit**

- MATH 260 Intermediate Calculus: 3 credits
- MATH 261 Differential Equations: 3 credits
- MATH 265 Advanced Calculus: 3 credits
- MATH 248 Advanced Calculus: 3 credits
- MATH 270 Applied Linear Algebra: 3 credits
- or MATH 247* Linear Algebra: 3 credits

* CGPA of 3.30 is required to register for MATH 247 and MATH 248.

**Departmental Courses**

<table>
<thead>
<tr>
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<th>Title</th>
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<tbody>
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<tr>
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<tr>
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<td>3</td>
</tr>
<tr>
<td>ECSE 305</td>
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</tr>
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<td>ECSE 330</td>
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</tr>
<tr>
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<td>ECSE 352</td>
<td>EM Waves and Optics</td>
<td>3</td>
</tr>
<tr>
<td>ECSE 361</td>
<td>Power Engineering</td>
<td>3</td>
</tr>
<tr>
<td>ECSE 494</td>
<td>Design Project</td>
<td>3</td>
</tr>
</tbody>
</table>

**COMPLEMENTARY COURSES**

**Technical Complementary Courses**

Six courses (18 credits) from the list of 400-level courses in Electrical Engineering that must include 9 credits (3 courses) from one of the areas of concentration listed below:

**Computer Systems Technology**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECSE 424</td>
<td>Human Computer Interaction</td>
</tr>
<tr>
<td>ECSE 425</td>
<td>Computer Organization and Architecture</td>
</tr>
<tr>
<td>ECSE 427</td>
<td>Operating Systems</td>
</tr>
</tbody>
</table>

**Control & Automation**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECSE 404</td>
<td>Control Systems</td>
</tr>
<tr>
<td>ECSE 412</td>
<td>Discrete Time Signal Processing</td>
</tr>
<tr>
<td>ECSE 426</td>
<td>Microprocessor Systems</td>
</tr>
</tbody>
</table>

**Integrated Circuits & Electronics**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECSE 425</td>
<td>Computer Organization and Architecture</td>
</tr>
<tr>
<td>ECSE 431</td>
<td>Electronic Design</td>
</tr>
<tr>
<td>ECSE 432</td>
<td>Physical Basis. Transistor Devices</td>
</tr>
<tr>
<td>ECSE 435</td>
<td>Mixed-Signal Test Techniques</td>
</tr>
</tbody>
</table>
Phototronics
ECSE 423 Optical Communications 1
ECSE 430 Optical Communications 2
ECSE 432 Physical Basis: Transistor Devices

Power Engineering
ECSE 404 Control Systems
ECSE 462 Electromechanical Energy Conversion
ECSE 464 Power System Analysis 1

Telecommunications*
ECSE 411 Communications Systems 1
ECSE 414 Introduction to Telecommunication Networks

and any one of the following:
ECSE 412 Discrete Time Signal Processing
ECSE 413 Communications Systems 2
ECSE 423 Optical Communications 1
ECSE 451 EM Transmission and Radiation

Laboratory Complementaries 4
Two 400-level laboratory courses in Electrical Engineering

General Complementaries 9
Two courses (6 credits) in Social Sciences, Administrative Studies or Humanities, selected from an approved list (category ii - section 3.4) and one course (3 credits) on the impact of technology (category i - section 3.4) in consultation with an academic advisor. At least one 3-credit course must be from category A (Humanities and Social Sciences) in section 3.4.

TOTAL CREDITS 110

*Enhanced ITT Concentration in Telecommunications
The International Institute of Telecommunications (ITT) was recently established in Montreal as a center for telecommunication education. It is funded by government and industry, and provides state-of-the-art laboratory facilities and a point of contact between local telecommunication industries and universities.

This program is open to students in the regular Electrical Engineering program only.

The benefits of the Concentration are:
– a guaranteed project lab (ECSE 494) in telecommunications, at ITT or with an IIT company; and
– permission to take ECSE 496 at ITT.

To complete the Concentration, students must take six courses as Technical Complementaries:
ECSE 411 Communications Systems 1
ECSE 414 Introduction to Telecommunication Networks
ECSE 496 Telecom. Systems and Services
and any three courses selected from the following list:
ECSE 412 Discrete Time Signal Processing
ECSE 413 Communications Systems 2
ECSE 423 Optical Communications 1
ECSE 451 EM Transmission and Radiation

In addition, students must take ECSE 491 (Communications Systems Lab) and complete ECSE 494 (Design Project) in telecommunications, at IIT or with an IIT company.

There may be an enrolment limitation in this concentration in any given semester.

CURRICULUM FOR THE B.ENG. DEGREE IN COMPUTER ENGINEERING

REQUIRED COURSES
Non-Departmental Courses
MATH 260 Intermediate Calculus 3
MATH 261 Differential Equations 3
or MATH 325 Ordinary Differential Equations (3)
MATH 265 Advanced Calculus 3
or MATH 248 Advanced Calculus 1 (3)
MATH 270 Applied Linear Algebra 3
or MATH 247 Linear Algebra (3)
MATH 363 Discrete Mathematics 3

MATH 381 Complex Variables & Transforms 3
CIVE 281 Mechanics 3
or PHYS 251 Mechanics (3)
MIME 221 Engineering Professional Practice 1
MIME 310 Engineering Economy 3
COMP 202 Intro. to Computing 1 3
COMP 250 Intro. to Computer Science 3
COMP 302 Programming Languages 3
EDEC 206 Communication in Engineering 3

* CGPA of 3.30 is required to register for MATH 247 and MATH 248.

Departmental Courses
ECSE 200 Fundamentals of Electrical Engineering 3
ECSE 210 Circuit Analysis 3
ECSE 221 Introduction to Computer Engineering 3
ECSE 291 Electrical Measurements Lab 2
ECSE 303 Signals & Systems 1 3
ECSE 304 Signals & Systems 2 3
ECSE 305 Probability & Random Sig. 1 3
ECSE 321 Introduction to Software Engineering 3
ECSE 322 Computer Engineering 3
ECSE 323 Digital System Design 5
ECSE 330 Electronic Circuits 1 3
ECSE 334 Electronic Circuits 2 5
ECSE 353 Electromagnetic Fields & Waves 3
ECSE 425 Computer Architecture 3
ECSE 427 Operating Systems 3
ECSE 494 Design Project 3

COMPLEMENTARY COURSES
Technical Complementaries 9
Three courses (9 credits) selected from the list of courses below:
ECSE 404 Control Systems
ECSE 411 Communications Systems 1
ECSE 412 Discrete-Time Signal Processing
ECSE 414 Introduction to Telecommunication Networks
ECSE 424 Human-Computer Interaction
ECSE 426 Microprocessor Systems
ECSE 428 Software Engineering Practice
ECSE 431 Electronic Design
ECSE 530 Logic Synthesis
ECSE 526 Artificial Intelligence
ECSE 531 Real-Time Systems
ECSE 532 Computer Graphics
ECSE 548 Introduction to VLSI Systems
COMP 420 File Systems
COMP 431 Algorithms & Data Structures
COMP 535 Computer Networks
COMP 575 Fundamentals of Parallel Computing

Laboratory Complementaries 4
Two 400-level laboratory courses in Electrical Engineering

General Complementaries 9
Two courses (6 credits) in Social Sciences, Administrative Studies or Humanities, selected from an approved list (category ii - section 3.4) and one course (3 credits) on the impact of technology (category i - section 3.4) in consultation with an academic advisor. At least one 3-credit course must be from category A (Humanities and Social Sciences) in section 3.4.

TOTAL CREDITS 110
CURRICULUM FOR THE BACHELOR IN SOFTWARE ENGINEERING (B.S.E.)
(subject to Ministry of Education approval)

REQUIRED COURSES

<table>
<thead>
<tr>
<th>COURSE</th>
<th>CREDIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECSE 221</td>
<td>Introduction to Computer Engineering</td>
</tr>
<tr>
<td>ECSE 321</td>
<td>Intro to Software Engineering</td>
</tr>
<tr>
<td>ECSE 322</td>
<td>Computer Engineering</td>
</tr>
<tr>
<td>ECSE 427</td>
<td>Operating Systems</td>
</tr>
<tr>
<td>ECSE 428</td>
<td>Software Engineering Practice</td>
</tr>
<tr>
<td>ECSE 495</td>
<td>Software Eng. Design Project</td>
</tr>
<tr>
<td>COMP 202</td>
<td>Introduction to Computing</td>
</tr>
<tr>
<td>COMP 206</td>
<td>Intro Software Systems</td>
</tr>
<tr>
<td>COMP 250</td>
<td>Intro to Computer Science</td>
</tr>
<tr>
<td>COMP 251</td>
<td>Data Structures and Algorithms</td>
</tr>
<tr>
<td>COMP 302</td>
<td>Programming Languages and Paradigms</td>
</tr>
<tr>
<td>COMP 330</td>
<td>Theoretical Aspects of Computer Science</td>
</tr>
<tr>
<td>COMP 360</td>
<td>Algorithm Design Techniques</td>
</tr>
<tr>
<td>COMP 361</td>
<td>Systems Programming Project</td>
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<tr>
<td>COMP 420</td>
<td>Files and Databases</td>
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</tbody>
</table>

Mathematics and Science Required Courses

<table>
<thead>
<tr>
<th>COURSE</th>
<th>CREDIT</th>
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</thead>
<tbody>
<tr>
<td>MATH 260</td>
<td>Intermediate Calculus</td>
</tr>
<tr>
<td>MATH 261</td>
<td>Differential Equations</td>
</tr>
<tr>
<td>MATH 270</td>
<td>Applied Linear Algebra</td>
</tr>
<tr>
<td>PHYS 230</td>
<td>Dynamics of Simple Systems</td>
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</tbody>
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Mathematics Complementary Course

<table>
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<tr>
<th>COURSE</th>
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<tbody>
<tr>
<td>MATH 363</td>
<td>Discrete Mathematics</td>
</tr>
<tr>
<td>or MATH 381</td>
<td>Complex Variables &amp; Transforms</td>
</tr>
</tbody>
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Engineering Breadth Required Courses

<table>
<thead>
<tr>
<th>COURSE</th>
<th>CREDIT</th>
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<tbody>
<tr>
<td>ECSE 200</td>
<td>Fundamentals of Electrical Engineering</td>
</tr>
<tr>
<td>ECSE 210</td>
<td>Circuit Analysis</td>
</tr>
<tr>
<td>ECSE 291</td>
<td>Electrical Measurements Lab</td>
</tr>
<tr>
<td>ECSE 303</td>
<td>Signals and Systems</td>
</tr>
<tr>
<td>ECSE 305</td>
<td>Probability and Random Sig.</td>
</tr>
<tr>
<td>ECSE 330</td>
<td>Electronic Circuits</td>
</tr>
<tr>
<td>EDEC 206</td>
<td>Communication in Engineering</td>
</tr>
<tr>
<td>MIME 310</td>
<td>Engineering Economy</td>
</tr>
<tr>
<td>MIME 221</td>
<td>Engineering Professional Practice</td>
</tr>
</tbody>
</table>

Technical Complementaries

<table>
<thead>
<tr>
<th>COURSE</th>
<th>CREDIT</th>
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<tbody>
<tr>
<td>Students must take 14-16 credits of technical complementaries from the following list, of which at least 6 credits must be taken from list A and the remainder from list B.</td>
<td></td>
</tr>
</tbody>
</table>

Group A Technical Complementaries

<table>
<thead>
<tr>
<th>COURSE</th>
<th>CREDIT</th>
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</thead>
<tbody>
<tr>
<td>COMP 350</td>
<td>Numerical Computing</td>
</tr>
<tr>
<td>COMP 409</td>
<td>Concurrent Programming</td>
</tr>
<tr>
<td>COMP 424</td>
<td>Topics in Artificial Intelligence</td>
</tr>
<tr>
<td>COMP 433</td>
<td>Personal Software Engineering</td>
</tr>
<tr>
<td>COMP 524</td>
<td>Theoretical Found. of Prog. Lang.</td>
</tr>
<tr>
<td>COMP 575</td>
<td>Fundamentals of Distributed Algorithms</td>
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</table>

Group B Technical Complementaries

<table>
<thead>
<tr>
<th>COURSE</th>
<th>CREDIT</th>
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<tbody>
<tr>
<td>ECSE 304</td>
<td>Signals and Systems</td>
</tr>
<tr>
<td>ECSE 323</td>
<td>Digital Systems Design</td>
</tr>
<tr>
<td>ECSE 404</td>
<td>Control Systems</td>
</tr>
<tr>
<td>ECSE 411</td>
<td>Communications Systems</td>
</tr>
<tr>
<td>ECSE 412</td>
<td>Discrete Time Signal Processing</td>
</tr>
<tr>
<td>ECSE 413</td>
<td>Communications Systems</td>
</tr>
<tr>
<td>ECSE 414</td>
<td>Introduction to Telecommunication Networks</td>
</tr>
<tr>
<td>ECSE 421</td>
<td>Embedded Systems</td>
</tr>
<tr>
<td>ECSE 422</td>
<td>Fault Tolerant Computing</td>
</tr>
<tr>
<td>ECSE 420</td>
<td>Parallel Computing</td>
</tr>
<tr>
<td>ECSE 424</td>
<td>Human-Computer Interaction</td>
</tr>
<tr>
<td>ECSE 425</td>
<td>Computer Organization and Architecture</td>
</tr>
<tr>
<td>ECSE 426</td>
<td>Microprocessor Systems</td>
</tr>
<tr>
<td>or COMP 573 Microcomputers</td>
<td>3</td>
</tr>
<tr>
<td>ECSE 504</td>
<td>Computer Control</td>
</tr>
<tr>
<td>ECSE 522</td>
<td>Asynchronous Circuits and Systems</td>
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<tr>
<th>COURSE</th>
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<tbody>
<tr>
<td>ECSE 526</td>
<td>Artificial Intelligence</td>
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<tr>
<td>ECSE 529</td>
<td>Image Processing &amp; Communications</td>
</tr>
<tr>
<td>ECSE 530</td>
<td>Logic Synthesis</td>
</tr>
<tr>
<td>ECSE 531</td>
<td>Real-Time Systems</td>
</tr>
<tr>
<td>ECSE 532</td>
<td>Computer Graphics</td>
</tr>
<tr>
<td>or COMP 557 Fundamentals of Computer Graphics</td>
<td>3</td>
</tr>
<tr>
<td>COMP 410</td>
<td>Mobile Computing</td>
</tr>
<tr>
<td>COMP 412</td>
<td>Software for e-commerce</td>
</tr>
<tr>
<td>COMP 505</td>
<td>High-Performance Computer Architecture</td>
</tr>
<tr>
<td>COMP 520</td>
<td>Compiler Design</td>
</tr>
<tr>
<td>COMP 535</td>
<td>Computer Networks</td>
</tr>
<tr>
<td>COMP 566</td>
<td>Computer Methods in Operations Research</td>
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</table>

General Complementaries

<table>
<thead>
<tr>
<th>COURSE</th>
<th>CREDIT</th>
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<tbody>
<tr>
<td>Two courses (6 credits) in Social Sciences, Administrative Studies or Humanities, selected from an approved list (category ii - section 3.4) and one course (3 credits) on the impact of technology (category i - section 3.4) in consultation with an academic advisor. At least one 3-credit course must be from category A (Humanities and Social Sciences) in section 3.4.</td>
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</table>

TOTAL CREDITS

<table>
<thead>
<tr>
<th>COURSE</th>
<th>CREDIT</th>
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<tbody>
<tr>
<td>110/112</td>
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</tbody>
</table>

COURSES OFFERED BY THE DEPARTMENT

For the Term (Fall and/or Winter), days, and times when courses will be offered, please refer to the 2002-2003 Class Schedule on the Web, http://www.mcgill.ca/students/. Class locations and names of instructors are also provided.

Students preparing to register are advised to consult the Class Schedule website for the most up-to-date list of courses available. New courses may have been added or courses rescheduled after this Calendar went to press.

The schedule of courses to be offered in Summer 2003 will be available on the website in January.

ECSE has replaced 304 as the prefix for Electrical and Computer Engineering courses.

The course credit weight is given in parentheses after the title.

\[ \text{Denotes courses not offered in 2002-03.} \]

\[ \text{Denotes courses with limited enrolment.} \]

All courses with limitations listed for section A01 have a section A02 open to other students but with Department permission required.

Courses with laboratory components: the average number of hours per week of scheduled lab time is indicated by the second of the three bracketed numbers after the course title, e.g. (1-3-2) means 3 hours per week. Lab schedules are determined at the start of classes.

ECSE 200 FUNDAMENTALS OF ELECTRICAL ENGINEERING. (3) (3-0-6) (Corequisites: MATH 261 or MATH 325) (Section A01: Limited to Electrical Honours, Regular, and Computer Engineering students only.) An introduction to part of the broad scope of electrical engineering: electrostatics, capacitance, conduction, magnetic fields, inductance, circuits and components, sine waves in time and space, electrical machines and transformers, signal amplification.

ECSE 210 CIRCUIT ANALYSIS. (3) (3-1-5) (Prerequisite: ECSE 200) (For Fall Term: Section A01: Limited to Electrical Honours and Computer Engineering students only.) (For Winter Term: Section A01: Limited to Regular Electrical Engineering students only.) Circuit models, KCL and KVL, branch relations, resistive circuit analysis, network theorems, one- and two-port networks, networks in sinusoidal steady-state, power considerations, transient analysis of first- and second-order networks, response to exponential driving functions, frequency response of networks.

ECSE 221 INTRODUCTION TO COMPUTER ENGINEERING. (3) (3-1-5) (Corequisite: COMP 202) (Section A01: Limited to Electrical Honours, Regular, and Computer Engineering students only) Data representation in digital computers. Boolean algebra. Basic combinational circuits; their analysis and synthesis. Elements of sequential circuits: latches, flip-flops, counters and memory cir-
ECSE 271 ELECTRIC POWER UTILIZATION. (2)

ECSE 281 ELECTRIC POWER. (3)

ECSE 291 ELECTRICAL MEASUREMENTS LABORATORY. (2) (1-4-1) (Corequisite: ECSE 210) Experiments with fundamental electric circuits are used to illustrate the principles and limitations of basic electrical and electronic instrumentation in typical measurement applications. Basic electrical laboratory practice and safety procedures are introduced. Introduction to error analysis and application to laboratory measurements.

ECSE 303 SIGNALS AND SYSTEMS 1. (3) (3-0-6) (Prerequisites: ECSE 210, MATH 270 or MATH 247. Corequisite: MATH 381 or MATH 249) (Section A01: Limited to Electrical Honours, Regular, and Computer Engineering students only) Elementary continuous and discrete-time signals, impulse functions, basic properties of discrete and continuous time-invariant (LTI) systems, Fourier representation of continuous-time periodic and aperiodic signals, the Laplace transform, time and frequency analysis of continuous-time LTI systems, application of transform techniques to electric circuit analysis.

ECSE 304 SIGNALS AND SYSTEMS 2. (3) (3-0-6) (Prerequisite: ECSE 303) (Section A01: Limited to Electrical Honours, Regular, and Computer Engineering students only) Application of transforms to the analysis of LTI single-loop feedback systems, the discrete-time Fourier series, the Z transform, and time frequency analysis of discrete-time LTI systems, sampling systems, application of continuous and discrete-time signal theory to communications LTI systems.

ECSE 305 PROBABILITY AND RANDOM SIG. 1. (3) (3-0-6) (Prerequisite: ECSE 303) The basic probability model, the heuristics of model-building and the additivity of probability; classical models; conditional probability and Bayes’ rule; random variables and vectors, distribution and density functions, expectation; statistical independence, laws of large numbers, central limit theorem; introduction to random processes and random signal analysis.

ECSE 321 INTRODUCTION TO SOFTWARE ENGINEERING. (3) (3-1-5) (Prerequisites: COMP 202 or COMP 208) Design, development and testing of software systems. Software life cycle: requirements analysis, software architecture and design, implementation, integration, test planning, and maintenance. The course involves a group project.

ECSE 322 COMPUTER ENGINEERING. (3) (3-0-6) (Prerequisites: ECSE 200 and ECSE 221) (Not open to students who have taken ECSE 222) Data structures (arrays, lists, stacks, queues, deques and trees) and their machine representation and simple algorithms. Peripheral devices: printers, keyboards, magnetic type drives, magnetic disc drives. Peripheral interfacing and busses. Introduction to operating systems. System integration. Computer systems and networks.

ECSE 323 DIGITAL SYSTEM DESIGN. (5) (3-6-6) (Prerequisites: ECSE 291, ECSE 221, and EDEC 206) (Section A01: Limited to Regular Electrical Engineering students only) Minimization and synthesis of combinational logic and finite state machines. Synthesis of synchronous and asynchronous sequential circuits. Principles of control design. Basic concepts in design for testability. The laboratory experiments involve the design and testing of digital systems using small and medium scale integrated circuits. CAD software is used in the design process.

ECSE 330 ELECTRONIC CIRCUITS 1. (3) (3-0-6) (Prerequisite: ECSE 210) (Section A01: Limited to Electrical Honours, Regular, and Computer Engineering students only) Operational amplifier circuits; conduction in semiconductors, PN junction diodes, diode circuit applications; JFET, MOSFET and Bipolar transistors, terminal characteristics, small and large signal models; simple amplifier configurations, three-tertiary properties of small-signal models; frequency response of simple amplifier configurations; simple multistage amplifiers.

ECSE 334 ELECTRONIC CIRCUITS 2. (5) (3-6-6) (Prerequisite: ECSE 291, ECSE 303, ECSE 330 and EDEC 206) (Section A01: Limited to Electrical Honours, Regular and Computer Engineering students only) Differential and multistage amplifiers, power amplifiers, feedback amplifiers, active filters, tuned amplifiers, oscillators; MOS and Bipolar digital circuits including gates, latches and multivibrators; A/D and D/A conversion techniques.

ECSE 351 ELECTROMAGNETIC FIELDS. (3) (3-1-5) (Prerequisites: ECSE 200 and MATH 265) (Section A01: Limited to Electrical Honours, Regular, and Computer Engineering students only) Maxwell’s equations, electrostatics, magnetostatics and induction for power-frequency electrical engineering problems.

ECSE 352 EM WAVES AND OPTICS. (3) (3-1-5) (Prerequisite: ECSE 351) (Limited to Electrical Honours, Regular, and Computer Engineering students only) Transient and steady state wave propagation in transmission lines. Telephone and radio frequency lines. Smith’s chart and impedance matching. Maxwell’s equations, Helmholtz’s equations, Poynting’s theorem. Plane waves, polarization, Snell’s law, critical and Brewster’s angle. Rectangular waveguides, optical fibres, dispersion. Radiation and antennas.

ECSE 353 ELECTROMAGNETIC FIELDS AND WAVES. (3) (3-1-5) (Prerequisites: ECSE 210 and MATH 265) Maxwell’s equations. Waves in free space and on transmission lines. Electric and magnetic force and energy. Magnetic materials. Faraday’s law. Applications to engineering problems.


ECSE 411 COMMUNICATIONS SYSTEMS 1. (3) (3-0-6) (Prerequisites: ECSE 304 and ECSE 305) Communication system models; AM and FM modulation, performance of AM and FM systems; modulation and demodulation; noise; sampling, PCM and DPCM techniques; FDM and TDM multiplexing systems; baseband digital transmission over bandwidth-limited channels, digital modulation and detection techniques; illustrative examples of subscriber loop telephone systems, cable TV systems and broadcasting systems.

ECSE 412 DISCRETE TIME SIGNAL PROCESSING. (3) (3-0-6) (Prerequisite: ECSE 304) Discrete-time signals and systems; Fourier and Z-transform analysis techniques, the discrete Fourier transform; elements of FIR and IIR filter design, filter structures, FFT techniques for high speed convolution; quantization effects.

ECSE 413 COMMUNICATIONS SYSTEMS 2. (3) (3-0-6) (Prerequisite: ECSE 411) Introduction to radio communications; satellite communication systems; the cellular concept; fading channel models, digital modulation techniques over fading channels, diversity systems, spread spectrum techniques; fixed assignment multiple access (FDMA, TDMA, CDMA), duplexing methods (FDD, TDD); illustrative examples of terrestrial mobile systems, fixed wireless systems, LEOs, etc.; overview of standardization activities.

ECSE 414 INTRODUCTION TO TELECOMMUNICATION NETWORKS. (3) (3-0-6) (Prerequisites: ECSE 304, ECSE 305 and ECSE 322) Introduction to the physical and software architecture of modern networks; transport configurations, multiplexing, the digital hierarchy; wired and wireless access systems; circuit and packet switching systems, signaling, addressing and routing; protocol


ECSE 422 FAULT TOLERANT COMPUTING. (3) (3-0-6) (Prerequisite: ECSE 427) Introduction to fault-tolerant systems. Fault-tolerance techniques through hardware, software, information and time redundancy. Failure classification, failure semantics, failure masking. Exception handling: detection, recovery, masking and propagation, termination vs resumption. Reliable storage, reliable communication. Process groups, synchronous and asynchronous group membership and broadcast services. Automatic redundancy management. Case studies.

ECSE 423 OPTICAL COMMUNICATIONS 1. (3) (3-0-6) (Prerequisites: ECSE 352, Corequisite: ECSE 350) Review of electromagnetic waves; propagation of light (free-space, optical fibers, and waveguides); dispersion; optical sources (fundamentals, LEDs, semiconductor lasers); optical detectors. Throughout the course, photonic systems applications will be addressed.

ECSE 424 HUMAN-COMPUTER INTERACTION. (3) (3-4-2) (Prerequisite: ECSE 322) The course highlights human-computer interaction strategies from an engineering perspective. Topics include user interfaces, novel paradigms in human-computer interaction, affordances, ecological interface design, ubiquitous computing and computer-supported cooperative work. Attention will be paid to issues of safety, usability, and performance.


ECSE 426 MICROPROCESSOR SYSTEMS. (3) (1-3-5) (Prerequisites: ECSE 323 and EDEC 205) (This course may be counted as a technical complementary or a lab complementary.) (Limited Enrolment (50)) Introduction to current microprocessors, their architecture, programming, interfacing and operating systems. The course includes lectures, use of crossassemblers, and simulators as well as laboratory experiments on actual microprocessor hardware.

ECSE 427 OPERATING SYSTEMS. (3) (3-3-3) (Prerequisite: ECSE 322) Operating system services, file system organization, disk and cpu scheduling, virtual memory management, concurrent processing and distributed systems, protection and security. Aspects of the DOS and UNIX operating systems and the C programming language. Programs that communicate between workstations across a network.

ECSE 428 SOFTWARE ENGINEERING PRACTICE. (3) (3-4-2) (Prerequisite: ECSE 321 or COMP 335) Software engineering practice in industry, related to the design and commissioning of large software systems. Ethical, social, economic, safety and legal issues. Metrics, project management, costing, marketing, control, standards, CASE tools and bugs. The course involves a large team project.

ECSE 429 SOFTWARE VALIDATION. (3) (3-0-6) (Prerequisite: ECSE 321) Correct and complete implementation of software requirements. Verification and validation lifecycle. Requirements analysis, model based analysis, and design analysis. Unit and system testing. Performance, risk management, software reuse. Ubiquitous computing.

ECSE 430 OPTICAL COMMUNICATIONS 2. (3) (3-0-6) (Prerequisites: ECSE 304 and ECSE 423) Modulation of optical signals; optical amplifiers; devices for optical signal processing (e.g. filters, routers, and cross-connect switches); link system engineering; concepts of WDM and TDM; issues in high-performance lightwave transmission systems.

ECSE 431 ELECTRONIC DESIGN. (3) (2-4-3) (Prerequisites: ECSE 323 and ECSE 330) (Limited enrolment - 30. Departmental permission required.) The computer-aided design of digital circuits. Hardware description languages, automatic synthesis, design for testability, technology mapping, simulation, timing analysis, generation of test vectors and fault coverage analysis. CAD tools supporting this design methodology are presented in the laboratory. The course includes a design project based on the gate array technology. This course may be counted as a technical complementary or a lab complementary.

ECSE 432 PHYSICAL BASIS: TRANSISTOR DEVICES. (3) (3-0-6) (Prerequisites: ECSE 330, ECSE 351 and PHYS 271) Quantitative analysis of diodes and transistors. Semiconductor fundamentals, equilibrium and non-equilibrium carrier transport, and Fermi levels. PN junction diodes, the ideal diode, and diode switching. Bipolar Junction Transistors (BJT), physics of the ideal BJT, the Ebers-Moll model. Field effect transistors, metal-oxide semiconductor structures, static and dynamic behaviour, small-signal models.

ECSE 435 MIXED-SIGNAL TEST TECHNIQUES. (3) (3-4-2) (Prerequisites: ECSE 304, and ECSE 334) Purpose and economics of mixed-signal test, DC measurements. Accuracy and repeatability. DSP-based theory and its applications to parametric testing of analog filters, DACs, and ADC. Timing and PLL measurements. Design for Testability. Laboratory experiments will be performed using a Teradyne A567 mixed-signal production tester.

ECSE 451 ELECTROMAGNETIC WAVES. (3) (3-0-6) (Prerequisite: ECSE 352) Microwave transmission through waveguides: impedance matching, microwave devices, filters and resonators; microwave transmission through free space; near and far field behaviour of electromagnetic radiators, simple antennas, antenna arrays, practical antenna parameters; the physics of the radio communication channel: reflection, diffraction and scattering and their macroscopic impact (multipath, fading).

ECSE 461 ELECTRIC MACHINERY. (3) (3-0-6) (Prerequisite: MECH 383) (Not open to students in Electrical Engineering) Electric and magnetic circuits. Notions of electromechanical energy conversion applied to electrical machines. Basic electrical machines - transformers, direct-current motors, synchronous motors and generators, three phase and single phase induction machines. Elements of modern electronically controlled electric drive systems.


ECSE 464 POWER SYSTEMS ANALYSIS 1. (3) (3-0-6) (Prerequisite: ECSE 361) Basic principles of planning and operating interconnected power systems with emphasis on Canadian conditions. Mathematical models for system. Steady-state analysis of power systems, load flow formulation and solution algorithms. Operating strategies, economic dispatch, voltage reactive power regulation, frequency and tie-line power control.
ECSE 472 Systems Design. (3) (2-2-5) (Prerequisite: At least 42 credits of Departmental courses and permission of instructor)

ECSE 485 IC Fabrication Laboratory. (2) (1-3-2) (Prerequisite: ECSE 334, EDEC 206. Corequisite: ECSE 432 or ECSE 533) (Limited Enrolment - 8) Essential processes for silicon semiconductor device fabrication: etching, diffusion, photolithography. Fabrication of large area PN junctions, selective area PN junctions and MOSFETs. Design and fabrication of simple MOS circuits. Electrical characterization of devices and circuits.

ECSE 486 Power Laboratory. (2) (1-3-2) (Prerequisites: EDEC 206, ECSE 361 and ECSE 334) (Limited Enrolment - 14) Techniques of electric power, efficiency, torque, speed measurements. Starting, running and control of electric machines: dc, synchronous, induction types. Power electronic controllers. Each group of students has access to a compact experiment bench containing a set of micro-machines and all the necessary equipment.

ECSE 487 Computer Architecture Laboratory. (2) (0-3-3) (Prerequisite: EDEC 206. Corequisite: ECSE 42S or ECSE 522) (Limited enrolment - 50) Basic software tools used in the design, synthesis and analysis of computer and communication systems such as data-paths, switching circuits, and arithmetic and logic circuits. Behavioral and structural modeling of hardware designs in the IEEE standard hardware description language VHDL. Synthesis and implementation of hardware designs using Programmable Logic Devices.


ECSE 489 Telecommunication Network Lab. (2) (Prerequisite: EDEC 206) (Corequisite: ECSE 414)

ECSE 490 Digital Signal Processing LAB. (2) (0-3-3) (Prerequisites: ECSE 291 and EDEC 206. Corequisite: ECSE 412 or ECSE 512) (Limited Enrolment - 30) (Departmental approval required) Experiments involving the digital processing of signals using computer-aided design tools for design, processing and visualization and real-time processing using DSP chips. Filter structures and design, multi-rate signal processing, filter banks, fast transforms, adaptive filtering, signal coding and quantization.

ECSE 491 Communication Systems Lab. (2) (0-3-3) (Prerequisites: ECSE 291 and EDEC 206. Corequisite: ECSE 411 or ECSE 511) (Limited Enrolment - 30) Experimental studies and simulation of analog and digital transmission techniques. Performance of AM and FM systems. FSK and PSK modulation techniques and spectra. Sampling of analog signals, PCM and TDM techniques.

ECSE 492 Optical Communications Lab. (2) (Prerequisite: ECSE 423 or ECSE 527, and EDEC 206) Hands-on experience of the physical layer of optical communications systems. Experiments involving fiber link characterization, laser measurements, beam divergence, coupling efficiency. Use of lasers, optical spectrum analyzer, data generator, beam profiler, photodetectors, optical filters. Experiments are supported with simulation and analysis software.

ECSE 493 Control and Robotics Laboratory. (2) (0-3-3) (Prerequisites: ECSE 291 and EDEC 206. Corequisite: ECSE 404 or ECSE 502) (Limited Enrolment - 16) Experimental studies for the design of control systems, with particular emphasis on motion control as applicable to robotics. Fundamentals of sensors and actuators. Linear compensator specification and design in the time and the frequency domain. Pole placement. Effect of model uncertainty on performance.

ECSE 494 Electrical Engineering Design Project. (3) (0-5-4) (Prerequisites: EDEC 206 and at least 42 Departmental credits) (Limited Enrolment - 50) A laboratory design project undertaken with close supervision of a staff member. The project consists of defining an engineering problem and seeking the solution through experimental investigation. Results are reported in a seminar at the end of term and in a technical paper.

ECSE 495 Software Engineering Design Project. (3) (0-5-4) (Prerequisites: ECSE 321 and at least 42 Departmental credits from Electrical and Computer Eng. and Computer Science)

ECSE 496 Telecommunications Systems and Services. (3) (3-3-3) (Prerequisites: ECSE 411 and ECSE 414) Case studies of several end-to-end telecommunications systems used for the delivery of various service application scenarios. Issues in network and systems architecture, technology, operations management, regulation and competition. Examples from conventional telephony, internet service delivery, wireless services and cable TV distribution.

ECSE 498 Honours Thesis 1. (3) (0-3-6) (Prerequisite: EDEC 206 and at least 42 Departmental credits) A research project undertaken with close supervision by a staff member. The work consists of defining an engineering problem, reviewing the associated literature, and seeking the solution through experimental investigation. A literature review and a written thesis proposal are required along with a seminar presentation at end of term.

ECSE 499 Honours Thesis 2. (3) (0-3-6) (Prerequisite: ECSE 498) A research project undertaken with close supervision by a staff member. A continuation of ECSE 498. The work consists of carrying out the research plan developed in ECSE 498 along with a seminar presentation at end of term.


ECSE 503 Linear Stochastic Systems 1. (3) (3-0-6) (Prerequisites: MATH 587 or ECSE 510)

ECSE 504 Computer Control. (3) (3-0-6) (Prerequisites: ECSE 404 or ECSE 502 and ECSE 305)

ECSE 505 Nonlinear Control Systems. (3) (3-0-6) (Prerequisite: ECSE 501) Basic ODE formulation of non-linear systems; structural properties; Lyapunov and LaSalle stability theory and nonlinear and multivariable controller design; input-output stability; small gain theorem, conservation, passivity; system linearization, zero and inverse dynamics and regulator design; discontinuous and sliding mode control; applications to deterministic adaptive control.

ECSE 507 Optimization and Optimal Control. (3) (3-0-6) (Prerequisites: MATH 265 or MATH 248 and MATH 270 or MATH 247) General Introduction to optimization methods including steepest descent, conjugate gradient, Newton algorithms. Generalized matrix inverses and the least squared error problem. Introduction to constrained optimality; convexity and duality; interior point methods. Introduction to dynamic optimization; existence theory, relaxed controls, the Pontryagin Maximum Principle. Sufficiency of the Maximum Principle.

ECSE 509 Probability and Random Sig. 2. (3) (3-0-6) (Prerequisites: ECSE 304 and ECSE 305) Multivariate Gaussian distributions; finite-dimensional mean-square estimation (multivariate case); principal components; introduction to random processes; weak stationarity: correlation functions, spectra, linear processing and estimation; Poisson processes and Markov chains: state processes, invariant distributions; stochastic simulation.
● ECSE 510 Random Processes. (3) (3-0-6) (Prerequisite: ECSE 509)

ECSE 511 Introduction to Digital Communication. (3) (3-0-6) (Prerequisite: ECSE 304. Corequisite: ECSE 509) (An advanced version of ECSE 411) Amplitude and angle modulation including AM, FM, FDM and television systems; introduction to random processes; sampling and quantization, PCM systems, TDMA; digital modulation techniques, Maximum-Likelihood receivers, synchronization issues; elements of information theory including information sources, source coding and channel capacity.

ECSE 512 Digital Signal Processing 1. (3) (3-0-6) (Prerequisite: ECSE 304 and ECSE 305) Review of discrete-time transforms, sampling and quantization, frequency analysis. Structures for IIR and FIR filters, coefficient quantization, roundoff noise. The DFT, its properties, frequency analysis and filtering using DFT methods, the FFT and its implementation. Multirate processing, subsampling and interpolation, oversampling techniques.


ECSE 523 Speech Communications. (3) (3-0-6) (Prerequisite: ECSE 412 or ECSE 512) Articulatory and acoustic descriptions of speech production, speech production models, speech perception, digital processing of speech signals, vocoders using formant, linear predictive and cepstral techniques, overview of automatic speech recognition systems, speech synthesis systems and speaker verification systems.

● ECSE 525 Computer Architecture. (3) (3-0-6) (Prerequisites: ECSE 322 and ECSE 323)

ECSE 526 Artificial Intelligence. (3) (3-0-6) (Prerequisite: ECSE 322) Design principles of autonomous agents, agent architectures, machine learning, neural networks, genetic algorithms, and multi-agent collaboration. The course includes a term project that consists of designing and implementing software agents that collaborate and compete in a simulated environment.

ECSE 527 Optical Engineering. (3) (3-0-6) (Prerequisite: ECSE 304 and ECSE 352) A structure introduction to modern optical engineering. Topics covered include the propagation of light through space, refraction, diffraction, polarization, lens systems, ray-tracing, aberrations, computer-aided design and optimization techniques, Gaussian beam analysis, micro-optics and computer generated diffractive optical elements. Systems and applications will be stressed throughout.


ECSE 529 Image Processing and Communication. (3) (3-0-6) (Prerequisite: ECSE 304) Introduction to vision in man and machine; computer vision systems; biological vision systems; biological signal processing; edge detection; spatial- and frequency-domain processing; color. Low-level visual processing in computer vision, psychophysics, and neurobiology, and their similarities and differences.

● ECSE 530 Logic Synthesis. (3) (3-2-4) (Prerequisite: ECSE 323)

ECSE 531 Real Time Systems. (3) (3-3-3) (Prerequisites: ECSE 322 and ECSE 323) Real-time engineering applications of computers to on-line control, communication systems and data acquisition. Aspects of hardware, software, interfacing, operating systems, and their integration into a complete system are addressed.

ECSE 532 Computer Graphics. (3) (3-3-3) (Prerequisite: ECSE 322) Introduction to computer graphics systems and display devices: raster scan, scan conversion, graphical input and interactive techniques - window environments; display files: graphics languages and data structures: 2D transformations; 3D computer graphics, hidden line removal and shading; graphics system design; applications. Laboratory project involving the preparation and running of graphics programs.

ECSE 533 Physical Basis of Semiconductor Devices. (3) (3-0-6) (Prerequisites: ECSE 330, ECSE 351 and PHYS 271) Qualitative analysis of diodes and transistors. Semiconductor fundamentals, equilibrium and non-equilibrium carrier transport, and Fermi levels. PN junction diodes, the ideal diode, and diode switching. Bipolar Junction Transistors (BJT), physics of the ideal BJT, the Ebers-Moll model. Field effect transistors, metal-oxide semiconductor structures, static and dynamic behaviour, small-signal models.

ECSE 534 Analog Microelectronics. (3) (3-0-6) (Prerequisite: ECSE 334) Design of analog ICs using specialized analog CAD tools such as SPICE. Voltage and current amplifier design which encompasses the study of biasing circuits, current sources and mirrors, input and output stages, and frequency compensation; precision reference sources; analog multipliers; oscillators; waveform generators and shaping circuits, and analog switches.

● ECSE 535 Synthesis of Digital Systems. (3)


● ECSE 545 Microelectronics Technology. (3) (3-0-6) (Prerequisite: ECSE 432 or ECSE 533)


ECSE 548 Introduction to VLSI Systems. (3) (2-2-5) (Prerequisites: ECSE 334 and ECSE 323) (Limited Enrolment - 20) (Departmental approval required) An interdisciplinary course for electrical engineering and computer science students. A structured design methodology for managing the complexity of VLSI system design. Sufficient information on integrated devices, circuits, digital subsystems and system architecture is presented to
enable students to span the range of abstractions from device physics to VLSI digital systems.


- **ECSE 559 Flexible AC Transmission Systems.** (3) (3-0-6) (Prerequisite: ECSE 361 and ECSE 334)
- **ECSE 560 Power Systems Analysis 2.** (3) (3-0-6) (Prerequisite: ECSE 464)
- **ECSE 562 Continuum Electromechanics.** (3) (3-0-6) (Prerequisite: ECSE 352)


**ECSE 565 Introduction to Power Electronics.** (3) (3-0-6) (Prerequisite: ECSE 334) Semiconductor power switches - thyristors, GTO's, bipolar transistors, MOSFET's. Switch mode power amplifiers. Buck and boost principles. Modulation methods -PWM, delta, hysteresis current control. Rectifiers, inverters, choppers.

**ECSE 571 Optoelectronic Devices.** (3) (3-0-6) (Prerequisites: ECSE 304, ECSE 305, ECSE 352 and ECSE 533) Physical basis of optoelectronic devices including Light Emitting Diodes, semiconductor optical amplifiers, semiconductor lasers, quantum well devices, and solid state lasers. Quantitative description of detectors, optical modulation, optical logic devices, optical interconnects, and optomechanical hardware. Throughout the course, photonic systems applications will be addressed.

**ECSE 573 Microwave Electronics.** (3) (3-0-6) (Prerequisite: ECSE 432 or ECSE 533) Physical basis of modern microwave devices and circuits. Microwave transistors and tunnel diodes, transferred electron devices, transit time devices and infra red devices. Microwave generation and amplification, microwave FET circuits. Noise and power amplification.

- **ECSE 578 Crystals and Conduction.** (3) (3-0-6) (Prerequisite: ECSE 432 or ECSE 533)
- **ECSE 579 Properties of Solids.** (3) (3-0-6) (Prerequisite: ECSE 533).
- **ECSE 596 Optical Waveguides.** (3) (3-0-6) (Prerequisite: ECSE 352)

**Graduate 600-Level Courses**

Generally, undergraduate students are not permitted to enroll in graduate 600-level courses. However, in exceptional circumstances, the Graduate Studies Office does grant this permission upon the request of the Department on behalf of the student. Please consult the Graduate Studies Calendar for 600-level courses.

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4.6 Department of Mechanical Engineering

Macdonald Engineering Building, Room 351
817 Sherbrooke Street West
Montreal, QC H3A 2K6
Telephone: (514) 398-6296
Fax: (514) 398-7365
http://www.mcgill.ca/mecheng

Chair — Arun K. Misra

Emeritus Professors
William Bruce; B.A.Sc., M.A.Sc.(Toronto), Eng.

Post-Retirement
Glen Bach; B.Sc.(Alta.), M.Sc.(Birm.), Ph.D.(McG.)

Professors
Abdul M. Ahmed; B.Sc.(Dhaka), M.Eng., Ph.D.(McG.), Eng. (Thomas Workman Professor of Mechanical Engineering)
Jorge Angeles; B.Eng., M.Eng.(UNAM Mexico), Ph.D.(Stanford), Eng., F.A.S.M.E., F.C.S.M.E.
Bantwal R. Baliga; B.Tech.(I.I.T., Kanpur), M.Sc.(Case), Ph.D.(Minnesota)
Weigle Hashabi; B.Eng., M. Eng.(McG.), Ph.D.(Cornell), P. Eng., F.A.S.M.E.
John H.S. Lee; B.Eng.(McG.), M.Sc.(M.I.T.), Ph.D.(McG.), Eng.
Stuart J. Price; B.Sc., Ph.D.(Bristol), P.Eng.

Associate Professors
Martin Buehler; M.Sc., Ph.D.(Yale)
Luca Cortelezzi; M.Sc., Ph.D.(Caltech)
David L. Frost; B.A.Sc.(U.B.C.), M.S., Ph.D.(Caltech), P.Eng.
Tim Lee; M.S.(Portland State), Ph.D.(Idaho)
Larry B. Lessard; B.Eng.(McG.), M.Sc., Ph.D.(Stanford), Eng. (Undergraduate Program Coordinator)
Meyer Nahon; B.Sc.(Queens'), M.Sc.(Tor.), Ph.D.(McG.), Eng.
James A. Nemes; B.Sc.(Maryland), M.S., D.Sc.(GWU) (William Dawson Scholar) (Graduate Program Coordinator)
Martin Ostota-Starzewski; M.Eng., Ph.D.(McG.), F.A.S.M.E.
Peter Radziszewski; B.Sc.(U.B.C.), M.Sc., Ph.D.(Laval)
Vince Thomson; B.Sc.(Windsor), Ph.D.(McMaster) (Werner Groupe Professor of Manufacturing Automation)

Assistant Professors
Andrew J. Higgins; B.Sc.(Ill.), M.S., Ph.D.(Wash.)
R. Mongrain; B.Sc., M.Sc.(Montb.), Ph.D.(Ecole Polytechnique), Eng.
Laurent Mydlarski; B.A.Sc.(Waterloo), Ph.D.(Cornell)

Laboratory Superintendents
D. Chellan, G. Savard, G. Tewfik

Associate Members
R.E. Kearney; B.Eng., M.Eng., Ph.D.(McG.), Biomedical Engineering Unit
B.H.K. Lee; B.Eng., M.Eng., Ph.D.(McG.)
M. Tanzer, M.D., Orthopaedic Surgery

Adjunct Professors

Mechanical engineers are traditionally concerned with the conception, design, implementation and operation of mechanical systems. Typical fields of work are aerospace, energy, manufacturing,
machinery, and transportation. Because of the very broad nature of the discipline there is usually a high demand for mechanical engineers. A recent study indicated that 39% of all engineering openings were for graduates of mechanical engineering.

Many mechanical engineers follow other career paths. Graduate studies are useful for the specialists working in research establishments, consulting firms or in corporate research and development.

To prepare the mechanical engineer for a wide range of career possibilities, there is a heavy stress in our curriculum on the fundamental analytical disciplines. This is balanced by a sequence of experimental and design engineering courses which include practice in design, manufacture and experimentation. In these courses students learn how to apply their analytical groundwork to the solution of practical problems.

Specialist interests are satisfied by selecting appropriate complementary courses from among those offered with a specific subject concentration, such as management, industrial engineering, computer science, controls and robotics, bio-engineering, aeronautics, combustion, systems engineering, etc.

The Department offers an Honours Program which is particularly suitable for those with a high aptitude in mathematics and physics and which gives a thorough grounding in the basic engineering sciences. The complementary courses in this program can be utilized to take courses with applied engineering orientation, such as those offered in the regular program, or if preferred, to obtain an even more advanced education in engineering science. Options in Aeronautical Engineering, Mechatronics and Design are available for students in either the Regular or Honours Programs who wish to specialize in these areas.

While the program is demanding, there is time for many extra-curricular activities. Students are active in such professional societies as CASI (Canadian Aeronautics and Space Institute), SAE (Society of Automotive Engineers), and ASME (American Society of Mechanical Engineers) and in various campus organizations.

Relations between faculty and students are extremely close. Social functions, at which students and professors meet to exchange views and get to know each other better, are organized frequently.

### CURRICULUM FOR THE B.ENG. DEGREE IN MECHANICAL ENGINEERING (REGULAR)

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<tr>
<th>Required Courses</th>
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<td>MATH 261 Differential Equations</td>
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<td>MIME 260 Materials Science and Engineering</td>
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<td>MIME 310 Engineering Economy</td>
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<td>MECH 240 Thermodynamics 1</td>
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<td>MECH 321 Mechanics of Deformable Solids</td>
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<td><strong>MECH 463D2</strong> Mechanical Engineering Project</td>
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**COMPLEMENTARY COURSES**

15 courses (6 credits) at the 300 level or higher to be selected from Mechanical Engineering. For students who entered in September 2000 or later, one of these two courses must be chosen from the following list:

- MECH 343 Energy Conversion
- MECH 413 Control Systems
- MECH 432 Aircraft Structures
- MECH 471 Industrial Engineering
- MECH 472 Case Studies in Project Mgmt
- MECH 495 Design 3
- MECH 496 Design 4
- MECH 497 Value Engineering
- MECH 524 Computer Integrated Manufacturing
- MECH 526 Manufacturing and the Environment
- MECH 528 Product Design
- MECH 532 Aircraft Performance, Stability and Control
- MECH 541 Kinematic Synthesis
- MECH 543 Design with Composite Materials
- MECH 554 Microprocessors for Mechanical Systems
- MECH 557 Mechatronic Design
- MECH 565 Fluid Flow & Heat Transfer Equipment
- MECH 572 Introduction to Robotics
- MECH 573 Mechanics of Robotic Systems
- MECH 577 Optimum Design

1 course (3 credits) at the 300-level or higher from the Faculty of Engineering or an approved course in the Faculty of Science, including Mathematics.

2 courses (6 credits), 1 course from the Impact of Technology on Society and 1 course from Humanities and Social Sciences selected from an approved list (see section 3.4).

**TOTAL CREDITS**

112

If advanced credit is given for MATH 260 Intermediate Calculus (see section 2.4), the total number of credits is reduced by three.

Students entering in September or January must plan their program of studies in accordance with the regulations described in Welcome to McGill. After registering, students must consult with their academic advisor.

In addition students admitted to the 8-semester program (see section 3.1.2), must take note of the additional courses that are specified in Welcome to McGill. These can also be found on the Faculty website, http://www.mcgill.ca/engineering.

### CURRICULUM FOR THE B.ENG. DEGREE IN MECHANICAL ENGINEERING (HONOURS)

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**COMPLEMENTARY COURSES**

2 courses (6 credits) at the 300 level or higher to be selected from Mechanical Engineering. For students who entered in September 2000 or later, one of these two courses must be chosen from the following list:

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<td>MECH 419</td>
<td>Advanced Mechanics of Systems</td>
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<td>MECH 452</td>
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<tr>
<td>MECH 554</td>
<td>Microprocessors for Mechanical Systems</td>
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<tr>
<td>MECH 557</td>
<td>Mechatronic Design</td>
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<tr>
<td>MECH 565</td>
<td>Fluid Flow &amp; Heat Transfer Equipment</td>
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<tr>
<td>MECH 572</td>
<td>Introduction to Robotics</td>
<td></td>
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<tr>
<td>MECH 573</td>
<td>Mechanics of Robotic Systems</td>
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</tr>
<tr>
<td>MECH 577</td>
<td>Optimum Design</td>
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</tbody>
</table>

1 course (3 credits) at the 300 level or higher from the Faculty of Engineering or an approved course in the Faculty of Science, including Mathematics.

2 courses (6 credits), 1 course from the Impact of Technology on Society and 1 course from Humanities and Social Sciences selected from an approved list (see section 3.4).

### TOTAL CREDITS

<table>
<thead>
<tr>
<th>Credits</th>
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<tbody>
<tr>
<td>112</td>
</tr>
</tbody>
</table>

Students entering in September or January must plan their program of studies in accordance with the regulations described in Welcome to McGill. After registering, students must consult with their academic advisor.

In addition students admitted to the 8-semester program (see section 3.1.2), must take note of the additional courses that are specified in Welcome to McGill. These can also be found on the Faculty website, [http://www.mcgill.ca/engineering](http://www.mcgill.ca/engineering).

### LIST OF COMPLEMENTARY COURSES (DEPARTMENTAL)

Each is 3 credits)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>MECH 343</td>
<td>Energy Conversion</td>
</tr>
<tr>
<td>MECH 413</td>
<td>Control Systems</td>
</tr>
<tr>
<td>MECH 432</td>
<td>Aircraft Structures</td>
</tr>
<tr>
<td>MECH 434</td>
<td>Turbomachinery</td>
</tr>
<tr>
<td>MECH 447</td>
<td>Combustion</td>
</tr>
<tr>
<td>MECH 471</td>
<td>Industrial Engineering</td>
</tr>
<tr>
<td>MECH 472</td>
<td>Case Studies in Project Mgmt</td>
</tr>
<tr>
<td>MECH 474</td>
<td>Selected Topics in Operations Research</td>
</tr>
<tr>
<td>MECH 495</td>
<td>Design 3</td>
</tr>
<tr>
<td>MECH 496</td>
<td>Design 4</td>
</tr>
<tr>
<td>MECH 497</td>
<td>Value Engineering</td>
</tr>
<tr>
<td>MECH 500</td>
<td>Selected Topics in Mechanical Engineering</td>
</tr>
<tr>
<td>MECH 501</td>
<td>Special Topics: Mechanical Engineering</td>
</tr>
<tr>
<td>MECH 522</td>
<td>Production Systems</td>
</tr>
<tr>
<td>MECH 524</td>
<td>Computer Integrated Manufacturing</td>
</tr>
<tr>
<td>MECH 526</td>
<td>Manufacturing and the Environment</td>
</tr>
<tr>
<td>MECH 528</td>
<td>Product Design</td>
</tr>
<tr>
<td>MECH 529</td>
<td>Discrete Manufacturing Systems</td>
</tr>
<tr>
<td>MECH 530</td>
<td>Mechanics of Composite Materials</td>
</tr>
<tr>
<td>MECH 531</td>
<td>Aeroelasticity</td>
</tr>
<tr>
<td>MECH 532</td>
<td>Aircraft Performance, Stability and Control</td>
</tr>
<tr>
<td>MECH 533</td>
<td>Subsonic Aerodynamics</td>
</tr>
<tr>
<td>MECH 534</td>
<td>Air Pollution Engineering</td>
</tr>
<tr>
<td>MECH 537</td>
<td>High Speed Aerodynamics</td>
</tr>
<tr>
<td>MECH 538</td>
<td>Unsteady Aerodynamics</td>
</tr>
<tr>
<td>MECH 539</td>
<td>Computational Aerodynamics</td>
</tr>
<tr>
<td>MECH 540</td>
<td>Design: Modelling and Decision</td>
</tr>
<tr>
<td>MECH 541</td>
<td>Kinematic Synthesis</td>
</tr>
<tr>
<td>MECH 542</td>
<td>Spacecraft Dynamics</td>
</tr>
<tr>
<td>MECH 543</td>
<td>Design with Composite Materials</td>
</tr>
<tr>
<td>MECH 545</td>
<td>Advanced Stress Analysis</td>
</tr>
<tr>
<td>MECH 552</td>
<td>Advanced Applied Mathematics</td>
</tr>
<tr>
<td>MECH 554</td>
<td>Microprocessors for Mechanical Systems</td>
</tr>
<tr>
<td>MECH 555</td>
<td>Applied Process Control</td>
</tr>
<tr>
<td>MECH 557</td>
<td>Mechatronic Design</td>
</tr>
<tr>
<td>MECH 561</td>
<td>Biomechanics of Musculoskeletal Systems</td>
</tr>
<tr>
<td>MECH 562</td>
<td>Advanced Fluid Mechanics</td>
</tr>
<tr>
<td>MECH 565</td>
<td>Fluid Flow &amp; Heat Transfer Equipment</td>
</tr>
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<td>Introduction to Robotics</td>
</tr>
<tr>
<td>MECH 573</td>
<td>Mechanics of Robotic Systems</td>
</tr>
<tr>
<td>MECH 576</td>
<td>Computer Graphics and Geometrical Modelling</td>
</tr>
<tr>
<td>MECH 577</td>
<td>Optimum Design</td>
</tr>
<tr>
<td>MECH 578</td>
<td>Advanced Thermodynamics</td>
</tr>
<tr>
<td>MECH 581</td>
<td>Nonlinear Dynamics and Chaos</td>
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</tbody>
</table>

### TYPICAL PROGRAM OF STUDIES FOR REGULAR OR HONOURS

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 (Fall)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMP 208</td>
<td>Computers in Engineering</td>
</tr>
<tr>
<td>MATH 260</td>
<td>Intermediate Calculus</td>
</tr>
<tr>
<td>MECH 201</td>
<td>Introduction to Mechanical Engineering</td>
</tr>
<tr>
<td>MECH 210</td>
<td>Mechanics 1</td>
</tr>
<tr>
<td>MECH 260</td>
<td>Machine Tool Laboratory</td>
</tr>
<tr>
<td>MIME 221</td>
<td>Engineering Professional Practice</td>
</tr>
<tr>
<td>EDEC 206</td>
<td>Communication in Engineering</td>
</tr>
<tr>
<td>MATH 261</td>
<td>Differential Equations</td>
</tr>
<tr>
<td>MATH 265</td>
<td>Advanced Calculus</td>
</tr>
<tr>
<td>MECH 220</td>
<td>Mechanics 2</td>
</tr>
<tr>
<td>MECH 262</td>
<td>Statistics &amp; Measurement Laboratory</td>
</tr>
<tr>
<td>MECH 291</td>
<td>Graphics</td>
</tr>
</tbody>
</table>

For all Minors and Options, students should complete a special form available from the Undergraduate Program Secretary indicating their intention to take the Minor or the Option.
AERONAUTICAL ENGINEERING OPTION

Students in this Option should take five courses in the area of Aeronautical Engineering. Specifically they must take the following two required courses:

MECH 532 Aircraft Performance, Stability and Control
MECH 533 Subsonic Aerodynamics

and at least one of the following:

MECH 432 Aircraft Structures
MECH 434 Turbomachinery

The remaining two courses may be chosen from the above or from the following courses:

MECH 531 Aeroelasticity
MECH 537 High Speed Aerodynamics
MECH 538 Unsteady Aerodynamics
MECH 539 Computational Aerodynamics

All courses must be passed at a level C or better.

Students should also discuss the matter with their advisor and complete a special form indicating their intention to take this Option.

DESIGN OPTION

The Design Option Program is comprised of six courses as follows:

MECH 495 Design 3
MECH 496 Design 4

Plus any four below:

MECH 497 Value Engineering
MECH 540 Design: Modelling and Decision
MECH 541 Kinematic Synthesis
MECH 543 Design with Composite Materials
MECH 557 Mechatronic Design
MECH 565 Fluid Flow & Heat Transfer Equipment
MECH 576 Computer Graphics and Geometrical Modelling
MECH 577 Optimum Design

MECHATRONICS OPTION

Students in this option should take six courses in the area of Control, Robotics and/or CAD/CAM. They must take the following four required courses:

MECH 413 Control Systems
MECH 554 Microprocessors for Mechanical Systems
MECH 557 Mechatronic Design
MECH 572 Introduction to Robotics

and two of the following:

MECH 528 Product Design
MECH 541 Kinematic Synthesis
MECH 573 Mechanics of Robotic Systems
MECH 576 Computer Graphics and Geometrical Modelling
ECSE 502 Control Engineering

COURSES OFFERED BY THE DEPARTMENT

For the Term (Fall and/or Winter), days, and times when courses will be offered, please refer to the 2002-2003 Class Schedule on the Web, http://www.mcgill.ca/students/. Class locations and names of instructors are also provided.

Students preparing to register are advised to consult the Class Schedule website for the most up-to-date list of courses available. New courses may have been added or courses rescheduled after this Calendar went to press.

The schedule of courses to be offered in Summer 2003 will be available on the website in January.

MECH has replaced 305 as the prefix for Mechanical Engineering courses.

The course credit weight is given in parentheses after the title.

● Denotes courses not offered in 2002-03.

□ Denotes courses with limited enrolment.

MECH 201 INTRODUCTION TO MECHANICAL ENGINEERING. (2) (3-0-3) The practice of Mechanical Engineering: its scope and context. The role of Design. Introduction to the Design process. The role of engineering analysis and socio-economic factors in Design. Introduction to the individual mechanical engineering subjects and their role in Design. Case studies.

MECH 210 MECHANICS 1. (4) (4-1-7) Basic principles of Newtonian mechanics. Kinematics, relative motion, momentum, forces (gravity, friction, elastic, etc.), pseudo-forces, impulse, energy (kinetic and potential) and mechanical work. Conservation of momentum and angular momentum, central force motion, centre of mass and moment of inertia. Engineering applications including beams, trusses, frames, mechanisms.


□ MECH 260 MACHINE TOOL LAB. (2) (1-3-2) Basic machine tool operations, numerical control of machine tools, and metrology. The use of hand tools, and sheet metal work. Introduction to rapid prototyping and nontraditional machining methods. Extensive laboratory hands-on exercises.

MECH 261 MEASUREMENT LAB. (2) (2-3-1) (Restricted to Civil Engineering students) Basic experimental laboratory measurements, such as measurement of strain, pressure, force, position, and temperature.

MECH 262 STATISTICS AND MEASUREMENT LABORATORY. (3) (3-3-3) Introduction to probability: conditional probability, binomial and Poisson distributions, random variables, laws of large numbers. Statistical analysis associated with measurements; regression and correlation. Basic experimental laboratory techniques, including the measurement of strain, pressure, force, position, and temperature.

MECH 290 GRAPHICS 2. (3) (3-3-0) (This course is intended for Civil Engineering students) Traditional descriptive geometry of points, lines and planes, done with modern tools. Constructed solutions with vector diagram projection; comparison with equivalent vector algebraic methods. Graphical statics, concurrent force problems including pure axial force plane structures. Structural drafting pertaining to steel, concrete and timber construction, standards and conventions. Drafting room and computer lab exercises are assigned.

MECH 291 GRAPHICS. (3) (3-3-3) Descriptive geometry of points, lines and planes, intersection and developments, auxiliary view and direct methods. Drawing standards. Working drawings and conventions, fits and tolerances, representation of welding, surface finish, threaded fasteners, standard mechanical components: motors, cylinders, bearings, gears and other elements. Sections and pictorials. Bills of material and cataloging. Computer lab exercises are assigned.

MECH 292 DESIGN 1. (3) (1-3-5) (Prerequisites: MECH 260 and MECH 291. Pre-/Co-requisites: CIVE 207, EDEC 206) (Course description change awaiting University approval) Introduction to design. Problem formulation, idea generation, feasibility study, preliminary design, design analysis, design evaluation, project management, and optimal design. The student’s creative ability will be developed by having to participate in a number of design projects. Case-study methods will be used to analyse actual design projects.

MECH 314 DYNAMICS OF MECHANISMS. (3) (3-1-5) (Prerequisite: MECH 210) First principles of analysis; motion; position; displacement; velocity; acceleration; force; inertia and its effects. Kinematic and dynamic analysis of rigid bodies in pure rotation and in
pin-connected systems; dynamic balance. Rigid bodies in rolling contact; planetary gear-trains. Bodies in sliding contact; lower and higher sliding pairs.

**MECH 315 DYNAMICS OF VIBRATIONS.** (3) (3-1-5) (Prerequisites: MECH 220, CIVE 207 and MATH 266) Modelling of vibration of mechanical systems. Single-degree-of-freedom systems: free vibrations; effect of damping; response to harmonic, periodic and arbitrary excitation; vibration isolation. Free and forced vibrations of n degree-of-freedom and continuous systems.

**MECH 321 MECHANICS OF DEFORMABLE SOLIDS.** (3) (3-1-5) (Prerequisite: CIVE 207) Modern phenomenological theories of the behaviour of engineering materials. Stress and strain concepts and introduction to constitutive theory. Applications of theory of elasticity and thermoelasticity. Introduction to finite element stress analysis methods.

**MECH 331 FLUID MECHANICS 1.** (3) (3-1-5) (Prerequisite: MECH 210. Pre-/Co-requisites: MECH 220, MECH 240 and MATH 266) Physical properties of fluids. Kinematics and dynamics of fluid flow: stress in a continuum, rates of strain, rotation. Control volume analysis; conservation of mass, linear momentum and energy; Euler and Bernoulli equations; Flow measurement. Dimensional analysis and dynamical similarity. Laminar and turbulent flow in pipes and boundary layers.

**MECH 341 THERMODYNAMICS 2.** (3) (3-1-5) (Prerequisite: MECH 240) (Course description change awaiting University approval) Generalized thermodynamic relations. Real gas effects, gas tables, dense gas equations of state and generalized compressibility, enthalpy, and entropy charts. Vapour and gas power cycle (coal/nuclear power plants). Refrigerators and heat pumps. Psychrometry and air conditioning processes. Thermodynamics of reactive gas mixtures.

**MECH 343 ENERGY CONVERSION.** (3) (3-0-6) (Prerequisite: MECH 240)

**MECH 346 HEAT TRANSFER.** (3) (3-1-5) (Prerequisites: MECH 240 or ABEN 301, MECH 301 or ABEN 305, MATH 266 or ABEN 319) Basic concepts and overview. Steady and unsteady heat conduction. Fin Theory. Convective heat transfer: governing equations; dimensionless parameters; analogy between momentum and heat transfer. Design correlations for forced, natural, and mixed convection. Heat exchangers. Radiative heat transfer: black- and grey-body radiation; shape factors; enclosure theory. Thermal engineering design project.

**MECH 362 MECHANICAL LABORATORY 1.** (2) (0-3-3) (Prerequisite: MECH 261 or MECH 262) (Prerequisite change awaiting University approval) Experiments will be performed in four areas: MECH 240 Thermodynamics, MECH 315 Vibrations, MECH 331 Fluid Mechanics 1, and MECH 346 Heat Transfer. Students should sign up to do experiments in one or more areas the term following the completion of one or more of the above courses. Students will not formally register for this course until the term in which they will complete all of the experiments.

**MECH 383 APPLIED ELECTRONICS AND INSTRUMENTATION.** (3) (3-2-4) (Prerequisites: MECH 261 or MECH 262, and MATH 261) Discrete and integrated components, both analogue and digital. Characteristics of passive elements. Semiconductors, amplifiers, filters, oscillators, power supplies and non-linear devices. Introduction to digital electronics. Transducer/signal conditioner interfacing considerations.

**MECH 393 DESIGN 2.** (3) (3-3-3) (Prerequisite: MECH 292. Pre-/co-requisites: MECH 314 and MIME 260) (Prerequisite change awaiting University approval) The design of machine elements for strength requirements in consideration of various methods of manufacture. Synthesis of mechanical systems to fulfill performance requirements following the engineering design process. Failure theory and fatigue life determination. Students form groups to work on a design project.

**MECH 403D1 THESIS (HONOURS).** (3) (0-6-12) (Prerequisite: Candidates must have completed courses in the Mechanical Engineering Program weighted at a minimum of 60 credits.) (Students must also register for MECH 403D2) (No credit will be given for this course unless both MECH 403D1 and MECH 403D2 are successfully completed in consecutive terms) This course, together with course MECH 404 involves a research project containing an explicit component of design, encompassing interrelated aspects of engineering theory and requiring a theoretical and/or experimental investigation. Students will work under the supervision of one or more staff members; completed work will be submitted in the form of a thesis.

**MECH 403D2 THESIS (HONOURS).** (3) (Prerequisite: MECH 403D1) (No credit will be given for this course unless both MECH 403D1 and MECH 403D2 are successfully completed in consecutive terms) See MECH 403D1 for course description.

**MECH 403N1 THESIS (HONOURS).** (3) (Students must also register for MECH 403N2) (No credit will be given for this course unless both MECH 403N1 and MECH 403N2 are successfully completed in the same calendar year) See MECH 403D1 for course description.

**MECH 404 HONOURS THESIS 2.** (3) (0-3-3) (Corequisite: MECH 403) This course is part of the same thesis project as course MECH 403.

**MECH 409 NUMERICAL METHODS IN MECHANICAL ENGINEERING.** (3) (3-1-5) (Prerequisites: MATH 261, MATH 266 and COMP 208) Numerical techniques for problems commonly encountered in Mechanical Engineering are presented. Chebyshev interpolation, quadrature, roots of one or more variables, matrices, curve fitting, splines and ordinary differential equations. The emphasis is on the analysis and understanding of the problem rather than the details of the actual numerical program.


**MECH 419 ADVANCED MECHANICS OF SYSTEMS.** (3) (3-1-5) (Prerequisites: MECH 220, CIVE 207, MATH 265 and MATH 266) Lagrangian and Hamiltonian dynamics. Variational methods. Discrete linear systems; classical and numerical solutions for conservative and non-conservative systems; matrix function methods. Electrical-mechanical-thermodynamical analogies. Stability considerations and closed-loop systems. Vibration of distributed parameter systems. Energy methods. Non-linear vibrations; the phase plane, perturbation of other methods of solution.


**MECH 432 AIRCRAFT STRUCTURES.** (3) (3-0-6) (Prerequisites: MECH 331 and MECH 321) Plane stress and strain. Theories of failure. Plastic and viscoelastic stress-strain relations. External and internal forces in spars. Bending, deflection of beams, plastic deformation and aeroelastic distortion of wings and fuselage. Structural characteristics of wings. Torsion of wings and related
critical aeroelastic design parameters; divergence and aeroelastic twist. Energy methods. Buckling in aeronautical structures. Flut-
ter.

**MECH 434 TURBOMACHINERY.** (3) (3-0-6) (Prerequisite: MECH 331) A broad general treatment of energy transfer between a fluid and a rotor, velocity vector diagrams, and non-dimensional character-
istics. Applications to hydraulic pumps and turbines. Two dimensional cascade theory leading to study of axial gas com-
pressors and turbine stages. Three dimensional free and forced vortex configurations. Centrifugal compressors and radial inflow
turbines.

**MECH 447 COMBUSTION.** (3) (3-0-6) (Prerequisite: MECH 240)

**MECH 452 MATHEMATICAL METHODS IN ENGINEERING 1.** (3) (3-1-
5) (Prerequisite: Candidates must have completed courses in the Mechanical Engineering Program weighted at 60 credits (mini-
imum)) The underlying theory and application of mathematical methods in fluid dynamics, vibration, stress and strain analysis,
heat transfer, etc. The eigenvalue problem, methods in analysis.

**MECH 463D1 MECHANICAL ENGINEERING PROJECT.** (3) (1-3-5)
(Prerequisite: MECH 393) (Students must also register for MECH 463D2) (No credit will be given for this course unless both MECH 463D1 and MECH 463D2 are successfully completed in consecutive terms) Team project work typically involving the design, fabrica-
tion, verification, and application of a mechanical device/ system, or experimental facility. The project work is comple-
mented with lectures in the Fall term on topics related to design and management of design projects. Emphasis is on the comple-
tion of a project of professional quality.

**MECH 463D2 MECHANICAL ENGINEERING PROJECT.** (3) (Prerequire-
site: MECH 463D1) (No credit will be given for this course unless both MECH 463D1 and MECH 463D2 are successfully completed in consecutive terms) See MECH 463D1 for course description.

**MECH 471 INDUSTRIAL ENGINEERING.** (3) (3-1-5)

**MECH 472 CASE STUDIES IN PROJECT MANAGEMENT.** (3-0-
6) (Prerequisite: U3 and permission of the instructor)

**MECH 474 SELECTED TOPICS IN OPERATIONS RESEARCH.** (3) (3-0-
6) (Prerequisites: MATH 266 and COMP 208) (Course title change awaiting University approval) Introduction to the general mathematical programming problem in the context of engineering design; linear programming, queuing theory, Monte Carlo simu-
lation. The above techniques will be used to study the optimization of engineering systems. The applications of linear programming in its various manifestations will be examined in depth.

**MECH 494 HONOURS DESIGN PROJECT.** (3) (0-6-3) (Prerequisite: MECH 292) (Restricted to Mechanical Engineering Honours stu-
dents.) An advanced design project course with emphasis on analytical solutions, performance prediction and validation, and planning for production.

**MECH 495 DESIGN 3.** (3) (0-6-3) (Prerequisite: MECH 463) A design project course of two terms together with MECH 496. Project approval required. Allows the completion of a project of greater complexity than Design II and Mechanical Engineering Project with emphasis on analytical solutions, stressing, planning for production. No lectures. Weekly consultations. Interim and final reports required.

**MECH 496 DESIGN 4.** (3) (0-6-3) (Prerequisite: MECH 495) Con-
tinuation of MECH 495. The two together constitute a design project course of two terms. The two courses permit the comple-
tion of a project of greater complexity than Design II and Mechanical Engineering Project with emphasis on analytical solutions, stressing, planning for production. No lectures. Weekly consulta-
tions. Interim and final reports required.

**MECH 497 VALUE ENGINEERING.** (3) (0-8-1) (Prerequisites: MECH 393 and completion of 45 credits) Value Engineering is an in-depth analysis of an industrial product or process with a view to improving its design and/or performance to increase its worth. This is a workshop type of course. Projects will be supplied by industrial firms and students will work in teams with industrial per-
sonnel.

**MECH 500 SELECTED TOPICS IN MECHANICAL ENGINEERING.** (3) (3-0-6)

**MECH 501 SPECIAL TOPICS: MECHANICAL ENGINEERING.** (3) (3-0-
6) A course to allow the introduction of new topics in Mechanical Engineering as needs arise, by regular and visiting staff.

**MECH 522 PRODUCTION SYSTEMS.** (3) (3-0-6) (Course description change awaiting University approval) Characteristics of produc-
tion systems. System boundaries, input-output, feedback time-lag effects, dynamics of production systems. Design for manufactura-
bility. Process planning, process/machine tool selection, break-
even analysis, CAPP. Production planning, scheduling and con-
trol of operations; quality management. Competitive strategies;
FMS, CIM. Hands-on experience with production modeling and industrial simulation software.

**MECH 524 COMPUTER INTEGRATED MANUFACTURING.** (3) (3-0-
6) (Prerequisite: Permission of the instructor) A study of the present impact of computers and automation on manufacturing. Computer aided systems. Information modelling. Information sys-
tem structures. Study of several types of production systems. Integration issues: inter-and intra-enterprise. Laboratory experi-
ence with manufacturing software systems.

**MECH 525 INTRODUCTION TO NUCLEAR ENGINEERING.** (3)

**MECH 526 MANUFACTURING AND THE ENVIRONMENT.** (3) (3-0-
6) (Prerequisite: Permission of the instructor) Course topics include: clean manufacturing, product and process design for minimizing materials and energy use, the product life cycle, impact of technology on the environment, environmental impact assessment, regulatory process, and managing the "political" process.

**MECH 527 COMPUTER-AIDED MECHANICAL DESIGN.** (3)

**MECH 528 PRODUCT DESIGN.** (3) (3-0-6) (Prerequisite: Per-
mission of the instructor) A study of the design issues present in product life cycle demands. Computer aided systems. Rapid pro-
totyping. Design for manufacturability. Integration of mechanics, electronics and software in products. Effect on design of product cost, maintainability, recycling, marketability.

**MECH 529 DISCRETE MANUFACTURING SYSTEMS.** (3) (3-0-
6) (Prerequisite: Permission of the instructor)

**MECH 530 MECHANICS OF COMPOSITE MATERIALS.** (3) (3-0-6)
(Corequisite: MECH 321 or equivalent/instructor’s permission) Fiber reinforced composites. Stress, strain, and strength of com-

**MECH 531 AEROELASTICITY.** (3) (3-1-5) (Prerequisites: MECH 419, MECH 319 or MECH 315 and MECH 533)

**MECH 532 AIRCRAFT PERFORMANCE, STABILITY AND CONTROL.** (3) (3-1-5) (Prerequisites: MECH 412, MECH 533) Aircraft perfor-
mance criteria such as range, endurance, rate of climb, maxi-
num ceiling for steady and accelerated flight. Landing and take-
off distances. Static and dynamic stability in the longitudinal (stick-fixed and stick-free) and coupled lateral and directional modes. Control response for all three modes.

**MECH 533 SUBSONIC AERODYNAMICS.** (3) (3-1-5) (Prerequisite: MECH 331) Kinematics: equations of motion; vorticity and circula-
tion, conformal mapping and flow round simple bodies. Two 
dimensional flow round aerofoils. Three dimensional flows; high and low aspect-ratio wings; airfoils. Wind tunnel interference. Similarity rules for subsonic irrotational flows.

**MECH 534 AIR POLLUTION ENGINEERING.** (3) (3-0-6) (Prerequi-
tsites: MECH 240, MECH 331, MECH 341 and MECH 447 or con-
sent of instructor.) Pollutants from power production and their effects on the environment. Mechanisms of pollutant formation in combustion. Photochemical pollutants and smog, atmospheric dispersion. Pollutant generation from industrial sources in engines
and stationary power plants. Methods of pollution control (exhaust gas treatment, absorption, filtration, scrubbers, etc.).

- MECH 536 FRICTION LUBRICATION AND WEAR. (3)


- MECH 538 VISCOELASTIC AERODYNAMICS. (3) (3-0-6) (Pre-require: MECH 533)


- MECH 540 DESIGN: MODELLING AND DECISION. (3) (3-3-3) 3-D geometric modelling for design; principles and practice. Selected topics/case studies requiring use of: 3-D CAD; component selection and integration; use of machine element design analysis software; practice in developing simple applications. Use of modern software for design decision making. Introduction to mechanism animation. Introduction to design for NC production.

- MECH 541 KINEMATIC SYNTHESIS. (3) (3-0-6)

- MECH 542 SPACECRAFT DYNAMICS. (3) (3-0-6) (Pre-require: MECH 220. Corequisite: MECH 412 or MECH 419) (Course description change awaiting University approval) Review of central force motion; Hohmann and other coplanar transfers, rotation of the orbital plane; patched conic method. Orbital perturbations due to the earth’s oblateness, solar-lunar attraction, solar radiation pressure and atmospheric drag. Attitude dynamics of a rigid spacecraft; attitude stabilization and control; attitude maneuvers; large space structures.


- MECH 555 APPLIED PROCESS CONTROL. (3) (3-2-4) (Pre-requisite: MECH 554 or equivalent)

- MECH 557 MECHATRONIC DESIGN. (3) (3-1-5) (Pre-requisites: ECSE 461, MECH 383 and MECH 412) Team project course on the design, modeling, model validation, and control of complete mechatronic systems, constructed with modern sensors, actuators, real time operating systems, embedded controllers, and intelligent control.


- MECH 562 ADVANCED FLUID MECHANICS. (3) (3-0-6) Conservation laws, control volume analysis, Navier stokes equations, dimensional analysis and limiting forms of N-S equation, laminar viscous flows, boundary layer theory, inviscid potential flows, lift and drag, introduction to turbulence.

- MECH 565 FLUID FLOW AND HEAT TRANSFER EQUIPMENT. (3) (3-1-5) (Pre-requisites: MECH 240, MECH 341, MECH 331 and MECH 346) Pipes and piping systems, pumps, and valves. Fans and building air distribution systems. Basic thermal design methods for fins and heat exchangers. Thermal design of shell-and-tube and compact heat exchangers.

- MECH 572 INTRODUCTION TO ROBOTICS. (3) (3-0-6) (Pre-requisites: MATH 266 and MECH 220 or permission of the instructor) (Not open to students who have taken MECH 573) Manipulator hardware structure, kinematics, statics, dynamics planning and control. Rigid-body, three-dimensional statics, kinematics and dynamics. Direct and inverse kinematics and dynamics. Trajectory planning subject to constraints. Manipulator control. In depth study of serial manipulators with extension to more complex robotic devices.

- MECH 573 MECHANICS OF ROBOTIC SYSTEMS. (3) (3-0-6) (Pre-requisite: Permission of the instructor) Numerical methods for the kinematic inversion of serial manipulators. The handling of redundancies and singularities. Kinematics and dynamics of parallel manipulators, manipulator performance evaluation and optimization, multfingered hand grasping and manipulation, robot compliant and constrained motion. Obstacle avoidance.


- MECH 577 OPTIMUM DESIGN. (3) (2-3-4) The role of optimization within the design process: Design methodology and philosophy. Constrained optimization: The Kuhn-Tucker conditions. Techniques of linear and non-linear programming. The simplex and the complex methods. Sensitivity of the design to manufacturing errors. Robustness of the design to manufacturing and operation errors.

- MECH 578 ADVANCED THERMODYNAMICS. (3) (3-0-6)

- MECH 581 NONLINEAR DYNAMICS AND CHAOS. (3) (3-1-5) (Pre-requisite: MECH 315 or MECH 419/MECH 319)

**GRADUATE 600-LEVEL COURSES**

Generally, undergraduate students are not permitted to enrol in graduate 600-level courses. However, in exceptional circumstances, the Faculty of Graduate Studies and Research notes that graduate students may enrol in the 600-level coursework if the student is enrolled in a full-time program in the College of Liberal Arts and Sciences, and if the student's advisor agrees to the request. The student must present a formal application to the Graduate Dean, who will review the request and approve or deny it. The student will be required to complete all course work with a grade of B or better to receive credit for the course.

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McGill Home Page
4.7 Department of Mining, Metals and Materials Engineering

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3610 University Street
Montreal, QC H3A 2B2
http://www.minmet.mcgill.ca

Metals and Materials –
Telephone: (514) 398-1040
Fax: (514) 398-4492
Mining –
Telephone: (514) 398-2215
Fax: (514) 398-7099

Chair — Robin A.L. Drew
Emeritus Professors
William M. Williams; B.Sc., M.Sc.(Brist.), Ph.D.(Tor.), Eng.
(Henry Birks Emeritus Professor of Metallurgy)

Post-Retirement
Phil A. Distin; B.Sc. Ph.D.(Lond.), D.I.C.

Professors
George P. Demopoulos; Dipl. Eng.(NTU Athens), M.Sc., Ph.D.(McG.), Eng.
Robin A.L. Drew; B.Tech.(Bradford), Ph.D.(Newcastle)
James A. Finch; B.Sc.(Birm.), M.Eng., Ph.D.(McG.), Eng.
(Industry Professor of Mineral Processing)
Raynaud Gauvin; B.Eng., Ph.D.(Montr.), Eng.
John E. Gruzleski; B.Sc., M.Sc.(Qu.), Ph.D.(Tor.), Eng. (Gerald G. Hatch Professor of Mining and Metallurgy)
Rod I.L. Guthrie; B.Sc., Ph.D.(Lond.), D.I.C., A.R.S.M., Eng. (William C. Macdonald Professor of Mining and Metallurgy)
Farzarz (Ferri) P. Hassani; B.Sc., Ph.D.(Nott.), C.Eng.(U.K. Reg.) (George Boyd Webster Professor of Mining Engineering)
John J. Jonas; B.Eng.(McG.), Ph.D.(Cantab.), F.A.S.M., Eng. (Henry Birks Professor of Metallurgy)
Hani S. Mitr; B.Sc.(Cairo), M.Sc., Ph.D.(McMaster), Eng.
Jerzy Szpunar; B.Sc., M.Sc., Ph.D., D.Sc.(Krakow)

Associate Professors
Ralph Harris; B.Sc.(Qld), M.Eng., Ph.D.(McG.)
Mainul Hasan; B.Eng.(Dhaka), M.Sc.(Dhahran), Ph.D.(McG.)
Janusz A. Kozinski; B.A., M.Eng., D.Sc.(Krakow)(William Dawson Scholar)
André Laplante; B.A.Sc., M.A.Sc.(Montr.), Ph.D.(Tor.), Eng.
Jacques Ouellet; B.A.Sc.(Laval), M.A.Sc., Ph.D.(Montr.), Eng.
Steve Yue; B.Sc., Ph.D.(Leeds)

Faculty Lecturer
John Mossop; B.Eng.(McG.), Eng.

Adjunct Professors
Marc Betournay; William Cabley; Roussos Dimitrakopoulos; Bryn Harris; Ahmad Hemati; Raad Jassim; Eric Lifshin; Martin Pugh; John H. Root; Raymond Thom, Eng.; William T. Thompson; Viwek Vaidya, Eng.; Albert E. Wrath

CO-OP Programs
Director — James A. Finch
Work-term Coordinator — Michel Vachon

The Department of Mining, Metals and Materials Engineering offers programs leading to the Bachelor of Engineering degree in Metals and Materials Engineering or Mining Engineering. In addition to regular courses and laboratories, the curriculum includes seminars, colloquia and student projects reinforced by field trips to industrial operations.

The equipment operated by the Department is the best available. On the metals and materials side there is a full range of laboratory facilities for extractive and process metallurgy as well as excellent materials characterization and processing facilities. In mining engineering the Department has rock engineering laborato-
tories to test the mechanical properties of both rock and backfill materials and computer-aided mine design facilities.

Metals and Materials Engineering (CO-OP). The Metals and Materials Engineering degree is a cooperative program leading to a B.Eng. and includes formal industrial work periods. It is built around a strong background of mathematics, basic sciences, computer skills and applications, and specific engineering and design courses to provide up-to-date training in metals/materials engineering. Students take core courses covering metals and materials extraction, processing, fabrication, applications and performance. The program conforms with requirements of the Canadian Engineering Accreditation Board (CEAB) and is designed to offer students the best training for employment in Canada’s large and vital metallurgical and manufacturing industries. The basic courses are supplemented by complementary courses which provide a good choice of specialties for the graduating engineer. The course structure is reinforced with laboratory exercises. Graduates in Metals and Materials Engineering find employment in a wide range of industries which include the mineral/metal producing and processing sectors, as well as the aerospace and manufacturing industries. Students in the CO-OP program benefit from the practical learning experience arising from work-term employment in meaningful engineering jobs. Students also benefit from the non-tangible learning experience arising from the increased responsibilities required to obtain and successfully complete the work terms.

Mining Engineering (CO-OP). McGill, which has the oldest mining engineering program in Canada, has always been noted for the excellence of its courses and for the training it provides in mining technology, mineral economics and mining practice. Graduates in mining engineering are in demand not only in Canada but throughout the world. Technical developments have been rapid in recent years. These offer a challenge to the imaginative student with a strong engineering interest. The Department offers a cooperative program leading to the B.Eng. degree in Mining Engineering. The CO-OP program is offered in collaboration with the Department of Civil, Geological and Mining Engineering at Ecole Polytechnique in Montreal, and includes formal industrial work periods. Students registered at McGill are required to take a series of technical mining courses from Ecole Polytechnique in the latter part of the program. These courses are designated as such in the listings below.

Scholarships. The Department offers Entrance Scholarships each year, valued at $3000; these scholarships are renewable. A substantial number of other scholarships and bursaries are awarded by the Department as well as by the Canadian Mineral Industry Education Foundation.

CURRICULUM FOR THE B.ENG. DEGREE IN METALS AND MATERIALS ENGINEERING – CO-OP PROGRAM

REQUIRED COURSES

Non-Departmental Courses

<table>
<thead>
<tr>
<th>COURSE</th>
<th>CREDITS</th>
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<tbody>
<tr>
<td>CHEM 233 Selected Topics in Physical Chemistry</td>
<td>3</td>
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<tr>
<td>CIVE 205 Statics</td>
<td>3</td>
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<tr>
<td>CIVE 207 Solid Mechanics</td>
<td>4</td>
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<tr>
<td>COMP 208 Computers in Engineering</td>
<td>3</td>
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<tr>
<td>MATH 260 Intermediate Calculus</td>
<td>3</td>
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<tr>
<td>MATH 261 Differential Equations</td>
<td>3</td>
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<tr>
<td>MATH 265 Advanced Calculus</td>
<td>3</td>
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<tr>
<td>MATH 265 Advanced Calculus</td>
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Departmental Courses

<table>
<thead>
<tr>
<th>COURSE</th>
<th>CREDITS</th>
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<tbody>
<tr>
<td>MIME 200 Intro to the Minerals Industry</td>
<td>3</td>
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<tr>
<td>MIME 202 Engineering Communication Skills</td>
<td>2</td>
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<tr>
<td>MIME 209 Mathematical Applications</td>
<td>3</td>
</tr>
<tr>
<td>MIME 212 Engineering Thermodynamics</td>
<td>3</td>
</tr>
<tr>
<td>MIME 221 Engineering Professional Practice</td>
<td>1</td>
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<tr>
<td>MIME 261 Structure of Materials</td>
<td>3</td>
</tr>
<tr>
<td>MIME 280 Industrial Training</td>
<td>2</td>
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<tr>
<td>MIME 310 Engineering Economy</td>
<td>3</td>
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<tr>
<td>MIME 311 Modelling and Automatic Control</td>
<td>3</td>
</tr>
<tr>
<td>MIME 317 Materials Characterization</td>
<td>3</td>
</tr>
<tr>
<td>MIME 337 Electrotechnology</td>
<td>2</td>
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</tbody>
</table>
MIME 341 Introduction to Mineral Processing 3
MIME 350 Extractive Metallurgical Engineering 3
MIME 352 Hydrochemical Processing 3
MIME 356 Heat, Mass and Fluid Flow 4
MIME 360 Phase Transformations in Solids 3
MIME 362 Mechanical Properties 3
MIME 367 Electronic Properties of Materials 3
MIME 380 Industrial Training 2 2
MIME 442 Modelling in Mineral Processing 3
MIME 452 Process and Materials Design 4
MIME 455 Advanced Process Engineering 3
MIME 456 Steelmaking and Steel Processing 3
MIME 465 Ceramic Engineering 3
MIME 480 Industrial Training 3 2
MIME 481 Industrial Training 4 2
CHEM 455 Polymer Chemistry 3 75

COMPLEMENTARY COURSES 12

Technical Courses
Four courses may be taken; one of these can be chosen from the Faculty list.

NOTE: Not all courses are given annually; verification with course instructor is advised.

CHEE 481 (3) Polymer Engineering
CHEE 581 (3) Polymer Composites Engineering
CHEM 585 (3) Colloid Chemistry
CIVE 512 (3) Advanced Civil Engineering Materials
MECH 530 (3) Mechanics of Composite Materials
MIME 361 (3) Liquid State Processing of Materials
MIME 410 (3) Research Project
MIME 412 (3) Corrosion and Degradation
MIME 451 (3) Environmental Controls
MIME 457 (3) Light Metals Extraction
MIME 463 (3) Deformation Processing of Metals
MIME 515 (3) Advanced Metallurgical and Materials Thermodynamics
MIME 544 (3) Mineral Processing Systems 1
MIME 545 (3) Mineral Processing Systems 2
MIME 551 (3) Electrochemical Processing
MIME 555 (3) Thermal Remediation of Wastes
MIME 560 (3) Joining Processes
MIME 563 (3) Hot Deformation of Metals
MIME 564 (3) X-ray Diffraction Analysis of Materials
MIME 566 (3) Texture, Structure and Properties of Polycrystalline Materials
MIME 567 (3) Aluminum Casting Alloys
MIME 568 (3) Topics in Advanced Materials
MIME 569 (3) Electron Beam Analysis of Materials
PHYS 558 (3) Solid State Physics

General Complementaries 6

2 courses (6 credits), 1 course from the Impact of Technology on Society and 1 course from Humanities and Social Sciences selected from an approved list (see section 3.4).

TOTAL 115

Advanced credit is given for MATH 260 Intermediate Calculus upon successful completion of a placement test (see section 2.4).

A fee of $500 is assessed by the University for each Industrial Training course.

CURRICULUM FOR THE B.ENG. DEGREE IN MINING ENGINEERING – CO-OP PROGRAM

REQUIRED COURSES

Non-Departmental Courses
CIVE 205 Statics 3
CIVE 207 Solid Mechanics 4
COMP 208 Computers in Engineering 3
EPSC 221 General Geology 3
EPSC 225 Properties of Minerals 1

MATH 260 Intermediate Calculus 3
MATH 261 Differential Equations 3
MATH 265 Advanced Calculus 3
MECH 290 Graphics 3 26

Departmental Mining Courses
MIME 200 Intro to the Minerals Industry 3
MIME 202 Eng. Communication Skills 2
MIME 203 Mine Surveying 2
(2 weeks at beginning of summer)
MIME 209 Mathematical Applications 3
MIME 221 Engineering Professional Practice 1
MIME 260 Materials Science and Engineering 3
MIME 290 Industrial Work Period 1 2
MIME 291 Industrial Work Period 2 2
MIME 310 Engineering Economy 3
MIME 322 Rock Fragmentation 3
MIME 323 Rock and Soil Mass Characterization 3
MIME 325 Mineral Industry Economics 3
MIME 333 Materials Handling 3
MIME 337 Electrotechnology 2
MIME 340 Applied Fluid Dynamics 3
MIME 341 Introduction to Mineral Processing 3
MIME 392 Industrial Work Period 3 2
MIME 419 Surface Mining 3
MIME 420 Feasibility Study 3
MIME 426 Development and Services 3
MIME 484 Mining Project 3 55

École Polytechnique Mining Courses
MPMC 320 CAO et informatique pour les mines 3
MPMC 321 Mécanique des roches et contrôle des terrains 3
MPMC 326 Recherche opérationnelle minière I 3
MPMC 328 Environnement et gestion des rejets miniers 3
MPMC 329 Géologie minière 2
MPMC 330 Géotechnique minière 3
MPMC 421 Exploitation en souterrain 3
MPMC 422 Ventilation minière et hygiène du travail 3 23

COMPLEMENTARY COURSES

Either Choice I or II 8 or 9

Choice I (8 credits)
MIME 494 (2) Industrial Work Period 4 and two Technical Complementaries

or Choice II (9 credits)
MIME 350 (3) Extractive Metallurgical Engineering
MIME 544 (3) Mineral Processing Systems 1 and one Technical Complementary

General Complementaries 6

2 courses (6 credits), 1 course from the Impact of Technology on Society and 1 course from Humanities and Social Sciences selected from an approved list (see section 3.4).

TOTAL 118 or 119

Mining Technical Complementary Course List:
MIME 320 (3) Extraction of Energy Resources
MIME 442 (3) Modelling in Mineral Processing
MIME 520 (3) Stability of Rock Slopes
MIME 521 (3) Stability of Underground Openings
MIME 526 (3) Mineral Economics
MIME 528 (3) Mining Automation
MIME 544 (3) Mineral Processing Systems 1
MIME 545 (3) Mineral Processing Systems 2
MPMC 327 (3) Hydrogéologie appliquée
MPMC 424 (2) Gérance d’exploitation minière
MPMC 525 (3) Recherche opérationnelle minière II

Advanced credit is given for MATH 260 Intermediate Calculus upon successful completion of a placement test (see section 2.4).
A fee of $300 is assessed by the University for each Industrial Work Period course.

Student Advising

Students entering the Mining or Metals and Materials Engineering programs must plan their schedule of studies in consultation with one of the departmental advisors: Professors Harris and Kozinski (Metallurgy) or Mr. J. Messepe (Mining).

COURSES OFFERED BY THE DEPARTMENT

For the Term (Fall and/or Winter), days, and times when courses will be offered, please refer to the 2002-2003 Class Schedule on the Web, http://www.mcgill.ca/students/. Class locations and names of instructors are also provided.

Students preparing to register are advised to consult the Class Schedule website for the most up-to-date list of courses available. New courses may have been added or courses rescheduled after this Calendar went to press.

The schedule of courses to be offered in Summer 2003 will be available on the website in January.

MIME has replaced 306 as the prefix for Mining, Metals and Materials Engineering courses.

MPMC has replaced 309 as the prefix for McGill/École Polytechnique courses. Those courses, associated with the CO-OP program in Mining Engineering, are listed after the MIME section.

The course credit weight is given in parentheses after the title.

- Denotes courses not offered in 2002-03.
- Denotes courses with limited enrolment.

Courses offered by the Department have been numbered to conform with the following classification system. The first digit is the level of instruction. The last two digits are classified as follows:

- 00 to 19 Common foundation courses
- 20 to 39 Mining courses
- 40 to 49 Mineral processing courses
- 50 to 59 Extractive and process metallurgy courses
- 60 to 69 Materials engineering courses
- 80 to 99 Co-op work terms

MIME 200 INTRODUCTION TO THE MINERALS INDUSTRY. (3) (3-3-3)


MIME 202 ENGINEERING COMMUNICATION SKILLS. (2) (1-2-3)

Basic forms of engineering communication: memoranda, executive summaries, letters, proposals, evaluations, oral presentations and presentation graphics, email, groupware, workflow, internet, graphics and presentation tools. Adaptation into engineering. Short assignments and oral presentations.

MIME 203 MINE SURVEYING. (2) (Prerequisite: MIME 200 or permission of instructor) A two-week field school with laboratories and assignments. The role of the mine surveyor. Techniques and instrumentation for measurement of levels, angles and distances. Shaft, raise, drift and stope surveying techniques. Graphical presentation of survey data and computer applications. Monitoring techniques for mining excavations with deformation and displacement measurements.

MIME 209 MATHEMATICAL APPLICATIONS. (3) (3-2-4)


- MIME 210 INTRODUCTION TO EXTRACTIVE METALLURGY. (3)

MIME 212 ENGINEERING THERMODYNAMICS. (3) (3-1-5)


MIME 221 ENGINEERING PROFESSIONAL PRACTICE. (1) (1-0-2)

Professional practice and ethics, professional liability, occupational health and safety, environmental responsibility. University Code of Student Rights and Responsibilities.

MIME 260 MATERIALS SCIENCE AND ENGINEERING. (3) (2-2-5)

Structure properties and fabrication of metals, polymers, ceramics, composites; engineering properties: tensile, fracture, creep, oxidation, corrosion, friction, wear; fabrication and joining methods; principles of materials selection.

MIME 261 STRUCTURE OF MATERIALS. (3) Classification of materials, electrons in atoms, molecules and solids, bonding in solids, elements of crystallography, common crystal structures, atoms positions, directions and planes in crystal structures, defects in crystalline solids, point defects, dislocations, structure of polycrystalline materials, grains, grain boundaries, non-crystalline solids.

MIME 280 INDUSTRIAL TRAINING 1. (2) 2 Four-month work period in industry. Work term report required upon completion.

MIME 290 INDUSTRIAL WORK PERIOD 1. (2) (Prerequisites: MIME 200 or MIME 203) A four-month work period in the mineral industry, to expose the student to an industrial environment. Candidates will receive basic industrial training. A complete report must be submitted at the end of the term.

MIME 291 INDUSTRIAL WORK PERIOD 2. (2) (Prerequisite: MIME 290) A four-month industrial work period in a mining company, research laboratory or government agency. The student will receive formal industrial training in a technical position. A complete report must be submitted at the end of the term.

MIME 308 SOCIAL IMPACT OF TECHNOLOGY. (3) (3-0-6) (Enrolment encouraged by students outside the Faculty of Engineering)

MIME 310 ENGINEERING ECONOMY. (3) (3-1-5) Introduction to the basic concepts required for the economic assessment of engineering projects. Topics include: accounting methods, marginal analysis, cash flow and time value of money, taxation and depreciation, discounted cash flow analysis techniques, cost of capital, inflation, sensitivity and risk analysis, analysis of R and D, ongoing as well as new investment opportunities.

MIME 311 MODELLING AND AUTOMATIC CONTROL. (3) (3-2-4) (Prerequisite: COMP 208) Mass and energy conservation laws. Dynamic versus steady state models, dynamic behaviour of first and higher order metallurgical systems, linear and nonlinear models, interacting and noninteracting systems. Laplace domain dynamics and transfer functions. Feedback control, control valves and controllers, transducers. Feedback-feedforward control, introduction to cascade, adaptive and statistical control strategies. Digital computer control, instruments and interfaces.

MIME 314 TECHNICAL REPORT. (2)

- MIME 317 ANALYTICAL AND CHARACTERIZATION TECHNIQUES. (3) (2-3-4) (Prerequisite: MIME 260)

MIME 320 EXTRACTION OF ENERGY RESOURCES. (3) (3-0-6) The extraction of energy resources, i.e. coal, gas, oil and tar sands. After a brief geological review, different extraction techniques for these substances will be discussed. Emphasis on problems such as northern mining and offshore oil extraction with reference to Canadian operations. Transportation and marketing.


MIME 323 ROCK AND SOIL Mass CHARACTERIZATION. (3) (3-3-3) (Prerequisites: EPSC 221 and MIME 201) Characteristics of soil and rock masses and the stability of mine workings. Mechanical
properties of rocks and soils related to physical/chemical properties. Characterization of rock mass discontinuities. Laboratory and in-situ techniques to define mechanical properties of soils, rocks and discontinuities. Permeability and groundwater flow principles. In-situ stresses and their measurement. Rock mass quality and classification systems.

**MIME 325 MINERAL INDUSTRY ECONOMICS.** (3) (3-1-5) (Prerequisite: MIME 310) Geographical distribution of mineral resources. Production, consumption and prices of minerals. Market structure of selected minerals. Economic evaluation aspects: grade-tonnage considerations; capital and operating cost estimation; assessment of market conditions; estimation of revenue; taxation; sensitivity and risk analyses; economic optimization of mine development and extraction.

**MIME 333 MATERIALS HANDLING.** (3) (3-3-3) (Prerequisite: MIME 200) Physical and mechanical characteristics of materials related to loading, transport and storage. Dynamics of particles, systems and rigid bodies, mass-acceleration, work-energy, impulse-momentum. Types and selection of excavation and haulage equipment. Layout of haul roads. Rail transport. Conveyor belts and chain conveyors. Mine hoists. Layouts of mine shafts.

**MIME 337 ELECTROTECHNOLOGY.** (2) (3-1-2) Emphasizes role of electrical equipment in the mining, metals and materials industry sectors. Operating theory and technical standards of prime electrical equipment, transformers, motors, generators, rectifiers, variable speed drives, circuit breakers, starters. DC and AC theory for circuit components, resistance, capacitance, inductance and impedance. Distribution system single line diagrams.


**MIME 341 INTRODUCTION TO MINERAL PROCESSING.** (3) (2-3-4) (Prerequisite: MIME 250) Theory and practice of unit operations including: size reduction-crushing and grinding; size separation-screening and classification; mineral separation-flotation, magnetic and gravity separation. Equipment and circuit design and selection. Mass balancing. Laboratory procedures; grindability, liberation, magnetic and gravity separation, flotation, and solid-liquid separation.

**MIME 350 EXTRACTIVE METALLURGICAL ENGINEERING.** (3) (2-3-4) (Prerequisites: MIME 250, MIME 212) Principle non-ferrous base-metal pyrometallurgical extraction processes, relevant thermodynamics, heat and mass balances, transport phenomena (copper, nickel, lead, zinc, aluminum magnesium). Ores, gangue, fuels slag, fluxes, recovery, refining, minor elements, byproducts and the environment. Roasting, drying, melting, converting, reverberatory furnaces, flash furnaces, continuous and batch operations, injection practices and oxygen enrichment. Simulation, modeling, control and optimization.

**MIME 351 NON-FERROUS EXTRACTIVE METALLURGY.** (3) MIME 352 HYDROCHEMICAL PROCESSING. (3) (3-2-4) (Prerequisites: CHEM 233, MIME 12, MIME 250) (Corequisite: MIME 355) Analysis and description of dissolution (leaching), solute separation (solvent extraction, ion exchange, carbon adsorption) and deposition operations (precipitation, crystallization, electrolysis) in aqueous reaction media as these apply to: (i) the hydrometallurgical extraction of metals from primary/secondary sources; (ii) the treatment of effluents and (iii) the production of inorganic materials.

- **MIME 354 PROCESS ENGINEERING LABORATORY.** (2) (0-3-3) (Prerequisite: MIME 355)


**MIME 360 PHASE TRANSFORMATIONS: SOLIDS.** (3) (2-3-4) (Prerequisites: MIME 212 and MIME 260, CHEM 233) Free energy (equilibrium) and kinetic (non-equilibrium) considerations, phase diagrams and TTT diagrams, solid state diffusion, diffusional (nucleation and growth) and shear (martensitic) transformations.

- **MIME 361 LIQUID STATE PROCESSING OF MATERIALS.** (3) (2-3-4) (Prerequisites: MIME 260, MIME 360)


- **MIME 367 ELECTRONIC PROPERTIES OF MATERIALS.** (3) (3-3-3) (Prerequisite: MIME 260)

**MIME 380 INDUSTRIAL TRAINING 2.** (2) 2 Four-month work period in industry. Work term report required upon completion.

**MIME 392 INDUSTRIAL WORK PERIOD 3.** (2) (Prerequisite: 75 credits including MIME 291) A four-month industrial work period in a mining company, research laboratory or government agency. Based on the experience gained during the first two work periods, the student may be asked to undertake more challenging technical tasks. A complete report must be submitted at the end of the term.

**MIME 410 RESEARCH PROJECT.** (3) (0-6-3) (Prerequisite: Recommendation of Instructor) A research project will be carried out, usually in groups, under the guidance of a staff member. A technical report will be prepared and the end and formal presentation will be made on the research topic.

- **MIME 412 CORROSION AND DEGRADATION.** (3) (2-3-4) (Prerequisites: MIME 260; MIME 352)

**MIME 419 SURFACE MINING.** (3) (3-3-3) (Prerequisites: MIME 322, MIME 333 and MIME 325) Choice of a surface mining method. Analysis of soil and rock mass properties related to surface mining. Calculation and monitoring of stripping ratios, ultimate pit depth, slope stability, rock reinforcement, bench and berm dimensioning and ramp design. Loading and hauling systems. Surface layout and development. Water drainage systems. Productions and cost analysis. Computerized design techniques.

**MIME 420 FEASIBILITY STUDY.** (3) (1-2-6) (Prerequisites: MIME 419, MIME 426 and MPMC 421) This course consists of a case study exercise in the application of the specialist skills which the student has developed in the mining engineering program. The objective is to combine these skills in carrying out a professional appraisal of the technical feasibility and economic viability of developing a mineral deposit. Students are required to prepare a professional level report and present seminars on particular aspects of the feasibility analysis.

**MIME 426 DEVELOPMENT AND SERVICES.** (3) (3-3-3) (Prerequisite: MIME 324 and MIME 333) Selection and design of the facilities required to start production at both surface and underground mines, based on design criteria dictated by mining plans, geology, geology and government regulations. Scheduling of development and construction. Staffing and health and safety considerations during development, construction and operations.

**MIME 442 MODELLING AND CONTROL: MINERAL PROCESSING.** (3) (2-3-4) (Prerequisite: MIME 341) Basic kinetic modelling: perfect mixers, plug-flow, zero and first-order kinetics, residence time distributions. Gridding: breakage and selection functions. Overview of the modelling of flotation and gravity separation. Introduction to control: economic incentives, basic PI control, applications to grinding and flotation circuits.
MIME 450 PROCESS DESIGN. (3) (3-0-6) (Prerequisites: MIME 350, MIME 355) Design of new metallurgical plants, processes and products based on knowledge acquired in previous core courses. Material and heat balances, metal economics, design and optimization.

MIME 451 ENVIRONMENTAL CONTROLS: MET’L PLANTS. (3) (3-2-4) (Prerequisite: MIME 352) A survey of the mineral/metallurgical industries from the standpoint of environmental impact and control. Characterization of gaseous, aqueous and solid wastes. Their effects on the ecosystem and government regulations. Methods of control: Particulate collection and detoxification of gaseous streams; Aqueous effluent treatment techniques; Disposal of solid wastes and their stability/containment.

● MIME 452 PROCESS AND MATERIALS DESIGN. (4)


MIME 456 STEELMAKING AND STEEL PROCESSING. (3) (2-2-5) (Prerequisites: MIME 360, MIME 455) The production and refining of liquid iron in the iron blast furnace, the production and refining of liquid steel, secondary refining operations, continuous casting and thermomechanical processing (hot rolling). Specialty steels and newly emerging technologies (e.g. thin slab casting, direct ironmaking) are discussed in terms of process/environment and productivity. "Downstream" topics will include cold rolling, batch and continuous annealing, and coating operations.

MIME 457 LIGHT METALS EXTRACTION AND PROCESSING. (3) (2-0-7) (Prerequisites: MIME 350, MIME 352) Physiochemical, kinetic and economic aspects of light metals extraction, refining and finishing for marketing. Alumina production, aluminum electrolysis, carbon technology, alloying and casting, magnesium smelting and electrolysis, smelting, lithium, sodium extraction.

MIME 463 DEFORMATION PROCESSING OF METALS. (3) (3-3-3) (Prerequisite: MIME 362) Basic plasticity theory (yield criteria, plastic strain/stress relationships, etc.); friction and lubrication; analysis of simple forming operations, e.g. rolling of flat products. Workability; concept and measurement; effect of process variables on material properties and microstructure. Effect of hot and cold processing on microstructure and properties technology and equipment; computer-aided design of deformation processing.


MIME 480 INDUSTRIAL TRAINING 3. (2) (See details listed under MIME 481) Four-month work period in industry. Work term report due upon completion of MIME 481.

MIME 481 INDUSTRIAL TRAINING 4. (2) Four-month work period in industry. This course is intended to be taken immediately after MIME 480 at the same work location. One work term report and one seminar is required upon completion of this course. If MIME 480 and MIME 481 are in different work locations, the work term report should be in two parts following the co-op handbook guidelines.

MIME 484 MINING PROJECT. (3) (0-0-9) (Corequisites: MIME 419, MIME 426, MPMC 328 and MPMC 421) A mining research project to be completed during one semester. The project must be approved by an academic advisor. A comprehensive report and a seminar presentation are required for the project.

MIME 494 INDUSTRIAL WORK PERIOD 4. (2) (0-0-6) (Prerequisites: MIME 419, MIME 426, MPMC 328 and MPMC 421) A four-month industrial work period after which the student must submit a report.

● MIME 511 MICROPROCESSORS IN MINING AND METALLURGICAL ENGINEERING. (3)

MIME 515 ADVANCED METALLURGICAL AND MATERIALS THERMODYNAMICS. (3) (2-2-5) (Prerequisite: MIME 212) Computational thermodynamics including phase diagram estimation, Gibbs energy minimization, solution modelling are considered in view of the Facility of Chemical Thermodynamics (FAC'T) computer database. Students undertake projects developed in consultation with the instructor and prepare verbal and written reports.

MIME 520 STABILITY OF ROCK SLOPES. (3) (3-0-6) (Prerequisite: permission of instructor) The properties of rock masses and of structural discontinuities. Influence of geological structure on stability. Linear, non-linear, and wedge failures. Site investigations. Methods of slope stabilization.

MIME 521 STABILITY OF UNDERGROUND OPENINGS. (3) (3-3-3) (Prerequisite: permission of instructor) The properties of rock masses and stability classification systems. The influence and properties of geological structural features. Stability related to the design of underground openings and mining systems. Site investigations. Methods of stabilization.

● MIME 524 MINERAL RESOURCES ECONOMICS. (3) (3-0-6) (Prerequisite: MIME 310 or equivalent, or permission of instructor)

MIME 526 MINERAL ECONOMICS. (3) (3-1-5) (Prerequisite: MIME 310 or equivalent) Mineral project evaluation techniques and applications. Topics covered include grade-tonnage relationships, capital and operating cost estimation techniques, assessment of mineral market conditions, taxation, discounted cash flow analysis, risk analysis, and optimization of project specifications with respect to capacity and cutoff grade.

● MIME 528 MINING AUTOMATION. (3) (3-3-3) (Prerequisite: MIME 426)

MIME 544 ANALYSIS: MINERAL PROCESSING SYSTEMS 1. (3) (2-3-4) (Prerequisite: MIME 341) The course covers three main topics: principles of separation, including data presentation, properties of recovery/yield plots, technical and economic efficiency and identification of limits to separation; column flotation, hydrodynamics of collection and froth zones, mixing, scale-up and design, measurements and control; surface and electrochemistry, including absorption, surface charge, coagulation, electron transfer reactions, electrochemistry in plant practice.

MIME 545 ANALYSIS: MINERAL PROCESSING SYSTEMS 2. (3) (4-2-3) (Prerequisite: MIME 341) Gold recovery (as a Professional Development Seminar): methods of recovery (gravity, flotation, cyanidation), refractory gold (roasting, pressure oxidation, bacterial leaching), dissolved gold recovery (Merrill-Crowe) and activated carbon methods. Sampling; definition of errors, sample extraction, size, and processing. Mass balancing; basic considerations, definition of networks, software. Blending; auto-correlation functions, transfer functions, blending systems. Effect of feed variability.

● MIME 546 SURFACE CHEM IN MATERIALS PROC. (3)

MIME 551 ELECTROCHEMICAL PROCESSING. (3) (3-2-4) (Prerequisite: MIME 352) Characterization of aqueous, fused salt and solid electrolytes; laws of electrolysis; ion transport mechanisms; interfacial phenomena (electrolyte-electrolyte, electrode-electrolyte); reversible cells and potentials; electrode kinetics, overpotential and potential-current laws; industrial applications; electrolytic winning and refining, electroplating, surface cleaning and coating, electrodialysis and electrochemical sensors.

MIME 553 IMPACT OF MATERIALS PRODUCTION. (3) (3-0-6) (Prerequisite: Permission of instructor) Impact on the environment of the production of major materials. Pollution control practices, emerging technologies, cost, resources and conservation. Review of flowsheets for various production methods. Analysis of
the use of materials, prices, consumption, fabrication, and recycling of waste materials.

- **MIME 555 THERMAL REMEDIATION OF WASTES.** (3) (3-0-6) (Prerequisites: CHEM 111 and MIME 212 or equivalent)

- **MIME 560 JOINING PROCESSES.** (3) (3-3-3) (Prerequisite: MIME 361 or equivalent) Physics of joining; interfacial requirements; energy sources, chemical, mechanical and electrical; homogeneous hot-joining, arc-, mig-, tig-, gas-, thermal- and plasma-welding; Autogeneous hot-joining, forge-, pressure-, friction-, explosive-, electron beam- and laser-welding; Heterogeneous hot-joining, brazing, soldering, diffusion bonding; Heterogeneous cold joining, adhesives, mechanical fastening; Filler materials; Joint metallurgy; Heat affected zone, non-metallic systems; joint design and economics; defects and testing methods.

- **MIME 561 ADVANCED MATERIALS DESIGN.** (3) (0-4-5) (Prerequisite: MIME 362 or equivalent) Advanced topics in materials design problems. Discussion and laboratory work, supplemented by detailed technical reports. Special attention is given to selection, design and failure problems in various materials systems.

- **MIME 562 SOLIDIFICATION PROCESSING.** (3)

- **MIME 563 HOT DEFORMATION OF METALS.** (3) (2-2-5) (Prerequisite: MIME 463 and MIME 360) High temperature deformation processing of metallic materials. Topics include static and dynamic recrystallization, recovery, precipitation; effect of deformation on phase transformations and microstructural evolution during industrial processing. Mathematical modelling of microstructural evolution.

- **MIME 564 X-RAY DIFFRACTION ANALYSIS OF MATERIALS.** (3) (2-3-4) (Prerequisite: MIME 317 or equivalent) The techniques of X-ray and neutron diffraction are discussed as applied to the minerals and materials production industries. Special emphasis is placed upon automated X-ray powder diffractometry as employed for determining the structure and composition of materials. The application of X-ray techniques to studies of crystal structure, crystal orientation, residual stress, short-range order in liquid metals, phase diagram determination, order-disorder transformation and chemical analysis are presented.

- **MIME 566 TEXTURE, STRUCTURE & PROPERTIES OF POLYCRYSTALLINE MATERIALS.** (3) (2-3-4) (Prerequisite: MIME 317) Concepts and quantitative methods for the description of the structure of minerals and materials are discussed. Special emphasis is placed on experimental techniques of texture measurement. Procedures are demonstrated for the control of deformation and recrystallization textures in order to obtain the properties required of industrial products. Finally, the correlation between texture and the anisotropy of elastic, plastic and magnetic properties of engineering materials is described and analyzed.

- **MIME 567 ALUMINUM CASTING ALLOYS.** (3) (3-0-6) (Prerequisite: MIME 361 or equivalent)


- **MIME 569 ELECTRON BEAM ANALYSIS OF MATERIALS.** (3) (2-3-4) (Prerequisite: MIME 317) Emphasis on operation of scanning and transmission electron microscopes. Topics covered are electron/specimen interactions, hardware description; image contrast description; qualitative and quantitative (ZAF) x-ray analysis; electron diffraction pattern analysis.

- **MPMC 320 CAO ET INFORMATIQUE POUR LES MINES.** (3) (2-3-4) Présentation de techniques informatisées et de logiciels permettant d’appler l’informatique dans le cadre des diverses opérations reliées à l’exploitation des mines. Utilisation de logiciels de support: chiffrier électronique, traitement de texte, éditeur graphique, utilitaires de DOS. Utilisation de graphisme, de traceurs à plumes, de tablettes numérisantes, d’interfaces pour capteurs analogique/numérique et numérique/ analogique. Notions de géométrie descriptive appliquées à des problèmes miniers.

- **MPMC 321 MÉCANIQUE DES ROCHES ET CONTRÔLE DES TERRAINS.** (3) (3-3-3) (Prerequisite: MIME 323) Pressions de terrains au pourtour des excavations: solutions analytiques et numériques. Stabilité des excavations souterraines et à ciel ouvert: analyse des instabilités structurelles par projection stéréographique mériéenne, analyse des instabilités causées par les excès de contraintes. Soutènement. Surveillance. Études de cas.


- **MPMC 328 ENVIRONnement et GESTION DES REJETS MINIERS.** (3) (3-3-3) (Prerequisite: MIME 200 and MIME 291) Effets du milieu de travail sur l’homme (hydrogène du travail): législation; contraintes théoriques, problèmes de bruit, de contaminants gazeux et de poussières; techniques de mesures. Effets de l’exploitation d’une mine sur le milieu (environnement et écologie): législation; études d’impacts; effluents miniers: origine, nature et traitement des effluents; entreposage des résidus; restauration des sites.

- **MPMC 329 GÉOLOGIE MINIÈRE.** (2) (2-2-2) (Prerequisite: EPSC 221, MIME 200 and MIME 209) Méthodes de cartographie minière, de sondages et d’échantillonnage. Notion de teneur de copure, calcul des réserves par les méthodes conventionnelles. Évaluation des réserves par les méthodes géostatistiques.

- **MPMC 330 GÉOTECHNIQUE MINIÈRE.** (3) (3-3-3) (Prerequisite: MIME 323) Propriétés mécaniques des matériaux meubles. Conception d’emplacements et de digues de retenue pour les matériaux miniers. Conception de structures enfouies. Problèmes particuliers avec les résidus miniers: liquéfaction, déposition, etc. Écroulement gravitaire des matériaux meubles.


- **MPMC 422 VENTILATION MINIÈRE ET HYGIÈNE DU TRAVAIL.** (3) (3-3-3) (Prerequisite: MIME 340) Description des composantes d’un système de ventilation. Ventilation naturelle et mécanique. Principe de mesure et de modélisation des écoulements d’air dans les réseaux de ventilation. Techniques de calcul des pertes de charges dans un circuit. Choix des composantes pour assurer et régulariser les écoulements. Simulation informatisée des écoulements. Chauffage de l’air.
work as planners and designers at various levels of government, in non-profit organizations and with private consulting firms. Their expertise ranges from historic preservation to traffic management, from housing development to computer imaging. They devote their efforts in increasing numbers to environmental planning and sustainable development.

The School is a partner in the Montreal Interuniversity Group “Urbanization and Development”, a consortium recognized by CIDA as a Centre of Excellence, which is devoted to the study of urban problems and the formulation of policies in developing regions. Faculty and students collaborate actively with members of other McGill departments, notably Architecture, Geography, Civil Engineering and Law, and with colleagues at other institutions in Canada and abroad.

The objective of the School is to produce qualified professional urban planners for the public and the private sectors. Training is provided at the post-graduate level; the degree offered is the Master of Urban Planning (M.U.P.). Upon completion of the two-year program of studies, graduates are expected to have acquired basic planning skills, a broad understanding of urban issues, and specialized knowledge in a field of their own choice.

The program of study offered by the School is fully recognized by the Ordre des Urbanistes du Québec (O.U.Q.) and the Canadian Institute of Planners (C.I.P.). Graduates can become full members of these professional organizations after meeting their internship requirements.

For details of the M.U.P. admission requirements and curriculum, consult the Graduate Studies Calendar, available on the web at http://www.mcgill.ca.

While the School of Urban Planning is a graduate program, a number of undergraduate courses are taught by the faculty members affiliated with the School. These are listed below.

UNDERGRADUATE COURSES OFFERED BY THE SCHOOL

For the Term (Fall and/or Winter), days, and times when courses will be offered, please refer to the 2002-2003 Class Schedule on the Web, http://www.mcgill.ca/students/. Class locations and names of instructors are also provided.

Students preparing to register are advised to consult the Class Schedule website for the most up-to-date list of courses available. New courses may have been added or courses rescheduled after this Calendar went to press.

The schedule of courses to be offered in Summer 2003 will be available on the website in January.

URBP has replaced 409 as the prefix for Urban Planning courses. The course credit weight is given in parentheses after the title.

Denotes courses with limited enrolment.

URBP 501 PRINCIPLES AND PRACTICE 1. (2) This six-week intensive course exposes students to issues and techniques that are applicable in diverse professional planning contexts. The subject matter, geographic area, scale of intervention and institutional location of planning varies from semester to semester. The course focuses on a specific case study and is taught by a visiting lecturer with professional experience in the selected subject matter.

URBP 505 GEOGRAPHIC INFORMATION SYSTEMS. (3) An introduction to fundamental geographic information system (GIS) concepts and a range of GIS applications in urban and regional planning.

Undergraduate courses offered jointly by the School and other academic units

GEOG 351 QUANTITATIVE METHODS. (3) (Fall) (3 hours) (Prerequisite: GEOG 203 or permission of instructor) Survey design; univariate and multi-dimensional scaling; cost-benefit analysis and matrix methods of plan evaluation; multiple regression and correlation; logic models; gravity models; population projection.

ARCH 550 URBAN PLANNING 1. (3) (2-0-7) (Prerequisite: B.Sc.(Arch.) or permission of instructor) (Not normally open to Urban Planning students) (Section 01: Architecture students) (Section 02: others; limited enrolment.) Theory and practice. An
examination of different basic approaches to urban planning with special reference to Quebec.

ARCH 551 URBAN PLANNING 2. (3) (2-1-6) (Prerequisite: ARCH 550) (Section 01: Architecture students) (Section 02: others; limited enrolment.) Urban design and project development, theory and practice. Detailed analysis of selected examples of the development process and of current techniques in urban design. Includes case studies from Quebec and elsewhere.

CIVE 433 URBAN PLANNING. (3) (3-1-5) (Prerequisites: CIVE 421 and MIME 310. Corequisite: CIVE 319) 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.

PUB 104 LAND USE PLANNING. (3) A comparative study of private and public control of land use and development, involving master plans, zoning bylaws, subdivision control, urban re-development, expropriation, and regional planning.

GRADUATE 600-LEVEL COURSES
Generally, undergraduate students are not permitted to enrol in graduate 600-level courses. However, in exceptional circumstances, the Graduate Studies Office does grant this permission upon the request of the department on behalf of the student. A list of such courses, described in detail in the Graduate Studies Calendar, is as follows:
URBP 612 History and Theory of Planning
URBP 614 Urban Environmental Planning
URBP 619 Transport and Land Development
URBP 620 Computer Applications in Planning
URBP 621 Theories of Urban Form
URBP 625 Principles And Practice of Planning 2
URBP 626 Principles And Practice of Planning 3
URBP 628 Practical Experience

5 Minor Programs and Choice of Electives or Complementary Courses

Minors are coherent sequences of courses which may be taken in addition to the courses required for the B.Eng. degree. Minor programs normally consist of 24 credits, allowing up to 12 credits of overlap with the degree program. The real credit cost to the student is typically 9 to 15 credits, representing one semester beyond the B.Eng. degree program. All courses in a Minor program must be passed with a grade of C or better.

Students of the Faculty have a considerable variety of complementary course choices, which fall into the categories of technical and complementary studies. Students should refer to their respective departments for information concerning complementary course selections. Departments also publish in this Calendar and in separate documents, information regarding the choice of courses. Students should also consult their course advisors.

Some general information applicable to all students of the Faculty is given below. This mainly covers the areas of materials engineering, management, biotechnology, economics, mathematics, arts, environmental engineering, computer science and chemistry. Further information is available through the Faculty of Engineering Student Affairs Office.

5.1 Arts Minor

Engineering students may obtain a Minor in Arts as part of their B.Eng. degree by satisfying the 24-credit requirement described below. In general, complementary studies courses given in the Faculty of Arts and listed under: (i) “3 credits of studies of the Impact of Technology on Society” and (ii) “the remaining credits to be elective social science and humanities courses” (see section 3.4), may be used to satisfy some of these requirements. In no case will more than 9 credits taken from these complementary studies requirements be credited towards the Minor in Arts.

Requirements
1. The program must consist of 24 credits as follows:
   a) at least two areas of concentration from within the Faculty of Arts must be chosen, with the minimum number of credits in any one area being 6;
   b) at least 12 credits must be at the 300 or above level.
2. All courses in the Minor program must be passed with a grade of C or better.
3. The selection of courses for the Minor is to be done in consultation with the Minor Advisor, Ms. Judy Pharo, Faculty of Engineering Student Affairs Office.

For further information, contact Professor B. Haskel, Political Science, or Ms. Pharo, Student Affairs Office, Faculty of Engineering.

5.2 Biotechnology Minor

The Faculties of Engineering and of Science offer a Minor in Biotechnology for students interested in taking additional courses in this area. For Engineering students, the Minor has been designed specifically for students within the Chemical Engineering Department, however other Engineering students are invited to contact the Minor program supervisor, Professor Bennett, or Ms. Judy Pharo, Faculty of Engineering Student Affairs Office, for further information.

Students should identify an interest in the Minor to their academic advisor and the supervisor of the program during the U1 year, and at the time of registration for the U2 year. With the agreement of the academic advisor, students should submit their course list to the program supervisor who will certify that the proposed program conforms to the requirements for the Minor.

The Biotechnology Minor Program is administered for the Faculties of Engineering and of Science by Prof. H. Bennett, Sheldon Biotechnology Centre (Lyman-Duff Building), phone 398-3998. A full description of the Minor program appears under the Biotechnology heading on page 386 of the Science section.

A Chemical Engineering student may complete the Biotechnology Minor by taking BIOL 200, BIOL 201, BIOL 202, MIMM 211, BIOT 505, plus one course from the list of additional courses not including MIME 310. The Department of Chemical Engineering permits students in the Minor program to complete BIOT 505 as one of their technical complementary requirements. The total course credit required for the Chemical Engineering student is 15 credits beyond the 110-credit B.Eng. program.

5.3 Chemistry/Chemical Engineering Minor

The Departments of Chemistry and Chemical Engineering offer a Minor Program in Chemistry, of particular interest to Chemical Engineering students, and a Minor in Chemical Engineering, of interest to Chemistry students (described in the Science section). The Minor in Chemistry consists of 25 credits as follows:

1. Required courses, 10 credits: CHEM 212, CHEM 233 and CHEM 234 (or CEGEP equivalent)
2. At least 15 credits from the following list, two of which must be laboratory courses (“ indicates lab). Note that CHEM 212 is a prerequisite for most of the courses listed below. If students take CHEM 222* instead of CHEM 234, they will receive credit for one of the two laboratories that are required but they must have a total of 25 Chemistry credits for the Minor.

Inorganic Chemistry
CHEM 281 Inorganic Chemistry 1
CHEM 371 Inorganic Chemistry Laboratory*
CHEM 381 Chemistry of Transition Elements
CHEM 591 Advanced Coordination Chemistry

Analytical Chemistry
CHEM 257D1 Introductory Analytical Chemistry*
CHEM 257D2 Introductory Analytical Chemistry* or CHEM 277D1 Classical Methods of Analysis*
CHEM 277D2 Classical Methods of Analysis*
CHEM 307 Environmental Analysis
CHEM 367  Instrumental Analysis 1
CHEM 377  Instrumental Analysis 2

Organic Chemistry
CHEM 302  Introductory Organic Chemistry 3
CHEM 352  Structural Organic Chemistry
CHEM 362  Advanced Organic Laboratory*
CHEM 382  Organic Chemistry of Natural Products
CHEM 402  Advanced Bio-organic Chemistry

Physical Chemistry
CHEM 345  Molecular Properties & Structure 1
CHEM 355  Molecular Properties & Structure 2
CHEM 363  Physical Chemistry Laboratory*
CHEM 393  Physical Chemistry Laboratory*
CHEM 455  Introductory Polymer Chemistry

Please consult the program coordinators for more information:
Prof. D. Cooper (Chemical Engineering) and Prof. M. Andrews (Chemistry). A passing grade for courses within the Minor is a C.

5.4 Computer Science Courses and Minor Program
The School of Computer Science offers an extensive range of courses for Engineering students interested in computers. The course explicitly for Engineering students, COMP 208 Computers in Engineering, and other courses in the core of the various Engineering programs are listed on page 282. Descriptions of other Computer Science courses can be found on page 394 in the Faculty of Science section.

Engineering students may obtain a Minor in Computer Science as part of their B.Eng. degree by satisfying the 24-credit requirement described below. In general, complementary courses within Engineering Departmental programs may be used to satisfy some of these requirements, but the Minor in Computer Science will require at least 12 extra credits from Computer Science (COMP) courses beyond those needed for the B.Eng. degree. Students should consult their departments about the use of complementaries, and credits that can be double counted.

Students should see the receptionist in 318 McConnell to pick up the appropriate forms, and to make an appointment to see the Minor Advisor for approval of their course selection. Forms must be approved before the end of the Add/Drop period of the student's final term.

For further information, please check the School of Computer Science website [http://www.cs.mcgill.ca/acadpages/undergrad].

Minor in Computer Science for Engineering Students

The program must consist of 24 credits, from courses passed with a grade of C or better, as follows:

**Required Course** (3 credits)
COMP 302  Programming Languages and Paradigms

**Complementary Courses** (21 credits)
3 credits – one of the following courses:
COMP 203  Introduction to Computing 2
COMP 250  Introduction to Computer Science
COMP 251  Data Structures and Algorithms
3 credits – one of the following courses:
COMP 260  Intro to Software Systems
ECSE 221  Introduction to Computer Engineering
3 credits – one of the following courses:
COMP 273  Introduction to Computer Systems
ECSE 222  Introduction to Computer Engineering 2
3 credits – one of the following courses:
COMP 350  Numerical Computing
MECH 409  Numerical Methods in Mechanical Engineering
9 credits chosen from Computer Science courses numbered 300 or higher, or any course making considerable use of computing and approved by the School of Computer Science for the Minor.*

* Students may consult with the School of Computer Science about the acceptability of particular courses. The courses in other departments are at a variety of levels. Some may be required courses in the student's Engineering program; some are courses that may be taken as technical complementaries. Students should consult with their advisors about the possibility of taking specific courses.

**Notes**
A. Courses COMP 202 Introduction to Computing 1, and COMP 208 Computers in Engineering (compulsory for some Engineering students) do not form part of the Minor.
B. COMP 202 is a prerequisite for COMP 203. Students with substantial high level language programming course may forego this prerequisite. Some additional make-up effort may be needed at the start of the course.

5.5 Construction Engineering and Management Minor
Students in the Faculty of Engineering may obtain a Minor in Construction Engineering and Management by completing 24 to 25 credits chosen from the required and complementary courses listed below. By a careful selection of complementary courses, a Civil Engineering student may obtain this Minor by completing as few as 9 additional credits. Students in other departments would typically require 12 to 15 additional credits to complete the Minor. For further information, contact Professor L. Chouinard at [phone number] 398-6446, Room 484, Macdonald Engineering Building.

**Prerequisites:**
CIVE 208  Civil Eng Systems Analysis or an equivalent course in Operations Research
CIVE 302  Probabilistic Systems or equivalent
MIME 310  Engineering Economy
COMP 208  Computers in Engineering or equivalent

**Requirements:**
The 24 to 25 credits listed below must be completed with a grade of C or higher in order to fulfill the requirements of the Minor.

1. **Management and Law:** 15 credits, as follows:
   FACC 220  (3)  Law for Architects and Engineers
   INDR 294  (3)  Intro to Labour-Management Relations
   MGCR 211  (3)  Introduction to Financial Accounting
   MGCR 341  (3)  Finance 1
   and one of:
   CIVE 324  (3)  Construction Project Management
   MECH 472  (3)  Case Studies in Project Mgmt

2. **Either 3 or 4 credits, as follows:**
   a) 4 credits - Any two of the following relating to Building Structures:
      ARCH 446  (2)  Mechanical Services in Buildings
      ARCH 447  (2)  Electrical Services
      ARCH 451  (2)  Building Regulations and Safety
      CIVE 492  (2)  Structures
   b) 3 credits - One of the following relating to Heavy Construction:
      MIME 322  (3)  Rock Fragmentation
      MIME 333  (3)  Materials Handling

3. **Other Construction-Related Complementaries:** 6 credits
   Any two of the following:
   ABEN 411  (3)  Off-Road Power Machinery
   BUSA 462  (3)  Management of New Enterprises
   CIVE 446  (3)  Construction Engineering
   CIVE 527  (3)  Renovation & Preservation of Infrastructure
   GIVE 586  (3)  Earthwork Engineering
   ECSE 461  (3)  Electric Machinery
   FINE 445  (3)  Real Estate Finance
   MME 520  (3)  Stability of Rock Slopes
   MME 521  (3)  Stability of Underground Openings
   MPME 321  (3)  Mécanique des roches et contrôle des pressions de terrains

**Total requirement:** 24 or 25 credits
5.6 Economics Minor
The Minor consists of 18 credits in courses given in the Economics Department. It consists of required courses and complementsaries. In addition, it is presumed that all Engineering students will have a sufficient background in statistics. Engineering Economy, MIME 310, does not form part of this minor. For more information see the Department of Economics, Leacock Room 443.

Required Courses (9 credits)
- ECON 230D1* Microeconomic Theory
- ECON 230D2* Microeconomic Theory
- ECON 209** Macroeconomic Analysis and Applications

Complementary Courses (9 credits) from:
- ECON 225 Economics of the Environment
- ECON 302D1 Money and Banking
- ECON 302D2 Money and Banking
- ECON 303D1 Canadian Economic Policy
- ECON 303D2 Canadian Economic Policy
- ECON 305 Industrial Organization
- ECON 306D1 Labour Economics and Institutions
- ECON 306D2 Labour Economics and Institutions
- ECON 308 Public Policies Toward Business
- ECON 311 United States Economic Development
- ECON 313 Economic Development
- ECON 314 Economic Development 2
- ECON 316 The Underground Economy
- ECON 321 The Quebec Economy
- ECON 326 Ecological Economics
- ECON 329 The Economics of Confederation
- ECON 330D1 Macroeconomic Theory
- ECON 330D2 Macroeconomic Theory
- ECON 331 Economic Development: Russia and the USSR
- ECON 332 Comparative Economic Systems
- ECON 333 Topics in Comparative Economic Systems
- ECON 335 The Japanese Economy
- ECON 337 Introductory Econometrics 1
- ECON 344 The International Economy, 1830 - 1914
- ECON 345 The International Economy Since 1914
- ECON 347 Economies of Climate Change
- ECON 404 Transportation
- ECON 405 Natural Resource Economics
- ECON 406 Topics in Economic Policy
- ECON 408D1 Public Sector Economics
- ECON 408D2 Public Sector Economics
- ECON 411 Economic Development: A World Area
- ECON 416 Topics in Economic Development 2
- ECON 420 Topics in Economic Theory
- ECON 423D1 International Trade and Finance
- ECON 423D2 International Trade and Finance
- ECON 426 Labour Economics
- ECON 434 Current Economic Problems
- ECON 440 Health Economics
- ECON 447 Economics of Information and Uncertainty
- ECON 467D1 Econometrics - Honours
- ECON 467D Econometrics - Honours
- ECON 525 Project Analysis
- ECON 534 The Pensions Crisis
- ECON 546 Game Theory

Mining Engineering students will be permitted to include Mineral Economics (MIME 526) among these 18 credits.

* Students may, with consent of instructor, take ECON 250D1/ECON 250D2 Introduction to Economic Theory - Honours, in place of ECON 230D1/ECON 230D2.

** This requirement is waived for students who choose ECON 330D1/ECON 330D2 from the list of complementsaries. Students may not take both ECON 209 and ECON 330D1/ ECON 330D2.

5.7 Environmental Engineering Minor
The Environmental Engineering Minor is offered for students of Engineering and the Department of Agricultural and Biosystems Engineering wishing to pursue studies in this area. The Minor program consists of 27 credits in courses. Through a judicious choice of core and complementary courses listed below, students may minimize the number of additional credits required to obtain this Minor. The Minor typically requires a minimum of 9 to 15 additional credits. This minimum depends on the department/school in which the student is registered.

The Environmental Engineering Minor Program is administered by the Department of Civil Engineering and Applied Mechanics. Further information may be obtained from Professor S. Ghoshal, Room 475C, Macdonald Engineering Building.

General Regulations
To complete the Minor in Environmental Engineering, students must:
a) complete a minimum of 21 credits of Engineering courses (a minimum of 6 credits in this category must be chosen outside the student's principal departmental program) (see section A below),
b) complete a minimum of 6 credits of non-Engineering courses (each course must be chosen from a different department, and neither from the student's home department) (see section B below),
c) complete one of the corequisite courses listed below in addition to the 27 credits counted toward the Minor,
d) in the case of Agricultural and Biosystems, Chemical, and Civil Engineering students, courses taken towards the Humanities and Impact course requirements for the Major cannot double-count as Minor program courses.
e) obtain a grade of C or better in all approved courses in the Minor, and
f) satisfy the requirements of both the Minor and the student's departmental program.

Note: Not all courses listed below are offered every year. Students should consult with the department concerned about the courses which are offered in a given year.

Corequisites
(Not credited to the Minor Program)
- CHEE 230 Environmental Aspects of Technology
- or CIVE 225 Environmental Engineering
- or MIME 308 Social Impact of Technology
- or equivalent environmental impact course

A. ENGINEERING COURSES (21 credits)

Agricultural Engineering (Macdonald Campus)
- ABEN 217 Hydrology and Drainage
- ABEN 322 Agro-food Waste Management
- ABEN 416 Engineering for Land Development
- ABEN 518 Pollution Control for Agriculture

Chemical Engineering
- CHEE 351 Separation Processes
- CHEE 370 Elements of Biotechnology
- CHEE 430 Technology Impact Assessment
- CHEE 452 Particulate Systems (offered in alternate years)
- CHEE 471 Industrial Water Pollution Control
- CHEE 472 Industrial Air Pollution Control
- CHEE 591 Environmental Bioremediation

Civil Engineering and Applied Mechanics
- CIVE 225 Environmental Engineering (not part of the Minor for Civil Engineering Students)
- CIVE 323 Hydrology and Water Resources (not open to students who have passed ABEN 217)
- CIVE 421 Municipal Systems
CIVE 430 Water Treatment and Pollution Control (not open to students who have passed CHEE 471)
CIVE 451 Geoenvironmental Engineering
CIVE 526 Solid Waste Management
CIVE 550 Water Resources Management
CIVE 553 Stream Pollution and Control
CIVE 572 Advanced Hydraulics
CIVE 574 Fluid Mechanics of Water Pollution
CIVE 575 Fluid Mechanics of Air Pollution
CIVE 577 River Engineering
CIVE 585 Groundwater Hydrology

Mechanical Engineering
MECH 343 Energy Conversion
MECH 434 Turbomachinery
MECH 447 Combustion
MECH 525 Intro. to Nuclear Engineering
MECH 526 Manufacturing and the Environment
MECH 534 Air Pollution Engineering

Mining, Metals and Materials Engineering
MIME 412 Corrosion and Degradation
MIME 451 Environmental Controls
MIME 555 Thermal Remediation of Wastes
MPMC 327 Hydrogeologie appliquée
MPMC 328 Environnement et gestion des rejets miniers
MPMC 422 Ventilation et hygiène du travail

B. NON-ENGINEERING COURSES (6 credits)

Agricultural Sciences (Macdonald Campus)
AEBI 200 Biology of Organisms 1
AEBI 201 Biology of Organisms 2
AEBI 205 Principles of Ecology
AEPH 510 Agricultural Micrometeorology
ENTO 380 Food Systems and the Environment
MICR 230 The Microbial World (not open to students who have passed CHEE 370)
MICR 331 Microbial Ecology (not open to students who have passed CHEE 370)
MICR 341 Mechanisms of Pathogenicity
SOIL 210 Principles of Soil Science (not part of the Minor for Agricultural Engineering Students)
SOIL 331 Soil Physics
WILD 333 Physical and Biological Aspects of Pollution
WILD 375 Issues in Environmental Sciences
WILD 415 Conservation Law
WILD 437 Assessing Environmental Impact (not open to students who have passed CHEE 430)
WOOD 420 Environmental Issues in Forestry
ZOOL 315 Science of Inland Waters

Anthropology
ANTH 206 Environment and Culture

Atmospheric and Oceanic Sciences
ATOC 210 Introduction to Atmospheric Science (not open to students who have passed GEOG 321)
ATOC 220 Introduction to Oceanic Sciences

Biography
BIOI 205 Biology of Organisms
BIOI 208 Introduction to Ecology
BIOI 432 Limnology
BIOI 470 Lake Management

Chemistry
CHEM 307 Environmental Analysis

Earth and Planetary Sciences
EPSC 243 Environmental Geology (not open to students who have passed or who will take EPSC 221)
EPSC 549 Groundwater Hydrology

Economics
ECON 225 Economics of the Environment
ECON 326 Ecological Economics
ECON 347 Economics of Climate Change

Geography
GEOG 200 Geographical Perspectives on World Environmental Problems
GEOG 201 Geographic Information Systems 1
GEOG 203 An Introduction to Environmental Studies
GEOG 205 Global Change: Past, Present and Future
GEOG 302 Environmental Analysis and Management
GEOG 303 Environmental Management I
GEOG 308 Air Photo Interpretation and Remote Sensing
GEOG 321 Climatic Environments (not open to students who have passed ATOC 210)
GEOG 404 Environmental Management for Parks and Protected Areas

Law
CMPL 580 Environment and the Law
Microbiology and Immunology
MIMM 211 Biology of Microorganisms

Religious Studies (Macdonald Campus)
RELG 270 Religious Ethics and the Environment

Sociology
SOCI 328 Environmental Sociology

5.8 Minor in Environment

Environmental studies involve the interactions between humans and their natural or technological environment. Environmental problems are frequently comprehensive and complex, and their satisfactory solutions require the synthesis of humanistic, scientific, and institutional knowledge.

The Minor in Environment is offered and administered by the McGill School of Environment (MSE). Inquiries should be directed to Mr. Peter Barry, MSE Program Coordinator. Email: info@mse.mcgill.ca or telephone: (514) 398-4306.

Since the program comprises a total of 18 credits for the Minor, additional credits beyond those needed for the B.Eng. degree are required. Students wishing to receive the Minor should prepare a program and have it approved by both their regular Engineering Advisor and the MSE Advisor. For program details, see “Minor in Environment” on page 492 in the MSE section.

5.9 Management Courses and Minor Program

Many engineers begin to assume management functions within a few years of graduation. They can, at this stage, take up the study of economics, behavioural science and other management subjects. Students wishing to include such studies in their undergraduate program can take suitable courses from Engineering and Management as listed below.

Engineering Economy MIME 310 introduces the concept of costs into evaluations of engineering projects and architectural proposals. Prerequisite to entry to this Minor is a grade C or better in MIME 310.

Several additional courses are available, subject to timetable requirements, from the core program of the Faculty of Management. Other courses from the Management core program have considerable overlap with Engineering courses and thus are not available to Engineering students.

Note: Course MGCR 211, a course in statistics, and a course in micro-economics are prerequisite for MGCR 341. If included in the Minor in Management, MGCR 423 should be taken at the end of the program.

Engineering students may obtain a Minor in Management by completing 15 credits of courses from the following list of Faculty of Management courses with a grade of C or better. Successful completion of this Minor is noted on a student's transcript.

Required Courses (6 credits)
MGCR 211 Introduction to Financial Accounting
MGCR 320 Managing Human Resources

Complementary Courses (9 credits)
3 credits, one of List A:
MGCR 213 Introduction to Managerial Accounting
MGCR 341 Finance I
MGCR 373 Operations Research
MGCR 382 International Business
3 credits, one of List B:
BUSA 462 Management of New Enterprises
or BUSA 465 Technological Entrepreneurship
MGCR 222 Organizational Behaviour
MGCR 352 Marketing Management 1
or MRKT 360 Marketing of Technology
MGCR 360 Social Context of Business
MGCR 423 Organizational Policy

3 credits, any available 300 or 400-level Management course (for which the prerequisites, if any, have been met).

An Engineering course deemed equivalent by the Faculty of Management may be substituted for course MGCR 373. There are three courses in Engineering that qualify: CIVE 208, MECH 474 and MPMC 326. It should be noted that MGCR 373 does not count as a technical complementary course.

A student embarking on the Minor must be prepared to take credits additional to the normal Engineering program. The student may choose the non-technical complementary course(s) required in his/her program from list B above, but under no circumstances will more than 6 credits of non-technical complementary courses count towards both the Engineering program and the Minor. Students considering this Minor should consult their advisor or the Faculty of Engineering Student Affairs Office.

5.10 Materials Engineering Minor
Engineering students may obtain a Minor in Materials Engineering by completing 24 credits chosen from the required and complementary courses listed below. By a careful selection of complementary courses, Engineering students may obtain this Minor with a minimum of 15 additional credits. It should be noted that some departments (e.g. Mechanical Engineering) will allow their students to take courses from this list, providing they complete the Minor prior to graduation. For further information, please contact the coordinator, Prof. J. Szpunar, Room 2M020, Wong Building.

Required Courses (15 credits)

MIME 260 Materials Science and Engineering
or CHEE 380 Materials Science
MIME 367 Electronic Properties of Materials
MIME 465 Ceramic Engineering
CHEE 481 Polymer Engineering
CHEE 484 Materials Engineering

Complementary Courses (9 credits)

Three courses to be chosen from the following list:
CHEE 381 Polymer Technology
CHEE 483 Industrial Rheology
CHEE 487 Chemical Processing in the Electronics Industry
CHEE 530C Structure and Properties of Paper
CHEE 581 Polymer Composites Engineering
CHEM 455 Introductory Polymer Chemistry
ECSE 545 Microelectronics Technology
MECH 530 Mechanics of Composite Materials
MIME 360 Phase Transformations in Solids
MIME 361 Liquid State Processing of Materials
MIME 362 Mechanical Properties
MIME 412 Corrosion and Degradation
MIME 560 Joining Processes
MIME 561 Advanced Materials Design
MIME 563 Hot Deformation of Metals
MIME 564 X-Ray Diffraction Analysis of Materials
MIME 566 Texture, Structure and Properties of Polycrystalline Materials
MIME 569 Electron Beam Analysis of Materials

5.11 Mathematics Minor
The Minor in Mathematics for students in the Faculty of Engineering requires satisfactory passes in 24 credits of approved courses in Mathematics not including MATH 247 (or MATH 223), MATH 260 (or MATH 222), MATH 261 (or MATH 315 or MATH 325), MATH 265 (or MATH 248 or MATH 314), MATH 266, MATH 270, MATH 319.

At least 18 credits must be chosen from the Mathematics and Statistics courses approved for the Mathematics Majors or Honours program, or from MATH 249, MATH 363, MATH 381, MATH 386. The remaining credits may be chosen from mathematically allied courses.

In addition to an Engineering Advisor, each student in the Minor program must have an Advisor designated by the Department of Mathematics and Statistics, normally beginning in the U2 year. The selection of courses for the Minor is to be done in conjunction with the Minor Advisor. Please consult the Department of Mathematics and Statistics for an Advisor.

5.12 Physics Minor
Students in Honours Electrical Engineering may obtain a Minor in Physics as part of their B.Eng. degree by satisfying the 18-credit requirement listed below:

PHYS 253 Thermal Physics
PHYS 357 Quantum Physics 1
PHYS 457 Quantum Physics 2

and at least 9 credits chosen from the following:

PHYS 332 Physics of Fluids
PHYS 362 Statistical Mechanics
PHYS 451 Classical Mechanics
PHYS 514 General Relativity
PHYS 551 Quantum Theory
PHYS 557 Nuclear Physics
PHYS 558 Solid State Physics
PHYS 559 Advanced Statistical Mechanics
PHYS 562 Electromagnetic Theory
PHYS 567 Particle Physics

Students who take PHYS 357 and PHYS 457 can omit PHYS 271 from their normal Electrical Engineering program. Candidates must go to the Department of Physics at registration time in their U3 year to fill out a Minor Program Form.

5.13 Technological Entrepreneurship Minor
Engineering students may obtain a Minor in Technological Entrepreneurship by completing 6 courses (18 credits) as listed below.

Up to two courses (6 credits) may be double-counted for credit towards the Humanities and Social Sciences Complementary Courses.

This Minor is offered jointly by the Faculties of Engineering and Management. It will appeal to those students who have a concept, process or product idea in mind and who want to explore the opportunity of commercializing it. It will also be of interest to students who have a general interest in entrepreneurship and intend to pursue a career in small and medium sized high technology/engineering companies.

Students considering the Minor should consult Ms. Judy Pharao, Faculty of Engineering Student Affairs Office, email: advisor@emf.lan.mcgill.ca

Required Courses (18 credits)

BUSA 465 (3) Technological Entrepreneurship
FACC 480 (3) Technological Entrepreneurship Project
MGCR 320 (3) Managing Human Resources
MGPO 562 (3) Organizational Strategies for Advanced Technology Firms
MRKT 360 (3) Marketing of Technology
ORG 321 (3) Leadership
5.14 Software Engineering Minor
This Minor will prepare an engineering student for a career in software engineering. It will provide a foundation in basic computer science, computer programming and software engineering practice.

The Minor consists of 24 credits (8 courses). Up to four of the courses (12 credits) may be double-counted for credit towards the B. Eng. degree in Electrical Engineering or Computer Engineering. Students in other programs may double-count up to three courses (9 credits).

Students considering this Minor should contact Ms. Judy Pharo, Faculty of Engineering Student Affairs Office, email: advisor@emf.iain.mcgill.ca.

Required Courses (9 credits)
ECSE 221 (3) Introduction to Computer Engineering
ECSE 321 (3) Introduction to Software Engineering
ECSE 428 (3) Software Engineering Practice

Complementary Courses (15 credits)
one course (3 credits), either:
COMP 203 (3) Introduction to Computing
or COMP 250 (3) Introduction to Computer Science
At least one course (3 credits) must be selected from the following list of engineering courses:
CHEE 458 (3) Computer Applications
CHEE 571 (3) Small Computer Applications in Chemical Eng.
CIVE 460 (3) Matrix Structural Analysis
CIVE 550 (3) Water Resources Management
CIVE 572 (3) Computational Hydraulics
ECSE 424 (3) Human-Computer Interaction
ECSE 427 (3) Operating Systems
ECSE 526 (3) Artificial Intelligence
ECSE 531 (3) Real Time Systems
ECSE 532 (3) Computer Graphics
MECH 474 (3) Selected Topics in Operations Research
MECH 524 (3) Computer Integrated Manufacturing
MECH 539 (3) Computational Aerodynamics
MECH 545 (3) Advanced Stress Analysis
MECH 576 (3) Computer Graphics and Geometrical Modelling

No more than two courses (6 credits) can be selected from the following list of courses offered by the School of Computer Science:
COMP 302 (3) Programming Languages and Paradigms
COMP 335 (3) Software Engineering Methods
COMP 420 (3) Files and Database Systems
COMP 421 (3) Introduction to Database Systems
COMP 424 (3) Topics in Artificial Intelligence
COMP 426 (3) Automated Reasoning
COMP 431 (3) Algorithms and Data Structures
COMP 433 (3) Personal Software Engineering
COMP 538 (3) Person-Machine Communication

6 Courses Given by other Faculties for Engineering Students

6.1 Faculty of Education
EDEC 206 COMMUNICATION IN ENGINEERING. (3) (Limited enrolment) (Restricted to B.Eng. students who have not taken EDES 201 or EDEC 202) (Because this course uses a workshop format, attendance at first class is desirable.) Written and oral communication in Engineering (in English): strategies for generating, developing, organizing, and presenting ideas in a technical setting; problem-solving; communicating to different audiences, editing and revising; and public speaking. Course work based on academic, technical, and professional writing in engineering.

6.2 Faculty of Science
Note: All Science courses have limited enrolment.

DEPARTMENT OF CHEMISTRY
CHEM 233 TOPICS IN PHYSICAL CHEMISTRY. (3) (3-0-6) (For Chemical Engineers only) Introduction to chemical kinetics, surface and colloid chemistry and electrochemistry. The topics to be discussed will be of particular interest to students in chemical engineering.

CHEM 234 TOPICS IN ORGANIC CHEMISTRY. (3) (3-0-6) (Prerequisites: CHEM 212 or equivalent) (For Chemical Engineers only) Modern spectroscopic techniques for structure determination. The chemistry of alkyl halides, alcohols, ethers, carbonyl compounds and amines with special attention to mechanistic aspects. Special topics.

SCHOOL OF COMPUTER SCIENCE
COMP 202 INTRODUCTION TO COMPUTING 1. (3) (3 hours) (Prerequisite: a CEGEP level mathematics course) (Restriction Note A: COMP 202 and COMP 208 cannot both be taken for credit.
COMP 202 is intended as a general introductory course, while COMP 208 is intended for students interested in scientific computations.) (Restriction Note B: COMP 202 cannot be taken for credit with or after COMP 250.) Overview of components of microcomputers, the internet design and implementation of programs using a modern high-level language, an introduction to modular software design and debugging. Programming concepts are illustrated using a variety of application areas.

COMP 208 COMPUTERS IN ENGINEERING. (3) (3 hours) (Prerequisites: differential and integral calculus. Corequisite: linear algebra: determinants, vectors, matrix operations.) (Restriction Note A: COMP 202 and COMP 208 cannot both be taken for credit.
COMP 208 is intended as a general introductory course, while COMP 208 is intended for students interested in scientific computations.) Introduction to computer systems. Concepts and structures for high level programming. Elements of structured programming using FORTRAN 90 and "C". Assignments in both mainframe and microcomputer environment. Numerical algorithms such as root finding, numerical integration and differential equations. Non-numerical algorithms for sorting and searching.

COMP 250 INTRODUCTION TO COMPUTER SCIENCE. (3) (Prerequisites: Familiarity with a high level programming language and CEGEP level Math.) (Restriction Note B: COMP 203 and COMP 250 are considered to be equivalent from a prerequisite point of view, and cannot both be taken for credit.) (Restriction Note C: Open only to students registered in a Core Group or Mathematics Group program, or the Major in Computer Engineering, as defined in the SOCS section, Undergraduate Programs Calendar) An introduction to the design of computer algorithms, including basic data structures, analysis of algorithms, establishing correctness of programs and program testing. Overview of topics in computer science.

COMP 302 PROGRAMMING LANGUAGES AND PARADIGMS. (3) (3 hours) (Prerequisite: COMP 250 or COMP 203) (Restriction Note L: Open only to students registered in a Core Group or Mathematics Group program, or the Major in Computer Engineering, or the Minor in Computer Science, as defined in the SOCS section, Undergraduate Programs Calendar) Programming language design issues and programming paradigms. Binding and scoping, parameter passing, lambda abstraction, data abstraction, type checking, functional and logic programming.

Department of Earth and Planetary Sciences
EPSC 221 GENERAL GEOLOGY. (3) (2-3-4) An introductory course in physical geology designed for majors in civil and mining engineering. Properties of rocks and minerals, major geological NSproceses, together with natural hazards and their effects on engineered structures are emphasized. The laboratory is an integral part of the course which includes rock and mineral identifica-
tion, basic techniques of airphoto and geological map interpretation, and structural geology.

EPSC 225 PROPERTIES OF MINERALS. (1) (1 hour lecture, 1 hour lab) (Not open to students who have taken EPSC 210) Survey of the physical and chemical properties of the main mineral groups. Discussion of their relationships to the chemical composition and structure of minerals. The practical exercises emphasize the physical and chemical properties that relate to industrial uses and environmental issues, and the identification of hand specimens.

DEPARTMENT OF MATHEMATICS AND STATISTICS

MATH 247 LINEAR ALGEBRA. (3) (Prerequisite: MATH 133 or equivalent. Intended for Honours Physics and Engineering students) (Not open to students who have taken or are taking MATH 236, MATH 223 or MATH 251) Matrix algebra, determinants, systems of linear equations. Abstract vector spaces, inner product spaces, Fourier series. Linear transformations and their matrix representations. Eigenvectors and eigenvectors, diagonalizable and defective matrices, positive definite and semidefinite matrices. Quadratic and Hermitian forms, generalized eigenvalue problems, simultaneous reduction of quadratic forms. Applications.

MATH 248 ADVANCED CALCULUS 1. (3) (Prerequisites: MATH 133 and MATH 222 or consent of Department. Intended for Honours Mathematics, Physics and Engineering students) (Not open to students who have taken or are taking MATH 314) Partial derivatives; implicit functions; Jacobians; maxima and minima; Lagrange multipliers. Scalar and vector fields; orthogonal curvilinear coordinates. Multiple integrals; arc length, volume and surface area. Line integrals; Green’s theorem; the divergence theorem. Stokes’ theorem; irrotational and solenoidal fields; applications.

MATH 249 ADVANCED CALCULUS 2. (3) (Prerequisite: MATH 248. Intended for Honours Physics and Engineering students) (Not open to students who have taken or are taking MATH 316) Functions of a complex variable; Cauchy-Riemann equations; Cauchy’s theorem and consequences. Taylor and Laurent expansions. Residue calculus; evaluation of real integrals; integral representation of special functions; the complex inversion integral. Conformal mapping; Schwarz-Christoffel transformation; Poisson’s integral formulas; applications.

MATH 260 INTERMEDIATE CALCULUS. (3) (3-1-5) (Prerequisites: MATH 141, MATH 133 or equivalent) Review of sequences and series. Power series, Taylor’s theorem and Taylor’s series, computations using series. Review of vectors, lines and planes, curves and curvature, conics, polar coordinates, Surfaces. Differential calculus of several variables. Double and triple integrals.

MATH 261 DIFFERENTIAL EQUATIONS. (3) (3-1-5) (Corequisite: MATH 260) Ordinary differential equations: first order, linear second-order and higher order, linear with constant coefficients. Solution by series, by Laplace transform, and by some simple numerical methods.

MATH 265 ADVANCED CALCULUS. (3) (3-1-5) (Prerequisites: MATH 260 or MATH 222 or MATH 151 or equivalent) Implicit functions, constrained and unconstrained extrema for functions of several variables. Change of variables in multiple integrals, Jacobians, surface integrals. Scalar and vector fields, line integrals, vector operators. Green’s divergence and Stokes’ theorems, applications to heat flow, electrostatics and fluid flow.


MATH 270 APPLIED LINEAR ALGEBRA. (3) (3-1-5) (Prerequisite: MATH 261) Review of matrix algebra, solution of linear equations, triangular factorization and Gaussian reduction, vector spaces, inner products, orthogonality concepts, projections, least squares.

Eigenvalues and eigenvectors, diagonalization of matrices and quadratic forms, Cayley-Hamilton theorem, the exponential matrix, analytical and numerical techniques for solving linear systems of ordinary differential equations, nonlinear equations and stability.

MATH 325 ORDINARY DIFFERENTIAL EQUATIONS. (3) (3-0-6) (Prerequisite: MATH 222. Intended for Honours Mathematics, Physics and Engineering programs.) (Not open to students who have taken MATH 261, MATH 315) First and second order equations, linear equations, series solutions, Frobenius method, introduction to numerical methods and to linear systems, Laplace transforms, applications.

MATH 363 DISCRETE MATHEMATICS. (3) (3-0-6) (Prerequisites: MATH 265 and either MATH 270 or consent of instructor) Logic and combinatorics. Mathematical reasoning and methods of proof. Sets, relations, functions, partially ordered sets, lattices, Boolean algebra. Propositional and predicate calculi. Recurrences and graph theory.

MATH 381 COMPLEX VARIABLES AND TRANSFORMS. (3) (3-1-5) (Prerequisite: MATH 265) Analytic functions, Cauchy-Riemann equations, simple mappings, Cauchy’s theorem, Cauchy’s integral formula, Taylor and Laurent expansions, residue calculus. Properties of one and two-sided Fourier and Laplace transforms, the complex inversion integral, relation between the Fourier and Laplace transforms, application of transform techniques to the solution of differential equations. The Z-transform and applications to difference equations.

DEPARTMENT OF PHYSICS

PHYS 251 CLASSICAL MECHANICS. (3) (3 hours lectures) (Prerequisite: CEGEP physics. Corequisite: MATH 222) (Not open to students taking or having taken PHYS 230.) Newton’s laws, work energy, angular momentum. Harmonic oscillator, forced oscillations. Inertial forces, rotating frames. Central forces, centre of mass, planetary orbits, Kepler’s laws.

PHYS 271 QUANTUM PHYSICS. (3) (3-0-6) (Prerequisite: PHYS 251 or CIVE 281) The observed properties of atoms and radiation from atoms. Electron waves. The Schroedinger Equation in one dimension. Quantum mechanics of the hydrogen atom. Angular momentum and spin. Quantum mechanics of many electron systems. Basic ideas of electrons in solids and solid state physics.

PHYS 350 ELECTROMAGNETISM. (3) (3 hours lectures) (Prerequisites: MATH 248, MATH 325. Honours students or permission of the instructor) (Not open to students having taken PHYS 340) Fundamental laws of electric and magnetic fields in both integral and differential form.