

Faculty of Engineering

Summary of Degree Programs

Undergraduate

BSc Programs

The Faculty of Engineering administers regular four year programs leading to the BSc degree in Chemical, Civil, Computer, Electrical, Geomatics, Manufacturing, Mechanical, Oil & Gas, and Software Engineering.

Specialization

The Departments of Chemical and Petroleum Engineering, Civil Engineering, Electrical and Computer Engineering, Mechanical and Manufacturing Engineering and Geomatics Engineering offer a specialization in Biomedical Engineering which can be combined with the regular four year programs leading to the BSc degree in Chemical, Civil, Electrical, Geomatics, Manufacturing and Mechanical Engineering.

Minors

In addition, the Department of Chemical and Petroleum Engineering offers a minor in Petroleum Engineering, the Department of Civil Engineering offers minors in Environmental, in Structural, and in Transportation Engineering, the Department of Mechanical and Manufacturing Engineering offers a Mechanical Engineering degree with minors in Mechatronics or in Petroleum Engineering (offered in conjunction with the Department of Chemical and Petroleum Engineering), and a Manufacturing Engineering degree with a minor in Mechatronics. The Faculty of

Engineering in conjunction with the Haskayne School of Business offers a Minor in Entrepreneurship and Enterprise Development.

Engineering Internship Program

The Faculty of Engineering also provides the option of an Internship Program. The Engineering Internship Program is a five-year program which includes, in addition to the regular four-year academic program, an internship year (a minimum of twelve and a maximum of sixteen consecutive months) of supervised work experience in industry.

Combined Programs

The Faculty of Engineering in conjunction with the Faculties of Humanities and Social Sciences offers combined degree programs. Program details are given in the section "Program Details – Combined Programs" below.

Graduate

Graduate work leading to the MSc, MEng and PhD degrees is offered by all engineering departments under the administration of the Faculty of Graduate Studies. Details of these programs appear in the Faculty of Graduate Studies Calendar.

Diplomas or Certificates

Diplomas of the Faculty of Engineering, which provide special qualifications in designated areas, are also offered. For additional details see the section "Program Details – Diplomas" below.

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Diploma of the Faculty of Engineering

The Faculty of Engineering sponsors a diploma program providing additional special qualifications in designated departments which lead to the Diploma of the Faculty of Engineering. This program is intended primarily for professional engineers engaged in practice who are not interested in submitting to the discipline of a true graduate degree including a thesis, or who are unable to meet the residence requirements of the MSc degree.

The Faculty of Engineering also sponsors a diploma program providing additional specialization in Environmental Engineering. This diploma is intended for professional engineers or holders of equivalent approved degrees and leads to the Diploma of the Faculty of Engineering in Environmental Engineering.

Degrees Offered

	Chemical	Civil	Computer	Electrical	Geomatics	Manufacturing	Mechanical	Oil & Gas	Software
UNDERGRADUATE	BSc	BSc	BSc	BSc	BSc	BSc	BSc	BSc	BSc
	BSc (Eng)/BSc*	BSc (Eng)/BSc*	BSc (Eng)/BSc*	BSc (Eng)/BSc*	BSc (Eng)/BSc*	BSc (Eng)/BSc*	BSc (Eng)/BSc*	BSc (Eng)/BSc*	BSc (Eng)/BSc*
	BSc (Eng)/BA*	BSc (Eng)/BA*	BSc (Eng)/BA*	BSc (Eng)/BA*	BSc (Eng)/BA*	BSc (Eng)/BA*	BSc (Eng)/BA*	BSc (Eng)/BA*	BSc (Eng)/BA*
	BSc (INTE)	BSc (INTE)	BSc (INTE)	BSc (INTE)	BSc (INTE)	BSc (INTE)	BSc (INTE)	BSc (INTE)	BSc (INTE)

* Combined Degree with Faculties of Humanities and Social Sciences

GRADUATE	MEng	MEng		MEng	MEng	MEng	MEng		
	MSc	MSc		MSc	MSc		MSc		
	PhD	PhD		PhD	PhD	PhD	PhD		

Diploma of the Faculty of Engineering and the Haskayne School of Business in Project Management Specialization

The Faculty of Engineering and the Haskayne School of Business jointly sponsor a diploma program providing additional special qualifications in the area of Project Management which leads to the Diploma of the Faculty of Engineering and of the Haskayne School of Business in Project Management. This program is intended primarily for professionals engaged in practice who are not interested in the MSc or MEng degrees.

Faculty Information

Contact Information

Location: Engineering Block C204

Student Information: (403) 220-5732

Web page URL: <http://www.eng.ucalgary.ca>

Introduction

The Faculty of Engineering at the University of Calgary was established in 1965. The degrees awarded by the Faculty since its inception have been recognized by the Canadian Engineering Accreditation Board. The engineering curriculum in Calgary consists of a well-balanced mixture of traditional topics in engineering sciences and specialization in subjects relevant to current industrial practice. The academic staff, as well as the students, of the Faculty of Engineering come from all parts of the world, giving the Faculty its uniquely friendly and international atmosphere.

Enquiries

Enquiries regarding admission, registration, interpretation of regulations, or any matter regarding undergraduate studies in Engineering should be directed to the Office of Undergraduate Studies, Faculty of Engineering, Room EN-C204, Telephone 220-5732. Students and prospective students are invited to view pertinent information available through the engineering website, www.eng.ucalgary.ca.

Pattern

Normal admission to the Faculty of Engineering takes one of two forms: (1) students are admitted to the first year of the program directly from high school; (2) students are admitted to the first year or second year of the program after having received advanced credits from another University of Calgary faculty or from another post-secondary institution.

The first year of the Engineering program is common to all students. In April of the first year of study, students apply for admission to a discipline: Chemical, Civil, Computer, Electrical, Geomatics, Manufacturing, Mechanical, Oil & Gas, or Software Engineering. During second year, students not only complete courses common for all

disciplines, but also courses specific to their chosen discipline.

In the third year students take specialized courses in their chosen discipline. At the end of third year students at their option may enroll in the Engineering Internship Program (EIP); this program consists of 12 to 16 months of work in an industry setting where students gain valuable practical engineering experience (see Engineering Internship Program, later in the Engineering section of this Calendar). This academic program is available to all students.

In some disciplines during the fourth year of study (fifth year for Internship enrollees) students have the option to take a minor specialization in one of several areas. In addition to the technical requirements, students take complementary studies courses in non-Engineering and non-Science subjects as an integral component of an Engineering education. This pattern is somewhat different for students who enroll in a combined degree program with one of the Faculties of Humanities or Social Sciences. (See Combined Programs, later in the Engineering section of this Calendar.)

Opportunities

To practice engineering in Canada as a professional (P.Eng.) one must be registered (licensed) with the professional engineering association of the province or territory in which one practices. All BSc degrees offered by the Faculty of Engineering are accredited by the Canadian Engineering Accreditation Board (CEAB) of the Canadian Council of Professional Engineers, a federation of the 12 professional engineering associations in Canada which registers and licenses engineers. Students graduating from these programs fulfill the academic requirements for registration as Professional Engineers with the province or territory where they choose to practice.

Student Affairs

Engineering Students' Society

The Engineering Students' Society (ESS) is an organization affiliated with the Association of Professional Engineers, Geologists and Geophysicists of Alberta. The ESS provides a social atmosphere for engineering students and, in addition, acquaints them with the professional and technical responsibilities of the profession. It is expected that all Engineering students will join the Society, participate in its activities and promote its interests.

By majority vote of the engineering-student population, in 1995 the Engineering Students' Society established the Calgary Engineering Endowment. A \$25.00 per session optional levy is included in the tuition of every engineering undergraduate student. Interest from the endowment is used to purchase equipment for the undergraduate laboratories. The funds are distributed by the Endowment Board of Directors whose membership consists of a majority of undergraduate students. Proposals are requested in March of each year.

Resources

Computers in Engineering

All engineering disciplines make extensive use of computers. Accordingly, microcomputers are used throughout the undergraduate curriculum. The faculty has a number of computer laboratories for use by undergraduates. Nevertheless, for the convenience of the student and to reduce load on the laboratories, students entering engineering are encouraged, but not required, to purchase a microcomputer for use throughout their academic careers. For guidance, note that the vast majority of machines in use in the Faculty of Engineering are Pentium III or 4 based machines that can be booted to run either a recent Microsoft Windows operating system or a recent version of the Linux operating system. In many cases software is made available at low cost through University licenses. Other software purchases may be suggested by instructors in individual courses.

Faculty Regulations

Students in the Faculty of Engineering are governed by the academic regulations contained in this section and also in the Academic Regulations section of this Calendar. Students are advised to read and consider all regulations and, in cases of doubt as to precise meaning of any statement or regulation, to consult the Undergraduate Studies Office, Faculty of Engineering, Room C204.

Admissions

Admission Requirements

New applicants should refer to "Admission Requirements" in the Academic Regulations section of this Calendar for regulations regarding University admission. Students wishing to enroll in the Faculty of Engineering must meet minimum admission requirements for Standard Admission as set out in the front section of this Calendar.

Students who have completed most of their high school work two or more years prior to the time of application should contact the Office of Undergraduate Studies, Faculty of Engineering.

Students required to withdraw from another faculty or another post-secondary educational institution because of an unsatisfactory academic record will not normally be considered for admission to the Faculty of Engineering within 12 months of the withdrawal. Students seeking admission or readmission to the Faculty of Engineering who have been determined (through due process) to be guilty of academic or non-academic misconduct at this or any other academic institution must accompany their application with a letter of explanation and will be considered for admission on an individual basis. Students who have been expelled from the Faculty of Engineering may not apply for readmission.

Students coming directly from high school must present English 30, Mathematics 30 (or Pure Mathematics 30), Mathematics 31, Physics 30 and Chemistry 30 as specified in the Academic Regulations section of this Calendar. They must apply for admission by the deadline indicated in the Applications for Admission Schedule and submit transcripts to the Registrars Office as soon as final grades become available and, in any case, not later than August 1. Students who present another matriculation subject (e.g., Biology 30, Social Studies 30) instead of Mathematics 31 and who achieve a high standing (at least five per cent above the guaranteed admission standard) over the five subjects used for admission purposes may be admitted to the Faculty under special conditions. These conditions involve enrollment in an alternative calculus stream.

Students who have attended a post-secondary institution must apply for admission by the appropriate deadline and submit all transcripts to the Registrars Office as soon as possible but not later than June 30. All applicants must present senior matriculation standing, or equivalent, in the five specified high school subjects, even though they may have attended a post-secondary institution.

Applicants who have an engineering degree may be considered for admission to a subsequent engineering degree at the University of Calgary if the degree program requested is determined by the Associate Dean, Student Affairs, to be sufficiently different from the prior degree program. A minimum of ten half-course equivalents is required for completion of a University degree.

Spring and Summer Sessions

Deadlines for admission to the Spring and Summer Sessions are given in the front section of this Calendar.

Admission to Engineering Program

Choice of an engineering program (Chemical, Civil, Computer, Electrical, Geomatics, Manufacturing, Mechanical, Oil & Gas, or Software) is normally made during April of the first year of studies. While a place in at least one of the programs is assured for every student advancing to second year with satisfactory performance, it is not always possible to accommodate every student's first choice of program. Students will not normally be admitted to a program if they are deficient more than two courses from the first year program or if they are deficient any courses which are prerequisites for second year courses in the program of choice.

First year Engineering students wishing to enter the Biomedical Engineering Specialization must apply for admission to the Biomedical Engineering Specialization program at the same time the choice of an engineering program is made.

In the event that the number choosing a program exceeds the program quota, students will be admitted to the program in order of academic performance until the enrollment limit is reached. Academic performance is judged on the student's GPA for those courses required for the engineering program and taken during the last review period. Priority is given to students who have taken a full-course load (normally eleven courses) in their last review period and who have all courses in the first year program complete.

The current second-year quotas for the various programs are as follows:

Chemical and Petroleum Engineering: 58

Civil Engineering: 76

Computer Engineering: 55

Electrical Engineering: 98

Geomatics Engineering: 50

Manufacturing Engineering: 44

Mechanical Engineering: 96

Oil & Gas Engineering: 16

Software Engineering: 43

Biomedical Engineering Specialization: 32

Students admitted to a program at the second year level include the continuing students who have completed their first year successfully in the Faculty and transfer students. Many transfer-student files are not complete and thus no admission decision has been taken at the time registration starts in the summer. To give transfer students a fair opportunity for admission to their program of first choice, a certain number of places will be allotted to the continuing students and the remaining places will be retained for transfer students. The number of places in the two categories will be decided each year based on an assessment of the demand, with the objective of admitting transfer and continuing students to each program with equivalent qualifications. Transfer students are assessed for program admission on an equivalent basis to continuing students in terms of (a) the courses for which they have obtained transfer credit towards the engineering technical program, and (b) their GPA on those courses. Continuing students who have not registered in both Fall and Winter Session classes in their programs by July 15 will not be guaranteed their place in their program. Students who have not been admitted to a program will not normally be permitted to register in courses in that program, even if there is room in the individual course.

Admission to Minors in Fourth Year

Choice of a minor within an engineering program (e.g., Civil Engineering with a Minor in Environmental Engineering) is normally made during April of the third year or of the internship year. To be admitted to a minor, a student must have completed the third year program in the appropriate specialization

and have a GPA of at least 2.00 in the student's last review period. In the event that the number choosing a minor exceeds the number that can be accommodated, students will be admitted to the minor in order of academic performance until the enrollment limit is reached. Academic performance means the student's GPA on only those courses taken in his/her last review period that are required for the engineering program.

Limited Enrollment

Enrollment in the Faculty of Engineering is limited. Applicants will be accepted on the basis of academic standing in high school and/or previous course work completed. As a consequence of the limitation in enrollment, the following procedures apply. In addition, refer to information given under the heading Admission to Engineering Program.

Readmission after Voluntary Withdrawal

Students who withdrew voluntarily from the Faculty of Engineering for two consecutive sessions (Fall and Winter Sessions of one academic year, or Winter Session and the following Fall Session) and who wish to return, must re-apply for admission by the prescribed deadlines and will be considered in competition with all other applicants. Students are encouraged to consult with the Associate Dean (Student Affairs) prior to making a decision concerning voluntary withdrawal.

Transfer of Course Credits

The Faculty of Engineering may grant transfer credit to students for courses taken in another post-secondary educational program. Students must normally have obtained an acceptable overall academic standing to be eligible for transfer credit. Transfer credit will be considered for courses which are approximately equivalent to courses in the Engineering program and in which grades of "C" or higher (60 per cent or above) have been obtained. (Under some circumstances students may also receive credit for courses with grades of "D" or "D+"). Transfer credit for a course will not be granted unless the student has obtained credit for the prerequisites for that course (as listed in this Calendar). Credit will not normally be granted for courses taken eight or more years prior to the date of admission to the Faculty of Engineering.

Minimum Residence Time

To qualify for a degree, a transfer student must successfully complete at least two regular sessions of full-time study and a minimum of 10 half courses or equivalent while registered in the Faculty of Engineering.

Effective Writing Requirement

All students must satisfy the Effective Writing Requirement as outlined in the Academic Regulations section of this Calendar.

Registration

Accuracy of Registration

All students are responsible for the completeness and accuracy of their registration and for arranging course selections to satisfy graduation requirements.

Course Work

Equivalent Courses

Approval may be given by the Associate Dean (Academic) or by the relevant Department Head for a student to replace one or more courses in the Engineering program by registering in equivalent courses in other faculties. To receive credit, the student must normally obtain a grade of "C" or higher.

Final Year Technical Options

A student in the final year of the Engineering undergraduate program, who has a high academic standing, may be permitted to substitute a graduate course(s) for a fourth year departmental course(s) with the approval of the department. The undergraduate grading scheme will apply to this student.

Part-Time Studies

The academic regulations allow eight years for successful completion of the program, with no stipulation for full-time study. Students wishing to pursue their education with a reduced course load or through studies coordinated with industrial experience are encouraged to contact the Office of Undergraduate Studies, Faculty of Engineering, at the start of their studies so that a suitable program may be planned. As many required courses are not offered in the evenings or during the Spring and Summer Sessions, students should anticipate that it will not be possible to complete their degree without a significant time commitment on weekdays during several academic sessions.

Permission to Take Courses for Credit at Another Institution

Normally students are expected to complete their programs through courses taken at the University of Calgary. Students who wish to take a course elsewhere should obtain written permission from the Faculty of Engineering before registering in the course, to ensure that it is acceptable for credit.

It is the responsibility of the student to ensure that an official transcript of grades is forwarded directly to the Registrar of the University of Calgary in order that the appropriate credit may be officially recorded. To receive transfer credit, a minimum grade of "C" or equivalent (60 per cent or above) must be obtained in each transfer course. (Under some circumstances students may also receive credit for courses with grades of "D" or "D+.") The grades obtained in such courses are not used in the computation of grade point averages for graduation purposes.

Complementary Studies

The following complementary studies courses are required for all students in the Faculty:

- Engineering 209 (Economics 209)* — not open to first-year students
- Engineering 481 or equivalent
Current approved equivalent courses are as follows:
General Studies (GNST) 341, Information Technology and Society
Science, Technology and Society (STAS) 325, Technology within Contemporary Society
Science, Technology and Society (STAS) 327, Science and Society
Science, Technology and Society (STAS) 343, Science Policy and Technology Development
- Communications Studies 363
- Engineering 513, The Role and Responsibilities of the Professional Engineer in Society
- For all degrees, two general complementary studies courses are required.

**Students entering Chemical Engineering, Chemical Engineering with a Petroleum Engineering Minor, or Oil & Gas Engineering may choose a general complementary studies course instead of Engineering Economics (Engineering 209).*

General complementary studies courses must be selected from acceptable courses offered by the Faculties of Communication and Culture, Fine Arts, Humanities, or Social Sciences. A list of acceptable courses may be obtained from the Office of Undergraduate Studies, Faculty of Engineering. Students are responsible for ensuring that any prerequisite conditions are satisfied. Students who have credit for Communications Studies 361 gained prior to the 2003/04 academic year are not required to take Communications Studies 363.

Student Standing

Regulations on Academic Performance

The Faculty of Engineering normally meets at the end of the Winter Session to review the academic performance of Engineering students. A student is subject to review if the student has completed six or more half-course equivalents since the student's previous review (or since admission to the Faculty, in the case of the first review). A student who has not completed at least six half-course equivalents is not normally evaluated until a subsequent annual review when the student has completed a total of six or more half-course equivalents. At the annual review all courses taken by the student since the previous review (or since admission in the case of the first review) will be included in the evaluation of academic performance. For any student who did not achieve a grade point average of 2.00 or higher on the student's previous review or who is on academic probation for other reasons, only those courses taken during the

review period that are required for the student's engineering program will be included in the count of courses and in the evaluation of academic performance. Students who have not cleared academic probation due to a failure to take six engineering courses within a period of two years will normally be denied further registration in the Faculty of Engineering.

For normal advancement towards the degree, students must register in courses directly applicable to the degree program in which they are registered and must maintain satisfactory performance in their programs. Students are referred to the general University regulations regarding Unsatisfactory Standing under Academic Standing in the Academic Regulations section of this Calendar.

Specific regulations for the Faculty of Engineering are listed below.

- A student who has a grade point average (GPA) of 2.00 or higher and no "F" grades in the courses taken during the period under review will be considered to have a satisfactory performance.
- A student who has a grade point average of 2.00 or higher and one or more "F" grades in the courses taken during the period under review shall clear such courses in the following review period.
- A student who has a grade point average of less than 2.00 will not be granted credit for any course in which a grade of "D" or "D+" was obtained during that review period. Such courses must be completed during the following review period.
- Students must take lower level courses before proceeding to higher-level courses even if they have the prerequisites for the higher-level courses.
- Students must clear all first year courses by the end of their second review period or they will be required to withdraw from the faculty.
- To clear a failed course or a course for which a grade of "D" or "D+" was obtained but credit was not obtained, a student must achieve a grade of at least "C-" in the course being repeated or in an approved replacement course. Consistent with University regulations, the same course may be attempted no more than twice. A student who fails to clear a course after two attempts may be required to withdraw.
- Any student who does not achieve a grade point average of 2.00 or greater for the period under review and who did not achieve a grade point average of 2.00 or greater for the student's previous review or a prior review (or who is on academic probation for other reasons) will be required to withdraw from the Faculty. (Students are permitted a maximum of one probationary period while registered as undergraduate students at the University of Calgary.)
- A student with a grade point average of less than 1.70 in any review period will be required to withdraw from the

Faculty. Such students will not be permitted to register in any course specified as part of the degree requirements in Engineering for a period of 12 months from the date of withdrawal.

9. A student who has been required to withdraw may apply for readmission after an interval of 12 months. Readmission is not automatic and will be considered on an individual basis in competition with all other admission applications received. On readmission, students' records will be reviewed to determine credits to be awarded.
10. A student who, after eight calendar years from initial registration in the Engineering program, has not completed degree requirements, will be denied further registration in Engineering. (The eight years does not include time spent in the Internship Program, if any, or the extra time spent by those students in the combined degree programs.) For a transfer student, the permissible number of years (properly rounded) will be prorated according to the number of credits in the program. Clarification of specific cases may be obtained from the Office of Undergraduate Studies, Faculty of Engineering.

Notes:

1. *The above regulations are stated in terms of grades in half courses. A grade in a full course will be considered to be equivalent to two such grades.*
2. *The method used to determine the grade point average is described under Academic Standing in the Academic Regulations section of this Calendar.*
3. *Grades obtained in courses in the Spring and Summer Sessions are not used to alter retroactively the ruling made on a student's performance at the end of the previous review period.*

Dean's List

To be included in the Dean's List, a student must achieve a grade point average of 3.60 or higher during the review period, with at least 10 half courses taken over the immediately preceding 12 month period of May 1 to April 30.

Examinations

Supplemental Examinations

At the discretion of the Engineering Faculty Council, supplemental privileges may be granted to fourth-year students. If these privileges are granted, the student will be informed in writing and must then make application to write the examinations prescribed. Supplemental examinations may be granted in Engineering courses required in the final year program to those students who, at the time of the May, October or January meeting of the Engineering Faculty Council, will be eligible to graduate if one or two "D," "D+" or "F" grades are raised by up to one full grade. A grade of at least "C-" is required to obtain credit for a course through a supplemental examination.

Where courses other than Engineering courses are involved, the successful completion of another approved course may be accepted as clearing the deficiency.

A student may be granted supplemental privileges only once and to a maximum of two supplemental examinations in the courses taken since the last review. Supplemental examinations granted at the January or October meeting of the Engineering Faculty Council will be written in the following April, and those granted at the May meeting of the Council will be written in the following August.

Graduation

Graduation Requirements

Students are required to obtain credit for the full set of courses listed in the Calendar for any particular program.

For graduation in all branches of Engineering, a student must have an overall grade point average of at least 2.00 with no uncleared "F" grades. The average will be calculated by using the numerical equivalent of the best grade in each course taken. A full-year course will be counted as two half courses for this purpose.

Note: *An "F" grade in any technical elective course or complementary studies elective course may be cleared by a passing grade in another acceptable technical elective or complementary studies elective, respectively.*

Degrees with Distinction

The notation With Distinction will be inscribed on the permanent record and graduation parchment of students who obtain a grade point average of at least 3.60 over the last 10 full-course equivalents taken at the University of Calgary, with no more than one "D" or "D+" grade and no failures. The notation With Distinction will not be granted if a student obtains an "F" grade in a CR/F course (including Internship) which has been completed during the time period in which the last 10 full-course equivalents have been taken. For cases in which the last 10 full-course equivalents must include some, but not all, of a group of courses taken concurrently, the selection will be made in the manner most advantageous to the student. Students who have taken part of their work at another university or who have transferred into this Faculty may be granted a degree With Distinction at the discretion of the Faculty.

Program Details

First Year, Curriculum Requirements Common to All Programs

1. AMAT 217 Calculus for Engineers and Scientists
2. AMAT 219 Multivariable Calculus for Engineers
3. CHEM 209 General Chemistry for Engineers

4. ENGG 201 Behaviour of Liquids, Gases and Solids
5. ENGG 205 Engineering Mechanics I
6. ENGG 233 Computing for Engineers I
7. ENGG 251 Design and Communications I
8. ENGG 253 Design and Communications II
9. MATH 221 Linear Algebra for Scientists and Engineers
10. PHYS 259 Electricity and Magnetism
11. Complementary Studies Course

Chemical Engineering

Admission

Refer to "Faculty Regulations – Admissions" above.

Requirements

See also "First Year Curriculum Requirements Common to All Programs" above.

2nd Year

Chemical Engineering, regular program and Minor in Petroleum Engineering

1. AMAT 307 Differential Equations for Engineers
2. CHEM 357 Industrial Organic Chemistry for Engineers
3. ENCH 315 Chemical Engineering Process Calculation
4. ENCH 331 Process Fluid Dynamics
5. ENGG 311 Engineering Thermodynamics
6. ENGG 317 Mechanics of Solids
7. ENGG 319 Probability and Statistics for Engineers
8. ENGG 325 Electric Circuits and Systems
9. ENGG 335 Computing for Engineers II
10. ENGG 349 Engineering Mechanics II
11. Science Option

Notes:

1. *Students are admitted to the Petroleum Engineering minor at the time of registration in the fourth-year programs. Prior to that time, students who wish to be considered for the minor must have completed GLGY 377 and ENPE 523. Students who take these two courses prior to the end of 3rd year and who are admitted to the regular program instead of the minor will receive credit for these courses as 4th year technical electives.*
2. *The courses that are acceptable for the Science option include PHYS 369 and GLGY 377; other courses from the Faculty of Science may be substituted with approval of the student's department and the relevant department in the Faculty of Science.*

3rd Year

Chemical Engineering, regular program and minor in Petroleum Engineering

1. CHEM 409 Applied Chemistry and Chemical Pathways for Engineers

2. ENCH 401 Analyses in Chemical, Oil & Gas Engineering
3. ENCH 403 Heat and Mass Transfer
4. ENCH 405 Separation Processes I
5. ENCH 421 Chemical Engineering Kinetics
6. ENCH 423 Chemical Engineering Process Development
7. ENCH 427 Chemical Engineering Thermodynamics
8. ENGG 407 Numerical Methods in Engineering
9. Technical Elective (one half-course equivalent)
- 10., 11. Two Complementary Studies Courses (two half-course equivalents) for students in the regular program, or one complementary studies course and one technical elective (two half-course equivalents) for students intending the Petroleum Engineering minor.

4th Year

Chemical Engineering, regular program

1. CHEM 579 Surface and Colloid Chemistry for Engineers
2. ENCH 501 Transport Processes
3. ENCH 505 Separation Processes II
4. ENCH 511 Chemical Process Design I
5. ENCH 529 Process Dynamics and Control
6. ENCH 531 Chemical Process Design II
7. ENCH 551 Chemical Engineering Laboratory
8. ENGG 513 The Role and Responsibilities of the Professional Engineer in Society
- 9., 10. Technical Electives (two half-course equivalents)
- 11., 12. Complementary Studies Courses (two half-course equivalents)

Chemical Engineering with a Minor in Petroleum Engineering

1. CHEM 579 Surface and Colloid Chemistry for Engineers
2. ENCH 501 Transport Processes
3. ENCH 529 Process Dynamics and Control
4. ENGG 513 The Role and Responsibilities of the Professional Engineer in Society
5. ENCH 505 Separation Processes II
6. ENPE 511 Design for Oil & Gas Engineering I
7. ENPE 531 Design for Oil & Gas Engineering II
8. ENPE 551 Petroleum Engineering Laboratory
9. Technical Elective (one half-course equivalent)
10. — 12. Complementary Studies Courses (three half-course equivalents)

Chemical Engineering Approved Technical Electives

Regular program.

Select three half-course equivalents.

Petroleum Engineering Minor, select one half-course equivalents.

- ENCH 503 Upgrading and Refining Processes
 ENCH 519 Special Topics
 ENCH 535 Principles of Biochemical Engineering
 ENCH 537 Computational Thermodynamics
 ENCH 539 Polymer Engineering
 ENCH 541 Introduction to Cell and Tissue Engineering
 ENCH 543 Geological Characterization of Oil & Gas Reservoirs
 ENPE 507 Well Logging and Formation Evaluation
 ENPE 509 Well Testing
 ENPE 513 Flow in Porous Media
 ENPE 515 Drilling and Well Completions
 ENPE 523 Introduction to Reservoir Engineering
 ENPE 525 Waterflooding
 ENPE 533 Petroleum Production Engineering
 ENPE 555 Oil & Gas Field Safety and Environment
 ENPE 561 Fuel Science and Technology
 ENPE 563 Materials Aspects of Oil & Gas Production
 GLGY 377 Petroleum Engineering Geology

Note: Students in the Petroleum Engineering Minor are required to take ENPE 523 and GLGY 377. Hence these two courses cannot be selected as technical electives.

Civil Engineering

Admission

Refer to "Faculty Regulations – Admissions" above.

Requirements

See also "First Year Curriculum Requirements Common to All Programs" above.

2nd Year

Civil Engineering, regular program and Minors in Environmental Engineering, Structural Engineering, and Transportation Engineering

1. AMAT 307 Differential Equations
2. ENCI 337 Computer Tools for Engineering Design
3. ENGG 311 Engineering Thermodynamics
4. ENGG 319 Probability and Statistics for Engineers
5. ENGG 317 Mechanics of Solids
6. ENGG 325 Electric Circuits and Systems
7. ENGG 349 Engineering Mechanics II
8. ENGG 407 Numerical Methods in Engineering
9. ENME 341 Fundamentals of Fluid Mechanics

10. PHYS 369 Acoustics, Optics and Radiation for Engineers
11. Complementary Studies Course (one half-course equivalent)

3rd Year

Civil Engineering, regular program and Minors in Environmental Engineering, Structural Engineering, and Transportation Engineering

1. ENCI 413 Introduction to Civil Engineering Materials
2. ENCI 423 Soil Mechanics
3. ENCI 451 Basic Structural Design
4. ENCI 461 Mechanics of Materials
5. ENCI 465 Engineering and Construction Management
6. ENCI 471 Introduction to Project Management
7. ENCI 473 Transportation Planning
8. ENCI 481 Environmental Engineering
9. ENGO 343 Fundamentals of Surveying
10. GLGY 471 Geology, Engineering and the Environment
- 11., 12. Complementary Studies Courses (two half-course equivalents)

4th Year

Civil Engineering, regular program

- 1., 2. ENCI 570 Group Design Project (two half-course equivalents)
3. ENGG 513 The Role and Responsibilities of the Professional Engineer in Society
4. — 11. Technical Electives (eight half-course equivalents)
12. Complementary Studies Course (one half-course equivalent)

Civil Engineering with a Minor in Environmental Engineering

- 1., 2. ENCI 570 Group Design Project (two half-course equivalents)
3. ENGG 513 The Role and Responsibilities of the Professional Engineer in Society
4. — 8. Environmental Engineering Technical Electives, selected from Group A (see electives list below) (five half-course equivalents)
9. — 11. Civil Engineering Technical Electives, selected from Group B (see electives list below) (three half-course equivalents)
12. Complementary Studies Course (one half-course equivalent)

Civil Engineering with a Minor in Structural Engineering

1. ENCI 545 Theory of Structures I
2. ENCI 547 Theory of Structures II
3. ENCI 555 Structural Concrete Design
4. ENCI 557 Structural Steel Design
- 5., 6. ENCI 570 Group Design Project (two half-course equivalents)

7. ENGG 513 The Role and Responsibilities of the Professional Engineer in Society
8. One of ENCI 513 Properties of Concrete and Masonry, or ENCI 523 Soil Mechanics and Foundation Engineering
9. One of (a) EVDA 511 Building Science and Technology I – a minimum GPA of 2.70 is required to register, (b) EVDA 719 Structures for Architects III – a minimum GPA of 3.00 is required to register, (c) ENCI 525 Applied Geotechnical Engineering, (d) an approved course on the Design of Wood, (e) ENCI 553 Structural Masonry Design, (f) an approved course on Structural Biomechanics
- 10., 11. Technical Electives (two half-course equivalents not otherwise taken)
12. Complementary Studies Course (one half-course equivalent)

Civil Engineering with a Minor in Transportation Engineering

- 1., 2. ENCI 570 Group Design Project (two half-course equivalents)
3. ENCI 573 Highway Engineering
4. ENCI 575 Operation of Transportation Systems
5. ENCI 577 Modelling of Transportation Systems
6. ENCI 579 Asphalt Pavement Design and Management
7. ENGG 513 The Role and Responsibilities of the Professional Engineer in Society
8. TRAN 599 Independent Research in Transportation Issues
9. — 11. Technical Electives (three half-course equivalents)
12. Complementary Studies Course (one half-course equivalent)

Civil Engineering Approved Technical Electives

Regular program.

Select eight half-course equivalents.

- ENCI 513 Properties of Concrete and Masonry
 ENCI 523 Soil Mechanics and Foundation Engineering
 ENCI 525 Applied Geotechnical Engineering
 ENCI 533 Engineering Hydrology
 ENCI 535 Open Channel Hydraulics
 ENCI 545 Theory of Structures I
 ENCI 547 Theory of Structures II
 ENCI 553 Structural Masonry Design
 ENCI 555 Structural Concrete Design
 ENCI 557 Structural Steel Design
 ENCI 573 Highway Engineering
 ENCI 575 Traffic Engineering and Operations
 ENCI 577 Modelling of Transportation Systems
 ENCI 579 Asphalt Pavement Design and Management
 ENCI 581 Water and Wastewater Engineering
 ENCI 587 Site Assessment and Remediation

- ENCI 589 Air and Water Pollution
 ENCI 591 Solid and Hazardous Waste Engineering
 ENCI 595 Special Topics
 ENCI 597 Civil Engineering Project I
 ENCI 599 Civil Engineering Project II

Environmental Engineering Minor. Five half-course equivalents in Group A and select three half-course equivalents from Group B.

Group A Technical Electives

- ENCI 581 Water and Wastewater Engineering
 ENCI 587 Site Assessment and Remediation
 ENCI 589 Air and Water Pollution
 ENCI 591 Solid and Hazardous Waste Engineering
 GLGY 401 Physical Hydrology

Group B Technical Electives

- ENCI 513 Properties of Concrete and Masonry
 ENCI 523 Soil Mechanics and Foundation Engineering
 ENCI 525 Applied Geotechnical Engineering
 ENCI 533 Engineering Hydrology
 ENCI 535 Open Channel Hydraulics
 ENCI 545 Theory of Structures I
 ENCI 547 Theory of Structures II
 ENCI 555 Structural Concrete Design
 ENCI 557 Structural Steel Design
 ENCI 573 Highway Engineering
 ENCI 575 Traffic Engineering and Operations
 ENCI 577 Modelling of Transportation Systems
 ENCI 579 Asphalt Pavement Design and Management
 ENCI 595 Special Topics

Structural Engineering Minor. Select two half-course equivalents.

- ENCI 513 Properties of Concrete and Masonry
 ENCI 523 Soil Mechanics and Foundation Engineering
 ENCI 525 Applied Geotechnical Engineering
 ENCI 533 Engineering Hydrology
 ENCI 535 Open Channel Hydraulics
 ENCI 573 Highway Engineering
 ENCI 575 Traffic Engineering and Operations
 ENCI 577 Modelling of Transportation Systems
 ENCI 579 Asphalt Pavement Design and Management
 ENCI 581 Water and Wastewater Engineering
 ENCI 587 Site Assessment and Remediation
 ENCI 589 Air and Water Pollution
 ENCI 591 Solid and Hazardous Waste Engineering
 ENCI 595 Special Topics

Transportation Engineering Minor. Select three half-course equivalents.

- ENCI 513 Properties of Concrete and Masonry
 ENCI 523 Soil Mechanics and Foundation Engineering

- ENCI 525 Applied Geotechnical Engineering
 ENCI 533 Engineering Hydrology
 ENCI 535 Open Channel Hydraulics
 ENCI 545 Theory of Structures I
 ENCI 547 Theory of Structures II
 ENCI 555 Structural Concrete Design
 ENCI 557 Structural Steel Design
 ENCI 581 Water and Wastewater Engineering
 ENCI 587 Site Assessment and Remediation
 ENCI 589 Air and Water Pollution
 ENCI 591 Solid and Hazardous Waste Engineering
 ENCI 595 Special Topics

Note: All technical-elective courses have similar workloads even though the hours in the timetable are variable. One 500-level or higher course from either the Faculty of Science or the Faculty of Engineering may be approved by the Department Head as a technical elective. Optional undergraduate courses and all graduate courses are offered, in any calendar year, at the discretion of the department.

Computer Engineering

Admission

Refer to "Faculty Regulations – Admissions" above.

Requirements

See also "First Year Curriculum Requirements Common to All Programs" above.

2nd Year

1. AMAT 307 Differential Equations
2. CPSC 331 Information Structures
3. ENCM 339 Programming Fundamentals
4. ENCM 369 Computer Organization
5. ENEL 327 Signals and Transforms
6. ENEL 341 Circuits I
7. ENEL 343 Circuits II
8. ENEL 353 Digital Circuits
9. ENGG 319 Probability and Statistics for Engineers
10. MATH 271 Discrete Mathematics
11. PHYS 369 Acoustics, Optics and Radiation for Engineers

3rd Year

1. CPSC 441 Computer Communications
2. CPSC 457 Principles of Operating Systems
3. ENCM 415 Assembly Language Programming and Interfacing
4. ENCM 467 Digital Electronics for Computer Engineers
5. ENCM 491 Real-Time Systems Design
6. ENCM 493 Software Development for Computer Engineers
7. ENEL 441 Control Systems I
8. ENEL 453 Digital Systems Design
9. ENEL 471 Analog Communications

- 10., 11. Complementary Studies Courses
(two half-course equivalents)

4th Year

1. CPSC 411 Compiler Construction
 2. ENCM 501 Principles of Computer Architecture
 3. ENCM 583 Fourth Year Computer Engineering Team Design Project, Part A
 4. ENCM 589 Fourth Year Computer Engineering Team Design Project, Part B
 5. ENGG 513 The Role and Responsibilities of the Professional Engineer in Society
 6. — 10. Technical Electives (five half-course equivalents)
- 11., 12. Complementary Studies Courses
(two half-course equivalents)
Block Course – ENCM 007 Introduction to the Fourth Year Computer Engineering Team Design Project (20 hours)

Computer Engineering Approved Technical Electives

Select five half-course equivalents

- CPSC 453 Introduction to Computer Graphics
CPSC 471 Data Base Management Systems
ENCM 503 Digital Video Processing
ENCM 505 Parallel Computer Architectures
ENCM 515 Digital Signal Processors
ENCM 519 Special Topics in Computer Engineering
ENCM 591 Individual Computer Engineering Project, Part II (1 session)
ENCM 598 Individual Computer Engineering Research Project (2 sessions, two half-course equivalents)
ENCM 599 Individual Computer Engineering Project (1 session)
ENEL 525 Neuro-Fuzzy and Soft Computing
ENEL 527 Design and Implementation of FPGA-Based DSP Systems
ENEL 529 Wireless Communications Systems
ENEL 541 Control Systems II
ENEL 563 Biomedical Signal Analysis
ENEL 567 CMOS VLSI Engineering
ENEL 571 Digital Communications
ENEL 573 Telecommunications and Computer Communications
ENEL 579 Optical Fibre Communications
ENEL 593 Digital Filters

Note: Selection of a course not on this list requires department approval. Elective courses are offered, in any calendar year, at the discretion of the department.

Note: Students may not take CPSC 471 as a technical elective if they have already completed ENSF 519.31 or ENCM 519.31.

Electrical Engineering

Admission

Refer to "Faculty Regulations – Admissions" above.

Requirements

See also "First Year Curriculum Requirements Common to All Programs" above.

2nd Year

1. AMAT 307 Differential Equations
2. AMAT 309 Vector Calculus for Engineers
3. ENCM 339 Programming Fundamentals
4. ENCM 369 Computer Organization
5. ENEL 327 Signals and Transforms
6. ENEL 341 Circuits I
7. ENEL 343 Circuits II
8. ENEL 353 Digital Circuits
9. ENEL 361 Electronic Materials
10. ENGG 319 Probability and Statistics for Engineers
11. PHYS 369 Acoustics, Optics and Radiation for Engineers

3rd Year

1. ENCM 415 Assembly Language Programming and Interfacing
 2. ENEL 409 Principles of Software Development
 3. ENEL 441 Control Systems I
 4. ENEL 453 Digital Systems Design
 5. ENEL 463 Electronic Devices and Circuits
 6. ENEL 465 Analog Integrated Electronics
 7. ENEL 471 Analog Communications
 8. ENEL 475 Fundamentals of Electromagnetic Fields
 9. ENEL 489 Electric Machines: Steady-State
- 10., 11. Complementary Studies Courses
(two half-course equivalents)

4th Year

1. ENEL 583 Fourth Year Electrical Engineering Team Design Project, Part A
 2. ENEL 589 Fourth Year Electrical Engineering Team Design Project, Part B
 3. ENEL 587 Power Systems: Steady State
 4. ENGG 513 The Role and Responsibilities of the Professional Engineer in Society
 5. — 10. Technical Electives (six half-course equivalents)
- 11., 12. Complementary Studies Courses
(two half-course equivalents)
Block Course — ENEL 007 Introduction to the Fourth Year Electrical Engineering Team Design Project (20 hours)

Electrical Engineering Approved Technical Electives

Select six half-course equivalents.

- ENCM 503 Digital Video Processing
ENCM 515 Digital Signal Processors
ENEL 519 Special Topics in Electrical Engineering
ENEL 525 Neuro-Fuzzy and Soft Computing
ENEL 527 Design and Implementation of FPGA-Based DSP Systems
ENEL 529 Wireless Communications Systems
ENEL 541 Control Systems II
ENEL 559 Analog Filter Design
ENEL 563 Biomedical Signal Analysis
ENEL 565 Digital Integrated Electronics
ENEL 567 CMOS/VLSI Engineering
ENEL 569 Electronics for Instrumentation
ENEL 571 Digital Communications
ENEL 573 Telecommunications and Computer Communications
ENEL 575 Microwave Circuits and Antennas
ENEL 577 Transmission Media
ENEL 579 Optical Fibre Communications
ENEL 585 Introduction to Power Electronics
ENEL 591 Individual Project, Part II
ENEL 593 Digital Filters
ENEL 598 Individual Research Project (two half-course equivalents)
ENEL 599 Individual Project

Note: Selection of a course not on this list requires department approval. Elective courses are offered, in any calendar year, at the discretion of the department.

Geomatics Engineering

Admission

Refer to "Faculty Regulations – Admissions" above.

Requirements

See also "First Year Curriculum Requirements Common to All Programs" above.

2nd Year

1. AMAT 307 Differential Equations
2. AMAT 309 Vector Calculus for Engineers
3. ENEL 327 Signals and Transforms
4. ENGG 319 Probability and Statistics for Engineers
5. ENGG 325 Electric Circuits and Systems
6. ENGG 335 Computing for Engineers II
7. ENGG 349[ENGG349] Engineering Mechanics II
8. ENGO 343 Fundamentals of Surveying
9. ENGO 351 Introduction to Geospatial Information Systems
10. ENGO 361 Adjustment of Observations
11. PHYS 369 Acoustics, Optics and Radiation for Engineers

3rd Year

1. ENCI 471 Introduction to Project Management
2. ENGG 407 Numerical Methods in Engineering
3. ENGO 419 Geomatics Networks
4. ENGO 421 Coordinate Systems and Map Projections
5. ENGO 423 Geodetic Positioning
6. ENGO 427 Physical Geodesy
7. ENGO 431 Analytical Photogrammetry
8. ENGO 435 Remote Sensing
9. ENGO 455 Cadastral Surveys and Land Registration Systems
- 10., 11. Complementary Studies Courses (two half-course equivalents)

4th Year

1. ENGG 513 The Role and Responsibilities of the Professional Engineer in Society
- 2., 3. ENGO 500 Geomatics Engineering Project (two half-course equivalents)
4. ENGO 501 Field Surveys
5. — 10. Technical Electives (six half-course equivalents)
- 11., 12. Complementary Studies Courses (two half-course equivalents)

Geomatics Engineering Approved Technical Electives**Select six half-course equivalents.**

BSEN 395 Legal Environment
 ENGO 545 Hydrography
 ENGO 557 Design and Implementation of Geospatial Information Systems
 ENGO 559 Digital Imaging and Applications
 ENGO 561 Satellite Positioning
 ENGO 563 Data Analysis in Engineering
 ENGO 567 High-Precision Surveys
 ENGO 573 Digital Terrain Modelling
 ENGO 579 Survey Law
 ENGO 581 Land Use Planning
 ENGO 583 Environmental Modelling

Notes:

1. A 400-level or higher technical course from the Faculty of Science or another Engineering department may be substituted for a technical elective with permission of the Head of the Department of Geomatics Engineering.
2. Technical electives in the undergraduate program and all graduate courses are offered, in any academic year, at the discretion of the department.
3. Students are eligible to obtain a Certificate of Completion from the Western Canadian Board of Examiners (WCBE) for Land Surveyors upon completion of approved courses on the following subjects, in addition to the required courses within the Geomatics Engineering program (WCBE examinations are noted in parentheses): Canadian Economic, Legal and

Business Systems (II-6); Survey Law (II-3) and Land Use Planning and Environmental Management (II-4). For more information on the WCBE go to their website: www.geomatics.ucalgary.ca/wcbe/index.htm

Manufacturing Engineering**Admission**

Refer to "Faculty Regulations – Admissions" above.

Requirements

See also "First Year Curriculum Requirements Common to All Programs" above.

2nd Year**Manufacturing Engineering, regular program and Minor in Mechatronics**

1. AMAT 307 Differential Equations
 2. CHEM 357 Industrial Inorganic Chemistry for Engineers
 3. ENGG 311 Engineering Thermodynamics
 4. ENGG 319 Probability and Statistics for Engineers
 5. ENGG 317 Mechanics of Solids
 6. ENGG 325 Electric Circuits and Systems
 7. ENGG 335 Computing for Engineers II
 8. ENGG 349 Engineering Mechanics II
 9. ENGG 407 Numerical Methods in Engineering
 10. ENME 341 Fundamentals of Fluid Mechanics
 11. PHYS 369 Acoustics, Optics and Radiation for Engineers
- Block Course — ENME 001 Mechanical and Manufacturing Engineering Block Course (32 hours)

3rd Year**Manufacturing Engineering, regular program and Minor in Mechatronics**

1. ENME 421 Materials I
2. ENME 461 Mechatronics
3. ENME 473 Kinematics and Dynamics of Machines
4. ENMF 401 Computer-Aided Design and Graphics
5. ENMF 405 Mechanics of Materials
6. ENMF 407 Human Behaviour in Organizations
7. ENMF 411 Quality Assurance
8. ENMF 415 Integrated Manufacturing Systems I
9. ENMF 417 Manufacturing and Production Processes
- 10., 11. Complementary Studies Courses (two half-course equivalents)

4th Year**Manufacturing Engineering, regular program**

1. ENGG 513 The Role and Responsibilities of the Professional Engineer in Society
- 2., 3. ENMF 512 Manufacturing Engineering Design Methodology and Application (two half-course equivalents)
4. ENMF 521 Manufacturing Practicum*
5. ENMF 533 Elements of Automation
6. — 9. Technical Electives (four half-course equivalents)
- 10., 11. Complementary Studies Courses (two half-course equivalents)

** Occurs over a 2-week period during the Summer Session. This course may be taken prior to third year (subject to space limitations). Contact department for dates.*

Note: Students are encouraged to select technical electives from a similar area in order to specialize in a subject stream. The subject streams for the manufacturing engineering technical electives are: Automation (ENME 585, 599, ENMF 503, 505, 513, 515, 529), Manufacturing Systems (ENMF 501, 507, 509, 513, 527), and Design and Manufacturing Processes (ENME 521, 547, ENMF 503, 517, 577).

Manufacturing Engineering with a Minor in Mechatronics

1. ENGG 513 The Role and Responsibilities of the Professional Engineer in Society
- 2., 3. ENME 560 Mechatronics Design Laboratory (two half-course equivalents)
4. ENME 585 Control Systems
- 5., 6. ENMF 512 Manufacturing Engineering Design Methodology and Application (two half-course equivalents)
7. ENMF 521 Manufacturing Practicum*
8. ENMF 533 Elements of Automation
- 9., 10. Technical Electives (two half-course equivalents)
- 11., 12. Complementary Studies Courses (two half-course equivalents)

** Occurs over a 2-week period during the Summer Session. This course may be taken prior to third year (subject to space limitations). Contact department for dates.*

Manufacturing Engineering Approved Technical Electives**Regular program.****Select four half-course equivalents.**

ENME 521 Materials II
 ENME 547 Finite Element Method
 ENME 585 Control Systems
 ENME 599 Vibrations and Machine Dynamics
 ENMF 501 Modelling and Simulation of Manufacturing Systems
 ENMF 503 Computer Numerically Controlled Machines
 ENMF 505 Robotics
 ENMF 507 Organization and Technical Management in Manufacturing

ENMF 509 Integrated Manufacturing Systems II
 ENMF 513 Artificial Intelligence in Manufacturing
 ENMF 515 Computer-Based Control for Manufacturing
 ENMF 517 Experimental Design and Analysis
 ENMF 519 Special Topics in Manufacturing Engineering
 ENMF 527 Production and Project Engineering
 ENMF 529 Introduction to Microelectromechanical Systems
 ENMF 577 Product and Process Development

Minor in Mechatronics. Select two half-course equivalents.

ENME 547 Finite Element Method
 ENME 599 Vibrations and Machine Dynamics
 ENMF 505 Robotics
 ENMF 513 Artificial Intelligence in Manufacturing
 ENMF 515 Computer-Based Control for Manufacturing
 ENMF 529 Introduction to Microelectromechanical Systems

Mechanical Engineering

Admission

Refer to "Faculty Regulations – Admissions" above.

Requirements

See also "First Year Curriculum Requirements Common to All Programs" above.

2nd Year

Mechanical Engineering, regular program and Minors in Mechatronics and Petroleum Engineering

1. AMAT 307 Differential Equations
2. CHEM 357 Industrial Inorganic Chemistry for Engineers
3. ENGG 311 Engineering Thermodynamics
4. ENGG 319 Probability and Statistics for Engineers
5. ENGG 317 Mechanics of Solids
6. ENGG 325 Electric Circuits and Systems
7. ENGG 335 Computing for Engineers II
8. ENGG 349 Engineering Mechanics II
9. ENGG 407 Numerical Methods in Engineering
10. ENME 341 Fundamentals of Fluid Mechanics
11. PHYS 369 Acoustics, Optics and Radiation for Engineers

Block Course – ENME 001 Mechanical and Manufacturing Engineering Block Course (32 hours)

3rd Year

Mechanical Engineering, regular program and Minors in Mechatronics and Petroleum Engineering

1. ENME 421 Materials I
2. ENME 461 Mechatronics
3. ENME 471 Heat Transfer
4. ENME 473 Fundamentals of Kinematics and Dynamics of Machines
5. ENME 479 Mechanics of Materials I
6. ENME 485 Mechanical Engineering Thermodynamics
7. ENME 493 Machine Component Design
8. ENME 495 Fluid Mechanics
9. ENMF 417 Manufacturing and Production Processes
- 10., 11. Complementary Studies Courses (two half-course equivalents)

4th Year

Mechanical Engineering, regular program

1. ENGG 513 The Role and Responsibilities of the Professional Engineer in Society
- 2., 3. ENME 538 Mechanical Engineering Design Methodology and Application (two half-course equivalents)
4. ENME 585 Control Systems
5. ENME 599 Vibrations and Machine Dynamics
6. — 9. Technical Electives (four half-course equivalents)
- 10., 11. Complementary Studies Courses (two half-course equivalents)

Mechanical Engineering with a Minor in Mechatronics

1. ENGG 513 The Role and Responsibilities of the Professional Engineer in Society
- 2., 3. ENME 538 Mechanical Engineering Design Methodology and Application (two half-course equivalents)
- 4., 5. ENME 560 Mechatronics Design Laboratory (two half-course equivalents)
6. ENME 585 Control Systems
7. ENME 599 Vibrations and Machine Dynamics
8. ENMF 533 Elements of Automation
- 9., 10. Technical Electives (two half-course equivalents)
- 11., 12. Complementary Studies Courses (two half-course equivalents)

Mechanical Engineering with a Minor in Petroleum Engineering

1. ENGG 513 The Role and Responsibilities of the Professional Engineer in Society
- 2., 3. ENME 538 Mechanical Engineering Design Methodology and Application (two half-course equivalents)
4. ENPE 523 Introduction to Reservoir Engineering

5. — 9. Technical Electives (five half-course equivalents)
- 10., 11. Complementary Studies Courses (two half-course equivalents)

Mechanical Engineering Approved Technical Electives

Regular program. Select four half-course equivalents.

ENME 519 Special Topics
 ENME 521 Materials II
 ENME 547 Finite Element Method
 ENME 583 Mechanical Systems in Buildings
 ENME 587 Mechanics of Materials II
 ENME 593 Energy Systems
 ENME 595 Gas Dynamics
 ENME 597 Turbomachinery
 ENMF 401 Computer-Aided Design and Graphics
 ENMF 415 Integrated Manufacturing Systems I
 ENMF 503 Computer Numerically Controlled Machines
 ENMF 505 Robotics
 ENMF 515 Computer-Based Control for Manufacturing
 ENMF 517 Experimental Design and Analysis
 ENMF 527 Production and Project Engineering
 ENMF 529 Introduction to Microelectromechanical Systems
 ENPE 555 Oil & Gas Field Safety and Environment
 ENPE 561 Fuel Science and Technology
 ENPE 563 Materials Aspects of Oil & Gas Production
 ENPE 565 Mechanics of Oil & Gas Production
 ENPE 567 Offshore Mechanical Engineering

Minor in Mechatronics. Select two half-course equivalents.

ENME 547 Finite Element Method
 ENMF 505 Robotics
 ENMF 513 Artificial Intelligence in Manufacturing
 ENMF 515 Computer-Based Control for Manufacturing
 ENMF 529 Introduction to Microelectromechanical Systems

Minor in Petroleum Engineering. Select five half-course equivalents.

ENME 595 Gas Dynamics
 ENME 597 Turbomachinery
 ENPE 525 Waterflooding
 ENPE 533 Petroleum Production Engineering
 ENPE 555 Oil & Gas Field Safety and Environment
 ENPE 561 Fuel Science and Technology
 ENPE 563 Materials Aspects of Oil & Gas Production
 ENPE 565 Mechanics of Oil & Gas Production
 ENPE 567 Offshore Mechanical Engineering
 GLGY 377 Petroleum Engineering Geology

Oil & Gas Engineering

Admission

Refer to "Faculty Regulations – Admissions" above.

Requirements

See also "First Year Curriculum Requirements Common to All Programs" above.

2nd Year

1. AMAT 307 Differential Equations for Engineers
2. CHEM 357 Industrial Organic Chemistry for Engineers
3. ENCH 315 Chemical Engineering Process Calculation
4. ENCH 331 Process Fluid Dynamics
5. ENGG 319 Probability and Statistics for Engineers
6. ENGG 325 Electric Circuits and Systems
7. ENGG 335 Computing for Engineers II
8. ENGG 311 Engineering Thermodynamics
9. ENGG 317 Mechanics of Solids
10. ENGG 349 Engineering Mechanics II
11. GLGY 377 Petroleum Engineering Geology

3rd Year

1. ENCH 401 Analyses in Chemical, Oil & Gas Engineering
2. ENCH 403 Heat and Mass Transfer
3. ENCH 405 Separation Processes I
4. ENCH 427 Chemical Engineering Thermodynamics
5. ENPE 423 Oil & Gas Engineering Process Development
6. ENPE 507 Well Logging and Formation Evaluation
7. ENPE 515 Drilling and Well Completions
8. ENPE 523 Introduction to Reservoir Engineering
9. ENPE 525 Waterflooding
10. ENPE 533 Petroleum Production Engineering
11. Complementary Studies Course (one half-course equivalent)

4th Year

1. ENGG 407 Numerical Methods in Engineering
2. ENGG 513 The Role and Responsibilities of the Professional Engineer in Society
3. ENCH 501 Transport Processes
4. ENPE 511 Design for Oil & Gas Engineering I
5. ENPE 513 Flow in Porous Media
6. ENPE 531 Design for Oil & Gas Engineering II
7. ENPE 551 Petroleum Engineering Laboratory

- 8., 9. Technical Electives (two half-course equivalents)
10. — 12. Complementary Studies Courses (four half-course equivalents)

Oil & Gas Engineering Approved Technical Electives

Select two half-course equivalents.

- CHEM 579 Surface and Colloid Chemistry for Engineers
 ENCH 503 Upgrading and Refining Processes
 ENCH 535 Principles of Biochemical Engineering
 ENCH 537 Computational Thermodynamics
 ENPE 509 Well Testing
 ENPE 519 Special Topics
 ENPE 543 Geological Characterization of Oil and Gas Reservoirs
 ENPE 555 Oil & Gas Field Safety and Environment
 ENPE 561 Fuel Science and Technology
 ENPE 563 Materials Aspects of Oil & Gas Production

Software Engineering

Admission

Refer to "Faculty Regulations – Admissions" above.

Requirements

See also "First Year Curriculum Requirements Common to All Programs" above.

2nd Year

1. AMAT 307 Differential Equations
2. CPSC 331 Information Structures
3. ENCM 339 Programming Fundamentals
4. ENCM 369 Computer Organization
5. ENEL 327 Signals and Transforms
6. ENEL 329 Circuits for Software Engineers
7. ENEL 353 Digital Circuits
8. ENGG 319 Probability and Statistics for Engineers
9. MATH 271 Discrete Mathematics
10. PHYS 369 Acoustics, Optics and Radiation for Engineers
11. Complementary Studies Course (one half-course equivalent)

3rd Year

1. CPSC 349 Programming Paradigms
2. CPSC 441 Computer Communications
3. CPSC 457 Principles of Operating Systems
4. CPSC 471 Data Base Management Systems
5. ENCM 415 Assembly Language Programming and Interfacing
6. ENCM 491 Real-Time System Design
7. SENG 311 Principles of Software Engineering

8. SENG 411 Human and Organizational Aspects in Software Engineering
9. SENG 421 Software Metrics
10. SENG 443 Software Architectures
11. Complementary Studies Course (one half-course equivalent)

4th Year

1. CPSC 411 Compiler Construction
2. ENGG 513 The Role and Responsibilities of the Professional Engineer in Society
3. ENSF 583 Fourth Year Software Team Design Project, Part A
4. ENSF 589 Fourth Year Software Team Design Project, Part B
5. SENG 521 Software Reliability and Testing
6. — 9. Technical electives (four half-course equivalents)
- 10., 11. Complementary Studies Courses (two half-course equivalents)

Block Course — ENSF 007 Introduction to the Fourth Year Software Engineering Team Design Project (20 hours)

Note: Students who took CPSC 599.24 (Compiler Construction) as part of their 3rd year program should not take CPSC 411 in 4th year; instead they must include CPSC 449 (Principles of Programming Languages) in their 4th year programs.

Software Engineering Approved Technical Electives

Select four half-course equivalents.

- CPSC 453 Introduction to Computer Graphics
 CPSC 471 Data Base Management Systems
 ENCM 503 Digital Video Processing
 ENCM 505 Parallel Computer Architectures
 ENCM 515 Digital Signal Processors
 ENEL 525 Neuro-Fuzzy and Soft Computing
 ENEL 529 Wireless Communications Systems
 ENEL 571 Digital Communications
 ENEL 573 Telecommunication and Computer Communications
 ENEL 579 Optical Fibre Communications
 ENEL 593 Digital Filters
 ENSF 519 Special Topics in Software Engineering
 ENSF 591 Individual Software Engineering Project, Part II (1 session)
 ENSF 598 Individual Software Engineering Research Project (2 sessions, two half-course equivalents)
 ENSF 599 Individual Software Engineering Project (1 session)
 SENG 501 Advanced Topics in Software Engineering
 SENG 511 Software Process Improvement
 SENG 513 Web Engineering
 SENG 523 Formal Methods
 SENG 531 Software Evolution
 PHIL 279 Logic I or PHIL 377 Elementary Formal Logic

Note: Selection of a course not on this list requires department approval. Elective courses are offered, in any calendar year, at the discretion of the department.

Note: CPSC 471, Data Base Management Systems, may be used as a technical elective only by students whose programs did not include CPSC 471 as a required course.

Note: Students may not take CPSC 471 as a technical elective if they have already completed ENSF 519.31 or ENCM 519.31.

Biomedical Engineering Specialization

Introduction

The Biomedical Engineering Specialization [BMES] allows a student to fulfill the requirements for a BSc degree in Civil, Chemical, Electrical, Geomatics, Manufacturing or Mechanical Engineering and at the same time complete a program in Biomedical Engineering.

Admission

First year Engineering students wishing to enter the Biomedical Engineering Specialization must apply for admission to the Biomedical Engineering Specialization program at the same time the choice of an engineering program is made.

Requirements

See also "First Year Curriculum Requirements Common to All Programs" above.

2nd Year

The second year BMES program is the same as the second year programs in Chemical, Civil, Electrical, Geomatics, Manufacturing or Mechanical Engineering regular programs above with the exception that:

- BMES students take the additional courses ENBM 309 Anatomy and Physiology for Engineers and ENBM 003 Health Care Management.
- BMES students attend regular ENGG 319 lectures but take a special BMES tutorial on applied statistics for the experimental sciences.
- Civil, Chemical, Geomatics, Manufacturing and Mechanical Engineering students in the BMES program take ENBM 325 Instrumentation and Measurement in Biomedical Engineering instead of ENGG 325 Electric Circuits and Systems.
- Electrical Engineering students in the BMES program take ENBM 327 Instrumentation and Measurement in Biomedical Engineering for Electrical Engineers instead of ENEL 341 Circuits I.

3rd and 4th Years

Students in the BMES program complete courses in the regular Engineering program for their discipline except that they take specialized BMES technical electives and a third year course on Biomedical Engineering

Research. BMES students in the fourth year of their program complete a capstone Biomedical Engineering Research Thesis.

Further information regarding the BMES program is available through the Faculty of Engineering Undergraduate Studies Office.

BMES Practicum

All BMES students are required to fulfill BMES Practicum requirements. This can be satisfied either through a regular Engineering Internship placement (between the third and fourth academic years) or through three summer BMES Practicum placements (totaling at least 12 months). Experience must be obtained with a suitable bio-engineering company/research laboratory or university research laboratory. All placements must be approved in advance by the Director of the Engineering Internship Program.

Combined Programs

An engineering undergraduate degree may be combined with any other undergraduate degree program on campus. Students may either be admitted to two degree programs when they first apply to the University or may seek admission to a second degree program after being admitted to engineering. Students are reminded that all degree programs at the University of Calgary are subject to quotas and it is the student's responsibility to meet the admission requirements for the second degree. Students should consult the engineering website or inquire at the Engineering Undergraduate Studies Office for more information.

BSc(Eng)/BA and BSc(Eng)/BSc Programs with the Faculties of Humanities and Social Sciences

Admission

Refer to "Faculty Regulations – Admissions" above.

Note: A quota applies to admission to the Psychology program. Students wishing to pursue a combined degree in Engineering and Psychology must consult the Associate Dean (Student Affairs) in the Faculty of Engineering regarding admission procedures.

Requirements

A combined Engineering degree and a BA degree in Humanities or a BA or BSc in Social Sciences can be obtained by taking a prescribed program over a period of five years. The framework of this program is summarized as follows (there are slight variations depending upon the combined degree sought):

1st Year

Four and one-half full-course equivalents from the first year engineering program

One full-course equivalent from Humanities/Social Sciences Major

2nd Year

One half-course equivalent from the first year engineering program

Two and one-half full-course equivalents from the second year engineering program
Two full-course equivalents from Humanities/Social Sciences Major

One full-course equivalent from the Engineering Complementary Studies requirement
3rd Year

Three full-course equivalents from second year engineering program

Two full-course equivalents from Humanities/Social Sciences Major

Communications Studies 361

4th Year

Required courses from third year engineering specialization

One full-course equivalent from Humanities/Social Sciences Major

5th Year

Required courses from fourth year engineering specialization

One full-course equivalent from Humanities/Social Sciences Major

Engineering 513

Other Requirements

Students planning a Humanities Major in French or German should present Alberta Grade XII standing in the subject area. Programs of students in the combined degrees will be approved by the associate deans of both faculties. Upon successful completion of the program requirements students will receive two degree parchments.

Note: Students seeking a BA in International Relations in the Faculty of Social Sciences must fulfill the requirement of two full-course equivalents in a modern language other than English in addition to the requirements listed above.

Regulations

It is possible for students to opt out of a combined degree program after one year and complete either the BSc (Engineering) or the Humanities or Social Sciences degree in the normal time.

Diplomas

Diploma of the Faculty of Engineering

Introduction

The Faculty of Engineering sponsors a diploma program providing additional special qualifications in designated departments which lead to the Diploma of the Faculty of Engineering. The designated departments offering the diploma program are: Chemical & Petroleum, Civil, Electrical & Computer, and Mechanical & Manufacturing Engineering. This program is intended primarily for professional engineers engaged in practice who are not interested in submitting to the discipline of a true graduate degree including a thesis, or who are unable to meet the residence requirements of the MSc degree.

Admission

Admission to the diploma program may be granted to holders of an approved degree or its equivalent. Engineers, without a degree, who are registered as Professional Engineers with the Association of Professional Engineers, Geologists and Geophysicists of Alberta, or an equivalent association, may also be eligible for admission to the diploma program.

Requirements

The diploma program consists of eight half courses of which at least four must be graduate courses in engineering. Courses which normally fall within an undergraduate program in the same area in which the diploma is sought will not be credited toward the diploma.

Regulations

A student must obtain a grade point average of at least 2.50 in the courses taken for credit toward the diploma. The minimum passing grade in courses taken for credit in the diploma program is "C."

Enquiries about the diploma program should be directed to the department in which the diploma is sought.

Environmental Engineering

The Faculty of Engineering also sponsors a diploma program providing additional specialization in Environmental Engineering, intended for professional engineers or holders of equivalent approved degrees and leading to the Diploma of the Faculty of Engineering in Environmental Engineering. The admission criteria, requirements and regulations for the diploma are the same as for the Diploma of the Faculty of Engineering. Enquiries about the specialization in Environmental Engineering should be directed to the Department of Civil Engineering.

Diploma of the Faculty of Engineering and the Haskayne School of Business in Project Management Specialization

Introduction

The Faculty of Engineering and the Haskayne School of Business jointly sponsor a diploma program providing additional special qualifications in the area of Project Management which leads to the Diploma of the Faculty of Engineering and of the Haskayne School of Business in Project Management. This program is intended primarily for professionals engaged in practice who are not interested in the MSc or MEng degrees.

Admission

Admission to the diploma program may be granted to holders of an approved Engineering degree, Engineers without a degree who are registered with APEGGA or an equivalent association, and those having equivalent qualifications or experience as determined by the Director of the Project Management specialization.

Criteria for admission to the Diploma with a Specialization in Project Management of the Faculty of Engineering and the Haskayne School of Business are as follows:

1. An approved Engineering degree or registration with APEGGA or an equivalent association or equivalent qualifications or experience as determined by the Director of the Project Management Specialization;
2. Up to five years of relevant experience in industry as determined by the Director of the Project Management Specialization;
3. Successful completion of up to four courses in the Project Management Specialization with a grade point average of at least 2.50, and a minimum passing grade of "C" for all courses.

Requirements

The diploma program consists of eight half courses of which at least six must be graduate courses in project management. Courses which fall within an undergraduate program in the area of Project Management will not normally be credited toward the diploma.

Regulations

A student must obtain a grade point average of at least 2.50 in the courses taken for credit toward the diploma. The minimum passing grade in courses taken for credit in the diploma program is "C."

Enquiries about the diploma program should be directed to the Director of the Project Management specialization.

Engineering Internship Program

Introduction

The Engineering Internship Program is a five-year program which includes, in addition to the regular four-year academic program, an internship year (a minimum of twelve and a maximum of sixteen consecutive months) of supervised work experience in industry. The internship year may commence in May or September after the student has completed the first three years of the Engineering program. The student is expected to return to complete the final academic year of the program in September of the following year. In certain circumstances, it may be possible to commence the internship year in January, and return to the academic program the following January. Interested students are encouraged to contact either the Engineering Internship office or the Career Services Office.

Admission

Students are encouraged to apply to the Career Services Office after the completion of their second year, and before October 1 in their third year. Students who do not meet the application deadline should contact the

Engineering Internship Office regarding admission.

To be provisionally admitted to the Engineering Internship Program, students must be full-time students in good academic standing after second year, and have completed the Career Development Workshop. In addition, a personal interview with the Executive Director or the Associate Director of the Engineering Internship Program is mandatory. Only students who are eligible for full-time registration in the Faculty of Engineering at the time they apply for the internship program and at the time they expect to start their internship are eligible for access to the placement processes of the Engineering Internship Program. Students are formally admitted to the program when they accept their first placement. Students should refer to the Co-operative Education/Internship section of this Calendar for general admission requirements.

Requirements

Students must complete a minimum of twelve months work experience while registered in the Internship courses, Internship in Engineering 513.01-04, in addition to the regular requirements for the BSc in Engineering. Students who have completed any portion of the twelve month requirement will not be permitted to apply for positions that extend beyond either the sixteen month maximum permitted to complete the requirements, or the date on which they are expected to resume their academic program.

Regulations

If a student's academic performance in the third year results in the student being required to withdraw from the Faculty of Engineering, or being placed on probation, the student will be required to withdraw from the Engineering Internship Program. Students who have been required to withdraw from the Engineering Internship Program will no longer have access to the program's job search systems or support. If the student is required to withdraw from the Engineering Internship Program but has already accepted a placement, the employer will be informed that the student is no longer registered in the Internship Program.

Students who have completed the twelve month minimum requirement will not be permitted to apply for further internship positions.

Students who have accepted a placement obtained through the Co-op/Internship Placement process are required to register in the Internship courses corresponding to the length of the placement. Students failing to do so will be registered by the office of Co-operative Education in the appropriate course(s) and appropriate fees will be payable.

In order to have the Internship designation appear on the BSc parchment, a student must complete the twelve-month minimum requirement and pass the requisite internship courses.

Each work experience is supervised by a Professional Engineer in the host company. Normally the entire internship year is spent with the same employer. Students are required to present letter reports to the Engineering Internship Office at the end of each four month period during the internship year. In addition, a comprehensive report on the student's work experience is required at the end of the internship assignment. This comprehensive report must be approved by the student's work supervisor and is marked and graded by members of the Faculty.

Minor

Minor in Entrepreneurship and Enterprise Development in the Faculty of Engineering

Introduction

The Faculty of Engineering in partnership with the Haskayne School of Business offers a Minor in Entrepreneurship and Enterprise Development (MEED) open to all engineering students. MEED typically commences in year two of the engineering program and consists of five Entrepreneurship and Innovation (ENTI) courses, all of which are currently offered by the Haskayne School of Business plus any five fourth-year engineering courses that are taken as part of the normal requirements for the engineering degree. Thus, to satisfy MEED requirements, students must receive credit for five half courses over and above the engineering degree requirements.

Admission

Students apply for admission to MEED at the same time as they apply for their choice of engineering program specialization, in April of their first year. Admission to the MEED program is limited to 50 students. In the event that the number of applicants exceeds

the number of spaces available, admission will be decided on the basis of academic performance, using the same process as is used for admission to the engineering program specialization. If students apply later in their program than second year, they will be admitted in order of academic performance according to the number of spaces available. Students are encouraged to apply as soon as possible in order that the Haskayne School of Business may plan for the required number of places in the ENTI courses. Application forms are available from and should be submitted to the Undergraduate Studies Office, Faculty of Engineering. Admission to the program depends upon the availability of space in the required ENTI courses.

Requirements

Students must receive credit for five half courses in addition to five fourth-year engineering courses that are part of the undergraduate engineering degree requirements. The five courses that are done in addition to the engineering degree requirements are:

1. ENTI 201 Introduction to Business Venturing
2. ENTI 381 Introduction to Entrepreneurship
3. ENTI 401 Opportunity Identification
4. ENTI 405 New Venture Start-Up
5. One of the following options:
BSEN 395 Business Law for Strategic Decision-Makers*
ENTI 403 New Venture Planning
ENTI 499 Family Business Management
FNCE 341 Canadian Business Finance
FNCE 343 Personal Financial Management
HROD 321 Human Resources and Organizational Dynamics**

MGIS 321 Information Systems in Business Organizations

MKTG 341 Introduction to Marketing

OPMA 301 Introduction to Production and Operations Management**

Note: ENTI 201 and 381 must be taken first in order to fulfill prerequisite requirements for the other ENTI courses.

* Not available as an option to Geomatics Engineering students who have completed OPMA 301 as a Technical Elective in their Geomatics program.

** Not available as an option to students in Manufacturing Engineering.

Regulations

Regulations of the Faculty of Engineering apply to students taking MEED courses. In order to have the Minor in Entrepreneurship and Enterprise Development appear on the student's transcript, the five-course MEED program must be completed before the student graduates.

Administration

Faculty Administrative Officers

Dean

S.C. Wirasinghe

Associate Dean (Academic)

L. E. Turner

Associate Dean (Research)

M. Sideris

Associate Dean (Student Affairs & Internship)

M.J. Collins

Director of the Engineering Internship Program

N. Dorjee

