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6.1 Faculty of Education

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1.1 Location

Macdonald Engineering Building
817 Sherbrooke Street West
Montreal, QC H3A 2K6
Canada
http://www.engineering.mcgill.ca
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.(Tor.), Eng.


Associate Dean (Student Affairs)


Associate Dean (Academic)

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

DENIS MITCHELL, B.A.Sc., M.A.Sc., Ph.D.(Tor.), F.A.C.I., Eng.

Chair, Department of Civil Engineering and Applied Mechanics


Chair, Department of Electrical and Computer Engineering

TBA

Chair, Department of Mechanical Engineering

ROBIN A.L. DREW, B.Tech.(Bradford), Ph.D.(Newcastle)

Chair, Department of Mining and Metallurgical Engineering


Building Director

STEVE YUE, B.Sc., Ph.D.(Leeds)

Secretary of Faculty

IDA GODEFROY

Assistant to the Dean

JOHN E. GRUZLESKI, B.Sc., M.Sc.(Queen's), Ph.D.(Tor.), Eng.

DAVID COVO, B.Sc.(Arch.), B.Arch.(McG.), M.R.A.I.C., O.A.Q.

DAVID F. BROWN, B.A.(Bishop's), M.U.P.(McG.), Ph.D.(Sheffield)

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STEVE YUE, B.Sc., Ph.D.(Leeds)

IDA GODEFROY

JUDY PHARO

SHARON LEWIS

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 and Metallurgical 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 Calendar.

Some of the courses offered by the BME Department may be of interest to students in the Faculty of Engineering. Students may consult the list of technical programs and applicants from outside of Canada can be found in section 2 of the Application Procedures, Admission Requirements chapter. Further information is available on the Libraries website http://www.library.mcgill.ca.

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 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 189-260 Intermediate Calculus upon successful completion of the Advanced Credit Examination. The 189-260 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 189-260 Intermediate Calculus examination will automatically have the number of credits required for the completion of their program reduced by three.

2.4 Registration
Students who are currently registered and intend to return to the same degree program in the following academic session are required to register on MARS. MARS information sheets are available in the Faculty of Engineering Student Affairs Office. 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.

Note that registration on MARS is not final until it has been approved by an Academic Advisor.

New students also register by MARS. Information is sent 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.

2.4.1 Registration for Continuing Education Courses
Students can register for Continuing Education courses through MARS. Students must refer to the Centre of Continuing Education Calendar and Timetable for course information and deadlines. For further information contact the Faculty of Engineering Student Affairs Office.

2.4.2 Course Withdrawal
Students may withdraw from a course using MARS 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.

2.5 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 Advising (514) 398-7256
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
Metallurgical Engineering (514) 398-4755 ext. 4365
Mining Engineering (514) 398-4755 ext. 0573
Urban Planning (514) 398-4075

In addition to departmental advising, the Faculty offers a free tutorial service, known as ACE, to help students in their first year of studies. Upper year Engineering students and graduate students provide the service daily. Hours will be posted in the Engineering Undergraduate Society Office, McConnell Engineering Building, Room 7, and in the Faculty of Engineering Student Affairs Office.

2.6 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 Undergraduate Society (AUS). 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 AUS, as appropriate.

2.7 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 (http://www.aro.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.

2.8 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.

Employment through the IYES Program typically begins in January or May and continues for 8, 12 or 16 months, including a four-month probationary training period. While employed by the participating companies, students work on assignments related to their field of study. Projects generally involve research and development or design.

Students may switch to the Internship Program from the regular program when they accept an Internship placement. Successful completion of an 8 to 16-month internship will qualify the student to graduate with the Internship Program designation.

Employers choose the most suitable students for their organization through the application, interview and ranking process.

SPECIALIZATION AREAS OF IYES STUDENTS
All students participating in this program must 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
- Chemistry
- Civil Engineering
- Computer Engineering
- Electrical Engineering
- Environmental Studies
- Mathematics and Statistics
- Mechanical Engineering
- Physics
- Science

STUDENT BENEFITS
- Professional experience related to course of study
- Salary within the average range of those for entry level professional positions
- Improved chance of obtaining a job upon graduation and at a higher starting salary
- Opportunity to test choice of career and assess pertinence of post-graduate study before making a long-term commitment
- 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
- Participation in the IYES Program will be noted on the student’s permanent record

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.
STUDENT ELIGIBILITY
- full-time registration in an Engineering or Science undergraduate program with fewer than 45 credits and more than 15 credits remaining
- strong leadership/communication skills, good academic record (satisfactory standing)
- remain degree candidate and 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.

Further information can be obtained from the internet posting (http://www.engineering.mcgill.ca/mecc) or by sending an email to info@mecc.mcgill.ca

2.9 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 McConnel 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 tests 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.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>180-111B</td>
<td>General Chemistry for Physical Science &amp; Engineering Students</td>
<td>4 credits</td>
</tr>
<tr>
<td>180-121A</td>
<td>General Chemistry for Physical Science &amp; Engineering Students</td>
<td>4 credits</td>
</tr>
<tr>
<td>189-140A or 189-139A</td>
<td>Calculus I or 189-140A</td>
<td>3 credits</td>
</tr>
<tr>
<td>or 189-150A</td>
<td>or Calculus A or 189-151B</td>
<td>4 credits</td>
</tr>
</tbody>
</table>

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 Faculty of Graduate Studies and Research 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.ccpe.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 for on-line registration. 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:

- History of Housing
- Environmental Aspects of Technology
- Technology Impact Assessment
- Infrastructure & Society
- Social Impact of Technology
- Intro. to History & Philosophy of Science I
- Intro. to History & Philosophy of Science II
- Interdisciplinary Seminar in the History and Philosophy of Science
- Economics of the Environment
- Technology and Society
- Industrial Sociology
- Women and Work
- Geographical Perspectives on World Environmental Problems
- Introduction to Environmental Studies
- Global Change: Past, Present and Future
- Environmental Anal. and Mgmt. I: Probs. and Pol.

183-333C The Habitable City
186-243A,B,L Environmental Geology (not available to students who have taken or who will take 186-221A, General Geology)
260-270A,B Religious Ethics and the Environment (Note: A term is offered at Macdonald Campus only)

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 154-208, 217, 227, 259 and 337)
- History
- Philosophy (excluding 107-210)
- Political Science
- Psychology (excluding 204-204, 305 and 435 but including 204-100)
- School of Social Work
- Sociology (excluding 166-350) or 189-338A History and Philosophy of Mathematics or 301-350A The Material Culture of Canada

B. Administrative Studies and Law
Faculty of Engineering
300-220A Law for Architects and Engineers

Faculty of Management
270-465B Technological Entrepreneurship
272-321B Leadership
275-360A,B Marketing of Technology
276-562B Organizational Strategies for Adv. Tech. Firms
279-294A,B,X,Y Introduction to Labour-Management Relations
280-222A,B,X,Y Organizational Behaviour
280-320A Managing Human Resources
280-352A,B,X,Y Marketing Management I
280-360B Social Context of Business

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 IVES 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 L Deferred
D Conditional Pass M Failed
F Failed N 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

An incomplete grade is indicated by a K. The maximum delay granted for completion of course work is three months, after which the student will automatically be given a grade of KF (incomplete/fail). The last day for submission of deferred grades is March 31st for A semester courses, August 15th for B semester courses, and December 1st for summer courses. The last date for submission of grades for summer courses for students graduating in November is September 15th.

The L grade indicates a deferred grade because of medical or other valid reason. An L grade will be replaced by a J grade if the student misses the next deferred or regular examination in the course, whichever occurs first.

3.5.3 Satisfactory/Unsatisfactory Option

The Satisfactory/Unsatisfactory Option may be used for elective courses only.

Students must code courses as U/S at the time of registration on MARS. 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 electives" or "architectural electives"; 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).

The decision to have an elective course graded as Satisfactory/Unsatisfactory must be made by the student and added on MARS before the end of the Drop/Add period, and no change can be made thereafter.

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 credit of three units 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 Standing Decisions

The Faculty of Engineering makes Academic Standing Decisions after the completion of each semester (Fall, Winter, Summer). A student's academic standing is based on the CGPA (Cumulative Grade Point Average) according to the following criteria.

Satisfactory standing:
CGPA equal to 2.00 or better

Probationary standing:
CGPA < 2.00

Unsatisfactory standing:
CGPA < 1.20 (first semester normally re-admitted to probationary standing by Faculty decision). See below for further information.

Students in satisfactory standing may proceed with the following conditions:

i) 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.

ii) 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 placed on probationary or unsatisfactory standing will receive notification from the Faculty through the mail.

Students on probationary standing may proceed for one semester. 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 SGPA (semestrial) 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 probationary standing.

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

While on probationary standing, failure to achieve either the SGPA or CGPA noted above will result in unsatisfactory standing, at which point, the student will be asked to withdraw from the Faculty. Currently registered courses will be deleted automatically from the student's record by the Faculty.

IMPORTANT:

Architecture, Civil, Mechanical, Mining and Metallurgical Engineering students placed on unsatisfactory standing must receive departmental support for readmission. Request for readmission must be made in writing to the Faculty of Engineering Student Affairs Office. Readmission will be considered by the Committee on Standing. If readmitted, a student must obtain a SGPA or CGPA of 2.00 or better during all subsequent semesters in order to remain in the Faculty of Engineering. If the student does not achieve either of these GPAs, he/she will be asked to withdraw permanently from the Faculty of Engineering.

Chemical, Electrical and Computer Engineering students placed on unsatisfactory standing will be permanently withdrawn from the department with no possibility of readmission.

For further information, students may consult the Faculty of Engineering Student Affairs Office.
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 in only one semester, the department responsible may, in appropriate cases, arrange "reading courses" during the other semester or during the summer months. Such courses taken during a regular 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 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 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).

The following conditions apply:
- students must be in satisfactory or probationary standing; those with an unsatisfactory standing are not permitted to write supplementals;
- 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 A courses is during the months of April and May, and for B and D courses 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 A courses and July 15th for B and D 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.

3.5.10 Deferred Examinations

Students who have missed a final examination due to illness must submit an original medical certificate to the Faculty of Engineering Student Affairs Office and apply for a deferred examination. The medical certificate must cover the date of the missed exam, and the nature and duration of the illness. 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.

Students must complete a Medical Certificate Authentication Form when submitting their medical certificate. This allows the Faculty of Engineering to verify with the medical institution that the medical certificate is a true copy. If the form is not completed, it will result in an automatic failure.

The Faculty of Engineering makes an Academic Standing Decision after the completion of each semester, regardless of a deferral. Any student who has been placed in either Probationary or Unsatisfactory Standing will receive notification from the Faculty through the mail.

A student who becomes ill during a formal examination, 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 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.

For Engineering courses, students granted a deferral must write the final exam the next time it is offered. Students should be aware that a deferred examination may not be available until the next time the course is given (possibly after one year).

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 and the supplemental examination schedule posted on InfoMcGill for the exact date and time of the exam. Deferrals are not permitted for summer courses. Students may be permitted to withdraw from a course without refund instead.

For Management and Continuing Education courses, a student should contact the Faculty of Management or the Centre for Continuing Education directly for more information.

The Faculty of Engineering makes an Academic Standing Decision after the completion of each semester, regardless of deferrals.

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

Please note:
- Denotes courses not offered in 2001-02
- Courses with Limited Enrolment

Where asterisks appear with a prerequisite, they have the following significance:
* a D grade is acceptable for prerequisite purposes.
** under special circumstances, the Department may permit this course to be taken as a co-requisite.

The curricula and courses described in the following pages have been approved for the 2001-02 session, but the Faculty reserves the right to introduce changes as may be deemed necessary or desirable.

4.1 Faculty Courses

A list of Faculty courses is offered and are listed below. These courses are of a more general nature than the departmental courses.

300-220A 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/liens, hypothecs/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.

300-230B ENVIRONMENTAL ASPECTS OF TECHNOLOGY. 3(3-0-6)
The impact of urbanization and technology on the environment. Topics include urbanization: causes, effects, land use regulations; environmental impact of energy conversions; energy policy alternatives; formulation of energy and environmental policy; air pollution: sources, effects, control; water pollution: sources, effects, control. Limited enrolment. MARS passwords distributed after the first class.

302-430A TECHNOLOGY IMPACT ASSESSMENT, 3 (3-1-5) The power of technology to shape our physical, economic and social environment: historical effects of technological transitions (e.g. industrial revolution, post-industrial era) on culture and ecology; practical-technology impact assessment (TIA), methodologies, public participation, engineering contributions, regulations; implications of TIA on social and economic development, and to the education and career of the engineer. Limited enrolment. Restricted to final year students. Mars passwords distributed in Department of Chemical Engineering.

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

306-221A, B 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. Professor Ouellett

306-308A SOCIAL IMPACT OF TECHNOLOGY, 3(3-0-6) (Enrolment encouraged by students outside the Faculty of Engineering.) Critical examination of the socio-economic costs and benefits of technology, case studies of old engineering works and new technologies. The integration of applied ethics and engineering practice, analysis of basic concepts of technology assessment, the interconnected processes of risk assessment, management, and communication. Professor Finch

306-310A, B 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. Professors Bilodeau and Laplante

4.1.1 Faculty Technical Complementaries

Each Engineering program requires a certain number of technical complementaries. Departments list the approved courses together with the program descriptions that appear in the following sections. In addition, some programs permit students to select one or more courses from the faculty-wide listing of technical complementaries that follow. Students should check the program description to determine if a course may be selected from the following list. It is advisable that students discuss their choice with an academic advisor, review the prerequisite requirements for the course choices, and if in doubt approach the course instructor to ensure that they have the appropriate background for the course selection. Refer to the following departmental sections for prerequisites and course descriptions.

Agricultural and Biosystems Engineering

336-217B Hydrology and Drainage
336-314B Agricultural Structures
336-322A Agro-Food Waste Management
336-325A Food Engineering
336-330B GIS and Biosystems Management
336-411A Off-Road Power Machinery
336-412A Agricultural Machinery
336-416A Engineering for Land Development
336-500B Advanced Applications of Microcomputers in Agriculture
336-504B Instrumentation and Control
336-518A Pollution Control for Agriculture
336-530B Advanced Food & Fermentation Engineering

Architecture

301-350A The Material Culture of Canada
301-377B Energy, Environment & Buildings
301-378A Site Usage
301-526B Philosophy of Structures
301-527B Civic Design
301-528A History of Housing

Chemical Engineering

302-200A Introduction to Chemical Engineering
302-204B Chemical Manufacturing Processes
302-220B Chemical Engineering Thermodynamics
302-230B Environmental Aspects of Technology
302-430B Technology Impact Assessment
302-452B Particulate Systems
302-471A Industrial Water Pollution Control
302-472B Industrial Air Pollution Control
302-481A Polymer Engineering
302-487A Chem. Processing in the Electronics Industry
302-581B Polymer Composites Engineering

Professor Volesky

Professor Bilodeau

Professor Ouellett

Professor Finch

Ms. Ladanowski

Professor Mirza

Professor Mirza
302-370A Elements of Biotechnology
302-474A Biochemical Engineering

Civil Engineering
303-207A Solid Mechanics
303-208A Civil Engineering Systems Analysis
303-225B Environmental Engineering
303-311A Geotechnical Mechanics
303-317A Structural Engineering I
303-323A Hydrology & Water Resources
303-327B Fluid Mechanics & Hydraulics I
303-430A Water Treatment & Pollution Control
303-433B Urban Planning
303-451A Geoenvironmental Engineering
303-469A Infrastructure & Society
303-526B Solid Waste Management
303-540A Urban Transportation Planning
303-541B Rail Engineering

Computer Science
308-203A,B Introduction to Computing II
308-250A Introduction to Computer Science
308-273A,B Introduction to Computer Systems
308-302A,B Programming Languages and Paradigms
308-305A Computer System Architecture
308-350A Numerical Computing
308-360A Algorithm Design Techniques
308-424A Topics in Artificial Intelligence I

Electrical and Computer Engineering
304-404A Control Systems
304-411A Communications Systems I
304-412B Discrete Time Signal Processing
304-425A Computer Organization and Architecture
304-427B Operating Systems
304-428B Software Engineering Practice
304-461 Electric Machinery
304-462B Electromechanical Energy Conversion
304-526B Artificial Intelligence

Mechanical Engineering
305-471A Industrial Engineering
305-472A Case Studies in Project Mgmt
305-474B Operations Research
305-522B Production Systems
305-577A Optimum Design

Metallurgical Engineering
306-250A Introduction to Extraction Metallurgy
306-311T Modelling and Automatic Control
306-317A Materials Characterization
306-341B Introduction to Mineral Processing
306-362A Engineering Materials
306-367B Electronic Properties of Materials
306-412C Corrosion and Degradation
306-555A Thermal Remediation of Wastes
306-560B Joining Processing

Minning Engineering
306-200A,B Mining Technology
306-320B Extraction of Energy Resources
306-322B Rock Fragmentation
306-323B Rock/Soil Mass Characterization
306-325A Mineral Industry Economics
306-333B Materials Handling
306-420B Feasibility Study

Urban Planning
409-501A,B Principles and Practice of Planning I
409-505B Geographic Information Systems
409-612A History and Theory of Planning
409-614B Urban Environment Planning
409-619B Transport and Land Development
409-621B Theories of Urban Form

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) (Saidye Rosner Brotman Professor of Architectural History)

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)

Adjunct Professors
Rhona Kenneally, Danieli Rohan

Associate Professors

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

Assistant Professors

Faculty Members

Course Lecturers
Pieter Sijpkes; B.Sc.(Arch.), B.Arch.(McG.)

Adjunct Professors

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

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

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)

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Associate Professors

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

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

Visiting Scholar
Hui Gao

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 2000, they were:
Jean Beaudoin, Barry Bell, Raouf Boutros, Martin Briere, Frances Bronnt, Glen Bydwell, Eric Carle, Henri Olineg,
Jane L. Cook, Cynthia Cooper, Milton Curry, Martine Dion, Georges Drolet, Aliki Economides, Wade Eide, Corinne Farazli, Karl Fischer, Francois Geraldau, Nathan Goddolvitch, Bob Hamilton, Jean-Paul Herby, Guy J. Joncas, Ron Keays, Mark Koot, Peter Lanken, Katherine Lapierre, Gilles L. Larose, Paul Laurendau, Barbara Lawson, Andrea MacElwee, Eric Marosi, Louis Martin, Grant McCracken, Carl Mulvey, Alina Payne, Mark Pimlott, Alessandra Ponte, Barry Sampson, Harm Scholtens, Andrea Simitch, Daniel Smith, Will Straw, Nadia Suboticnic, Ken Taylor, Elizabeth Terragni, Katherine Venert, Andrea Wolff.

ARCHITECTURAL CERTIFICATION IN CANADA

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

Masters degree programs may consist of a pre-professional undergraduate degree and a professional graduate degree, which, when earned sequentially, comprise an accredited professional education. However, the pre-professional degree is not, by itself, recognized as an accredited degree. Since all provincial associations in Canada recommend any applicant for licensure to have graduated from a CACB-accredited program, obtaining such a degree is an essential aspect of preparing for the professional practice of architecture. While graduation from a CACB-accredited program does not assure registration, the accrediting process is intended to verify that each accredited program substantially meets those standards that, as a whole, comprise an appropriate education for an architect.

PROGRAMS OF STUDY

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

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

The second part, for students with the B.Sc.(Arch.) degree, is a one and a half year, or nine semester, program leading to the professional Master of Architecture 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 – Jonathan Rousham, Technician.

Communications Laboratory, including Photo Lab – Professor Ricardo Castro.

Computers in Architecture Laboratory and the Apple Design and Modeling Centre – Professors Robert Mellin and Richard Russell.

Building Science Resource Centre – Dr. Avi Friedman.

Library


Collections

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

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

Orson Wheeler Architectural Model Collection – Professo rPieter Sijpkes.

Materials Resource Centre – Dr. Avi Friedman.

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

REQUUIRED COURSES

<table>
<thead>
<tr>
<th>COURSE</th>
<th>CREDIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>300-220A</td>
<td>Law for Architects and Engineers</td>
</tr>
<tr>
<td>303-205A,B</td>
<td>Statics</td>
</tr>
<tr>
<td>303-229A</td>
<td>Surveying for Architects</td>
</tr>
<tr>
<td>303-283B</td>
<td>Strength of Materials</td>
</tr>
<tr>
<td>303-385A</td>
<td>Structural Steel and Timber Design</td>
</tr>
<tr>
<td>303-388B</td>
<td>Foundation &amp; Concrete Design</td>
</tr>
<tr>
<td>303-492A</td>
<td>Structures</td>
</tr>
<tr>
<td>306-310A,B</td>
<td>Engineering Economy</td>
</tr>
</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

<table>
<thead>
<tr>
<th>COURSE</th>
<th>CREDIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>301-201A</td>
<td>Communication, Behaviour &amp; Arch.</td>
</tr>
<tr>
<td>301-202B</td>
<td>Arch. Graphics and Design Elements</td>
</tr>
<tr>
<td>301-217A</td>
<td>Freehand Drawing I</td>
</tr>
<tr>
<td>301-218B</td>
<td>Freehand Drawing II</td>
</tr>
<tr>
<td>301-240B</td>
<td>Organization of Materials in Building</td>
</tr>
<tr>
<td>301-250A</td>
<td>Architectural History I</td>
</tr>
<tr>
<td>301-251B</td>
<td>Architectural History II</td>
</tr>
<tr>
<td>301-303A</td>
<td>Design and Construction I</td>
</tr>
<tr>
<td>301-304B</td>
<td>Design and Construction II</td>
</tr>
<tr>
<td>301-321A</td>
<td>Freehand Drawing III</td>
</tr>
<tr>
<td>301-322B</td>
<td>Freehand Drawing IV</td>
</tr>
<tr>
<td>301-324T</td>
<td>Sketching School I</td>
</tr>
<tr>
<td>301-375A</td>
<td>Landscape</td>
</tr>
<tr>
<td>301-405A</td>
<td>Design and Construction III</td>
</tr>
<tr>
<td>301-406B</td>
<td>Design and Construction IV</td>
</tr>
<tr>
<td>301-447B</td>
<td>Electrical Services</td>
</tr>
<tr>
<td>301-451B</td>
<td>Building Regulations &amp; Safety</td>
</tr>
</tbody>
</table>

COMPLEMENTARY COURSES

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

301-372A  301-352B  301-350A  301-318C
301-379C,L  301-363A  301-378B  301-319C
301-388A  301-383B  301-379C,L  301-364B
301-522A  301-524A  301-520B  301-377B
301-523B  301-525A  301-521B  301-461B
301-528A  301-529B  301-527B  301-471A,B
301-531A  580-442B  301-526B
301-532B
301-533B

OUTSIDE ELECTIVES:  6

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

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

Architectural Complementaries

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

COURSES OFFERED BY THE SCHOOL

- Denotes courses not offered in 2001-02.
- Denotes limited enrolment.
- Denotes courses offered only in alternate years.

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

301-201A COMMUNICATION, BEHAVIOUR & ARCH. 6(2-10-6)  
Introduction to design; development of design judgement and communication skills in a series of exercises addressing light, scale, space, form and colour in the built environment; introduction to techniques of oral and graphic presentation, including model making, photography, sketching and architectural drawing. The course is based in the studio and includes lectures, seminars and field trips.  
Professor Covo and Adjunct Faculty

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

301-217A FREEHAND DRAWING I. 1(0-3-0) Drawing in pencil and charcoal.  
Professor Nash

301-218B FREEHAND DRAWING II. 1(0-3-0) (Prerequisite: 301-217A) A continuation of course 301-217A.  
Professor Nash

301-240B 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.  
Professor Friedman

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

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

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

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

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

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

301-318C DESIGN SKETCHING. 3(2-4-3) (Prerequisite: 301-202B) Pictorial drawing in the design process; relationship of drawing type to design intention; strategies for visualization and representation based on perspective sketching, axonometric and oblique projection in selected media; studio work based on design exercises and problems varying in length from several minutes to several days. Limited enrolment; password card required.  
Professor Covo

301-319C THE CAMERA AND PERCEPTION. 3(2-4-3) (Prerequisite: 301-202B) An intensive study of man and the urban environment. Through the use of still photography, the relationship of time, motion, space, place and light are explored in order to gain insights into the urban environment. Topics include: “photographic seeing”, light, survey of masters, history of photography, camera and darkroom techniques, tonal control, composition, etc. Limited enrolment; password card required.  
Staff
301-321A Freehand Drawing III. 1(0-3-0) (Prerequisite: 301-202B) A continuation of course 301-218B. Professor Nash
301-322B Freehand Drawing IV. 1(0-3-0) (Prerequisite: 301-321A) A continuation of course 301-321A. Professor Nash
301-324T Sketching School I. 1(0-0-3) (Prerequisite: 301-218B) An eight-day supervised field trip in the late summer to sketch places or things having specific visual characteristics. Students are required to include Sketching School I in the B.Sc.(Arch.) program. Professors Castro and Covo
301-350A The Material Culture of Canada. 3(2-1-6) A study of Material Culture in Canada, the "stuff" of our lives; using a multidisciplinary approach to the interpretation of the non-textual materials which have shaped the lives of past and present Canadians, using the resources of the McCord Museum and other Montreal museums, galleries and collections. Rhona Kenneally and visitors
Section 01: reserved for Architecture students. Section 02: reserved for Canadian Studies. Section 03: reserved for others.
301-352B Art and Theory of House Design. 3(2-2-5) (Prerequisite: 301-202B or permission of instructor.) An examination of the art and theory of the design of houses by architects who developed the form to perfection. Lectures and field trips will focus on the work of selected house architects from antiquity to the present. Professor Bruce Anderson
Section 01: reserved for Architecture students. Section 02: reserved for others.
301-364B Architectural Modeling. 3(2-1-6) (Prerequisite: 301-202B and 301-471B) Architectural modeling using digital media. Topics include: advanced 3-D modeling and rendering techniques; raster and vector image editing; digital animation; hypertext and the World Wide Web; issues of representation and methodology; comparison of various publishing media. Limited enrolment. Professor Yip
301-372A History of Architecture in Canada. 2(2-0-4) (Prerequisite: 301-202B) (Given alternate years, alternating with 301-388A.) French, British and American influences in the Maritime Provinces, Quebec and Ontario. Limited enrolment; password card required. Professor Gersovitz
301-375A Landscape. 2(2-2-2) (Prerequisite: 301-202B) Land form, plant life, microclimate; land use and land preservation; elements and methods of landscape design. Professor Émond
301-377B Energy, Environment and Buildings. 2(2-0-4) (Prerequisite: 301-202B or permission of instructor) Energy consumption in the built environment; architectural means to conserve energy; the potential and limitations of unconventional sources of energy; a comparative study of energy conserving buildings and their long-term environmental impact; effects of legislation and financing. Professors Pearli and Poddubiuk
Section 01: reserved for Architecture students. Section 02: reserved for others. Limited enrolment; password card required.
301-378A Site Usage. 3(2-0-7) (Prerequisite: 301-202B or permission of instructor) The study of the creation, form and usage of the exterior space generated in various patterns of low-rise housing. Socio-cultural aspects of patterns; exterior space as a logical extension of the living unit; social control of the use of urban and suburban land; comparative model for low-rise housing patterns. Professor Drummond
Section 01: reserved for Architecture students. Section 02: reserved for others. Limited enrolment; password card required.
301-379L Summer Course Abroad. 3(0-0-9) (Prerequisite: 301-202B or permission of instructor) Study of a distinct urban environment and its key buildings; graphic recording and analysis of physical configuration, constructional peculiarities and present use. Excursions to neighbouring sites of special architectural interest. Limited enrolment; password card required. Professors Castro and Zuk
301-383B Geometry, Architecture and Environment. 2(2-0-4) (Prerequisite: 301-202B or permission of instructor) Geometry in the formal structure of design. Grids, lattices, polygons and polyhedra; proportional systems. Evidence of these figures and structures in natural objects and phenomena. Graphical and physical models. Application to architecture and the human environment. Professor Zuk
301-388A Introduction to Historic Preservation. 2(2-2-2) (Prerequisite: 301-303A) (Given alternate years, alternating with 301-372A.) Historic attitudes and terminologies of conservation; historic research techniques. Restoration technology of building materials and principles of interior design in the 19th and 20th centuries; current preservation planning. Professor Gersovitz
301-405A Design and Construction III. 6(2-10-6) (Prerequisite: 301-304B) A structured investigation of architectural concepts; program interpretation with respect to relevant cultural, social and environmental contexts; applications of appropriate formal languages and building technologies in integrated proposals for a variety of building forms. Professors Anderson, Sheppard and Zuk an d Adjunct Faculty
301-406B Design and Construction IV. 6(2-10-6) (Prerequisite: 301-405A) A detailed study and comprehensive development of architectural proposals for complex building types and site conditions; the exploration of coherent initial concepts with respect to programmatic requirements, image and form; subsequent elaboration leading to meaningful and technologically viable designs for the built environment. Professors Anderson and Sheppard, and Adjunct Faculty
301-447B Electrical Services. 2(2-2-2) (Prerequisite: 301-304B) Production, measurement and control of light; design of lighting systems; electrical distribution in residential and commercial buildings; Canadian Electrical Code. Professor Edwards
Section 01: reserved for Architecture students. Section 02: reserved for others. Limited enrolment; password card required.
301-451B Building Regulations and Safety. 2(2-2-2) (Prerequisite: 301-405A) 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. Professor Zorko
Section 01: reserved for Architecture students. Section 02: reserved for others. Limited enrolment; password card required.
301-461B Freehand Drawing and Sketching. 1(0-3-0) (Prerequisite: 301-324C) Drawing and sketching in pencil, charcoal and other media both in the studio and out-of-doors. Professor Covo
301-461A,B Computer-Aided Building Design. 2(2-2-2) (Prerequisite: 301-202B or equivalent) An introduction to selected applications of interactive computing in architecture; emphasis on development of simple algorithms in graphic, as well as non-graphic, modes in hands-on situations in the lab; field trips to several in use installations. Limited enrolment; password card required. Professor Russell
301-490A,B Selected Topics in Design. 2(2-0-4) (Prerequisite: 301-202B or permission of instructor.) A course to allow the introduction of special topics in related areas of design. Staff
301-520B Montreal: Urban Morphology. 3(2-1-6) (Prerequisite: 301-251B) Historical, geographical, demographical, and regional evolution of the metropolis of Montreal. Topics include: important 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. Professor Ronin
Section 01: reserved for Architecture students. Section 02: reserved for others. Limited enrolment; enrolment cap.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Instructor</th>
<th>Prerequisites</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>301-521B</td>
<td>Structure of Cities.</td>
<td>Professor Anderson</td>
<td>(Prerequisite: 301-202B or permission of instructor) Nature, pattern and life of modern cities. Urban networks, special areas, problems and prospects.</td>
<td>Section 01: reserved for Architecture students. Section 02: reserved for others. Limited enrolment; password card required.</td>
</tr>
<tr>
<td>301-522A</td>
<td>History of Domestic Arch. in Quebec.</td>
<td>Professor Pérez-Gómez</td>
<td>(Prerequisite: 301-251A) The architecture of houses in Quebec from 1650 to the present. Distinguished buildings are reviewed from the point of view of form, style, siting and material, as influenced by climate, culture and architectural antecedents in France, England and the United States. The course material is presented through alternating bi-weekly lectures and seminars. Limited enrolment; password card required.</td>
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<tr>
<td>301-523B</td>
<td>Significant Texts &amp; Buildings.</td>
<td>Professor Anderson</td>
<td>(Prerequisite: 301-251A) Alternating with 301-524B. Critical study of significant architectural thought since 1750 as it has been expressed in buildings and texts (treatises, manifestos, criticisms). A specific theme will be addressed every year to allow in-depth interpretation of the material presented and discussed. Limited enrolment; password card required.</td>
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<tr>
<td>301-524B</td>
<td>Seminar on Architectural Criticism.</td>
<td>Professor Castro</td>
<td>(Prerequisite: 301-202B or permission of instructor) Analysis and evaluation of significant architectural projects with reference to contemporary architectural theories. Limited enrolment: password card required.</td>
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<tr>
<td>301-525A</td>
<td>Seminar on Analysis and Theory.</td>
<td>Professor Castro</td>
<td>(Prerequisite: 301-202B or permission of instructor) Examination of architectural intentions (theory and practice) in the European context (especially France, Italy and England), during the crucial period that marked the beginning of the modern era. Limited enrolment; password card required.</td>
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</tr>
<tr>
<td>301-526B</td>
<td>Philosophy of Structure.</td>
<td>Professor Zuk</td>
<td>(Prerequisite: 301-202B or permission of instructor) (Not open to students who have taken 301-374B.) Philosophy of Structure aims to investigate structure in its broadest sense. The course is divided in two halves; the first one gives an overview of the development of theoretical structural frameworks such as mathematics and geometry, while the second one highlights physical structures constructed by nature (geology, turbulence), man or animals.</td>
<td>Professor Sijpkes Section 01: reserved for Architecture students. Section 02: reserved for others. Limited enrolment; password card required.</td>
</tr>
<tr>
<td>301-527B</td>
<td>Civic Design.</td>
<td>Professor Drummond</td>
<td>(Prerequisite: 301-378A) The elements of form in buildings and their siting design in the urban setting.</td>
<td>Professor Sijpkes Section 01: reserved for Architecture students. Section 02: reserved for others. Limited enrolment; password card required.</td>
</tr>
<tr>
<td>301-528A</td>
<td>History of Housing.</td>
<td>Professor Schoenauer</td>
<td>(Prerequisite: 301-251A or permission of instructor) Indigenous housing both transient and permanent, from the standpoint of individual structure and pattern of settlements. The principal historic examples of houses including housing in the age of industrial revolution and contemporary housing. Limited enrolment. Enrolment Cap is placed on each section.</td>
<td>Professor Sijpkes Section 01: reserved for Architecture students. Section 02: reserved for others. Limited enrolment; password card required.</td>
</tr>
<tr>
<td>301-529B</td>
<td>Housing Theory.</td>
<td>Professor Sijpkes</td>
<td>(Prerequisite: 301-528A or permission of instructor) A review of environmental alternatives in housing; contemporary housing and the physical and sociological determinants that shape it; Canadian housing.</td>
<td>Professor Sijpkes Section 01: reserved for Architecture students. Section 02: reserved for others. Limited enrolment; password card required.</td>
</tr>
<tr>
<td>301-531A</td>
<td>Architectural Intentions from Vitruvius to the Renaissance.</td>
<td>Professor Pérez-Gómez</td>
<td>(Prerequisite: 301-251A) Architectural intentions embodied in buildings and writings of architects from antiquity to the Renaissance. Special emphasis is placed on the cultural connections of architecture to science and philosophy.</td>
<td>Professor Perez-Gomez Section 01: reserved for Architecture students. Section 02: reserved for others. Limited enrolment; password card required.</td>
</tr>
<tr>
<td>301-532B</td>
<td>Origins of Modern Architecture.</td>
<td>Professor Pérez-Gómez</td>
<td>(Prerequisite: 301-251A) Examination of architectural intentions (theory and practice) in the European context (especially France, Italy and England), during the crucial period that marked the beginning of the modern era.</td>
<td>Professor Perez-Gomez Section 01: reserved for Architecture students. Section 02: reserved for others. Limited enrolment; password card required.</td>
</tr>
<tr>
<td>301-533B</td>
<td>New Approaches to Architectural History.</td>
<td>Professor Adams</td>
<td>(Prerequisite: 301-251A or permission of instructor) An exploration of the aims, tools, and methods of Architectural History as a discipline; the use of primary sources from the Canadian Centre for Architecture and other archives. Limited enrolment; password card required.</td>
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</tr>
<tr>
<td>301-534A,B</td>
<td>Selected Topics in Architecture I.</td>
<td>Staff</td>
<td>(Prerequisite: 301-251A) A course to allow the introduction of new topics in Architecture as needs arise, by regular and visiting staff.</td>
<td>Staff Section 01: reserved for Architecture students. Section 02: reserved for others. Limited enrolment; password card required.</td>
</tr>
<tr>
<td>301-535A,B</td>
<td>Selected Topics in Architecture II.</td>
<td>Staff</td>
<td>(Prerequisite: 301-251A) A course to allow the introduction of new topics in Architecture as needs arise, by regular and visiting staff.</td>
<td>Staff Section 01: reserved for Architecture students. Section 02: reserved for others. Limited enrolment; password card required.</td>
</tr>
<tr>
<td>301-536A</td>
<td>Urban Planning I.</td>
<td>Professor Fischler</td>
<td>(Prerequisite: 301-550B) Urban design and project development, theory and practice. Detailed analysis of selected examples of the development process and of current techniques in urban design.</td>
<td>Professor Fischler Section 01: reserved for Architecture students. Section 02: reserved for others. Limited enrolment; password card required.</td>
</tr>
<tr>
<td>301-537A</td>
<td>Urban Planning II.</td>
<td>Professor Levine</td>
<td>(Prerequisite: 301-550B) Urban design and project development, theory and practice. Detailed analysis of selected examples of the development process and of current techniques in urban design.</td>
<td>Professor Levine Section 01: reserved for Architecture students. Section 02: reserved for others. Limited enrolment; password card required.</td>
</tr>
<tr>
<td>301-538A</td>
<td>Mechanical Services in Buildings.</td>
<td>Professor Melanson</td>
<td>(Prerequisite: 301-405A or permission of instructor.) Problems encountered in providing mechanical services in buildings. Physiological and environmental aspects of heat, ventilation and air conditions, estimation of heating and cooling loads and selection and specification of equipment. Sprinkler systems and plumbing. Construction problems produced by installation of this equipment.</td>
<td>Professor Melanson Section 01: reserved for Architecture students. Section 02: reserved for others. Limited enrolment; password card required.</td>
</tr>
</tbody>
</table>
the supervision of faculty and visitors on projects in the design and construction of environments for the disabled drawn from case histories of selected institutions. Course work may include group and individual field trips to hospitals, clinics or specific project sites. Limited enrolment. 

Professors Gisel, Covo and visitors

4.3 Department of Chemical Engineering

M.H. Wong Building, Room 3060
3610 University Street
Montreal, QC H3A 2B2

Telephone: (514) 398-4494
Fax: (514) 398-6678


Chair — Richard J. Munz

Post-Retirement

W.J. Murray Douglas; B.Sc.(Qu.), M.S.E., Ph.D.(Mich.)

Professors

David G. Cooper; B.Sc., Ph.D.(Tor.)
John M. Desay; 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)
Juan H. Vera; B.Mat.(Chile), Ing.Qim.(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 Simandl; B.Eng.(McG.), Ph.D.(Calg.), P.Eng.

Assistant Professors

Daryoosh Beigzadeh; B.Sc., M.Sc.(Amirkabir U. of Tech.), Ph.D.(Wat.)
Wayne A. Brown; B.Eng., M.Eng., Ph.D.(McG.)

Associate Members

Thomas M.S. Chang; B.Sc., M.D., Ph.D.(McG.), F.R.C.P.(C)
Reinhold H. Crotogino; B.A.Sc.(U.B.C.), Ph.D.(McG.)
Harry L. Goldsmith; B.Sc., M.A.(Oxon.), Ph.D.(McG.)

(Experimental Medicine)

PAPRICAN Adjunct Professor

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

Adjunct Professors


The discipline of chemical engineering is distinctive in being based equally on physics, mathematics and chemistry. Application of these three fundamental sciences is basic to a quantitative understanding of the process industries. Those with an interest in the fourth major science, biology, will find several courses in the chemical engineering curriculum which integrate aspects of the biological sciences relevant to process industries such as food processing, fermentation and water pollution control. Courses on the technical operations and economics of the process industries are added to this foundation. The core curriculum concludes with process design courses taught by practicing design engineers. Problem-solving, experimenting, planning and communication skills are emphasized in courses throughout the core curriculum. By means of complementary courses, students can also obtain further depth in technical areas and breadth in non-technical subjects. Some students elect to complete a minor in biotechnology, management, materials engineering, computer science, environmental engineering or chemistry.

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

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

ACADEMIC PROGRAM

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

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

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

Students must obtain a C grade or better in all core courses. For the Department of Chemical Engineering, core courses include all required courses (departmental and non-departmental) as well as complementary courses (departmental). A grade of “D” is a passing grade in other complementary courses and in any elective courses taken.
### CURRICULUM FOR THE B.ENG. DEGREE IN CHEMICAL ENGINEERING

#### REQUIRED COURSES

<table>
<thead>
<tr>
<th>COURSE</th>
<th>CREDIT</th>
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</thead>
<tbody>
<tr>
<td>180-212A,B Introductory Organic Chemistry I</td>
<td>4</td>
</tr>
<tr>
<td>180-233B Sel. Topics in Phys. Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>180-234A,B Sel. Topics in Org. Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>189-260A,B Intermediate Calculus</td>
<td>3</td>
</tr>
<tr>
<td>189-261A,B Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>189-265A,B Advanced Calculus</td>
<td>3</td>
</tr>
<tr>
<td>306-221A,B Engineering Professional Practice</td>
<td>1</td>
</tr>
<tr>
<td>306-310A,B Engineering Economy</td>
<td>3</td>
</tr>
<tr>
<td>308-208A,B Computers in Engineering</td>
<td>3</td>
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</tbody>
</table>

#### Chemical Engineering Courses

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<thead>
<tr>
<th>COURSE</th>
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<tbody>
<tr>
<td>302-200A Intro. to Chemical Eng.</td>
<td>4</td>
</tr>
<tr>
<td>302-204B Chemical Manuf. Processes</td>
<td>3</td>
</tr>
<tr>
<td>302-220B Chem. Eng. Thermodynamics</td>
<td>3</td>
</tr>
<tr>
<td>302-291A Instr. Measurements Lab.</td>
<td>4</td>
</tr>
<tr>
<td>302-314A Fluid Mechanics</td>
<td>4</td>
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<tr>
<td>302-315B Heat and Mass Transfer</td>
<td>4</td>
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<tr>
<td>302-340B Process Modelling</td>
<td>3</td>
</tr>
<tr>
<td>302-351B Separation Processes</td>
<td>3</td>
</tr>
<tr>
<td>302-360A,B Technical Paper I</td>
<td>1</td>
</tr>
<tr>
<td>302-370A Elements of Biotechnology</td>
<td>3</td>
</tr>
<tr>
<td>302-380A Materials Science</td>
<td>3</td>
</tr>
<tr>
<td>302-392A Project Laboratory I</td>
<td>4</td>
</tr>
<tr>
<td>302-395B Project Laboratory II</td>
<td>5</td>
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<tr>
<td>302-423A Chemical Reaction Engineering</td>
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<tr>
<td>302-453A Process Design</td>
<td>4</td>
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<td>302-455B Process Control</td>
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<td>302-456A,B Design Project I</td>
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<tr>
<td>302-457A,B Design Project II</td>
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<tr>
<td>302-462A,B Technical Paper II</td>
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<tr>
<td>302-474A Biochemical Engineering</td>
<td>3</td>
</tr>
<tr>
<td>302-484B 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 complementaries below)

<table>
<thead>
<tr>
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<tr>
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#### TOTAL

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<tr>
<td>302-455B Process Control</td>
<td>4</td>
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<tr>
<td>302-456A,B Design Project I</td>
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<tr>
<td>302-457A,B Design Project II</td>
<td>5</td>
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<tr>
<td>302-462A,B Technical Paper II</td>
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<tr>
<td>302-474A Biochemical Engineering</td>
<td>3</td>
</tr>
<tr>
<td>302-484B Materials Engineering</td>
<td>3</td>
</tr>
</tbody>
</table>

For 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 University, Undergraduate Programs 2001-2002.

### TECHNICAL COMPLEMENTARIES

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

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

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

- 302-363A,B Projects in Chemical Engineering I
- 302-452B Particulate Systems
- 302-458A Computer Applications
- 302-464A,B Projects in Chemical Engineering II
- 302-471A Industrial Water Pollution Control (or 303-430A)
- 302-472B Industrial Air Pollution Control (or 305-534B)
- 302-481A Polymer Engineering
- 302-487A Chemical Processing in the Electronics Industry
- 302-494A,B Research Project and Seminar
- 302-495A,B Research Project and Seminar
- 302-517B Small Computer Applications in Chemical Engineering
- 302-581B Polymer Composites Engineering
- 202-505B Selected Topics in Biotechnology

(Biotechnology Minor students only)

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

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

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

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

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

### ELECTIVE COURSES

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

**CURRICULUM COMMITTEE**

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

**CANADIAN SOCIETY FOR CHEMICAL ENGINEERING**

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

**COURSES OFFERED BY THE DEPARTMENT**

- Denotes courses not offered in 2001-02
- Complementary courses
- Courses with Limited Enrolment

**302-200A INTRODUCTION TO CHEMICAL ENGINEERING.** 4(3-2-8)

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

**Professors Deany an dVera**

**302-204B CHEMICAL MANUFACTURING PROCESSES.** 3(2-3-4) (Prerequisite: 302-200A) Introduction to degrees of freedom. Problem solving in the design of separation processes (evaporation, binary distillation), reactor design and environmental applications. (Course description change awaiting University approval)

**Professor Staf**

**302-220B CHEMICAL ENGINEERING THERMODYNAMICS.** 3(3-1-8)

(Prerequisite: 302-200A) Application of thermodynamic equilibrium; free energy and equilibrium; phase rule; chemical reaction equilibrium for homogeneous and multicomponent/multiphase systems. Application to the design of binary distillation. Laboratory exercises.

**Professor Cooper**

**302-230B ENVIRONMENTAL ASPECTS OF TECHNOLOGY.** 3(3-0-6)

The impact of urbanization and technology on the environment. Topics include urbanization: causes, effects, land use regulations; transportation technology and environmental implications; environmental impact of energy conversions; energy policy alternatives; formulation of energy and environmental policy; air pollution: sources, effects, control; water pollution: sources, effects, control. MARS passwords distributed after the first class.

**Professor Volesky**

**302-291A INSTRUMENTAL MEASUREMENT LABORATORY.** 4(2-5-5)

Elements of statistical analysis associated with instrumental measurements. Principles of operation and calibration of selected measuring instruments. Principles of modern data acquisition and processing. Introduction to instrument system selection in chemical engineering.

**Professor Cooper**

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

**TBA**

**302-315B HEAT AND MASS TRANSFER.** 4(3-2-7) (Prerequisite: 302-314A)

Transport of heat and mass by convection, transport of heat by radiation; diffusion; convective mass transfer; drying; absorption; mathematical formulation of problems and equipment design for heat and mass transfer; laboratory exercises. (Course description change awaiting University approval)

**Professor Brown**

**302-340B PROCESS MODELLING.** 3(3-1-5) (Prerequisites: 189-261A, B; 189-265A, B; 302-314A)

Principles of mathematical modelling in chemical engineering: problem formulation, solution, discrete systems; difference and difference-differential equations, methods of solution; understanding system behaviour, optimization.

**Professor Rey**


**Professor Simon**

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

**Mr. Denman**

**302-363A,B PROJECTS IN CHEMICAL ENGINEERING I.** 1(2-1-0-5)

(Prerequisite: 302-200A) Projects on social or technical aspects of chemical engineering practice. Students must suggest their own projects to be approved and supervised by a member of the staff. Students may work in groups.

**Staff**

**302-370A ELEMENTS OF BIOTECHNOLOGY.** 3(3-0-6)

(Prerequisite: 180-234A, B) Enzyme kinetics; proteins, carbohydrates and other biocatalysts; industrially significant microbes; introduction to genetic engineering, cell structure and metabolism; laboratory exercises. (Course description change awaiting University approval)

**Professor Brown**

**302-380A MATERIALS SCIENCE.** 3(3-1-5) (Prerequisite: 302-220B)


**Professor Meunier**

**302-392A PROJECT LABORATORY I.** 4(3-3-6) (Prerequisites: 302-291B)

Planning for the solution of experimental problems; design of experiments for logical and statistical interpretation; statistical analysis of experimental data; effective work in groups; selected laboratory exercises.

**Professor Weber**

**302-393B PROJECT LABORATORY II.** 5(2-10-4) (Prerequisite: 302-392A)

Student groups execute and report on experimental projects.

**Professor Weber and Staff**

**302-423A CHEMICAL REACTION ENGINEERING.** 4(3-1-8) (Prerequisites: 180-233B; 302-315B)


**Professor Berk**

**302-430A TECHNOLOGY IMPACT ASSESSMENT.** 3(3-1-5)

(Restricted to final year students by permission of instructor.) The power of technology to shape man's physical, economic and social environment: effects of technological transitions on culture and ecology; TIA methodologies, public participation, engineering contributions, regulations; implications of TIA on social and economic development. Limited enrolment.

**Ms Ladanowski**

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

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

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

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

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

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

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

**302-462A,B TECHNICAL PAPER II.** 1(0-0-3) (Prerequisite: 302-360A) A technical paper prepared according to instructions issued by the Department. Mr. Bisai1oa

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

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

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

**302-474A BIOCHEMICAL ENGINEERING.** 3(3-0-6) (Prerequisites: 302-370A, 302-423A) 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 - product recovery. (Course description change awaiting University approval) Professor Volesky

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

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

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

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

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

**302-496A,B,T ENVIRONMENTAL RESEARCH PROJECT.** 3(1-6-2) (Prerequisite: 302-393B or permission of instructor.) Independent study and experimental work on an environmental topic chosen by consultation between the student and Departmental staff. Staff

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

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

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

Macdonald Engineering Building, Room 492
817 Sherbrooke Street West
Montreal, QC H3A 2A7
Telephone: (514) 398-6860
Fax: (514) 398-7361
http://www.mcgill.ca/civil

Chair — Denis Mitchell
Emeritus Professors
Richard G. Redwood; B.Sc.(Eng.) (Bristol), M.A.Sc.(Tor.), Ph.D.(Bristol), F.C.S.C.E., F.I.Struct.Eng., Eng.
Stuart B. Savage; B.Eng.(McG.), M.S.Eng.(Cal. Tech.), Ph.D.(McG.), F.R.S.C.

Professors
Vincent H. Chu; B.Eng.(Taiwan), M.A.Sc.(Tor.), Ph.D.(M.I.T.), Eng.
Denis Mitchell; B.A.Sc., M.A.Sc., Ph.D.(Tor.), F.A.C.I., Eng.
Suresh C. Shrivastava; B.Sc.(Eng.) (Vikram), M.C.E.(Del.), Sc.D.(Col.), Eng.

Associate Professors
Ronald Gehr; B.Sc.(Eng.) (Rand), M.A.Sc., Ph.D.(Tor.), P.Eng.
James Nicell; B.A.Sc., M.A.Sc., Ph.D.(Windsor), P.Eng.

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

Adjunct Professors

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

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

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

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

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

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

ACADEMIC PROGRAMS

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

Guidance on the sequence in which required core courses should be taken is provided for students in the form of a sample program which covers the entire period of study. The technical complementary courses selected, usually in the last two semesters of the program, will depend upon the student's interests. U0 and U1 students should consult 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

REQUIRED COURSES

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<tr>
<th>COURSE</th>
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<tbody>
<tr>
<td>186-221A</td>
<td>General Geology</td>
</tr>
<tr>
<td>189-260A,B</td>
<td>Intermediate Calculus</td>
</tr>
<tr>
<td>189-261A,B</td>
<td>Differential Equations</td>
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<tr>
<td>189-265A,B</td>
<td>Advanced Calculus</td>
</tr>
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<td>305-261B,C</td>
<td>Measurement Laboratory</td>
</tr>
<tr>
<td>305-290A</td>
<td>Graphics</td>
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<tr>
<td>306-221A,B</td>
<td>Engineering Professional Practice</td>
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<tr>
<td>306-310A,B</td>
<td>Engineering Economy</td>
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<tr>
<td>308-208A,B</td>
<td>Computers in Engineering</td>
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<tr>
<td>455-206B</td>
<td>Communication in Engineering</td>
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Departmental courses

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<th>COURSE</th>
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<tr>
<td>303-202B</td>
<td>Construction Materials</td>
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<tr>
<td>303-205A,B</td>
<td>Statics</td>
</tr>
<tr>
<td>303-206B</td>
<td>Dynamics</td>
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</table>
303-207A,B Solid Mechanics
303-208A Civil Engrg Systems Analysis
303-210C Surveying
303-225B Environmental Engineering
303-290A Thermodynamics & Heat Transfer
303-302B Probabilistic Systems
303-311A Geotechnical Mechanics
303-317A Structural Engineering I
303-318B Structural Engineering II
303-319B Transportation Engineering
303-320A Numerical Methods
303-323A Hydrology & Water Resources
303-324B Construction Project Management
303-327B Fluid Mechanics & Hydraulics I
303-418A,B Project
303-432A,B Technical Paper

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

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

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

303-416B (3) Geotechnical Engineering
303-421B (3) Municipal Systems
303-428A (3) Fluid Mechanics & Hydraulics II
303-430A (3) Water Treatment & Pollut Control
303-433B (3) Urban Planning
303-440A (3) Traffic Engineering
303-446A (3) Construction Engineering
303-451A (3) Geoenvironmental Engineering
303-460A (3) Matrix Structural Analysis
303-462A (3) Design of Steel Structures
303-463B (3) Design of Concrete Structures
303-470A,B (3) Research Project
303-512B (3) Advanced Civil Engrg Materials
303-526B (3) Solid Waste Management
303-527A (3) Renov & Preserve of Infrastructure
303-540A (3) Urban Transportation Planning
303-541B (3) Rail Engineering
303-550B (3) Water Resources Management
303-553A (3) Stream Pollution and Control
303-555B (3) Environmental Data Analysis
303-572A (3) Computational Hydraulics
303-573A (3) Hydraulic Structures
303-574B (3) Fluid Mech of Water Pollution
303-575B (3) Fluid Mechanics of Air Pollution
303-576B (3) Hydrodynamics
303-577A (3) River Engineering
303-579B (3) Water Power Engineering
303-585B (3) Groundwater Hydrology
303-586A (3) Earthwork Engineering
303-587A (3) Pavement Design

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

TOTAL CREDITS 108

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

TOTAL CREDITS 105

COURSES OFFERED BY THE DEPARTMENT
- Denotes courses not offered in 2001-02

Where asterisks appear with a prerequisite, they have the following significance:
- A D grade is acceptable for prerequisite purposes.
- ** under special circumstances, the Department may permit this course to be taken as a co-requisite.

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

303-205A,B STATICS. 3(3-2-4) Systems of forces and couples, resultants, equilibrium. Trusses, frames and beams, reaction forces, bending moments. Centroids, centres of gravity, distributed forces, moments of inertia. Friction, limiting equilibrium. Moving coordinate systems. Lagrange's equations. Vibrations and waves.  Professor Gaskins


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

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

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

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

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

303-281A ANALYTICAL MECHANICS. 3(3-1-5) (Co-requisites: 189-260A,B and 189-261A,B) Kinematics of particles, dynamics of par-

**Professor Chu and Dr. Babarutsi**

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

**Dr. Babarutsi**

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

**Professor Nicell**

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

**Professor MacKenzie**

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

**Professor Japp**

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

**Professor McClure**

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

**Professor Rogers**

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

**Mr. Hiroi, Mr. Hamaoui and Mr. Belovski**

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

**Professor Chouinard**


**Professor Nguyen**

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

**Mr. Taylor**

**303-327B FLUID MECHANICS AND HYDRAULICS.** 4(3-6-3) (Prerequisites: 303-206B and 189-265A,B) Fluid properties, hydrostatics; dimensional analysis and similitude, fluxes of mass, momentum and energy; Bernoulli's equation; method of control volume; streamline curvature, potential flow and boundary layers, pipe flow, hydraulic machinery and introduction to open-channel flow. (Title and description change awaiting University approval)

**Professor Chu**

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

**Professor Selvadurai**

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

**Mr. Vrana**

**303-388B FOUNDATION & CONCRETE DESIGN.** 3(3-1-5) (Prerequisite: 303-283B) Physical properties of concrete; behaviour and design of reinforced concrete members in compression, tension, bending, shear and combined loadings; bond and anchorage; soil properties, soil testing, footings; pile foundation; shorting; retaining walls.

**Mr. Vrana**

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

**Professor Japp**

**303-418A,B DESIGN PROJECT.** 3(1-2-6) (Prerequisite: Completion of an approved set of required and complementary courses.) Capstone design project to be carried out by teams. Written and oral reporting and reviewing of progress on a regular basis. A written report and oral presentation of the final design are required. Guidance provided by Department staff and by practising engineers. Project normally carried out in a student's last semester. (Title and description change awaiting University approval)

**TBA**

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

**Professor Nicell**

**303-428A WATER RESOURCES AND HYDRAULIC ENGR.** 3(3-3-3) (Prerequisite: 303-327B) Application of continuity, energy and momentum concepts to open-channel flow; design of channels considering uniform flow and flow resistance, non-uniform flow and longitudinal profiles; design of channel controls and transitions; unsteady flow and flood routing; river ice engineering. (Title and description change awaiting University approval)

**Professor Gaskin**

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

**Professor Gehr**

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

**Staff**

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

**Mr. Danielsen**

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

**Mr. Byrns**

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

**Mr. Taylor**

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

**Professor Ghoshal**

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

**Professor Chouinard**

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

**Professor Rogers**

**303-463B DESIGN OF CONCRETE STRUCTURES. 3(3-3-3) (Prerequisite: 303-318B)** Review of flexural behaviour and design concepts. Design of flexural members, columns, two-way slab systems, retaining walls, disturbed regions, and shear walls. Introduction to prestressed concrete design. (Description change awaiting University approval)  

**Professor Mitchell**

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

**Professor Mirza**

**303-470A,B RESEARCH PROJECT. 3(0-1-8) (Prerequisite: 60 credits in the Civil Engineering and Applied Mechanics program) Open to students with a high CGPA. A research project must be carried out and a technical paper prepared under the supervision of a member of staff. The project must be established with the consent of the Staff Supervisor, and must be approved by the Department before registration. May be taken in conjunction with the required course 303-418A,B and the project therefore can be carried out through two semesters.**  

**Staff**

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

**Professor Mitchell**

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

**Professor Shao**

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

**Professor Sririvastava**

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

**Professor Nicell**

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

**Professor Mirza**

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

**TBA**

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

**Mr. Patterson**

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

**TBA**

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

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

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

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

**Professor Nguyen**

**303-553A STREAM POLLUTION AND CONTROL.** (3.3-2-4) (Prerequisite: 303-225B) Water quality standards; physical, chemical, and bacterial contamination of surface waters; effects of specific types of pollution such as thermal, point and non-point sources; stream self-purification; effects on lake eutrophication; pollution surveys and methods of control; laboratory tests. **Professor Gehr**

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


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

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

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

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

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

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

- **303-579B WATER POWER ENGINEERING.** 3(3-0-6) (Prerequisites: 303-325A and 303-310A) A practical approach to planning and design of hydro-electric power installations. Fundamental theory of water availability and demand; flow, power and load duration curves; classification of power sources; project planning; economic analysis including costs and benefits; special features of hydrop plants; and appurtenances for hydro plants. **TBA**

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

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

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

### 4.5 Department of Electrical and Computer Engineering

McConnell Engineering Building, Room 633
3480 University Street
Montreal, QC H3A 2K6
Telephone: (514) 398-7110
Fax: (514) 398-4470
http://www.ece.mcgill.ca

**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**


**Professors**

Clifford H. Champness; M.Sc.(Lond.), Ph.D.(McG.) (part-time)
Peter Kabal; B.A.Sc., M.A.Sc., Ph.D.(Tor.)
Theo Le-Ngoc; M.Eng.(McG.), Ph.D.(Ott.), F.I.E.E.E.
Jonathan Webb; B.A., Ph.D.(Cantab.)

**Associate Professors**

Benoit Champagne; B.Eng., M.Eng.(Montr.), Ph.D.(Tor.)
James Clark; B.Sc., Ph.D.(Br.Col.)
Steve McFee; B.Eng., Ph.D.(McG.)
The program in Electrical Engineering gives students a broad understanding of the key principles that are responsible for the extraordinary advances in the technology of computers, microelectronics, automation and robotics, telecommunications and power systems. These areas are critical to the development of our industries and, more generally, to our economy. A graduate of this program is exposed to all basic elements of electrical engineering and can function in any of our client industries. This breadth is what distinguishes an engineer from, say, a computer scientist or physicist.

The program in Electrical Engineering (Honours) is designed for students who wish to pursue postgraduate work and look to a career in advanced research and development. The technical complementaries are selected from graduate courses, facilitating the transition to postgraduate studies. Students in this curriculum benefit from small classes and have more contact with professional 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 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 361.]

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.

**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 complementaries are selected from graduate courses, facilitating the transition to postgraduate studies. Students in this curriculum benefit from small classes and have more contact with professional staff and graduate students. However, the program is quite demanding. Students are expected to register for at least 14 credits per semester; they may register for a smaller number only with the permission of the Chair of this Department. Students in the Honours program must maintain a minimum GPA of 3.00. Those who fail to maintain this standard are transferred to the regular program.

The program in Computer Engineering provides students with greater depth and breadth of knowledge in the hardware and software aspects of computers. Students are exposed to both theoretical and practical issues of both hardware and software in well-equipped laboratories. Although the program is designed to meet the growing demands by industry for engineers with a strong 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 361.]

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 189-260 Intermediate Calculus by passing the Advanced Credit examination described in section 2.3.

**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:

- **189-235 Ordinary Differential Eqns** instead of **189-261**
- **189-247 Linear Algebra** instead of **189-270**
- **189-248 Advanced Calculus I** instead of **189-265**
- **189-249 Advanced Calculus II** instead of **189-381**
- **198-251 Mechanics** instead of **303-281**

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)

REQUIRED COURSES

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<tr>
<th>COURSE</th>
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<tbody>
<tr>
<td>189-260 Intermediate Calculus</td>
<td>3</td>
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<tr>
<td>189-247* Linear Algebra</td>
<td>3</td>
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<tr>
<td>or 189-270 Applied Linear Algebra (3)</td>
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<tr>
<td>189-248* Advanced Calculus I</td>
<td>3</td>
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<tr>
<td>or 189-265 Advanced Calculus (3)</td>
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<tr>
<td>189-249 Advanced Calculus II</td>
<td>3</td>
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<tr>
<td>or 189-381 Complex Variables &amp; Transforms (3)</td>
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<tr>
<td>189-325 Ordinary Differential Eqns</td>
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<td>or 189-261 Differential Equations (3)</td>
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<td>198-251 Mechanics</td>
<td>3</td>
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<td>or 303-281 Analytical Mechanics (3)</td>
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<td>198-271 Quantum Physics</td>
<td>3</td>
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<tr>
<td>306-221 Engineering Professional Practice</td>
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<tr>
<td>306-310 Engineering Economy</td>
<td>3</td>
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<tr>
<td>308-202 Intro. to Computer Science I</td>
<td>3</td>
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<tr>
<td>455-206 Communication in Engineering</td>
<td>2</td>
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</tbody>
</table>

* CGPA of 3.30 is required to register for 189-247 and 189-248.

Departmental Courses

<table>
<thead>
<tr>
<th>COURSE</th>
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<tbody>
<tr>
<td>304-200 Fundamentals of Electrical Engineering</td>
<td>3</td>
</tr>
<tr>
<td>304-210 Circuit Analysis</td>
<td>3</td>
</tr>
<tr>
<td>304-221 Intro to Computer Engineering I</td>
<td>3</td>
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<tr>
<td>304-222 Intro to Computer Engineering II</td>
<td>3</td>
</tr>
<tr>
<td>304-291 Electrical Measurements Lab</td>
<td>2</td>
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<tr>
<td>304-303 Signals &amp; Systems I</td>
<td>3</td>
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<tr>
<td>304-304 Signals &amp; Systems II</td>
<td>3</td>
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<tr>
<td>304-305 Probability &amp; Random Sig. I</td>
<td>3</td>
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<tr>
<td>304-323 Digital System Design</td>
<td>5</td>
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<tr>
<td>304-330 Electronic Circuits I</td>
<td>3</td>
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<tr>
<td>304-334 Electronic Circuits II</td>
<td>5</td>
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<tr>
<td>304-351 Electromagnetic Fields</td>
<td>3</td>
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<tr>
<td>304-352 EM Waves and Optics</td>
<td>3</td>
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<tr>
<td>304-361 Power Engineering</td>
<td>3</td>
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<tr>
<td>304-498 Honours Thesis I</td>
<td>3</td>
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<tr>
<td>304-499 Honours Thesis II</td>
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COMPLEMENTARY COURSES

Technical Complementaries

Five technical complementary courses (15 credits), which must be Electrical Engineering Courses at the 500 level (or 304-427, 304-451). 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 I and II (304-496 and 304-499) 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

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<thead>
<tr>
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<tbody>
<tr>
<td>304-427 Operating Systems</td>
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<tr>
<td>304-525 Computer Architecture</td>
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<tr>
<td>304-532 Computer Graphics</td>
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<tr>
<td>304-548 Introduction to VLSI</td>
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Control and Automation

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<tr>
<td>304-501 Linear Systems</td>
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<tr>
<td>304-502 Control Engineering</td>
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<tr>
<td>304-503 Linear Stochastic Systems I</td>
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<td>304-504 Computer Control</td>
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<tr>
<td>304-505 Nonlinear Control Systems</td>
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<tr>
<td>304-507 Optimization and Optimal Control</td>
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<tr>
<td>304-509 Probability and Random Sig. II</td>
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<tr>
<td>304-512 Digital Signal Processing I</td>
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<tr>
<td>304-529 Image Processing &amp; Communication</td>
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<tr>
<td>304-531 Real Time Systems</td>
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Integrated Circuits and Electronics

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<tr>
<td>304-522 Asynchronous Circuits and Systems</td>
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<td>304-527 Optical Engineering</td>
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<tr>
<td>304-530 Logic Synthesis</td>
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<tr>
<td>304-533 Physical Basis of Semiconductors</td>
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<tr>
<td>304-534 Analog Microelectronics</td>
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<tr>
<td>304-545 Microelectronics Technology</td>
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<tr>
<td>304-548 Introduction to VLSI</td>
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<tr>
<td>304-571 Optoelectronic Devices</td>
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<td>304-573 Microwave Electronics</td>
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Power Engineering

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<td>304-502 Control Engineering</td>
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<tr>
<td>304-549 Expert Systems in Electrical Design</td>
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<tr>
<td>304-559 Flexible AC Transmission Systems</td>
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<tr>
<td>304-560 Power Systems II</td>
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<tr>
<td>304-563 Power Systems Operation and Planning</td>
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<tr>
<td>304-565 Power Electronics</td>
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Telecommunications

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<td>304-451 EM Transmission and Radiation</td>
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<tr>
<td>304-511 Intro. to Digital Comm.</td>
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<tr>
<td>304-512 Digital Signal Processing I</td>
<td></td>
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<tr>
<td>304-521 Digital Communications I</td>
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<tr>
<td>304-523 Speech Communications</td>
<td></td>
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<tr>
<td>304-527 Optical Engineering</td>
<td></td>
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<tr>
<td>304-528 Telecom. Network Architecture</td>
<td></td>
</tr>
<tr>
<td>304-571 Optoelectronic Devices</td>
<td></td>
</tr>
<tr>
<td>304-596 Optical Waveguides</td>
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</table>

Laboratory Complementaries

Two 400-level laboratory courses in Electrical Engineering.

General Complementaries

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 B.ENG. DEGREE IN ELECTRICAL ENGINEERING (REGULAR)

REQUIRED COURSES

<table>
<thead>
<tr>
<th>COURSE</th>
<th>CREDIT</th>
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<tbody>
<tr>
<td>189-260 Intermediate Calculus</td>
<td>3</td>
</tr>
<tr>
<td>189-261 Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>or 189-325 Ordinary Differential Eqns (3)</td>
<td></td>
</tr>
<tr>
<td>189-265 Advanced Calculus</td>
<td>3</td>
</tr>
<tr>
<td>or 189-248* Advanced Calculus (3)</td>
<td></td>
</tr>
<tr>
<td>189-270 Applied Linear Algebra</td>
<td>3</td>
</tr>
<tr>
<td>or 189-247* Linear Algebra (3)</td>
<td></td>
</tr>
<tr>
<td>189-381 Complex Variables &amp; Transforms</td>
<td>3</td>
</tr>
<tr>
<td>198-271 Quantum Physics</td>
<td>3</td>
</tr>
<tr>
<td>303-281 Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>or 198-251 Mechanics (3)</td>
<td></td>
</tr>
<tr>
<td>306-221 Engineering Professional Practice</td>
<td>1</td>
</tr>
<tr>
<td>306-310 Engineering Economy</td>
<td>3</td>
</tr>
<tr>
<td>308-202 Intro. to Computing I</td>
<td>3</td>
</tr>
<tr>
<td>455-206 Communication in Engineering</td>
<td>3</td>
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</tbody>
</table>

* CGPA of 3.30 is required to register for 189-247 and 189-248.

Departmental Courses

<table>
<thead>
<tr>
<th>COURSE</th>
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<tbody>
<tr>
<td>304-200 Fundamentals of Electrical Engineering</td>
<td>3</td>
</tr>
<tr>
<td>304-210 Circuit Analysis</td>
<td>3</td>
</tr>
<tr>
<td>304-221 Intro to Computer Engineering I</td>
<td>3</td>
</tr>
<tr>
<td>304-222 Intro to Computer Engineering II</td>
<td>3</td>
</tr>
<tr>
<td>304-291 Electrical Measurements Lab</td>
<td>2</td>
</tr>
</tbody>
</table>
The International Institute of Telecommunications (IIT) was recently established in Montreal as a center for telecommunications education. It is funded by government and industry, and provides state-of-the-art laboratory facilities and a point of contact between local telecommunications 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 (304-494) in telecommunications, at IIT or with an IIT company; and
- permission to take 304-496 at IIT.

To complete the Concentration, students must take six courses as Technical Complementaries:

<table>
<thead>
<tr>
<th>Course</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>304-411 Communications Systems I</td>
<td>3</td>
</tr>
<tr>
<td>304-414 Intro. to Telecom. Networks</td>
<td>3</td>
</tr>
<tr>
<td>304-496 Telecom. Systems and Services</td>
<td>3</td>
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</tbody>
</table>

and any three courses selected from the following list:

<table>
<thead>
<tr>
<th>Course</th>
<th>Credit</th>
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<tbody>
<tr>
<td>304-412 Discrete Time Signal Processing</td>
<td>3</td>
</tr>
<tr>
<td>304-413 Communications Systems II</td>
<td>3</td>
</tr>
<tr>
<td>304-423 Optical Communications</td>
<td>3</td>
</tr>
<tr>
<td>304-451 EM Signal Transmission and Radiation</td>
<td>3</td>
</tr>
</tbody>
</table>

In addition, students must take 304-491 (Communications Systems Lab) and complete 304-494 (Design Project) in telecommunications, at IIT or with an IIT company.

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

**CURRICULUM FOR THE B.ENG. DEGREE IN COMPUTER ENGINEERING**

<table>
<thead>
<tr>
<th>COURSE</th>
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<tbody>
<tr>
<td>189-260 Intermediate Calculus</td>
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<tr>
<td>189-261 Differential Equations</td>
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<td>189-325 Ordinary Differential Eqns (3)</td>
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<tr>
<td>189-265 Advanced Calculus</td>
<td>3</td>
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<tr>
<td>189-248* Advanced Calculus I (3)</td>
<td>3</td>
</tr>
<tr>
<td>189-270 Applied Linear Algebra</td>
<td>3</td>
</tr>
<tr>
<td>189-247* Linear Algebra (3)</td>
<td>3</td>
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<tr>
<td>189-363 Discrete Mathematics</td>
<td>3</td>
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<tr>
<td>189-381 Complex Variables &amp; Transforms</td>
<td>3</td>
</tr>
<tr>
<td>303-281 Mechanics</td>
<td>3</td>
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<tr>
<td>198-251 Mechanics (3)</td>
<td>3</td>
</tr>
<tr>
<td>306-221 Engineering Professional Practice</td>
<td>1</td>
</tr>
<tr>
<td>306-310 Engineering Economy</td>
<td>3</td>
</tr>
<tr>
<td>308-202 Intro. to Computing I</td>
<td>3</td>
</tr>
<tr>
<td>308-250 Intro. to Computer Science</td>
<td>3</td>
</tr>
<tr>
<td>308-302 Programming Languages</td>
<td>3</td>
</tr>
<tr>
<td>455-206 Communication in Engineering</td>
<td>3</td>
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</tbody>
</table>

* CGPA of 3.30 is required to register for 189-247 and 189-248.

** Departmental Courses **

<table>
<thead>
<tr>
<th>COURSE</th>
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<tbody>
<tr>
<td>304-200 Fundamentals of Electrical Engineering</td>
<td>3</td>
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<tr>
<td>304-210 Circuit Analysis</td>
<td>3</td>
</tr>
<tr>
<td>304-221 Intro to Computer Engineering I</td>
<td>3</td>
</tr>
<tr>
<td>304-222 Intro to Computer Engineering II</td>
<td>3</td>
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<tr>
<td>304-291 Electrical Measurements Lab</td>
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</tr>
<tr>
<td>304-303 Signals &amp; Systems I</td>
<td>3</td>
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<tr>
<td>304-304 Signals &amp; Systems II</td>
<td>3</td>
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<tr>
<td>304-305 Probability &amp; Random Sig. I</td>
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<tr>
<td>304-321 Introduction to Software Engineering</td>
<td>3</td>
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<tr>
<td>304-323 Digital System Design</td>
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<tr>
<td>304-330 Electronic Circuits I</td>
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<tr>
<td>304-334 Electronic Circuits II</td>
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<tr>
<td>304-353 Electronic Circuits &amp; Waves</td>
<td>3</td>
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<tr>
<td>304-425 Computer Architecture</td>
<td>3</td>
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<tr>
<td>304-427 Operating Systems</td>
<td>3</td>
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<tr>
<td>304-494 Design Project</td>
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** COMPLEMENTARY COURSES **

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<td>304-404 Control Systems</td>
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<td>304-411 Communications Systems I</td>
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<td>304-412 Discrete-Time Signal Processing</td>
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<tr>
<td>304-424 Human-Computer Interaction</td>
<td>3</td>
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<tr>
<td>304-426 Microprocessor Systems</td>
<td>3</td>
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<tr>
<td>304-428 Software Engineering Practice</td>
<td>3</td>
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<tr>
<td>304-431 Electronic Design</td>
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**Technical Complementaries**

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>304-300 Intro to Computer Engineering I</td>
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<td>304-302 Intro to Computer Engineering II</td>
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<td>304-321 Intro to Software Engineering</td>
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<tr>
<td>304-427 Operating Systems</td>
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<td>304-428 Software Engineering Practice</td>
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<td>304-429 Software Validation</td>
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<td>308-202 Introduction to Computing I</td>
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<tr>
<td>308-206 Intro Software Systems</td>
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<tr>
<td>308-250 Intro to Computer Science</td>
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<tr>
<td>308-251 Data Structures and Algorithms</td>
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<tr>
<td>308-290 Programming Languages and Paradigms</td>
<td>3</td>
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<tr>
<td>308-330 Theoretical Aspects of Computer Science</td>
<td>3</td>
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<tr>
<td>308-360 Algorithm Design Techniques</td>
<td>3</td>
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<td>308-361 Systems Programming Project</td>
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<tr>
<td>308-420 Files and Databases</td>
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**Mathematics and Science Required Courses**

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<tr>
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<td>189-261 Differential Equations</td>
<td>3</td>
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<tr>
<td>189-270 Applied Linear Algebra</td>
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<td>198-230 Dynamics of Simple Systems</td>
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**Mathematics Complementary Course**

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<td>or 189-381 Complex Variables &amp; Transformations</td>
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**Engineering Breadth Required Courses**

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<tr>
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<td>304-210 Circuit Analysis</td>
<td>3</td>
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<td>304-291 Electrical Measurements Lab</td>
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<tr>
<td>304-303 Signals and Systems</td>
<td>3</td>
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<tr>
<td>304-305 Probability and Random Sig. I</td>
<td>3</td>
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<tr>
<td>304-330 Electronic Circuits</td>
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<tr>
<td>455-206 Communication In Engineering</td>
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<tr>
<td>306-310 Engineering Economy</td>
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<tr>
<td>306-221 Engineering Professional Practice</td>
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**Technical Complementaries**

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**Group A Technical Complementaries**

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<tr>
<td>308-409 Concurrent Programming</td>
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</tr>
<tr>
<td>308-424 Topics In Artificial Intelligence I</td>
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</tr>
<tr>
<td>308-433 Personal Software Engineering</td>
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<tr>
<td>308-524 Theoretical Found. of Prog. Lang.</td>
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<td>308-575 Fundamentals of Distributed Algorithms</td>
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**Group B Technical Complementaries**

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<td>304-323 Digital Systems Design</td>
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<td>304-404 Control Systems</td>
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<td>304-411 Communications Systems I</td>
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<tr>
<td>304-413 Communications Systems II</td>
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<td>304-414 Intro. To Telecom Networks</td>
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<tr>
<td>304-421 Embedded Systems</td>
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<td>304-422 Fault Tolerant Computing</td>
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<tr>
<td>304-420 Parallel Computing</td>
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<tr>
<td>304-424 Human-Computer Interaction</td>
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<tr>
<td>304-425 Computer Organization and Architecture</td>
<td></td>
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<tr>
<td>304-426 Microprocessor Systems</td>
<td></td>
</tr>
<tr>
<td>or 308-573 Microcomputers</td>
<td></td>
</tr>
<tr>
<td>304-410 Mobile Computing</td>
<td></td>
</tr>
<tr>
<td>304-522 Asynchronous Circuits and Systems</td>
<td></td>
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<tr>
<td>304-526 Artificial Intelligence</td>
<td></td>
</tr>
<tr>
<td>304-529 Image Processing &amp; Communications</td>
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<td>304-530 Logic Synthesis</td>
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<td>304-531 Real-Time Systems</td>
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<tr>
<td>304-532 Computer Graphics</td>
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<tr>
<td>or 308-557 Fundamentals of Computer Graphics</td>
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<tr>
<td>304-305 Computer System Architecture</td>
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<tr>
<td>304-410 Mobile Computing</td>
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<td>304-412 Software for e-commerce</td>
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<tr>
<td>308-505 High-Performance Computer Architecture</td>
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<td>308-520 Compiler Design</td>
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<tr>
<td>308-535 Computer Networks</td>
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<tr>
<td>308-566 Computer Methods in Operations Research</td>
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**General Complementaries**

<table>
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<tr>
<th>COURSE</th>
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<tr>
<td>252 2001-2002 Undergraduate Programs, McGill University</td>
<td></td>
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</tbody>
</table>

**Courses Offered by the Department**

- Denotes courses not offered in 2001-02
- Denotes courses with limited enrolment

All courses with limitations listed for section A01 have a section A02 open to other students but with password control.

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.

**304-200A,B Fundamentals of Electrical Engineering.**
3(3-0-6) (Corequisites: 189-261 or 189-325) 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. 

**Professor McFee**

Section A01: Limited to Electrical Honours, Regular, and Computer Engineering students only.

Professor Levine

For A Term: Section A01: Limited to Electrical Honours and Computer Engineering students only.

For B Term: Section A01: Limited to Regular Electrical Engineering students only.


Section A01: Limited to Electrical Honours, Regular, and Computer Engineering students only.

304-222A,B INTRODUCTION TO COMPUTER ENGINEERING II. 3(3-1-5) (Prerequisite: 304-221. Corequisite: 308-202) Data structures (arrays, lists, stacks, queues, dequesues and trees) and their machine representation and simple algorithms. Peripheral devices: printers, keyboards, magnetic tape drives, magnetic disc drives. Peripheral interfacing and busses. Introduction to operating systems. System integration. Computer systems and networks. Professor Lowther

Section A01: Limited to Electrical Honours, Regular, and Computer Engineering students only.

304-291A,B ELECTRICAL MEASUREMENTS LABORATORY. 2(1-4-1) (Corequisite: 304-210) 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. Professor Giannacopoulos

304-303A,B SIGNALS AND SYSTEMS I. 3(3-0-6) (Prerequisites: 304-210, 189-270 or 189-247. Corequisite: 189-381 or 189-249.) Elementary continuous and discrete-time signals, impulse functions, basic properties of discrete and continuous linear 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. Professor Bielstein

Section A01: Limited to Electrical Honours, Regular, and Computer Engineering students only.

304-304B SIGNALS AND SYSTEMS II. 3(3-0-6) (Prerequisite: 304-303) Application of transforms to the analysis of LTI single-loop feedback systems, the discrete-time Fourier series, the discrete-time Fourier transform, time and frequency analysis of discrete-time LTI systems, sampling systems, application of continuous and discrete-time signal theory to communications LTI systems. Professor Boulet

Section A01: Limited to Electrical Honours, Regular, and Computer Engineering students only.

304-305A,B PROBABILITY AND RANDOM SIG. I. 3(3-0-6) (Prerequisite: 304-303) 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. Professor Champagne

304-321A INTRODUCTION TO SOFTWARE ENGINEERING. 3(3-1-5) (Prerequisites: 308-203 or 308-250) 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. Professors Negulescu / Cooperstock

304-323A,B DIGITAL SYSTEMS DESIGN. 5(3-6-6) (Prerequisites: 304-291, 304-221, and 455-206) Minimization and synthesis of combinational logic and finite state machines. Synthesis of synchronous and asynchronous sequential circuits. Principles of control design. Classic 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. Professor Clark

Section A01: Limited to Regular Electrical Engineering students only.

304-330A,B ELECTRONIC CIRCUITS I. 3(3-0-6) (Prerequisite: 304-210) 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-terminal properties of small-signal models; frequency response of simple amplifier configurations; simple multistage amplifiers. Professor Plant

Section A01: Limited to Electrical Honours, Regular, and Computer Engineering students only.

304-334A,B ELECTRONIC CIRCUITS II. 5(3-6-6) (Prerequisite: 304-291, 304-303, 304-330 and 455-206) 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. Professor Roberts

Sections A01 to A05, each section with enrolment limit of 22:

Limited to Electrical Honours, Regular and Computer Engineering students only.

304-351A,B ELECTROMAGNETIC FIELDS. 3(3-1-5) (Prerequisites: 304-200 and 189-265) Maxwell's equations, electrostatics, magnetostatics and induction for power-frequency electrical engineering problems. Professor Kirk

Section A01: Limited to Electrical Honours, Regular and Computer Engineering students only.

304-352A EM WAVES AND OPTICS. 3(3-1-5) (Prerequisite: 304-351) 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. Professor Kirk

Section A01: Limited to Electrical Honours, Regular, and Computer Engineering students only.

304-353A ELECTROMAGNETIC FIELDS AND WAVES. 3(3-1-5) (Prerequisites: 304-210 and 189-265) 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. Professor Webb


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

Professor Leib

304-412B DISCRETE TIME SIGNAL PROCESSING. 3(3-0-6) (Prerequisites: 304-304) 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. Professor Kabal

304-413B COMMUNICATIONS SYSTEMS II. 3(3-0-6) (Prerequisite: 304-411) Introduction to radio communications; satellite communications systems; the cellular concept; fading channel models, digital modulation techniques over fading channels, diversity techniques, 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. Staff

304-414B INTRO. TO TELECOM. NETWORKS. 3(3-0-6) (Prerequisites: 304-304, 304-305 and 304-222) 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 stacks; local area networking; introduction to network engineering; examples include: ATM, ISDN, IP, Frame Relay, Ethernet.

Staff

G


Staff

304-421B, EMBEDDED SYSTEMS. 3(3-0-6) (Prerequisite: 304-427) Definition, structure and properties of embedded systems. Real-time programming; interrupts, latency, context, re-entrancy, thread and process models. Microcontroller and DSP architectures, I/O systems, timing and event management. Real-time kernels and services. Techniques for development, debugging and verification. Techniques for limited resource environments. Networking for distributed systems.

Staff

304-422A, FAULT TOLERANT COMPUTING. 3(3-0-6) (Prerequisite: 304-427) 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.

Staff

304-423B OPTICAL COMMUNICATIONS. 3(3-0-6) (Prerequisites: 304-352 and 198-271) A structured introduction to optical fiber communication systems, covering optical sources (lasers and light emitting diodes), fibers, receivers, wavelength filters, switches, transmission schemes and network level issues, including signal degradation (dispersion and attenuation), link design, amplification, wavelength division multiplexing and non-linear effects are also included.

Professors Kirk and Plant

304-424A HUMAN-COMPUTER INTERACTION. 3(3-4-2) (Prerequisite: 304-222 ) 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.

Professor Cooperstock


Professor Hayward

304-426A,B MICROPROCESSOR SYSTEMS. 3(1-3-5) (Prerequisites: 304-323 and 455-206) 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. (This course may be counted as a technical complementary or a lab complementary.) Limited Enrolment (50).

Professor Zilic

304-427B OPERATING SYSTEMS. 3(3-3) (Prerequisite: 304-222) 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.

Professor Khordoc

304-428B SOFTWARE ENGINEERING PRACTICE. 3(3-0-6) (Prerequisite: 304-321) 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.

Staff

304-431A ELECTRONIC DESIGN. 3(2-4-3) (Prerequisites: 304-323 and 304-330) 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. CAE 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. Limited enrolment (30).

Professor El-Gamal

304-432B PHYSICAL BASIS OF TRANSISTOR DEVICES. 3(3-0-6) (Prerequisites: 304-330, 304-351 and 198-271 ) 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.

Professor Plant

304-435B MIXED-SIGNAL TEST TECHNIQUES. 3(3-4-2) (Prerequisites: 304-304, 304-305, and 304-334) 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.

Professor Roberts

304-451B EM TRANSMISSION & RADIATION. 3(3-0-6) (Prerequisite: 304-352) 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).

Professor Webb

304-461A ELECTRIC MACHINERY. 3(3-0-6) (Prerequisite: 305-383) (Not open to students in Electrical Engineering.) Electric and magnetic circuits. Notions of electromechanical energy conversion applied to electrical machines. Basic electrical machines - trans-
formers, direct-current motors, synchronous motors and generators, three phase and single phase induction machines. Elements of modern electronically controlled electric drive systems.

Professor Galiana


Professor Ooi

304-464B POWER SYSTEMS ANALYSIS I. 3(3-0-6) (Prerequisite: 304-361) 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.

Professor Galiana

304-472A SYSTEMS DESIGN. 3(2-2-5) (Prerequisite: At least 42 credits of Departmental courses and permission of the instructor.) A design course where the class works as a team to design a large project in either control, power, communications or computer systems. The design is carried out in close collaboration with an industrial partner who acts as a consultant to the project.

Staff

304-485B IC FABRICATION LABORATORY. 2(1-3-2) (Prerequisite: 304-334, 455-206. Corequisite: 304-432 or 304-533) 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 characteristics of devices and circuits. Limited Enrolment (8).

Professor Shih

304-486B POWER LABORATORY. 2(1-3-2) (Prerequisites: 455-206, 304-361 and 304-334) 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. Limited Enrolled Equipment (14).

Professor Ooi

304-487A,B COMPUTER ARCHITECTURE LABORATORY. 2(0-3-3) (Prerequisite: 455-206. Corequisite: 304-425 or 304-525) 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. Limited enrollment (50).

Professor Hayward


Mr. Fraser

304-489A,B TELECOMMUNICATION NETWORK LAB. 2(0-3-3) (Prerequisite: 455-206. Corequisite: 304-414) Experiments involving the configuration and operation of telecommunication network technologies, and the modelling of telecommunication networks. Configuration of transport facility (SONET), bandwidth management with permanent virtual connections (ATM), implementation of a routing plan in a packet switched network (IP), configuration of end-to-end service (telephony over IP). (Awaiting University approval).

Professor Blostein

304-490A,B DIGITAL SIGNAL PROCESSING LAB. 2(0-3-3) (Prerequisite: 304-291 and 455-206. Corequisite: 304-412 or 304-512) 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. Limited Enrolment (30). Password card required.

Professor Kabal


Professor Leib

304-492A OPTICAL COMMUNICATIONS LAB. 2(0-3-3) (Prerequisite: 304-423 or 304-527, and 455-206) Hands-on experience of the physical layer of optical communications systems. Experiments involving optical fiber link characterization, laser measurements, beam divergence, coupling efficiency. Use of lasers, optical spectrum analyser, data generator, beam profiler, photodetectors, optical filters. Experiments are supported with simulation and analysis software.

Professors Kirk and Plant

304-493B CONTROL AND ROBOTICS LAB. 2(0-3-3) (Prerequisites: 304-291 and 455-206. Corequisite: 304-404 or 304-502) 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. Limited Enrolment (16).

Professor Hayward

304-494A,B ELECTRICAL ENGINEERING DESIGN PROJECT. 3(0-5-4) (Prerequisites: 455-206 and at least 42 Departmental credits.) A laboratory design project undertaken with close supervision by 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. Limited Enrolment (50).

Mr. Fraser

304-495A,B,C SOFTWARE ENG. DESIGN PROJECT. 3(0-5-4) (Prerequisites: 304-321 and at least 42 Departmental credits from Electrical and Computer Eng. and Computer Science) Self-managed design and implementation of a complex software system according to a set or prescribed specification.

Staff

304-496B TELECOM. SYSTEMS AND SERVICES. 3(3-3-3) (Prerequisites: 304-411 and 304-414) 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.

Mr. Fraser

304-498A,B,C HONOURS THESIS I. 3(0-3-6) (Prerequisite: 455-206 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.

Mr. Fraser

304-499A,B,C HONOURS THESIS II. 3(0-3-6) (Prerequisite: 304-498) A research project undertaken with close supervision by a staff member. A continuation of 304-498. The work consists of carrying out the research plan developed in 304-498 along with a seminar presentation at end of term.

Mr. Fraser


Professor Boulet

frequency domain. Sampled-data implementation of continuous-time design.  


Professor Caines  
304-504B Computer Control. 3(3-0-6) (Prerequisites: 304-404 or 304-502 and 304-305) Sampling and aliasing. Conversion of continuous-time filters using s-to-z transformations; pre-filtering and post-filtering. Discrete time state representation and z-transfer function of sampled linear, time-invariant systems. Correspondence between system theoretic results for continuous- and discrete-time systems. Sampled-data design, including deadbeat and LQG control. Quantization. Specification of computer system. Study of control system design through case studies.  

Staff  
304-505B Nonlinear Control Systems. 3(3-0-6) (Prerequisite: 304-501) 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.  

Professors Caines and Michalska  
304-507A Optimization and Optimal Control. 3(3-0-6) (Prerequisites: 189-265 or 189-248 and 189-270 or 189-247) 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.  

Professor Michalska  
304-509A Probability and Random Sig. II. 3(3-0-6) (Prerequisites: 304-304 and 304-305) 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.  

Staff  
304-510B Random Processes. 3(3-0-6) (Prerequisite: 304-509) Finite-dimensional distribution functions. Estimation, Orthogonal Projection Theorem. Linear stochastic systems; Kalman filtering. Stationary stochastic processes: spectral Representation Theorem, Wiener filtering, Wold decomposition; ARMA processes; Brownian Motion; Ito integral and stochastic differential equations; forward and backward equations for diffusions. Ergodic theorems. Stochastic dynamic programming. Applications to communication and control systems.  

Professor Caines  
304-511A Intro. to Digital Comm. 3(3-0-6) (Prerequisite: 303-304. Corequisite: 304-509.) (An advanced version of 304-411.) Amplitude and angle modulation including AM, FM, FDM and telecommunication systems; introduction to random processes; sampling and quantization, PCM systems, TDM; digital modulation techniques, Maximum-Likelihood receivers, synchronization issues; elements of information theory including information sources, source coding and channel capacity.  

Professor Leib  
304-512A Digital Signal Processing I. 3(3-0-6) (Prerequisite: 304-304 and 304-305) Review of discrete-time transforms, sampling and quantization, PCM systems, TDM; digital modulation techniques, Maximum-Likelihood receivers, synchronization issues; elements of information theory including information sources, source coding and channel capacity.  

Professor Leib  

Professor Rumin  

Professor Kabal  

Professor Negulescu  
304-523B Speech Communications. 3(3-0-6) (Prerequisite: 304-412 or 304-512) 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.  

Dr. O’Shaughnessy  

Staff  
304-526B Artificial Intelligence. 3(3-0-6) (Prerequisite: 304-222) Fundamentals of automated reasoning in expert systems: Semantics and satisfaction, inference procedures, logical implication, proofs, unification, resolution, soundness and completeness. Searching strategies and problem solving. Limits of monotonic logic: forms of non-monotonic reasoning. The course includes a term project which consists of writing a small inference engine in Lisp.  

Professor Cooperstock  
304-527A,B Optical Engineering. 3(3-0-6) (Prerequisite: 304-304 and 304-352) A structure introduction to modern optical engineering. Topic 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.  

Professor Kirk  

Staff  
304-529A Image Processing & Communication. 3(3-3-0) (Prerequisite: 304-304) 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.  

Professor Levine

304-531B REAL TIME SYSTEMS. 3(3-3-3) (Prerequisites: 304-222 and 304-323) 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. Staff

304-532A COMPUTER GRAPHICS. 3(3-3-3) (Prerequisite: 304-222) 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.

Ms. Leszkonowicz

304-533B PHYSICAL BASIS OF SEMICONDUCTOR DEVICES. 3(3-0-6) (Prerequisites: 304-330, 304-351 and 198-271) 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.

Professor Plant

304-534A ANALOG MICROELECTRONICS. 3(3-0-6) (Prerequisite: 304-334) 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.

Professor Roberts

304-536A RF MICROELECTRONICS. 3(3-3-3) (Prerequisites: 304-334 and 304-352) Introduction to Radio Frequency Integrated Circuits and wireless transceiver architectures. Modeling of passive/active integrated devices. Design of monolithic bipolar and CMOS LNAs, mixers, filters, broadband amplifiers, RF power amplifiers, VCOs, and frequency synthesizers. Analysis of noise and non-linearity in RFICs. Project using modern RFIC simulation/layout CAD tools.

Professor El-Gamal


Professor Webb

304-545A MICROELECTRONICS TECHNOLOGY. 3(3-0-6) (Prerequisite: 304-432 or 304-533) Basic techniques in the fabrication of microelectronic circuits. Four-point probe, alloyed contacts, diffusion processes, ion implantation epitaxy, silicon dioxide, photo-lithography, selected diffusion and metallization, transistor fabrication, dry etching, monolithic integrated circuits, isolation, mask making, thin and thick film components, MOS gate voltage and integrated circuits.

Professor Champness


Professor McFee

304-548A INTRODUCTION TO VLSI SYSTEMS. 3(2-2-5) (Prerequisites: 304-334 and 304-323) 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. Limited Enrolment (20). Password card required.

Professor Rumin


Professor Lowther

304-559X FLEXIBLE AC TRANSMISSION SYSTEMS. 3(3-0-6) (Prerequisite: 304-361 and 304-334) Operating principles of controllers of flexible AC transmission systems (FACTS). Transformer, thyristor and gate-turn- off thyristor (GTO) technologies. Modulation methods: harmonic elimination, pulse width modulation. Applications in: shunt and series advanced static VAR Controllers (ASVC), phase shifters, unified power flow controllers (UPFC).

Professor Ooi

304-560A POWER SYSTEMS ANALYSIS II. 3(3-0-6) (Prerequisite: 304-454) Main power system analysis tools for system and component design. Balanced and unbalanced operation of three-phase systems, symmetrical components, fault analysis, transient behaviour due to switching and lightning. Applications for a wide range of typical situations such as line design, circuit breaker rating, protective relaying, and insulation coordination are covered.

Professor Galiana


304-565A INTRODUCTION TO POWER ELECTRONICS. 3(3-0-6) (Prerequisite: 304-334) 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.

Professor Ooi

304-571A OPTOELECTRONIC DEVICES. 3(3-0-6) (Prerequisites: 304-304, 304-305, 304-352 and 304-533) 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.

Professor Plant

304-573A MICROWAVE ELECTRONICS. 3(3-0-6) (Prerequisite: 304-432 or 304-533) Physical basis of modern microwave devices and circuits. Microwave transistors and tunnel diodes, transferred electron devices, transit time devices and infrared devices. Microwave generation and amplification, microwave FET circuits. Noise and power amplification.

Professor Shih

304-578A CRYSTALS AND CONDUCTION. 3(3-0-6) (Prerequisite: 304-432 or 304-533) Crystal lattices, point symmetry operations, Miller indices, important crystal structures, lattice matrix, reciprocal matrix, characteristics of X-rays, diffraction theory, structure factor. Kinetic theory of gases review, free electron theory of metals, mobility, classical theory anomalies, quantum treatment, density of states, Fermi Dirac distribution, Kronig Penney model, Brillouin zones, band filling, thermoionic emission.

Professor Champness

304-596B OPTICAL WAVEGUIDES. 3(3-0-6) (Prerequisite: 304-352) Introduction to wave and ray optics, ray equation. Kirchhoff-
Huygens diffraction theory, Fourier optics, Gaussian beams, propagation characteristics of optical fibers and dielectric waveguides for wideband optical fiber communication systems, waveguide group velocity and dispersion, thin-film waveguides. Discussion of optical fiber communication systems and guided-wave photonic devices.

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

4.6 Department of Mechanical Engineering
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William Bruce; B.A.Sc., M.A.Sc.(Toronto), Eng.
John C. Chen; Dipl.-Ing.(Swiss Fed. Inst.), Eng., F.E.I.C.
(Thomas Workman Emeritus Professor of Mechanical Engineering)
Post-Retirement
Glenn Bach
Lucian Kopps
Professors
Abdel H. 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)
Wagdi Habashi; 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 Corteledge; M.Sc., Ph.D.(Caltech)
(Graduate Program Coordinator)
Larry B. Lessard; B.Eng.(McG.), M.Sc., Ph.D.(Stanford), Eng.
James A. Nemes; B.Sc.(Maryland), M.S., D.Sc.(GWU) (Graduate Program Coordinator)
Peter Radziszewski; B.Sc.(U.B.C.), M.Sc., Ph.D.(Laval)
Vincent Thomson; B.Sc.(Windsor), Ph.D.(McMaster) (Werner Graupe Professor of Manufacturing Automation)
Assistant Professors
Bogdan Epureanu; Ph.D.(Duke)
Andrew J. Higgins, B.Sc.(ill.), M.S., Ph.D.(Wash.)
Venkat N. Kovri; B.Tech.(I.I.T., Madras), Ph.D.(Penn.)
Timothy Lee; M.S.(Portland State), Ph.D.(Idaho)
Laurent Mydlarski; B.A.Sc.(Waterloo), Ph.D.(Cornell)

Laboratory Superintendents
D. Chellian, 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)

REQUIRED COURSES

<table>
<thead>
<tr>
<th>COURSE</th>
<th>CREDIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>189-260A,B</td>
<td>Intermediate Calculus</td>
</tr>
<tr>
<td>189-261A,B</td>
<td>Differential Equations</td>
</tr>
<tr>
<td>189-265A,B</td>
<td>Advanced Calculus</td>
</tr>
<tr>
<td>189-266A,B</td>
<td>Linear Algebra and BVP</td>
</tr>
<tr>
<td>303-207A</td>
<td>Solid Mechanics</td>
</tr>
<tr>
<td>304-461A</td>
<td>Electric Machinery</td>
</tr>
<tr>
<td>306-221A,B</td>
<td>Engineering Professional Practice</td>
</tr>
<tr>
<td>306-310A,B</td>
<td>Engineering Economy</td>
</tr>
<tr>
<td>308-208A,B</td>
<td>Computers in Engineering</td>
</tr>
<tr>
<td>455-206A,B</td>
<td>Communication in Engineering</td>
</tr>
</tbody>
</table>
Welcome to McGill. After registering by MARS, students must complete their program of studies in accordance with the regulations described in section 2.3, the total number of credits is reduced by three.

If advanced credit is given for 189-260 Intermediate Calculus (see section 3.4), 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 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.engineering.mcgill.ca).

Curriculum for the B.Eng. Degree in Mechanical Engineering (Honours)

<table>
<thead>
<tr>
<th>Required Courses</th>
<th>Course Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>189-260A,B</td>
<td>Intermediate Calculus</td>
</tr>
<tr>
<td>189-261A,B</td>
<td>Differential Equations</td>
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<td>455-206A,B</td>
<td>Communication in Engineering</td>
</tr>
</tbody>
</table>

Departmental Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>305-201A</td>
<td>Intro. to Mechanical Engineering</td>
</tr>
<tr>
<td>305-210A</td>
<td>Mechanics I</td>
</tr>
<tr>
<td>305-220A</td>
<td>Mechanics II</td>
</tr>
<tr>
<td>305-240A</td>
<td>Thermodynamics I</td>
</tr>
<tr>
<td>305-260A</td>
<td>Machine Tool Laboratory</td>
</tr>
<tr>
<td>305-262B</td>
<td>Statistics and Measurement Laboratory</td>
</tr>
<tr>
<td>305-291B</td>
<td>Graphics</td>
</tr>
<tr>
<td>305-292A</td>
<td>Design I</td>
</tr>
<tr>
<td>305-314A</td>
<td>Dynamics of Mechanisms</td>
</tr>
<tr>
<td>305-315A</td>
<td>Dynamics of Vibrations</td>
</tr>
<tr>
<td>305-321B</td>
<td>Mechanics of Deformable Solids</td>
</tr>
<tr>
<td>305-321A</td>
<td>Fluid Mechanics I</td>
</tr>
<tr>
<td>305-341A</td>
<td>Thermodynamics II</td>
</tr>
<tr>
<td>305-346A</td>
<td>Heat Transfer</td>
</tr>
<tr>
<td>305-362A</td>
<td>Mechanical Laboratory</td>
</tr>
<tr>
<td>305-383A</td>
<td>Applied Electronics and Instrumentation</td>
</tr>
<tr>
<td>305-393B</td>
<td>Design II</td>
</tr>
<tr>
<td>305-409B</td>
<td>Numerical Methods in Mechanical Engineering</td>
</tr>
<tr>
<td>305-412B</td>
<td>Dynamics of Systems</td>
</tr>
<tr>
<td>305-430A</td>
<td>Fluid Mechanics II</td>
</tr>
<tr>
<td>305-463D</td>
<td>Mechanical Engineering Project</td>
</tr>
</tbody>
</table>

Complementary Courses 15

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:

- 305-343 Energy Conversion
- 305-413 Control Systems
- 305-432 Aircraft Structures
- 305-471 Industrial Engineering
- 305-472 Case Studies in Project Mgmt
- 305-495 Design III
- 305-496 Design IV
- 305-497 Value Engineering
- 305-524 Computer Integrated Manufacturing
- 305-526 Manufacturing and the Environment
- 305-528 Product Design
- 305-532 Aircraft Perform., Stability and Control
- 305-541 Kinematic Synthesis
- 305-543 Design with Composite Materials
- 305-557 Mechatronic Design
- 305-565 Fluid Flow & Heat Transfer Equipment
- 305-572 Introduction to Robotics
- 305-573 Mechanics of Robotic Systems
- 305-577 Optimum Design

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

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:

- 305-343 Energy Conversion
- 305-413 Control Systems
- 305-432 Aircraft Structures
- 305-471 Industrial Engineering
- 305-472 Case Studies in Project Mgmt
- 305-495 Design III
- 305-496 Design IV
- 305-497 Value Engineering
- 305-524 Computer Integrated Manufacturing
- 305-526 Manufacturing and the Environment
- 305-528 Product Design
- 305-532 Aircraft Perform., Stability and Control
- 305-541 Kinematic Synthesis
- 305-543 Design with Composite Materials
- 305-557 Mechatronic Design
- 305-565 Fluid Flow & Heat Transfer Equipment
- 305-572 Introduction to Robotics
- 305-573 Mechanics of Robotic Systems
- 305-577 Optimum Design

And any two of these three:

- 305-545A Advanced Stress Analysis (3)
- 305-562A Advanced Fluid Mechanics (3)
- 305-578B Advanced Thermodynamics (3)

Complementary Courses 15
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

Students entering in September or January must plan their program of studies in accordance with the regulations described in Welcome to McGill. After registering by MARS, 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.engineering.mcgill.ca).

LIST OF COMPLEMENTARY COURSES (DEPARTMENTAL)
(Each is 3 credits)

305-343A Energy Conversion
305-413A Control Systems
305-432A Aircraft Structures
305-434A Turbomachinery
305-447A Combustion
305-471A Industrial Engineering
305-472A Case Studies in Project Mgmt
305-474B Operations Research
305-495A Design III
305-496B Design IV
305-497A Value Engineering
305-500A,B Sel. Topics in Mechanical Eng.
305-501A,B Sel. Topics in Mechanical Eng.
305-522B Production Systems
305-524B Computer Integrated Manufacturing
305-526C Manufacturing and the Environment
305-528A Product Design
305-529C Discrete Manufacturing Systems
305-530A Mechanics of Composite Materials
305-531B Aeroelasticity
305-532B Aircraft Perform., Stability and Control
305-533A Subsonic Aerodynamics
305-534B Air Pollution Engineering
305-537B High Speed Aerodynamics
305-538B Unsteady Aerodynamics
305-539A Computational Aerodynamics
305-540A,B,C Advanced Fluid Mechanics
305-541B Kinematic Synthesis
305-542B Spacecraft Dynamics
305-543A Design with Composite Materials
305-545A Advanced Stress Analysis
305-552B Advanced Applied Mathematics
305-555B Applied Process Control
305-557B Mechatronic Design
305-561B Biomechanics of Musculoskeletal Systems
305-562B Advanced Fluid Mechanics
305-565B Fluid Flow & Heat Transfer Equip.
305-572A Introduction to Robotics
305-573B Mechanics of Robotic Systems
305-577A Optimum Design
305-578B Advanced Thermodynamics
305-581A Nonlinear Dynamics and Chaos

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)
189-260A Intermediate Calculus
305-201A Intro. to Mechanical Engineering
305-210A Mechanics I
305-260A Machine Tool Laboratory
306-221A Engineering Professional Practice
308-208A Computers in Engineering

Semester 2 (Winter)
189-261B Differential Equations
189-265B Advanced Calculus
305-220B Mechanics II
305-262B,C Statistics & Measurement Laboratory
305-291B Graphics
455-206B Communication in Engineering

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:

305-532B Aircraft Perform., Stability and Control
305-533A Subsonic Aerodynamics

and at least one of the following:

305-432A Aircraft Structures
305-434A Turbomachinery
305-437B High Speed Aerodynamics
305-438B Unsteady Aerodynamics
305-439B 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:

305-495A Design III
305-496B Design IV

Plus any four below:

305-497A Value Engineering
305-540A,B Design: Modelling and Decision
305-541B Kinematic Synthesis
305-542B Spacecraft Dynamics
305-543A Design with Composite Materials
305-545A Advanced Stress Analysis
305-552B Advanced Applied Mathematics
305-555B Applied Process Control
305-557B Mechatronic Design
305-561B Biomechanics of Musculoskeletal Systems
305-562B Advanced Fluid Mechanics
305-565B Fluid Flow & Heat Transfer Equip.
305-572A Introduction to Robotics
305-573B Mechanics of Robotic Systems
305-577A 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:

305-413A Control Systems
305-557B Mechatronic Design
305-572A Introduction to Robotics

and two of the following:

305-528A Product Design
305-541B Kinematic Synthesis
305-573B Mechanics of Robotic Systems
304-502A Control Engineering
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>305-210A,B</td>
<td>Mechanics I.</td>
<td>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.</td>
</tr>
<tr>
<td>305-261B</td>
<td>Measurement Lab.</td>
<td>Basic experimental laboratory measurements, such as measurement of strain, pressure, force, position, and temperature.</td>
</tr>
<tr>
<td>305-262B,C</td>
<td>Statistics &amp; Measurement Laboratory.</td>
<td>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.</td>
</tr>
<tr>
<td>305-290A</td>
<td>Graphics.</td>
<td>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.</td>
</tr>
<tr>
<td>305-292A,B</td>
<td>Design I.</td>
<td>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. (Course description change awaiting University approval)</td>
</tr>
<tr>
<td>305-314A,B</td>
<td>Dynamics of Mechanics.</td>
<td>First principles of analysis; motion; position; displacement; velocity; acceleration; force; inertia and its effects. Kinematics 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.</td>
</tr>
<tr>
<td>305-343A</td>
<td>Energy Conversion.</td>
<td>Overview of different energy conversion systems is considered. The theory and practical applications are specifically covered for: thermoelectric, and photovoltaic systems, fuel cells, magneto-hydrodynamics, and solar radiation. Students will present a paper on an energy conversion subject of their choice.</td>
</tr>
<tr>
<td>305-346A,B</td>
<td>Heat Transfer.</td>
<td>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 gray-body radiation; shape factors; enclosure theory. Thermal engineering design project. (Prerequisite change awaiting University approval)</td>
</tr>
<tr>
<td>305-362A,B</td>
<td>Mechanical Laboratory.</td>
<td>Experiments will be performed in four areas: 305-240 Thermodynamics, 305-315 Vibrations, 305-331 Fluid Mechanics I, and 305-346 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. (Prerequisite change awaiting University approval)</td>
</tr>
<tr>
<td>305-383A,B</td>
<td>Applied Electronics &amp; Instrumentation.</td>
<td>Discrete and integrated components, both analogue and digital. Characteristics</td>
</tr>
</tbody>
</table>
305-393B DESIGN II. 3(3-3-3) (Prerequisite: 305-292. Pre- or co-requisites: 305-314 and 306-260) 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. (Prerequisite change awaiting University approval) Professor T. Lee

305-403D,N HONOURS THESIS I. 6(0-6-12) (Prerequisite: Candidates must have completed courses in the Mechanical Engineering Program weighted at a minimum of 60 credits.) This course, together with course 305-404A,B, 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. TBA

305-404A,B HONOURS THESIS II. 2(0-3-3) (Corequisite: 305-403) This course is part of the same thesis project as course 305-403D,N. TBA

305-409B NUMERICAL METHODS IN MECH. ENG. 3(3-1-5) (Prerequisites: 189-261, 189-266 and 308-208) 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. Professors Cortelezzi


© 305-413A CONTROL SYSTEMS. 3(3-1-5) (Prerequisite: 305-412) Stability of Linear Systems. Controller design based on root-locus and frequency response methods. Tuning of PID controllers. State-space representation of dynamic systems. Concepts of controllability and observability. Design of state feedback control and state observer based on state-space and polynomial methods. Introduction to digital control. Staff


© 305-434A TURBOMACHINERY. 3(3-0-6) (Prerequisite: 305-331) A broad general treatment of energy transfer between a fluid and a rotor, velocity vector diagrams, and non-dimensional characteristics. Applications to hydraulic pumps and turbines. Two dimensional cascade theory leading to study of axial gas compressors and turbine stages. Three dimensional free and forced vortex configurations. Centrifugal compressors and radial inflow turbines. TBA

© 305-447A COMBUSTION. 3(3-0-6) (Prerequisite: 305-240) Equilibrium analysis of reacting systems, Hugoniot analysis, flame propagation mechanisms, introduction to chemical kinetics, models for laminar flame propagation, ignition, quenching, flammability limits, turbulent flames, flame instability mechanisms, detonations, solid and liquid combustion. Professors J. Lee and Frost

305-452A MATHEMATICAL METHODS IN ENGINEERING. 3(3-1-5) (Prerequisite: Candidates must have completed courses in the Mechanical Engineering Program weighted at 60 credits (minimum).) 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. Professor Bach

305-463D MECHANICAL ENGINEERING PROJECT. 6(1-3-5) (Prerequisite: 305-393) Team project work typically involving the design, fabrication, verification, and application of a mechanical device/system, or experimental facility. The project work is complemented with lectures in the Fall term on topics related to design and management of design projects. Emphasis is on the completion of a project of professional quality. Professors Mongrain, Radziszewski and Staff

© 305-471A INDUSTRIAL ENGINEERING. 3(3-1-5) Survey of industrial engineering covering the roles of people, technology and management. Includes: design of work systems; factory planning, location, layout, and services; human factors; productivity, process management, performance management, methods engineering; quality management; systems engineering. OVERSIGHTS OF OPERATIONS RESEARCH, AND PRODUCTION SYSTEMS. Present issues for industrial competitiveness. Professor Thomson

© 305-472A CASE STUDIES IN PROJECT MGMT. 3(3-0-6) (Prerequisite: U3 and permission of the instructor) Introduction to principles of the integrated multidisciplinary approach to project management in use by engineering firms. Working in teams students will have the opportunity to assess the real-life pressures in project management by working on an actual recent project and presenting their results to a professional evaluation panel. Staff

© 305-474B OPERATIONS RESEARCH. 3(3-0-6) (Prerequisites: 189-266 and 308-208) Introduction to the general mathematical programming problem in the context of engineering design; linear programming, queuing theory, Monte Carlo simulation. 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. (Course title change awaiting University approval) Dr. Mackenzie

305-494A HONOURS DESIGN PROJECT. 3(0-6-3) (Prerequisite: 305-292) (Restricted to Mechanical Engineering Honours students.) AN advanced design project course with emphasis on analytical solutions, performance prediction and validation, and planning for production. Professor T. Lee

© 305-495A DESIGN III. 3(0-6-3) (Prerequisite: 305-463) A design project course of two terms together with 305-496B. 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. Professor T. Lee
professor Lee 305-496B Design Iv, 3(0-6-3) (Prerequisite: 305-495) Continuation of 305-495A. The two together constitute a design project course of two terms. The two courses permit 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. Professor T. Lee

305-497A Value Engineering, 3(0-8-1) (Prerequisites: 305-393 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 personnel. Professor Thomson and Staff

305-500A, B Sel. Topics in Mechanical Eng, 3(3-0-6) A course to allow the introduction of new topics in Mechanical Engineering as needs arise, by regular and visiting staff.

305-501A, B Sel. Topics in Mechanical Eng, 3(3-0-6) A course to allow the introduction of new topics in Mechanical Engineering as needs arise, by regular and visiting staff.

305-522B Production Systems, 3(3-0-6) Characteristics of production systems. System boundaries, input-output, feedback time-lag effects, dynamics of production systems. Design for manufacturability. Process planning, process/machine tool selection, break-even analysis, CAPP. Production planning, scheduling and control of operations; quality management. Competitive strategies; FMS, CIM. Hands-on experience with production modeling and industrial simulation software. (Course description change awaiting University approval) Professor Kops


305-526C 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.


305-529C Discrete Manufacturing Systems, 3(3-0-6) (Prerequisite: Permission of the instructor) An overview of present day production machines and systems with special emphasis on automation, computer control and integration techniques. Material handling, automatic inspection, process monitoring, maintenance. Socio-economic and environmental issues. Laboratory experience with factory simulation.


305-531B Aerelasticity, 3(3-1-5) (Prerequisites: 305-419/319 or 305-315 and 305-533) Wing divergence using strip theory aerodynamics. Effect of aircraft flexibility on the control and stability. Flutter calculations for two dimensional wings with discussion of three dimensional effects. Some examples of aerelastic instability, and the relevant analysis of non-aeronautical problems. Professor Price

305-532B Aircraft Perform, Stability & Control, 3(3-1-5) (Prerequisites: 305-412, 305-533) Aircraft performance criteria such as range, endurance, rate of climb, maximum 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. Professor Price & Dmr. Asselin

305-533A Subsonic Aerodynamics, 3(3-1-5) (Prerequisite: 305-331) Kinematics: equations of motion; vorticity and circulation, conformal mapping and flow round simple bodies. Two dimensional flow round aerfoils. Three dimensional flows; high and low aspect-ratio wings; air screws. Wind tunnel interference. Similarity rules for subsonic irrotational flows. Professor Mateescu

305-534B Air Pollution Engineering, 3(3-0-6) (Prerequisites: 305-240, 305-331, 305-341 and 305-447 or consent of instructor.) Pollutants from power production and their effects on the environment. Mechanisms of pollutant formation in combustion. Photochemical pollutants and smog, atmospheric dispersion. Pollution generation from internal combustion engines and stationary power plants. Methods of pollution control (exhaust gas treatment, absorption, filtration, scrubbers, etc.). Professor J. Lee and Frost


305-538B Unsteady Aerodynamics, 3(3-0-6) (Prerequisite: 305-533) Fundamental equations of unsteady compressible flows in fixed or moving reference frames. Unsteady flows past bodies in translation and having oscillatory motions. Oscillations of cylindrical pipes or shells subjected to internal flows. Vortex theory of oscillating aerofoils in incompressible flows. Theodorsen’s method. Unsteady compressible flow past oscillating aerofoils.


305-540B Design: Modelling & 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. Mr. Yee


305-542B spacecraft Dynamics, 3(3-0-6) (Prerequisite: 305-220. Corequisite: 305-412 or 305-419) Review of central force motion; Hohmann and other coplanar transfers, rotation of the orbital plane, patched conic method. Orbital perturbations due to

305-543B spacecraft Dynamics, 3(3-0-6) (Prerequisite: 305-220. Corequisite: 305-412 or 305-419) 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. (Course description change awaiting University approval)

**Professor Krovi**


**Professor Lessard**


**Professors Nemes and Lessard**


**TBA**

305-554A **MICROPROCESSORS FOR MEC. SYS.** 3(2-3-4) (Prerequisites: 305-383 and 305-308) Digital logic and circuits - asynchronous and synchronous design. Microcontroller architectures, organization and programming - assembly and high-level. Analog/Digital/Hybrid Sensors and Actuators. Sensing and conditioning subsystems. Interfacing issues. Real time issues. Operator interfaces. Lab exercises on digital logic design, interfacing and control of peripherals with a final team project.

**Professor Krovi**

3(3-1-5)

305-555B **APPLIED PROCESS CONTROL.** 3(3-2-4) (Prerequisite: 305-554 or equivalent) Hardware and software aspects of real time computers in process control and related applications. Fundamental hardware. Digital and analogue transducers, actuators, filters, interfaces and processors. Fundamental software: Process assembler language and machine architecture, real time operating systems, process oriented subsystems, interrupts, drivers, service routines.

**Professor Buehler**

305-557B **MECHATRONIC DESIGN.** 3(3-1-5) (Prerequisites: 304-461, 305-383 and 305-412) 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.

**Professor Zsombor-Murray**


**Professor Ahmed**

305-562A **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.

**Professors J. Lee and Cortelezi**

305-565B **FLUID FLOW & HEAT TRANSFER EQUIP.** 3(3-1-5) (Prerequisites: 305-240, 305-341, 305-331 and 305-346) 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. (Course description change awaiting University approval)

**Professor Baliga**

305-572A **INTRODUCTION TO ROBOTICS.** 3(3-0-6) (Prerequisites: 189-266 and 305-220 or permission of the instructor). Not open to students who have taken 305-573.) Manipulator hardware structure, planning and control. Rigid-body three-dimensional statics, kinematics and dynamics, Direct and inverse kinematics and dynamics. Trajectory planning. Manipulator control. In-depth study of serial manipulators.

**Professor Angeles**

305-573B **MECHANICS OF ROBOTIC SYSTEMS.** 3(3-0-6) (Prerequisite: 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, multifingered hand grasping and manipulation, robot compliant and constrained motion. Obstacle avoidance.

**Professor Angeles**


**Professor Zsombor-Murray**

305-577A **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.

**Professor Angeles**

305-581A **NONLINEAR DYNAMICS AND CHAOS.** 3(3-1-5) (Prerequisite: 305-315 or 305-419/319) Approximate solutions to nonlinear dynamical systems: Lindstedt's, multiple-scale and averaging techniques; centre manifold, normal form theorem; applications. Transcritical, saddle-node, pitchfork, Hopf, period-doubling and homoclinic bifurcations; fractal dimensions, Lyapunov exponents and chaos. Applications to two-well potential oscillator, van der Pol, Lorenz, fluid elastic systems.
4.7 Department of Mining and Metallurgical Engineering

Wong Building, Room 2160
3610 University Street
Montreal, QC H3A 2B2
http://minmet.mcgill.ca

Mining — Telephone: (514) 398-2215 Fax: (514) 398-7099
Metallurgical — Telephone: (514) 398-1040 Fax: (514) 398-4492

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)
John E. Gruzleski; B.Sc., M.Sc.(Qu.), Ph.D.(Tor.), C.Eng.(U.K.
Reg.) (George Boyd Webster Professor of Mining Engineering)
(Henry Birks Professor of Metallurgy)

Associate Professors
Mainou Hasan; B.Eng.(Dhaka), M.Sc.(Dhahran), Ph.D.(McG.), Eng.
Janusz A. Kozinski; B.A., M.Eng., D.Sc.(Kراكow)
André Laplante; B.A.Sc., M.A.Sc.(Montr.), Ph.D.(Tor.), Eng.
Hani S. Mitri; B.Sc.(Cairo), M.Eng., Ph.D.(McMaster), Eng.
Frank Mucciaridi; B.Eng., M.Eng., Ph.D.(McG.), Eng.
Jacques Ouellet; B.A.Sc.(Laval), M.A.Sc., Ph.D.(Montr.)
Steve Yue; B.Sc., Ph.D.(Leeds)

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

Adjunct Professors
William Caley; Roussos Dimitrakopoulos; Bryn Harris;
Ahmad Hemami; Bibhu Mohanty; Martin Pugh; John H. Root;
Malcolm J. Scoble; P.Eng.; Raymond Thom, Eng.;
William T. Thompson; Viwek Vaidya, Eng.; Albert E. Wraith

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

The Department of Mining and Metallurgical Engineering offers programs leading to the Bachelor of Engineering degree in Mining Engineering or Metallurgical Engineering. The curriculum is dynamic and evolves along with new technology in both the mining and metallurgical industries. 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 metallurgical side there is a full range of laboratory facilities for mineral processing, hydrometallurgy and high temperature extractive process metallurgy as well as excellent materials characterization and processing facilities. In mining engineering the Department has rock engineering laboratories to test the mechanical properties of both rock and backfill materials and computer-aided mine design facilities. The Department houses laboratories for two McGill Research Centres: the McGill Metals Processing Centre (MMPC) and the Canadian Centre for Automation and Robotics in Mining (CCARM), which focus on R & D and high technology applications for the minerals, metals and materials industries at large.

Metallurgical Engineering (CO-OP), The Metallurgical 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/materitals engineering. Students take core courses covering a complete range of the industry, from metal extraction to processing, fabrication and applications. 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 Metallurgical 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 École Polytechnique in Montreal, and includes formal industrial work periods. Students registered at McGill are required to take a series of technical mining courses from École 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 $3,000; 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 METALLURGICAL ENGINEERING – CO-OP PROGRAM

REQUIRED COURSES

<table>
<thead>
<tr>
<th>COURSE CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Non-Departmental Courses</strong></td>
</tr>
<tr>
<td>180-233B Selected Topics in Physical Chemistry</td>
</tr>
<tr>
<td>189-260A Intermediate Calculus</td>
</tr>
<tr>
<td>189-261A Differential Equations</td>
</tr>
<tr>
<td>189-265C Advanced Calculus</td>
</tr>
<tr>
<td>303-205A Statics</td>
</tr>
<tr>
<td>303-207A Solid Mechanics</td>
</tr>
<tr>
<td>308-208A Computers in Engineering</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Departmental Courses</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>306-206B Mathematical Applications</td>
</tr>
<tr>
<td>306-212B Engineering Thermodynamics</td>
</tr>
<tr>
<td>306-221A Engineering Professional Practice</td>
</tr>
<tr>
<td>306-250A Introduction to Extraction Metallurgy</td>
</tr>
<tr>
<td>306-260B Materials Science and Engineering</td>
</tr>
<tr>
<td>306-280T Industrial Training I</td>
</tr>
<tr>
<td>306-310AB Engineering Economy</td>
</tr>
<tr>
<td>306-311B Modelling and Automatic Control</td>
</tr>
<tr>
<td>306-317C Materials Characterization</td>
</tr>
</tbody>
</table>
COMPLEMENTARY COURSES

Technical Courses 6

Two courses may be taken; one of these can be chosen from the Faculty list (see section 4.1.1).

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

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>302-481A</td>
<td>Polymer Engineering</td>
<td>3</td>
</tr>
<tr>
<td>306-361B</td>
<td>Liquid State Processing of Materials</td>
<td>3</td>
</tr>
<tr>
<td>306-367B</td>
<td>Electronic Properties of Materials</td>
<td>3</td>
</tr>
<tr>
<td>306-451A</td>
<td>Environmental Controls</td>
<td>3</td>
</tr>
<tr>
<td>306-457B</td>
<td>Light Metals Extraction</td>
<td>3</td>
</tr>
<tr>
<td>306-515A</td>
<td>Advanced Metallurgical and Materials Thermodynamics</td>
<td>3</td>
</tr>
<tr>
<td>306-544A</td>
<td>Mineral Processing Systems I</td>
<td>3</td>
</tr>
<tr>
<td>306-545B</td>
<td>Mineral Processing Systems II</td>
<td>3</td>
</tr>
<tr>
<td>306-551B</td>
<td>Electrochemical Processing</td>
<td>3</td>
</tr>
<tr>
<td>306-555A</td>
<td>Thermal Remediation of Wastes</td>
<td>3</td>
</tr>
<tr>
<td>306-560B</td>
<td>Joining Processes</td>
<td>3</td>
</tr>
<tr>
<td>306-561A</td>
<td>Materials Design and Selection</td>
<td>3</td>
</tr>
<tr>
<td>306-563A</td>
<td>Hot Deformation of Metals</td>
<td>3</td>
</tr>
<tr>
<td>306-564B</td>
<td>X-ray Diffraction Analysis of Materials</td>
<td>3</td>
</tr>
<tr>
<td>306-566B</td>
<td>Texture, Structure and Properties of Polycrystalline Materials</td>
<td>3</td>
</tr>
<tr>
<td>306-567B</td>
<td>Aluminum Casting Alloys</td>
<td>3</td>
</tr>
<tr>
<td>306-569B</td>
<td>Electron Beam Analysis of Materials</td>
<td>3</td>
</tr>
</tbody>
</table>

Social Sciences and Humanities Courses 6

(see section 3.4 on page 231)

TOTAL 113

Advanced credit is given for 189-260 Intermediate Calculus upon successful completion of a placement test (see section 2.3).

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

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>186-221A</td>
<td>General Geology</td>
<td>3</td>
</tr>
<tr>
<td>186-225A</td>
<td>Properties of Minerals</td>
<td>1</td>
</tr>
<tr>
<td>189-260A,B</td>
<td>Intermediate Calculus</td>
<td>3</td>
</tr>
<tr>
<td>189-261A,B</td>
<td>Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>189-265C</td>
<td>Advanced Calculus</td>
<td>3</td>
</tr>
<tr>
<td>303-205A,B</td>
<td>Statics</td>
<td>3</td>
</tr>
<tr>
<td>303-207A,B</td>
<td>Solid Mechanics</td>
<td>4</td>
</tr>
<tr>
<td>305-290A</td>
<td>Graphics</td>
<td>3</td>
</tr>
<tr>
<td>308-208A,B</td>
<td>Computers in Engineering</td>
<td>3</td>
</tr>
</tbody>
</table>

COMPLEMENTARY COURSES

Technical Courses 6

Two courses selected from those listed below or 6 credits of any other approved technical course(s).

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

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>306-320A</td>
<td>CAO et informatique pour les mines</td>
<td>3</td>
</tr>
<tr>
<td>306-321B</td>
<td>Mécanique des roches et contrôle des terrains</td>
<td>3</td>
</tr>
<tr>
<td>309-326A</td>
<td>Recherche opérationnelle minière</td>
<td>3</td>
</tr>
<tr>
<td>309-328C or T</td>
<td>Environnement et gestion des rejets miniers</td>
<td>3</td>
</tr>
<tr>
<td>309-329A</td>
<td>Géologie minière</td>
<td>2</td>
</tr>
<tr>
<td>309-330A</td>
<td>Géotechnique minière</td>
<td>3</td>
</tr>
<tr>
<td>309-421C or T</td>
<td>Exploitation en souterrain</td>
<td>3</td>
</tr>
<tr>
<td>309-422A</td>
<td>Ventilation minière et hygiène du travail</td>
<td>3</td>
</tr>
</tbody>
</table>

TOTAL 119

Advanced credit is given for 189-260 Intermediate Calculus upon successful completion of a placement test (see section 2.3).

A fee of $300 is assessed by the University for each Industrial Work Period course.

Student Advising

Students entering the Mining or Metallurgical Engineering programs must plan their schedule of studies in consultation with one of the departmental advisors: Professors Harris and Kozinski (Metallurgy) or Mr. J. Mossop (Mining).
COURSES OFFERED BY THE DEPARTMENT

Denotes courses not offered in 2001-02

Complementary Courses

Courses offered by the Department have been numbered to conform with the following classification system. The first three digits (i.e. 306) represent the departmental code. The next 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

DEPARTMENTAL METALLURGY COURSES

Courses associated with the CO-OP program in Mining Engineering are listed separately following this section.


DEPARTMENTAL MINING AND METALLURGICAL ENGINEERING COURSES

306-204A MELTING AND CASTING. 3(2-3-4) Introduction to melting and casting processes. Constitutional undercooling, solidification microstructures, ingot structure.


306-211B MODELLING AND AUTOMATIC CONTROL. 3(2-3-4) (Prerequisite: 306-208A,B) Mass and energy conservation laws.


306-250A INTRODUCTION TO EXTRACTION METALLURGY. 3(2-3-4) Raw materials, processes and products of metallurgical operations. Mineral processing; comminution including size classification, separation of minerals with emphasis of flotation, waste disposal. Extractive metallurgy: roasting, smelting, refining, hydrometallurgy, environmental protection.

306-260A,B 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.

306-280T INDUSTRIAL TRAINING I. 2 Four-month work period in industry. Work term report required upon completion.

306-311B MODELLING AND AUTOMATIC CONTROL. 3(2-3-4) (Prerequisite: 306-310B) Bulk, surface and microanalytical techniques for materials characterization. Bulk analysis: spectrophotometry using UV, visible, flame and atomic absorption, x-ray diffraction and x-ray fluorescence. Surface and microanalysis: infrared spectroscopy, scanning and transmission electron microscopy, Auger electron and x-ray photoelectron spectroscopy.

306-340C PROCESS ENGINEERING LABORATORY. 2(0-3-3) A series of laboratory exercises which cover various transfer phenomena encountered in metallurgical and materials processing including mass transfer in aqueous and high temperature systems, laminar and turbulent flow characteristics, particle and bubble motion in liquids, mixing and settling.


306-360A PHASE TRANSFORMATIONS IN SOLIDS. 3(2-3-4) (Prerequisites: 306-212B and 306-260A,B) Free energy (equilibrium) and kinetic (nonequilibrium) considerations, phase diagrams and TTT diagrams, solid state diffusion, diffusional (nucleation and growth) and shear (martensitic) transformations.

306-361B LIQUID STATE PROCESSING OF MATERIALS. 3(2-3-4) (Prerequisites: 306-260A,B) Liquid-solid phase transformation in material processing. Topics covered include: casting techniques, nucleation and grain refining, freezing of pure materials, alloy freezing, solute redistribution, segregation, constitutional undercooling, solidification microstructures, ingot structures, gases in liquid metals, liquid metal cleansing, modification of phase morphology.

306-380B INDUSTRIAL TRAINING II. 2 Four-month work period in industry. Work term report required upon completion. Professor Finch

306-410A,B 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 at the end and formal presentation will be made on the research topic. Professor Guthrie


306-442A MODELLING IN MINERAL PROCESSING. 3(2-3-4) (Prerequisite: 306-341B) Basic kinetic modelling: perfect mixers, plug-flow, zero and first-order kinetics, residence time distributions. Grinding: 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. Professor Laplante


306-456B STEELMAKING & STEEL PROCESSING. 3(2-2-5) (Prerequisites: 306-360A, 306-455B) 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 also discussed in terms of process/environment and productivity. "Downstream" topics will include cold rolling, batch and continuous annealing, and coating operations. Professors Guthrie and Jonas © 306-457A LIGHT METALS EXTRACTION. 3(2-0-7) (Prerequisites: 306-350B, 306-352A) Physiochemical, kinetic and economic aspects of light metals extraction, refining and finishing for marketing. Alumina production, aluminium electrolysis, carbon technology, alloying and casting, magnesium smelting and electrolysis, strontium, lithium, sodium extraction. Professor Harris

306-463B DEFORMATION PROCESSING OF METALS. 3(3-3-3) (Prerequisite: 306-362A) Basic plasticity theory (yield criteria, plastic stress/strain relationships, etc.); friction and lubrication; analysis of simple forming operations, e.g. rolling of flat products. Workability; concept and measurement; effect of process variables, material properties and microstructure. Effect of hot and cold processing on microstructure and properties technology and equipment; computer-aided design of deformation processing. Professor Jonas


306-480T INDUSTRIAL TRAINING III. (2) Four-month work period in industry. Work term report due upon completion of 306-481A (see details listed under 306-481A). Professor Finch

306-481A INDUSTRIAL TRAINING IV. (2) Four-month work period in industry. This course is intended to be taken immediately after 306-480T at the same work location. One work term report and one seminar is required upon completion of this course. If 306-480T and 306-481A are in different work locations, the work term report should be in two parts following the co-op handbook guidelines. Professor Finch © 306-515A ADVANCED METALLURGICAL & MATERIALS THERMODYNAMICS. 3(2-2-5) (Prerequisite: 306-212B) Computational thermodynamics including phase diagram estimation; Energy minimization, solution modelling are considered in view of the Facility of Chemical Thermodynamics (F*A*C*T) computer database. Students undertake projects developed in consultation with the instructor and prepare verbal and written reports.

Metallurgical Staff • 306-544A MINERAL PROCESSING SYSTEMS I. 3(2-3-4) (Prerequisite: 306-341B) 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. Professor Finch and Dr. Rao

© 306-545B MINERAL PROCESSING SYSTEMS II. 3(4-2-3) (Prerequisite: 306-341B) 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. Professor Laplante • 306-551B ELECTROCHEMICAL PROCESSING. 3(3-2-4) (Prerequisite: 306-352B) 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, electrolysis and electrochemical sensors.

Professor Demopoulos


Professor Kozinski

- 306-560B JOINING PROCESSES. 3(3-3-3) (Prerequisite: 306-361B or equivalent) Physics of joining; interfacial requirements; energy sources, chemical, mechanical and electrical; homogeneous hot-joining, arc-, mig-, tig-, gas-, thermit- and Plasma welding; Autogenous 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.

Mr. Vaidya

- 306-561A MATERIALS DESIGN AND SELECTION. 3(0-4-5) (Prerequisite: 306-362A 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.

Professors Drew and Gruzleski

- 306-563A HOT DEFORMATION OF METALS. 3(2-2-5) (Prerequisite: 306-463B and 306-360A) 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.

Professor Yue

- 306-564B X-RAY DIFFRACTION ANALYSIS OF MATERIALS. 3(2-3-4) (Prerequisite: 306-317A) 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.

Professor Szpunar

- 306-565B TEXTURE, STRUCTURE & PROPERTIES OF POLYCRYSTALLINE MATERIALS. 3(2-3-4) (Prerequisite: 306-317A) 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.

Professor Szpunar

- 306-567B ALUMINUM CASTING ALLOYS. 3(3-0-6) (Prerequisite: 306-361B or equivalent) The family of aluminum foundry alloys; alloy systems, intermetallic phases and their formation, heat treatment processes, mechanical and physical properties of aluminum casting alloys, foundry properties, eutectic modification, porosity formation, gassing and degassing, refinement of hypereutectic alloys, grain refinement, filtration; non destructive control of microstructure.

Professor Gruzleski

- 306-569B ELECTRON BEAM ANALYSIS OF MATERIALS. 3(2-3-4) (Prerequisite: 306-317A) Emphasis on operation of scanning and transmission electron microscopes. Topics covered are electron/specimen interactions, hardware description; image contrast description; quantitative and qualitative (ZAF) x-ray analysis; electron diffraction pattern analysis.

Professor Yue and Ms. Campbell

DEPARTMENTAL MINING COURSES


Mr. Mossop

306-203C MINE SURVEYING. 2 (Prerequisite: 306-200 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. Deformation and displacement measurements.

Dr. Momayez and Mr. Vachon


Professors Ouettel and Hassani

306-290T INDUSTRIAL WORK PERIOD I. 2 (Prerequisites: 306-200 or 306-203) 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.

Mr. Vachon

306-291T INDUSTRIAL WORK PERIOD II. 2 (Prerequisite: 306-290) 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.

Mr. Vachon

306-310A,B 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&D, ongoing as well as new investment opportunities.

Professors Bilodeau and Laplante

306-320A,B,C 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.

Professor Hassani


Professor Ouellet

306-323B ROCK AND SOIL MASS CHARACTERIZATION. 3(3-3-3) (Prerequisites: 186-221 and 306-200) 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. Insitu stresses and their measurement. Rock mass quality and classification systems.

Professor Hassani
306-324B ELECTROTECHNOLOGY FOR MINING, METALLURGICAL & MATERIALS ENGINEERS. 3(3-3-3) (Prerequisites: 189-261 and 189-265) AC theory including vector and complex number representation of sinusoidal currents, voltages and impedances. Effect of frequency on LCR circuit outputs. Logic circuits including two-state logic and logic components, logic ports and toggles, Boolean algebra, and complex circuits. Microprocessors including organization logic, programming, and microcomputers. Data acquisition including sensors, noise, A/D and D/A converters, and programming. Operational amplifiers. Applications to systems control.

Professor Bilodeau

306-325A MINERAL INDUSTRY ECONOMICS. 3(3-1-5) (Prerequisite: 306-310) Geographical distribution of mineral resources. Production, consumption and prices of minerals. Market structure of selected minerals. Economic evaluation aspects: grade-tennage considerations; capital and operating cost estimation; assessment of mineral conditions; estimation of revenue; taxation; sensitivity and risk analyses; economic optimization of mine development and extraction.

Professor Mitri


Professor Mitri


Professor Mitri

306-392B INDUSTRIAL WORK PERIOD III. 2 (Prerequisite: 75 credits including 306-291) 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.

Mr. Vachon


Professor Ouellet

306-420B FEASIBILITY STUDY. 3(1-2-6) (Prerequisites: 306-419, 306-426 and 309-421) 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.

Mr. Mossop and Professor Bilodeau

306-426C OR T DEVELOPMENT AND SERVICES. 3(3-3-3) (Prerequisite: 306-324 and 306-333) Selection and design of the facilities required to start production at both surface and underground mines, based on design criteria dictated by mining plans, geography, geology and government regulations. Scheduling of development and construction. Staffing and health and safety considerations during development, construction and operations.

Mr. Mossop

306-484A,B,T MINING PROJECT. 3(0-0-9) (Corequisites: 306-419, 306-426, 309-328 and 309-421) 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.

Mr. Mossop

306-494A,B,T INDUSTRIAL WORK PERIOD IV. 2(0-0-6) (Prerequisites: 306-419, 306-426, 309-328 and 309-421) A four-month industrial work period after which the student must submit a report.

Mr. Vachon

© 306-520B 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.

Professor Hassan

© 306-521C OR T STABILITY OF UNDERGROUND OPENINGS. 3(3-3-3) (Prerequisite: permission of instructor) The properties of rock masses and stability classification. The analysis, review of optimization methods. Mining system modelling applied to rock cutting, materials transport, and bunkerage, pitch, yaw and roll steering of mining machines. Control and robotics: digitization, discrete systems, sensors, actuators and real time algorithms. Data communication in mines. Simulation exercises.

Professor Mitri

COURSES OFFERED BY ÉCOLE POLYTECHNIQUE

309-320A CAO ET INFORMA TIQUE POUR LES MINES. 3(2-3-4) (Prerequisite: 306-200 and 308-208) Présentation de techniques informatisées et de logiciels permettant d'apprécier l'informatique dans le cadre des diverses opérations reliées à l'exploitation des mines. Utilisation de logiciels de support: chiffrer 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/analogue. Notions de géométrie descriptive appliquées à des problèmes miniers.

Professor Cortésy


Professor Aubertin

linéaire, théorie des graphes. Modèles de capacité: théorie des files d'attente, simulation, silos et stockage. Modèles de mélange.

**Professor Gamache**


**Professor Chapuis**

309-328C OR T Environnement et gestion des rejets miniers. 3(3-3-3) (Prérequis: 306-200 et 306-291) Effets du milieu de travail sur l'homme (hygiène du travail): législation; contraintes thermiques, 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.

**Professors Aubertin and Simon**


### 4.8 School of Urban Planning

Macdonald-Harrington Building 815 Sherbrooke Street West Montreal, QC H3A 2K6 Telephone: (514) 398-4075 Fax: (514) 398-8376 http://www.mcgill.ca/urbanplanning

**Director**

David F. Brown

**Emeritus Professor**

Jeanne M. Wolfe; B.Sc.(Lond.), M.Sc.(W.Ont.), M.A.(McG.)

**Post-Retirement**

D. Farley

**Professor**

Jane M. Glenn; B.A., LL.B.(Qu.), D. en Droit(Stras.)

**Associate Professors**

David F. Brown; B.A.(Bishop's), M.U.P.(McG.), Ph.D.(Sheffield)

Raphaël Fischer; B.Eng.(Eindhoven), M.Sc., M.C.P.(MIT), Ph.D.(U.C. Berk.)

**Associate Member**

Gordon O. Ewing; M.A.(Glas.), M.A., Ph.D.(McG.)

**Instructor**

Pierre Gauthier; B.Arch.(Montr.), M.Arch.(Laval)

**Adjunct Professors**

David Farley; B.Arch.(McG.), M.Arch., Master of City Planning(Harvard)

Mario Polèse; B.A.(CUNY), M.A., Ph.D.(Penn.)

**Guest Lecturers**

Cameron Charlebois, Luc Danielse, Marc Denhez, Andrew Hoffmann, Peter Jacobs, Brenda Lee, Mohammed Qadeer, Alain Trudeau, Ray Tomalty, Martin Wexler

Modern urban planning developed into a profession in the early decades of the twentieth century, largely as a response to the appalling sanitary, social and economic conditions of rapidly developing industrial cities. Initially the disciplines of architecture, civil engineering and public health provided the nucleus of concerned professionals; beautification schemes and infrastructure works marked the early stages of public intervention in the nineteenth century. Architects, engineers and public health specialists were joined by economists, sociologists, lawyers and geographers as the complexities of the city’s problems came to be more fully understood and public pressure mounted for their solution. Contemporary urban and regional planning techniques for survey, analysis, design and implementation developed from an interdisciplinary synthesis of these various fields.

Today, urban planning can be described as the collective management of urban development. It is concerned with the welfare of communities, control of the use of land, design of the built environment, including transportation and communication networks, and protection and enhancement of the natural environment. It is at once a technical and a political process which brings together actors from the public, private and community spheres. Planners participate in that process in a variety of ways, as designers and analysts, advocates and mediators.

McGill University was the first institution in Canada to offer a full-time planning program. An inter-disciplinary program was established in 1947, in which students combined a master’s degree in Urban Planning with one in a related field. An autonomous program was established in 1972. It became the School of Urban Planning in 1976.

Students come to the School from diverse backgrounds, the physical sciences, the traditional professions, such as architecture and engineering, and the social sciences. Alumni of the School 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 Interruralist Group “Urbanization and Development”, a consortium recognized by CIAD 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
FACULTY OF ENGINEERING

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 Faculty of Graduate Studies Calendar (available on the web at http://www.aro.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

409-501A, B PRINCIPLES AND PRACTICE I. (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.

Staff and Visitors

409-505B GEOGRAPHIC INFORMATION SYSTEMS. (3) An introduction to fundamental geographic information system (GIS) concepts and a range of GIS applications in urban and regional planning.

Professor Brown

UNDERGRADUATE COURSES OFFERED JOINTLY BY THE SCHOOL AND OTHER ACADEMIC UNITS

183-351A APPLIED QUANTITATIVE METHODS IN GEOGRAPHY. (3) Survey design; uni- and multi-dimensional scaling; cost-benefit analysis and matrix methods of plan evaluation; multiple regression and correlation; logic models; gravity models; population projection.

Professor Fischler

301-550B URBAN PLANNING I. (2) Theory and practice. An examination of different basic approaches to urban planning with special reference to Quebec.

TBA

301-551A URBAN PLANNING II. (2) Urban Design and Project Feasibility. Theory and practice. The course considers the urban and real-estate development process, with a focus on economic and political constraints. It introduces students to techniques in urban design, zoning, and financial analysis.

Professor Ewing

303-433B URBAN PLANNING I. (3) 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.

409-600A LAND USE PLANNING LAW. (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.

Professor J.M. Glenn

GRADUATE 600-LEVEL COURSES

Generally, undergraduate students are not permitted to enroll in graduate 600-level courses. However, in exceptional circumstances, the Faculty of Graduate Studies and Research 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 Faculty of Graduate Studies and Research Calendar, is as follows:

409-604A Planning Projects III
409-605A,B Graduate Seminar
409-606B Supervised Research Seminar
409-607D Reading Course
409-609A Planning Graphics
409-612A History and Theory of Planning
409-614B Urban Environmental Planning
409-616A,B Selected Topics I
409-617A,B Selected Topics II
409-618A,B Selected Topics III
409-619B Transport and Land Development
409-620A Computer Applications in Planning
409-621B Theories of Urban Form
409-622A Planning Projects I
409-623B Planning Projects II
409-625A,B Principles And Practice of Planning II
409-626A,B Principles And Practice of Planning III
409-628A,B,C Practical Experience
409-630A,B,C Supervised Research Project I
409-631A,B,C Supervised Research Project II
409-632A,B,C Supervised Research Project III

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 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.

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 Facilities 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 374 of the Science section.

A Chemical Engineering student may complete the Biotechnology Minor by taking 177-200A, 177-201B, 177-202B, 528-211A, 202-505B, plus one course from the list of additional courses not including 306-310. The Department of Chemical Engineering permits students in the Minor program to complete 202-505B 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: 180-212, 233 and 234 (or CEGEP equivalent).
2. At least 15 credits from the following list, two of which must be laboratory courses (* indicates lab). Note that 180-212 is a prerequisite for most of the courses listed below. If students take 180-222* instead of 180-234, 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
180-281A, Inorganic Chemistry I
180-371A,B Inorganic Chemistry Laboratory*
180-381A Chemistry of Transition Elements
180-591B Advanced Coordination Chemistry

Analytical Chemistry
180-257D Introductory Analytical Chemistry*
or 180-277D Classical Methods of Analysis*
180-307A Environmental Analysis
180-367A Instrumental Analysis I
180-377B Instrumental Analysis II

Organic Chemistry
180-302A Introductory Organic Chemistry III
180-352B Structural Organic Chemistry
180-362A,B Advanced Organic Laboratory*
180-382B Organic Chemistry of Natural Products
180-402B Advanced Bio-organic Chemistry

Physical Chemistry
180-345A Molecular Properties & Structure I
180-355B Molecular Properties & Structure II
180-363A,B Physical Chemistry Laboratory*
180-393A,B Advanced Physical Chemistry Laboratory*
180-455A 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, 308-208 Computers in Engineering, and other courses in the core of the various Engineering programs are listed in section . Descriptions of other Computer Science courses can be found on page 381 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 12extra credits from Computer Science (308-) courses beyond those needed for the B.Eng. degree. Students should consult their departments about the use of complementary credits and their total number of credits that can be double counted.

Students should see the receptionist in 318 McConnell to pick up the appropriate forms, 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.

Minor in Computer Science for Engineering Students
(Program change awaiting University approval)
The program must consist of 24 credits, from courses passed with a grade of C or better, as follows:

Required Course (3 credits)
308-302 (3) Programming Languages and Paradigms

Complementary Courses (21 credits)
3 credits – one of the following courses:
308-203A,B (3) Introduction to Computing II
308-250A,B (3) Introduction to Computer Science
308-251A (3) Data Structures and Algorithms
3 credits – one of the following courses:
308-206A,B (3) Intro to Software Systems
304-221A,B (3) Introduction to Computer Engineering I
3 credits – one of the following courses:
308-273A,B (3) Introduction to Computer Systems
304-222A,B (3) Introduction to Computer Engineering II
3 credits – one of the following courses:
308-350A (3) Numerical Computing
9 credits chosen from Computer Science courses numbered 305 or higher, or any course making considerable use of computing that is approved by 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 308-202 Introduction to Computing I, and 308-208 Computers in Engineering (compulsory for some Engineering students) do not form part of the Minor.
B. 308-202 is a prerequisite for 308-203. Students with a 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 (514) 398-6446, Room 484, Macdonald Engineering Building.

Prerequisites:
303-208A Civil Engineering Systems Analysis or an equivalent course in Operations Research
303-302B Probabilistic Systems or equivalent
306-310A,B Engineering Economy
308-208A,B Computers in Engineering or equivalent
Faculté de génie

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:
   280-211 (3) Introduction to Financial Accounting
   280-341 (3) Finance I
   279-284 (3) Intro to Labour-Management Relations
   300-220A (5) Law for Architects and Engineers
   and one of:
   303-324B (3) Construction Project Management
   305-472A (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:
      301-446A (2) Mechanical Services in Buildings
      301-447A (2) Electrical Services
      301-451B (2) Building Regulations and Safety
      303-492A (2) Structures
   or
   b) 3 credits - One of the following relating to Heavy Construction:
      306-322B (3) Rock Fragmentation
      306-333B (3) Materials Handling

3. Other Construction-Related Complementaries: 6 credits
   Any two of the following:
   270-462 (3) Management of New Enterprises
   274-445 (3) Real Estate Finance
   303-446A (3) Construction Engineering
   303-527A (3) Renovation & Preservation of Infrastructure
   303-586A (3) Earthwork Engineering
   304-461A (3) Electric Machinery
   306-520A (3) Stability of Rock Slopes
   306-521A (3) Stability of Underground Openings
   309-321B (3) Mecanique des roches et controle des pressions de terrains
   336-411A (3) Off-Road Power Machinery

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 complementaries. In addition, it is presumed that all Engineering students will have a sufficient background in statistics. Engineering Economy, 306-310, does not form part of this minor. For more information see the Department of Economics, Leacock Room 443.

Required Courses (9 credits)
154-230D* Microeconomic Theory
154-209A,B** Macroeconomic Analysis and Applications

Complementary Courses (9 credits) from:
154-225A Economics of the Environment
154-302D Money and Banking
154-303D Canadian Economic Policy
154-305A Industrial Organization
154-306D Labour Economics and Institutions
154-308B Public Policies Toward Business
154-311A United States Economic Development
154-313D Economic Development
154-316A,B The Underground Economy
154-321A The Quebec Economy
154-326A Ecological Economics
154-329A The Economics of Confederation
154-330D Macroeconomic Theory
154-331A Economic Development: Russia and the USSR
154-332A Comparative Economic Systems
154-333B Topics in Comparative Economic Systems
154-335A The Japanese Economy
154-337A,B Introductory Econometrics I
154-344A The International Economy, 1830 - 1914
154-345B The International Economy Since 1914
154-347B Economics of Climate Change
154-404A,B Transportation
154-405A,B Natural Resource Economics
154-406A,B Topics in Economic Policy
154-408D Public Sector Economics
154-411A,B Economic Development: A World Area
154-416A,B Topics in Economic Development II
154-420A,B Topics in Economic Theory
154-423D International Trade and Finance
154-436B Labour Economics
154-434A,B Current Economic Problems
154-440A,B Health Economics
154-447A Economics of Information and Uncertainty
154-467D Econometrics - Honours
154-525B Project Analysis
154-534B The Pensions Crisis
154-546A Game Theory

Mining Engineering students will be permitted to include Mineral Economics (306-526A,B) among these 18 credits.

* Students may, with consent of instructor, take 154-250D Introduction to Economic Theory - Honours, in place of 154-230D.

** This requirement is waived for students who choose 154-330D from the list of complementaries. Students may not take both 154-209A,B and 154-330D.

5.7 Environmental Engineering Minor
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 2 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 2 credits counted toward the Minor.

d) in the case of Agricultural and Biosystems Engineering students, select all courses for the Minor program in the student's principal program, other than those taken as part of the Humanities and impact course requirements.

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)
302-230 Environmental Aspects of Technology
or 303-225 Environmental Engineering
or 306-308 Social Impact of Technology
or equivalent environmental impact course

A. ENGINEERING COURSES (21 credits)

Agricultural Engineering (Macdonald Campus)
336-217 Hydrology and Drainage
(Not open to students who have passed 303-323)
336-322 Agro-food Waste Management
336-416 Engineering for Land Development
336-518 Pollution Control for Agriculture

Civil Engineering and Applied Mechanics
303-225 Environmental Engineering
(Not part of the Minor for Civil Engineering Students)
303-323 Hydrology and Water Resources
(Not open to students who have passed 336-217)
303-421 Municipal Systems
303-430 Water Treatment and Pollution Control
(Not open to students who have passed 302-471)
303-451 Geoenvironmental Engineering
303-526 Solid Waste Management
303-550 Water Resources Management
303-553 Stream Pollution and Control
303-572 Advanced Hydraulics
303-574 Fluid Mechanics of Water Pollution
303-575 Fluid Mechanics of Air Pollution
303-577 River Engineering
303-585 Groundwater Hydrology

Mechanical Engineering
305-343 Energy Conversion
305-434 Turbomachinery
305-447 Combustion
305-525 Intro. to Nuclear Engineering
305-526 Manufacturing and the Environment
305-534 Air Pollution Engineering

Mining and Metallurgical Engineering
306-412 Corrosion and Degradation
306-451 Environmental Controls
306-555 Thermal Remediation of Wastes
309-327 Hydrogéologie appliquée
309-328 Environnement et gestion des rejets miniers
309-422 Ventilation et hygiène du travail

B. NON-ENGINEERING COURSES (6 credits)

Agricultural Sciences (Macdonald Campus)
338-510 Agricultural Micrometeorology
344-200 Biology of Organisms I
344-201 Biology of Organisms II
344-205 Principles of Ecology
349-315 Science of Inland Waters
350-380 Food Systems and the Environment
362-230 The Microbial World
(Not open to students who have passed 302-370)
362-331 Microbial Ecology
(Not open to students who have passed 302-370)
362-341 Mechanisms of Pathogenicity
372-210 Principles of Soil Science (not part of the Minor for Agricultural Engineering Students)
372-331 Soil Physics
374-420 Environmental Issues in Forestry

375-333 Physical and Biological Aspects of Pollution
375-375 Issues in Environmental Sciences
375-415 Conservation Law
375-437 Assessing Environmental Impact
(Not open to students who have passed 302-430)

Anthropology
151-206 Environment and Culture

Atmospheric and Oceanic Sciences
195-210 Introduction to Atmospheric Science (Not open to students who have passed 183-321)
195-220 Introduction to Oceanic Sciences

Biology
177-205 Biology of Organisms
177-208 Introduction to Ecology
177-432 Limnology
177-470 Lake Management

Chemistry
180-307 Environmental Analysis

Earth and Planetary Sciences
186-243 Environmental Geology (Not open to students who have passed or who will take 186-221)
186-549 Groundwater Hydrology

Economics
154-225 Economics of the Environment
154-326 Ecological Economics
154-347 Economics of Climate Change

Geography
183-200 Geographical Perspectives on World Environmental Problems
183-201 Geographic Information Systems I
183-203 An Introduction to Environmental Studies
183-205 Global Change: Past, Present and Future
183-302 Environmental Analysis and Management
183-308 Air Photo Interpretation and Remote Sensing
183-321 Climatic Environments
(Not open to students who have passed 195-210)
183-404 Environmental Management for Parks and Protected Areas

Law
389-580 Environment and the Law

Microbiology and Immunology
528-211 Biology of Microorganisms

Religious Studies (Macdonald Campus)
260-270 Religious Ethics and the Environment

Sociology
166-328 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 472 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 306-310 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 306-310.

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 280-211, a course in statistics, and a course in micro-economics are prerequisite for 280-341. If included in the Minor in Management, 280-423 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)

- 280-211 Introduction to Financial Accounting
- 280-320 Managing Human Resources

Complementary Courses (9 credits)

3 credits, one of List A:
- 280-213 Introduction to Managerial Accounting
- 280-341 Finance I
- 280-373 Operations Research
- 280-382 International Business

3 credits, one of List B:
- 270-462 Management of New Enterprises
- 270-465 Technological Entrepreneurship
- 280-222 Organizational Behaviour
- 280-352 Marketing Management I
- 280-360 Social Context of Business
- 280-423 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 280-373. There are three courses in Engineering that qualify: 303-208, 305-474 and 309-326. It should be noted that 280-373 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)

- 306-260AB Materials Science and Engineering
- 306-367B Electronic Properties of Materials
- 306-461B Ceramic Engineering
- 302-481A Polymer Engineering
- 302-484B Materials Engineering

Complementary Courses (9 credits)

Three courses to be chosen from the following list:

198-357A Quantum Physics I
198-362B Statistical Mechanics
198-451B Classical Mechanics
198-514B General Relativity
198-551A Quantum Theory
198-557A Nuclear Physics
198-558A Solid State Physics
198-559A Advanced Statistical Mechanics
198-562B Electromagnetic Theory
198-567B Particle Physics

Students who take 198-357A and 198-457B can omit 198-271B 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 contact Ms. Judy Pharo, Faculty of Engineering Student Affairs Office, email: advisor@emf.lan.mcgill.ca

#### Required Courses (18 credits)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>303-576B</td>
<td>Introduction to Software Engineering</td>
<td>3</td>
</tr>
<tr>
<td>303-460</td>
<td>Matrix Structural Analysis</td>
<td>3</td>
</tr>
<tr>
<td>303-562B</td>
<td>Organizational Strategies for Advanced Technology Firms</td>
<td>3</td>
</tr>
</tbody>
</table>

#### Complementary Courses (12 credits)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>300-480B</td>
<td>Technological Entrepreneurship Project</td>
</tr>
</tbody>
</table>

### 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.lan.mcgill.ca

#### Required Courses (12 credits)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>308-221</td>
<td>Introduction to Computer Engineering I</td>
</tr>
<tr>
<td>308-231</td>
<td>Introduction to Computer Engineering II</td>
</tr>
<tr>
<td>308-428</td>
<td>Software Engineering Practice</td>
</tr>
</tbody>
</table>

#### Complementary Courses (12 credits)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>303-203</td>
<td>Introduction to Computing II</td>
</tr>
<tr>
<td>303-250</td>
<td>Introduction to Computer Science</td>
</tr>
</tbody>
</table>

At least one course (3 credits) must be selected from the following list of engineering courses:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>302-458</td>
<td>Computer Applications</td>
</tr>
<tr>
<td>302-571</td>
<td>Small Computer Applications in Chemical Eng.</td>
</tr>
<tr>
<td>303-460</td>
<td>Matrix Structural Analysis</td>
</tr>
<tr>
<td>303-550</td>
<td>Water Resources Management</td>
</tr>
<tr>
<td>303-573</td>
<td>Computational Hydraulics</td>
</tr>
<tr>
<td>303-424</td>
<td>Human-Computer Interaction</td>
</tr>
<tr>
<td>304-427</td>
<td>Operating Systems</td>
</tr>
<tr>
<td>304-526</td>
<td>Artificial Intelligence</td>
</tr>
<tr>
<td>304-531</td>
<td>Real Time Systems</td>
</tr>
<tr>
<td>304-532</td>
<td>Computer Graphics</td>
</tr>
<tr>
<td>305-474</td>
<td>Sel. Topics in Operations Research</td>
</tr>
<tr>
<td>305-524</td>
<td>Computer Integrated Manufacturing</td>
</tr>
<tr>
<td>305-539</td>
<td>Computational Aerodynamics</td>
</tr>
<tr>
<td>305-545</td>
<td>Advanced Stress Analysis</td>
</tr>
</tbody>
</table>

No more than two courses (6 credits) can be selected from the following list of courses offered by the School of Computer Science:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>308-302</td>
<td>Programming Languages and Paradigms</td>
</tr>
<tr>
<td>308-335</td>
<td>Software Engineering Methods</td>
</tr>
</tbody>
</table>

### 6 Courses Given by other Faculties for Engineering Students

- Denotes courses not offered in 2001-02

#### 6.1 Faculty of Education

**455-206A,B COMMUNICATION IN ENGINEERING. (3 credits) (Limited enrolment)** 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 communication in engineering. Attendance at first class is imperative.

#### 6.2 Faculty of Science

**Note:** All Sciences courses have limited enrolment.

**Department of Chemistry**

**180-233B SELECTED 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.

**180-234A,B SELECTED TOPICS IN ORGANIC CHEMISTRY. 3(3-0-6)** (Prerequisite: 180-212A,B 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**

**308-202A,B INTRODUCTION TO COMPUTING 1. (3 credits) (3 hours)** (Prerequisite: a CEGEP level mathematics course.) Overview of components of microcomputers, the internet design and implementation of programs using a modern highlevel language, an introduction to modular software design and debugging. Programming concepts are illustrated using a variety of applications.

**308-208A,B COMPUTERS IN ENGINEERING. (3 credits) (3 hours)** (Prerequisite: differential and integral calculus. Co-requisite: linear algebra: determinants, vectors, matrix operations.) 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.

**308-250A,B INTRODUCTION TO COMPUTER SCIENCE. (3 credits) (3 hours)** (Prerequisites: Familiarity with a high level programming language and CEGEP level Math.) 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.

**308-302A,B PROGRAMMING LANGUAGES AND PARADIGMS. (3 credits) (3 hours)** (Prerequisite: 308-250 or 308-203) 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
186-221A 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 processes, 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 identification, basic techniques of airphoto and geological map interpretation, and structural geology.

186-225A PROPERTIES OF MINERALS. 1 (1 hour lecture, 1 hour laboratory) (Not open to students who have taken 186-210A) 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
189-247B LINEAR ALGEBRA. 3 (credits) (Prerequisite: 189-133 or equivalent. Intended for Honours Physics and Engineering students. Not open to students who have taken or are taking 189-283 or 198-282 or 198-283.) Matrix algebra, determinants, systems of linear equations. Abstract vector spaces, inner products, orthogonal vector spaces, Fourier series. Linear transformations and their matrix representations. Eigenvalues and eigenvectors, diagonalizable and defective matrices, positive definite and semidefinite matrices. Quadratic and Hermitian forms, generalized eigenvalue problems, simultaneous reduction of quadratic forms. Applications.

189-248A ADVANCED CALCULUS I. 3 (credits) (Prerequisites: 189-133 and 222 or consent of Department. Intended for Honours Mathematics, Physics and Engineering students. Not open to students who have taken or are taking 189-314.) 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; irrational and solenoidal fields; applications.

189-249B ADVANCED CALCULUS II. 3 (credits) (Prerequisite: 189-248. Intended for Honours Physics and Engineering students. Not open to students who have taken or are taking 189-316.) 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.


189-251A,B DIFFERENTIAL EQUATIONS. 3(3-1-5) (Corequisite: 189-250) 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.

189-252A,B ADVANCED CALCULUS. 3(3-1-5) (Prerequisites: 189-250 or 189-222 or 189-151B 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.


189-270A,B APPLIED LINEAR ALGEBRA. 3(3-1-5) (Prerequisite: 189-251) 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.

189-325A,B ORDINARY DIFFERENTIAL EQNS. 3(3-0-6) (Prerequisite: 189-222. Intended for Honours Mathematics, Physics and Engineering programs.) (Not open to students who have taken 189-261, 189-315.) First and second order equations, linear equations, series solutions, Frobenius method, introduction to numerical methods and to linear systems, Laplace transforms, applications.

189-363B DISCRETE MATHEMATICS. 3(3-0-6) (Prerequisites: 189-265 and either 189-270 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.

189-381A,B COMPLEX VARIABLES AND TRANSFORMS. 3(3-1-5) (Prerequisite: 189-265) 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
198-251A CLASSICAL MECHANICS I. 3 (credits; 3 hours lectures) (Prerequisite: CEGEP physics; Corequisite: 189-222A,B) 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.


198-350A ELECTROMAGNETISM. 3 (credits) (3 hours lectures) (Prerequisites: 189-248A,B, 325B. Honours students or permission of the instructor) Fundamental laws of electric and magnetic fields in both integral and differential form.