

# Faculty of Engineering

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## 81 Members of the Faculty

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### 81.1 Officers of the Faculty

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#### Professor and Dean

DT Lynch, PhD, PEng

#### Associate Deans

KC Porteous, PhD, PEng

PK Robertson, PhD, PEng

#### Ernest E and Gertrude Poole Chair in Management for Engineers

JR McDougall, BSc, PEng

#### Administrative Officers

RM Green, MA

LE Swanson, MSc

### 81.2 Chemical and Materials Engineering

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#### Professor and Chair

SE Wanke, PhD, PEng

#### Professors Emeriti

N Berkowitz, PhD, PEng

SA Bradford, PhD, PEng

IG Dalla Lana, PhD, PEng

DG Fisher, PhD, PEng

W Nader, Dr Phil

FD Otto, PhD, PEng, FCAE

DB Robinson, PhD, PEng

JT Ryan, PhD

RK Wood, PhD, PEng

#### Professors

KT Chuang, PhD, PEng

RL Eadie, PhD, PEng

NO Egiebor, PhD, PEng

TH Etsell, PhD, PEng

MR Gray, PhD, PEng

RE Hayes, PhD, PEng

H Henein, PhD, PEng

DG Ivey, PhD (NSERC University Research Fellow)

DT Lynch, PhD, PEng

JH Masliyah, PhD, PEng, FRSC (NSERC Industrial Research Chair in Oil Sands)

AE Mather, PhD, PEng

K Nandakumar, PhD, PEng

BM Patchett, PhD, PEng

KC Porteous, PhD, PEng

SL Shah, PhD, PEng

ML Wayman, PhD, PEng

MC Williams, PhD

#### Associate Professors

SM Kresta, PhD, PEng

M Rao, PhD

Z Xu, PhD

#### Assistant Professors

RP Batycky, PhD

JAW Elliott, PhD

JF Forbes, PhD, PEng

S Liu, PhD

J Luo, PhD

TM Maccagno, PhD

WC McCaffrey, PhD

PAJ Mees, PhD

### 81.3 Civil and Environmental Engineering

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#### University Professor and Chair

NR Morgenstern, PhD, PEng, FRSC, FCAE

#### University Professor Emeritus

JG MacGregor, PhD, PEng, FRSC, FCAE

#### Professors Emeriti

PF Adams, PhD, PEng, FCAE

KO Anderson, MSc, PEng

JJ Baker, MSCE, PEng

PH Bouthillier, MSc, PEng

PM Dranchuk, MSc, PEng

Z Eisenstein, PhD, PEng

DL Flock, PhD, PEng

EL Fowler, MSc, PEng

WH Griffin, MSc, PEng

DJL Kennedy, PhD, PEng

GL Kulak, PhD, PEng (C W Carry Chair in Steel Structures)

EO Lilge, MSc, PEng

J Longworth, MSc, PEng

DW Murray, PhD, PEng

TH Patching, BSc, PEng

AW Peterson, MSc, PEng

LR Plitt, MSc, PEng

WW Preston, BSc

JD Scott, PhD, PEng

SH Simmonds, PhD, PEng

S Thomson, PhD, PEng

JP Verschuren, PhD, PEng

J Warwaruk, PhD, PEng

WA Weir, BSc, PEng

JM Whiting, PhD, PEng

GT Wormsbecker, BSc, PEng

#### Professors

SM AbouRizk, PhD, PEng (Alberta Construction Industry/NSERC Senior Industrial Research Chair in Construction Engineering and Management)

K Barron, PhD, PEng

RG Bentsen, PhD, PEng

J-J Cheng, PhD, PEng

DM Cruden, PhD, PGeol (Joint Appointment with Geology)

SP Dozzi, MEng, PEng

AE Elwi, PhD, PEng

SM Farouq Ali, PhD, PEng

GR Finch, PhD, PEng

TM Hrudey, PhD, PEng

IR Muirhead, MA, PEng

AE Peterson, MSc, PEng

N Rajaratnam, PhD, PEng

PK Robertson, PhD, PEng

DM Rogowsky, PhD, PEng

DC Sego, PhD, PEng

DW Smith, PhD, PEng

PM Steffler, PhD, PEng

J Szymanski, PhD, PEng

S Teply, PhD, PEng

#### Associate Professors

KW Biggar, PhD

DH-K Chan, PhD, PEng

S Frimpong, PhD, PEng

TY Gan, PhD, PEng

FE Hicks, PhD, PEng

CA Zeiss, PhD, PEng

#### Assistant Professors

SDB Alexander, PhD, PEng

ST Ariaratnam, PhD

ID Buchanan, PhD

QT Doan, PhD, PEng

A Fayek, PhD

GY Grondin, PhD, PEng

WB Kindzierski, PhD, PEng

SJ Stanley, MSc, PEng

#### Industrial Professor, Safety and Loss Management

AL Wilson, BSc, PEng

#### Faculty Service Officer

GS Hoye, PhD

#### Administrative Officer

PA Barrow, MSc, PEng

### 81.4 Electrical and Computer Engineering

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#### Professor and Chair

CE Capjack, PhD, PEng

#### University Professor Emeritus

GB Walker, PhD, PEng

#### Professors Emeriti

KE Bollinger, MSc, PEng

GS Christensen, PhD, PEng

FS Chute, PhD, PEng

GD Cormack, PhD, PEng

CG Englefield, PhD

PA Goud, PhD, PEng

V Gourishankar, PhD, PEng

PJR Harding, MASc, PEng

CR James, PhD, PEng

DH Kelly, PhD, PEng

RW King, BSc, PEng

YJ Kingma, Ir, PEng

AA Offenberger, PhD  
 RE Phillips, BSc, PEng  
 RE Rink, PhD, PEng  
 HG Schmidt-Weinmar, PhD  
 PR Smy, PhD, DSc, PEng  
 KA Stromsmoe, PhD, PEng  
 WAG Voss, PhD

**Professors**

MJ Brett, PhD, PEng  
 J Conradi, PhD, PEng (NSERC/Nortel/TRLabs Chair in Fibre Optic Communications)  
 NG Durdle, PhD, PEng  
 R Fedosejevs, PhD, PEng  
 I Filanovsky, PhD  
 WD Grover, PhD, PEng  
 WB Joerg, Dipl Math  
 DO Koval, PhD, PEng  
 WA Krzymien, PhD, PEng  
 RPW Lawson, PhD, PEng  
 RI MacDonald, PhD, PEng  
 JN McMullin, PhD  
 AM Robinson, PhD, PEng  
 D Routledge, PhD, PEng  
 JC Salmon, PhD  
 HJJ Seguin, PhD, PEng  
 WR Tinga, PhD, PEng  
 J Tulip, PhD  
 JF Vaneidik, PhD, PEng  
 FE Vermeulen, PhD, PEng

**Associate Professors**

T Chen, PhD  
 BF Cockburn, PhD, PEng  
 SK Dew, PhD  
 WW Xu, PhD

**Assistant Professors**

DG Elliott, PhD  
 HJ Marquez, PhD  
 Q-HM Meng, PhD  
 X Sun, PhD

**81.5 Mechanical Engineering**

**Professor and Chair**  
 TW Forest, PhD, PEng

**Professors Emeriti**

DG Bellow, PhD, PEng, FCAE  
 KC Cheng, PhD  
 JR Colbourne, PhD, PEng  
 A Craggs, PhD, PEng  
 G Ford, PhD, PEng  
 JB Haddow, PhD  
 JS Kennedy, PhD, PEng  
 GSH Lock, PhD, PEng  
 DJ Marsden, PhD, PEng  
 CM Rodkiewicz, PhD  
 GW Sadler, MSc, PEng  
 JC Sprague, PhD, PEng  
 FH Vitovec, Dr TechSci, PEng

**Professors**

DR Budney, PhD, PEng  
 MD Checkel, PhD, PEng  
 JD Dale, PhD, PEng  
 F Ellyin, PhD, PEng (NSERC Industrial Research Chair in Advanced Pipeline Materials)  
 MG Faulkner, PhD, PEng  
 WH Finlay, PhD, PEng  
 AW Lipsett, PhD, PEng  
 A Mioduchowski, PhD, PEng  
 DJ Steigmann, PhD  
 JD Whittaker, PhD, PEng  
 DJ Wilson, PhD, PEng

**Associate Professors**

KR Fyfe, PhD, PEng  
 LW Sigurdson, PhD, PEng  
 RW Toogood, PhD, PEng  
 JW Yokota, PhD  
 M Zuo, PhD

**Assistant Professors**

A Bhattacharyya, PhD  
 ZJ Gao, PhD  
 LW Kostiuik, PhD  
 D Li, PhD  
 P Schiavone, PhD  
 Z Xia, PhD

**Faculty Service Officer**

MY Ackerman, MSc, PEng

**81.6 Sessional Lecturer in Engineering**

BR Touchings, LLB

**81.7 Engineering Co-op Centre****Professor and Director**

KC Porteous, PhD, PEng

**Assistant Director and Coordinator**

CJ Ottosen, BEd

**Administrative Officers**

CM Ens, BCom, Coordinator  
 JL Esdale, BEd, Coordinator  
 RC Kully, BEd, Coordinator  
 BJ Strang, BA, Coordinator  
 LJ Szekeley, BEd, Coordinator

**81.8 Additional Members of Faculty Council****President and Vice-Chancellor**

RW Fraser, PhD

**Professors**

JJ Leonard, PhD, PEng (Agricultural, Food, and Nutritional Sciences)  
 TA Marsland, PhD (Computing Science)  
 PE Prestwich, PhD (History and Classics)  
 TJT Spanos, PhD (Physics)

**Associate Professors**

JR Beamish, PhD (Physics)  
 UM Maydell, MSc (Computing Science)  
 JD Mulvihill, PhD (English)  
 M Shirvani, PhD (Mathematical Sciences)

**Representatives**

(The Association of Professional Engineers, Geologists, and Geophysicists of Alberta)  
 VSV Rajan, PhD, PEng

**Representatives from Engineering Students**

ED Carcoux (Undergraduate)  
 S Shorey (Undergraduate)  
 A Muradali, BSc (Graduate)  
 KJ Robbie, BSc (Graduate)

**Registrar of the University**

BJ Silzer, MEd

**82 General Information****82.1 BSc Engineering**

The Faculty of Engineering offers undergraduate programs leading to BSc degrees in Chemical Engineering, Civil Engineering, Computer Engineering, Electrical Engineering, Engineering Physics, Mechanical Engineering, Materials Engineering, Mining Engineering and Petroleum Engineering.

All engineering students follow a common curriculum in their first year and take courses in Chemistry, Mathematics, Physics, Computing, Humanities, Engineering Mechanics, and Introduction to the Engineering Profession. In March of the first year, students are asked to make a choice among the various engineering disciplines offered and also between the traditional and cooperative education streams. The disciplines and education streams are described in the following sections.

The second-year program includes courses such as Mathematics and English which are common to all departments as well as courses specific to the chosen discipline. As the student progresses through the program the courses taken become more specialized. Also, exposure to basic business concepts is an important aspect of an engineering education. Programs for all disciplines include courses in engineering economics and several engineering management and business electives are available. Enrolment in all Engineering programs is limited.

**82.2 Cooperative Education Program**

The Faculty of Engineering offers two types of degree programs: the traditional program and the cooperative education program. Students in the traditional program attend classes from September to April over a four-year period (eight academic terms) to obtain their degree. In the cooperative education program, students complement their academic studies with five four-month work terms of paid work experience. The academic requirements for both programs are identical. Because of the work experience component, co-op students complete the last six academic terms over a four-year period so a degree with the Cooperative Program designation requires five years.

The cooperative education program is offered in all engineering programs with the exception of Engineering Physics. Programs normally include one fall work term (September to December), one winter work term (January to April) and three summer work terms (May to August). The sequence of

academic and work terms for each discipline is illustrated in §84.4. Because of the year round nature of the cooperative program, co-op students are considered to be full-time students of the University of Alberta for the full 12 months of any academic year (July 1–June 30).

Students accepted into the cooperative education program must successfully complete the following six courses in addition to the regular requirements for an engineering degree within their specialization: ENGG 299, WKEXP 901, WKEXP 902, WKEXP 903, WKEXP 904, and WKEXP 905.

Since work experience is a program requirement, the Engineering Co-op Centre within the Faculty of Engineering assists students in finding suitable engineering-related employment. Most of the jobs are within Alberta but some jobs are located elsewhere in Canada or even overseas. The ultimate responsibility for obtaining work-term employment rests with the student. Co-op students pay a modest administrative fee for each work term. Visa students (student visitors) are not eligible for the cooperative education program.

## 82.3 Chemical Engineering

Every day we use many products of chemical industries. We take it for granted that enough steel is available to build all of the cars, bridges, railways, and machines we need. We never doubt that there will be enough fertilizer for our farms; that oil, gas, electricity, and clean water will be provided to our homes; that we can buy clothes in a variety of fabrics in a rainbow of colours; and that solutions will become available for our environmental problems. Those people who have not lived through a major war or visited a developing region of the world find it difficult to imagine life without the products of chemical industries.

Chemical engineers design the complex plants needed to convert a laboratory or pilot scale experiment into an industrial operation capable of producing tons of material every day. They supervise the construction of these plants, and are also involved in running and maintaining them. These activities call for a thorough understanding of the chemistry of a process, but require many other skills as well.

The chemical engineer must understand the physics and mathematics which lie behind the problems of heat and mass flow when very large quantities of reacting material have to be heated or cooled, and moved from one section of the plant to another. He or she must understand the properties of the materials available to build the plant; how they will stand up to high pressures and temperatures, and how they will resist corrosion and wear. In the design and operation of biotechnology or environmental protection processes, the Chemical engineer also needs to understand the basic biological principles.

Students study the fundamentals of chemistry, physics, and mathematics, then go on to learn engineering science and design. By selecting appropriate electives, students can specialize in advanced materials, biotechnology, engineering management, environmental engineering, petroleum and natural gas, polymers or process control. The computer process control option (described below) is unique to the University of Alberta.

Graduates are well equipped to embark on careers in the chemical, petrochemical, food processing, forest products, pharmaceutical, and semiconductors industries, or work for a government agency.

### 82.3.1 Computer Process Control Option in Chemical Engineering

With the increased use of distributed digital computer control systems in the process industries, as well as microprocessor-based analyzers and instruments, there is a need for process engineers that have a background in areas that have traditionally been in the domain of the electrical engineer and computing scientist. This program, which retains all of the core chemical engineering courses, is designed to provide the necessary background for engineering positions that are concerned with the application of computers to the control of process systems.

Enrolment in this option is limited.

### 82.3.2 Elective Patterns in Chemical Engineering

In addition to required courses, programs in Chemical Engineering offer considerable flexibility through electives to develop interdisciplinary interests or to study certain fields in some depth.

A brief description of some fields in which electives may be chosen follows:

(1) **Advanced Materials and Polymers:** The remarkable advances in current technology are supported by new materials with unique properties, fabricated from metals, ceramics, semiconductors, and synthetic organic polymers. Development of these new materials involves a broad spectrum of basic science and engineering disciplines. Chemical engineering students who select electives in the advanced materials

program will be able to make significant contributions to this interdisciplinary field. As an alternative, students can focus on polymer materials, wherein the molecules are engineered to achieve unique properties. Chain-like polymer molecules are designed for end uses such as plastics, rubbers, fibres, films, and combinations with other materials to form composites. The chemical engineer, with a solid background in chemistry, is ideally suited for specialization in this area of materials engineering.

- (2) **Biotechnology:** Advances in molecular biology have given rise to important new biotechnology industries, which produce a range of products for medical, agricultural, food, and chemical applications. Chemical engineers work in this industry on the design, development, and operation of product and separation processes. Interested students can pursue specialization in biotechnology by supplementing their chemistry training with courses in the life sciences and biochemical engineering. This program also provides the necessary background for graduate study in engineering aspects of biotechnology.
- (3) **Process Control:** Industrial plants although designed for steady state operation often do not operate in this manner due to planned changes in process conditions or from unexpected disturbances, such as changes in raw materials. Process control is concerned with the development of control systems ranging from schemes that use simple instruments to sophisticated distributed digital computer systems which will keep industrial units operating at the desired conditions. An introduction to some of the more advanced concepts in process control can be obtained by selecting one or more of the appropriate elective courses given by the Department. Students interested in pursuing a career in the control and instrumentation field should consider the "Computer Process Control Option" described in §82.3.1.
- (4) **Environmental Engineering:** As a result of the need to protect the quality of our environment, many chemical engineers are involved in developing technically and economically feasible solutions to environmental pollution problems. Chemical engineering electives, and courses offered by the Department of Civil and Environmental and Mechanical Engineering and by Faculties outside of Engineering will help students become aware of environmental technology and also serve as appropriate background for those desiring to specialize in the environmental field.
- (5) **Engineering Management:** Chemical engineers very frequently are employed in a position in which their primary function is technical management. For engineers involved in production or design, many tasks will involve establishing optimal operating conditions. The Department elective course in optimization, taken in conjunction with courses offered by the Department of Mechanical Engineering in the operations management area will provide pertinent background material for students interested in technical management.
- By proper choice of electives, students may, depending on their academic standing, be able to select courses that may be applied for advance credit towards a Master of Business Administration (MBA) or Master of Arts (MA) in Economics.
- (6) **Oil and Natural Gas:** Chemical Engineering graduates often find employment in industries which produce, process and refine natural gas, petroleum, and oil sands. The Department offers electives in natural gas processing and properties of heavy oils and petroleum. Elective courses, concerned with petroleum production, are offered by the School of Mining and Petroleum Engineering.

## 82.4 Civil Engineering

Civil engineers apply science in the planning, design, construction, operation, or management of airports, buildings, bridges, harbours, highways, flood control structures, transit systems, water supply and distribution systems, waste collection and storm drainage, and other public works. Today, Civil engineers are being asked to meet the challenges of pollution, the deteriorating urban infrastructure, traffic congestion, energy needs, urban development, and community planning.

Civil Engineering offers a virtually unlimited range of career opportunities to satisfy individual interests, aptitudes, and goals. Civil engineers can specialize in one field or a combination of many technical specialties. They can direct their efforts into planning, design, construction, research, teaching, sales, or management.

The University of Alberta curriculum provides the preparation required for a career in Civil Engineering. All students take a core program which provides the basis for professional practice in the Civil Engineering disciplines of construction, environmental, geotechnical, structural, surveying, transportation, and water resources. Students then select elective courses in the fourth year to permit some degree of specialization in these disciplines.

## 82.4.1 Disciplines in Civil Engineering

### Construction Engineering

Construction engineers combine engineering and management disciplines to plan and execute projects. They apply their knowledge of construction methods and equipment to ensure that work is completed on time, within budget, safely, and in accordance with the designer's specifications. Construction engineers will lead a team of financial planners, technicians, tradespeople, and professional engineers from other disciplines.

### Environmental Engineering

Environmental engineers incorporate the principles of chemistry, biology, microbiology, mathematics, chemical engineering, and civil engineering to provide technological solutions to environmental problems such as water pollution control, the provision of safe drinking water, disposal and recycling of solid wastes, and hazardous waste. In addition, Environmental engineers are concerned about the provisions of municipal services such as sewers, water mains, and solid waste collection.

### Geotechnical Engineering

Geotechnical engineers analyze the properties of soils and rock, both in the field and in the laboratory, which supports and affects the behaviour of structures, pavement, and underground facilities. They evaluate the potential settlement of buildings, the stability of slopes and fills, the analysis of landslides, the seepage of groundwater, and effects of earthquakes. Geotechnical engineers and Structural engineers design the construction of dams, foundations of buildings, and tunnels.

### Structural Engineering

Structural engineers plan and design all kinds of structures including buildings, bridges, storage tanks, containment facilities, and towers. They analyze the forces that each structure must resist, select the appropriate construction materials (concrete, steel, timber, or other materials) and proportion all members and connections to produce a safe and economical structure. Structural engineers also plan and supervise the construction of these structures.

### Surveying Engineering

Surveying engineers make precise measurements of the earth's surface to obtain reliable information for locating and designing engineering projects. They use data from satellites, aerial and terrestrial photogrammetry, and computer-processed satellite imagery. Their maps give accurate information for building highways and dams, for boring tunnels, plotting flood control and irrigation projects, and for virtually all other areas of Civil Engineering.

### Transportation Engineering

Transportation engineers plan and design for the safe and efficient movement of both people and goods. They construct and manage all types of transportation facilities including streets and highways, transit systems, airports, railroads, ports, and harbours.

### Water Resources Engineering

Water Resources engineers use their expertise in areas such as hydraulics, hydrology, fluid mechanics, coastal and river engineering, water resources management and planning, mathematics and computer analysis to solve problems associated with the control and use of water. This includes flood control and protection, water distribution and wastewater collection systems, hydroelectric power development, road and pipeline river crossings, irrigation, drainage, coastal and bank erosion protection, and marine and river navigation facilities.

## 82.4.2 Environmental Engineering Option in Civil Engineering

Interest in design, construction, operation, and maintenance of developments with minimal impact on public and environmental health for all aspects of the biosphere is a major component of engineering. The ability to incorporate the principles of chemistry, biology, microbiology, mathematics, chemical engineering, and civil engineering to provide project analysis, technological solutions, risk assessment, impact minimization, and environmental management are the essentials of environmental engineering. The most common areas of interest are provision of safe drinking water, water pollution control, disposal and recycling of solid and hazardous wastes, and air quality control in both the industrial and municipal environments. Environmental engineers are also involved in the provision of municipal components such as water mains, sewers, storm sewers, and solid waste collection.

Enrolment in this option is limited.

## 82.5 Computer Engineering

Computer systems are a critical component of many consumer products which we take for granted in modern life. For example, computers are found in automobiles, compact disk players, and telephones. Computers are also a key element of industrial products such as electronic instruments,

biomedical instruments, communications equipment, and chemical plant control systems. Computer Engineering is the discipline which is concerned with the design of computer systems for applications such as these.

A computer system consists of both hardware and software components, and the computer engineer must be knowledgeable in the design of both components. The Computer Engineering program provides the fundamentals of hardware design through courses in electrical circuits, electronics, digital systems, computer organization, and microcomputer systems. The fundamentals of software design are provided through courses in data structures, algorithm design, operating systems, and software engineering. Students also take courses dealing with the key application areas of computers, namely control systems and communication systems. Students also have the opportunity of taking several elective courses in Electrical Engineering and Computing Science.

Computer engineers are uniquely equipped in being educated to design computer systems where the hardware and software components are closely coupled, and where both components are critical to the success of the design. In addition, the background of our graduates is sufficiently broad that they are able to pursue careers in related areas, ranging from software design and systems analysis to electronics design.

Computer Engineering draws on material from the two disciplines of electrical engineering and computing science. Because of this, the Computer Engineering program is offered jointly by the Department of Electrical and Computer Engineering and the Department of Computing Science. The program is administered by the Division of Computer Engineering (a division of the Department of Electrical and Computer Engineering) which is headed by the Director of Computer Engineering.

## 82.6 Electrical Engineering

Electrical Engineering encompasses the study and understanding of all aspects of electrical phenomena in nature, and the application of the knowledge so gained to the benefit and betterment of society. The main areas of interest to Electrical engineers are: the generation, transmission, distribution, and utilization of electrical power; analogue and digital signal processing and telecommunication systems; control systems and robotics; and electronics, including microelectronics and electronic circuitry. Electrical engineers are concerned with both the theory and practice of such diverse fields as fibre optics, lasers, integrated circuits, sensors, biomedical engineering, computers, microprocessors, radio astronomy, satellite communications, and applications of electromagnetic energy.

The fundamentals of electricity and magnetism, and the laws governing electric circuits, are explored in the introductory courses, branching into the specific areas of electrical engineering in the third and fourth years of study. There is plenty of opportunity for practical experience throughout the program. Laboratory experiments form an integral part of many of the courses, and various design projects are offered in the final year of study.

Students are encouraged to contact the Department of Electrical and Computer Engineering for advice regarding the selection of appropriate elective courses.

### 82.6.1 Elective Patterns in Electrical Engineering

#### Electric Power Engineering

Power engineers utilize a background in mathematics, circuit analysis, control systems, electric machines, reliability, and computer software and hardware to design and maintain power related devices and systems. They are involved with power electronics, power delivery systems, power plants and sub-stations, industrial loads, and power system protection and control. Their work includes involvement with computer-based systems for data acquisition, planning, transmission, utilization, and control of electric energy.

#### Communications

Communications concerns the transmission of information from one point to another, using wires, coaxial cable, fibre-optics, or radio. The information may originate as an analog signal, such as a voice or video signal, or it may originate as a digital signal in a computer. As more analog signals are converted to digital form for transmission over the communications networks, communications engineers must be familiar with various methods for transmitting, routing, and receiving both analog and digital signals, as well as methods for processing these signals. The design of communications systems requires knowledge in such areas as network theory and statistical analysis, while the design of the elements that make up these systems will draw heavily on digital and analog circuit design, signal processing and filtering, and electronics.

#### Control Systems

The control of physical systems is an interdisciplinary subject that cuts across many specialized engineering fields. This versatile area ranks today as one of the most promising fields and its growth potentials are unlimited. Control systems engineers have made contributions to robotics, space-vehicle systems, oil refineries, paper-making machines, power systems, control of ships, and various aspects of automobiles and household

appliances. Many new digital control applications are being stimulated by advances in microprocessor technology.

Senior undergraduate students in Electrical or Computer Engineering, wishing to specialize in this area can select one or more elective courses given by the Department of Electrical and Computer Engineering in control systems, microprocessor design, and software engineering. They can also take courses in process control offered by the Department of Chemical and Material Engineering, and courses in robotics and computer vision offered by the Departments of Electrical and Computer Engineering and Computing Science.

### Digital Systems Engineering

Digital systems engineers design hardware systems for a broad range of applications including process control, robotics, digital signal processing, computers, communications, instrumentation, and analogue/digital conversion. Digital systems engineers are making increased use of powerful new building blocks such as programmable logic devices, field-programmable gate arrays, microprocessors, micro-controllers, signal processing chips, and personal computers. The electives which make up the digital systems stream deal with low-level hardware design issues such as microprocessor system design, digital system design, and analogue/digital electronics.

### Electronics

Electronics is an area of Electrical Engineering that finds applications in all fields of technology. It overlaps into all the other areas of electrical engineering such as communications, digital, control, and power systems.

Electronics includes the study of solid state devices, integrated circuits (including fabrication technology), digital and analog circuits, VLSI, and computer-aided design. Electronic engineers use these devices and techniques to design and analyze systems that can be used in a wide variety of applications from radio frequency or microwave systems to solving instrumentation problems. Electronic engineers require a broad background in all aspects of electrical engineering with special expertise in circuit analysis techniques and a thorough understanding of electronic components and how they are used.

## 82.7 Engineering Physics

The Engineering Physics program, offered in cooperation with the Department of Physics, leads to the degree of BSc in Engineering Physics. It is of a more fundamental nature than the Electrical Engineering program. It provides students with an extensive background in mathematics and physics.

Students who wish to take Engineering Physics must have a high standing in mathematics and physics and normally will be required to have a minimum GPA of 7.0 in the first year. Exceptions to this rule may be made by the Chair of the Department of Electrical and Computer Engineering.

In this program the core material consists of courses in the basic sciences and electrical engineering. This provides a basis for more intensive studies in a number of specialized areas in Electrical Engineering. These areas are covered by elective courses which may be chosen to meet the student's requirements. Some of these areas are lasers, plasmas, communications, microelectronics, microwave, and high vacuum.

## 82.8 Materials Engineering

Materials Engineering is a discipline which has evolved from dealing only with metals and alloys to one which is concerned with the production and engineering applications of both metallic and non-metallic materials (polymers, ceramics, composites and electronic materials). Materials engineers develop, modify, and utilize processes to convert raw materials into useful engineering materials with specified desirable properties. The discipline therefore includes aspects of materials production, materials processing and materials applications and design. Materials Engineering embraces physics, chemistry and mechanics to understand processing and applications of materials. Graduates of the program find employment in all sectors of the material cycle. The primary sector is raw materials processing and includes such industries as mineral processing, aluminum smelting and steel making. The next sector is manufacturing and extends from the rolling and rod mills of the metals industry to the materials aspects of manufacturing of a wide variety of engineered products in the aerospace, automotive, electronics, photonics, petrochemical and other industries. The final sector includes the service industries with such specialities as corrosion, wear, fracture mechanics and failure investigation. This sector would also include the recycling industries. The undergraduate Materials Engineering program, the only one of its kind in the Prairie provinces, includes a balance of lectures and laboratory sessions emphasizing underlying principles and their engineering applications. The program deals with mineral processing, extractive metallurgy, physical metallurgy, ceramics, polymers, composites and various aspects of the behavior of materials in service including failure,

wear, and corrosion. With the technical electives it is possible for the student to go into more depth in particular areas of interest. With a quota of only 25 students the class size is smaller than many other disciplines which leads to an intensive educational experience.

## 82.9 Mechanical Engineering

Mechanical Engineering covers a diverse range of engineering fields with five major areas of study: solid mechanics and dynamics, fluid mechanics, thermodynamics, mechanical design, and engineering management. Some of the jobs performed by Mechanical engineers are the design of machinery and production equipment for industry; the development of new products, devices, and manufacturing processes; the development of energy sources and energy conversion systems; analysis of the dynamics and vibrations of structures and mechanical systems; design of heating, ventilation, and air conditioning systems; and planning and management of engineering projects or manufacturing operations. Examples of more specialized areas of work include acoustics, aerodynamics, biomechanical engineering, combustion engines, energy conversion systems, environmental engineering, material science including fracture and fatigue, robotics and vehicle design.

The undergraduate program initially exposes students to a wide range of topics covering the fundamentals of solid mechanics, dynamics, fluid mechanics, thermodynamics, design, and engineering management. Advanced courses and technical electives provide a more specialized knowledge and an emphasis on applications. Many courses include experimental laboratories to give students "hands-on" experience with current engineering and measurement equipment. Throughout the program, several courses are devoted specifically to mechanical engineering design. Working on individual and group projects, the student applies engineering principles to challenging design projects and develops communication skills through oral and written presentations as well as preparation of drawings for fabrication in the department's machine shop. Computers are used extensively in the program with students involved both in programming and in using engineering analysis and design packages.

### 82.9.1 Areas of Study

#### Solid Mechanics and Dynamics

Mechanical engineers are involved in the design of structures and mechanical components to safely withstand normal working stresses. Many structures and machines are also subjected to the additional stresses caused by vibrations, for example due to the imbalance in a compressor or engine, and these effects can be critical for their safe use. Stress analysis predicts the internal loads in a component and allows the designer to select materials and shapes suitable for the service the component will experience. Traditional materials such as steel and aluminium as well as recently developed materials such as ceramics and fibre reinforced composites are considered to optimize the performance of the component.

#### Fluid Mechanics

Fluid mechanics is concerned with the motions of liquids and gases and the machinery which causes that motion (e.g. pumps), or uses it (e.g. windmills). Applications include acoustics, aerodynamics, meteorology, pollutant dispersion, pumps, fans, turbines, pipelines, and lubrication. Mechanical engineers with a specialization in fluid mechanics work on the design and improvement of a wide range of fluids-related equipment as well as concerns related to the flow of water and air in the environment. Another major area of work for Mechanical engineers with a fluid mechanics background is in the aerodynamics industry designing everything from wings to jet engines.

#### Thermodynamics

Applied thermodynamics is the study of conversion of energy from one form to another. A typical application is the production of electricity. Energy from the combustion of fuels like coal, oil, or natural gas is used to heat a fluid such as air or water and then the fluid is expanded through machinery to produce mechanical work and drive a generator. The electricity produced is an easily transported form of energy that can be used at locations remote to the original energy source. Mechanical engineers with a specialization in thermodynamics work on the design and improvement of power plants, engines, heat exchangers, and many other forms of equipment. Specific examples include heating, ventilation and air conditioning systems for living space and industrial processes, use of alternate fuels in engines and reducing pollution from internal combustion engines.

#### Design

Design is the most challenging and therefore the most rewarding aspect of Mechanical Engineering. The design process starts with the recognition of a need for a new product, device, or industrial process and then carries on to specifically defining the problem to be solved, gathering the necessary information, performing the required analysis and optimization, building prototypes, and evaluating different concepts. There is usually no single

correct solution for a given design problem as many different designs can all solve the same problem. Some designs are better than others as they may be lighter or more efficient, or cost less so that by constant refinement and iteration throughout the design process, acceptable designs can be made.

#### Engineering Management

Many engineering graduates spend a significant part of their career as managers of plants, companies, or other engineers. Engineering Management is the field that bridges the gap between engineering and management. Some of the areas that these engineers deal with are management of engineering processes, engineering economics, operations management, quality improvement, quality control, and the use of computers in business.

### 82.10 Mining Engineering

Mining engineers deal with the discovery and exploitation of the earth's mineral resources. This includes exploration and testing as well as mine design, mine equipment, mine operation, economic evaluation, and the development of management skills. These engineers are trained to utilize knowledge from the fields of geology, civil engineering, mechanical engineering, materials engineering, environmental engineering, and engineering management. Our undergraduate mining program, which is the only one of its kind in the Prairies, combines lecture and laboratory courses with field trips for practical training. Emphasis is placed on close interaction between staff and students—often on a one-to-one basis.

Mining engineers find work in a variety of industries such as the oil sands, coal, industrial minerals, precious metals, and base metal exploration and mining.

### 82.11 Petroleum Engineering

Working in the upstream sector of the oil and natural gas (O and NG) industry, Petroleum engineers are responsible for the technical and economic analysis leading to the appraisal, development, and production of O and NG reserves. Petroleum engineers apply scientific principles to the challenge of drilling wells into underground formations, and to provide safe and efficient production of O and NG reserves. They appraise the value of the resource and manage the reservoir to maximize returns. Petroleum engineering encompasses skills from a broad array of scientific disciplines including geology and chemical, civil, and mechanical engineering.

Most graduates find work in the Canadian O and NG industry, while some choose to work overseas. Others work in areas where their training has given them appropriate skills, such as in underground contaminant flow. Our undergraduate degree program remains the only accredited petroleum engineering program in Canada.

### 82.12 Combined Degree BSc in Engineering/ Master of Business Administration

The Faculty of Engineering has an arrangement with the Faculty of Business whereby students with suitable academic standing may choose electives which can be applied for advance credit towards a Master of Business Administration (MBA) degree. In this manner it is possible to complete part of the MBA degree requirements during the undergraduate engineering program. The MBA degree requires at least one additional year of study after graduation with a BSc in Engineering.

Because of the limited number of electives within some engineering programs, the combined program is not practical in all disciplines. Second year students interested in this program should consult with their Department for complete details.

### 82.13 Business Course Electives for Engineering Students

For those students who do not wish to take an MBA but wish to have some exposure to Business courses, the Faculty of Engineering has entered into an agreement with the Faculty of Business to permit a limited number of engineering students to take business courses. The intent of the agreement is to permit an engineering student to select a number of electives in a given business area. Possible areas include: accounting, finance, industrial relations, and management science. Interested students should contact their Program Advisor for referral to the Engineering-Business Advisor.

### 82.14 Honors Mathematics Courses

Students with exceptionally high interest and ability in mathematics may replace certain engineering mathematics courses with honors mathematics courses. These students would follow the honors sequence MATH 117, 118, 217, and 317, and the honors linear algebra-differential equations sequence MATH 127 and 336. Interested students should contact the Honors Chair of the Department of Mathematics for an interview and approval to register immediately upon receiving notification of their admission to the first-year Engineering program.

### 82.15 Industrial Safety and Loss Management Courses for Engineering and Business Students

Safety, risk, and loss management principles applicable to all industries are covered in ENGG 404 and ENGG 406. The objective of these courses is to provide a basic understanding of the integrated practices of reducing the risks to people, environment, assets, and production. The key role of the Engineering and Business graduate in this ever expanding field is thoroughly explored, including strong emphasis on the proactive team approach.

### 82.16 Arrangements with Other Institutions

#### 82.16.1 Engineering Transfer Programs at Alberta Colleges

Students may complete their first year of Engineering at any of the following Alberta postsecondary institutions: Grande Prairie Regional College, Keyano College (Fort McMurray), University of Lethbridge, Medicine Hat College, Grant MacEwan Community College, Mount Royal College, and Red Deer College. Students who complete the Engineering Transfer Program at one of these institutions may apply to enter second year Engineering at the University of Alberta and will be considered for program placement on an equal basis with continuing University of Alberta Engineering students.

#### 82.16.2 Transfer Credit Agreement between the University of Alberta and the University of Calgary Faculties of Engineering

A transfer student may obtain credit for a full year of the Engineering program at either the University of Calgary or the University of Alberta by completing courses at a transfer institution equivalent to the following:

Course Type	University of Calgary	University of Alberta
Two Chemistry Courses	ENGG 201 CHEM 209	CHEM 103 CHEM 105
Three Engineering Physics Courses	PHYS 269 ENGG 203 ENGG 249	PHYS 130 ENGG 130 ENPH 131
Two Calculus Courses	AMAT 217 AMAT 219	MATH 100 MATH 101
One Linear Algebra Course	MATH 221	MATH 102
One Computing Course	ENGG 233	ENCMP 100 (see Note 2 below)
One Introduction to Engineering/Writing Course		ENGG 215 (see Note 2 below)
One Elective	As chosen by the student in accordance with the regulations of the Faculty involved (see Note 3 below)	

#### Notes:

- Students transferring to the University of Calgary will not be granted credit for ENCMP 100. Students transferring to the University of Alberta will be given credit to take the place of ENGG 233.
- Students transferring to the University of Alberta will receive credit for ENGG 100, ENGG 101 and ENGL 199. Students transferring to the University of Calgary will receive credit for a Complementary Studies elective.
- A student may wish to take a Complementary Studies course or
  - for transfer to the University of Calgary—(University of Calgary PHYS 259 equivalent) Electricity and Magnetism  
**Note:** Students entering Year 2 at the University of Calgary who wish to transfer directly into the Department of Electrical, Mechanical, or Geomatics Engineering must have the equivalent of PHYS 259.
  - for transfer to the University of Alberta—(University of Alberta MATH 102 equivalent), Applied Linear Algebra

**Note:** Students transferring to the Civil Engineering program at the University of Alberta cannot obtain transfer credit for both PHYS 259 and PHYS 269

- (4) Students transferring from the engineering program at the University of Alberta to the engineering program at the University of Calgary are assured full course-by-course credit for all required courses with a grade of 5.0 or higher.
- (5) Students transferring from the engineering program at the University of Calgary to the engineering program at the University of Alberta are assured full course-by-course credit for all required courses with a grade of C- or higher.

### 82.16.3 Transfer from Alberta Technical Institutes

Students from Alberta Institutes of Technology (e.g. NAIT, SAIT) should refer to the Alberta Transfer Guide for information on potential transfer credit.

### 82.16.4 Geomatics Engineering at the University of Calgary

A four-year program leading to a BSc in Geomatics Engineering is offered at the University of Calgary. After appropriate practical experience, a graduate may register as a Professional Surveying engineer and/or a Provincial and/or Canada Lands Surveyor.

A student interested in a career in geomatics (surveying) may take the first year of the Engineering program at the University of Alberta. Upon successful completion of the first-year program, students would be admitted to the second year of Geomatics Engineering at the University of Calgary. For information regarding Geomatics Engineering at the University of Calgary, please write the Dean, Faculty of Engineering, University of Calgary, Calgary, Alberta T2N 1N4.

### 82.16.5 BSc Program in Agricultural Engineering

A four-year program leading to the BSc in Agricultural Engineering is offered at the University of Saskatchewan. Students wishing to transfer to the Agricultural Engineering program at the University of Saskatchewan following one year of engineering at the University of Alberta should write to Head, Agricultural Engineering Department, College of Engineering, University of Saskatchewan, Saskatoon, Saskatchewan, S7N 0W0.

### 82.16.6 Exchange Program with Ecole Polytechnique

Students in the Faculty of Engineering at the University of Alberta may participate in an exchange program whereby one year of their studies is completed at Ecole Polytechnique in Montréal. Ecole Polytechnique, affiliated with the University of Montréal, is one of the premier schools of engineering in Canada and is the largest French-language school of engineering in the country. Students wishing to participate in the exchange program must have demonstrated superior academic ability and be fluent in French. The exchange normally takes place in a student's third year. Exchange programs are available in all engineering programs with the exception of Petroleum Engineering. Please consult the Associate Dean (Student Services), Faculty of Engineering, for additional information.

### 82.16.7 Exchange Program with the Technical University of Berlin

Students in the Faculty of Engineering at the University of Alberta may participate in an exchange program with the Technische Universität Berlin (TUB). Students may attend TUB for one year as part of their BSc program in Engineering. Students wishing to participate must have demonstrated superior academic ability and must be fluent in German. Programs are available in a wide variety of engineering disciplines. Please consult the Associate Dean (Student Services), Faculty of Engineering, for additional information.

## 82.17 Special Students

Students holding a BSc in Engineering or a Science specialization (e.g. Mathematics, Physics, Chemistry, Computing Science, Geology), may register as special students in the Faculty of Engineering. For further information regarding admissibility see §12.2(7).

## 82.18 Graduate Studies

After obtaining a Bachelor of Science degree, students may elect to continue into graduate programs for more advanced courses and research experience. The U of A's flourishing research programs indicate a commitment to scholarship, pursuit of knowledge, and the application of that knowledge to the solution of contemporary problems. There are graduate programs in many fields of engineering leading to the degrees of Master of Science (MSc), Master of Engineering (MEng), and Doctor of Philosophy (PhD). A combined Master of Business Administration/Master of Engineering

(MBA/MEng) degree program is also available. For more information on Graduate Studies contact the individual engineering departments.

## 82.19 Professional Associations and Technical Societies

All engineering programs listed in the Calendar are accredited by the Canadian Engineering Accreditation Board of the Canadian Council of Professional Engineers. Therefore graduation from the Faculty of Engineering can lead to registration as a Professional Engineer in the Provincial Associations of Professional Engineers, in accordance with their individual policies.

The practice of Engineering throughout Canada is regulated by Professional Associations in each province. The right to practise and accept professional responsibility is limited to those who are registered with the professional organization in the particular province concerned. In Alberta this is The Association of Professional Engineers, Geologists, and Geophysicists of Alberta. Members of the Engineering Students' Society are automatically student members of the Association. Graduates are encouraged to join the Association as Engineers in Training. Four years of acceptable experience following graduation are necessary for registration as a Professional Engineer.

The practising engineer keeps abreast of technological developments through membership in one of several technical societies. Student Branches of these societies (CSAE; CSE; CSCE; IEEE; CSME; CIM; ISA; SPE) have active chapters on campus. Engineering students are encouraged to join the society closest to their speciality.

## 83 Faculty Regulations

### 83.1 Admission and Registration

General University admission requirements are set out in §§13 and 14. Specific admission information for the Faculty of Engineering is detailed in §15.6.

### 83.2 Residence Requirements

A student proceeding towards a BSc degree in engineering must normally attend at least the equivalent of two academic years in the Faculty of Engineering and complete four full terms of approved course work comprising a minimum of 72 units of credit. This should comprise the last four terms of the student's program.

Where a student has been accepted as a transfer student from another accredited engineering program at a Canadian university and has the equivalent of six full terms of transfer credit, consideration may be given to reducing the residence requirement to one academic year consisting of two full terms.

### 83.3 Academic Regulations

- (1) **Admissions:** The Faculty of Engineering admits students into a first or qualifying year program and into specialized programs at the second year level. All admissions are on a competitive basis.

There are 590 entry places in the first year and 580 entry places in the second year of the Engineering program (75 Chemical; 110 Civil; 30 Civil-Environmental; 65 Computer; 115 Electrical; 115 Mechanical; 25 Materials [Metallurgical]; 15 Mining; 30 Petroleum). Approximately 35% of the entry places within each discipline are allocated to the cooperative education program.

Entry to a specialized program is based upon the student's academic performance in the first, or qualifying, year. All students in qualifying year, and new applicants to the Faculty with previous postsecondary education, must submit a Second Year Engineering Program Selection Form (PSF) by the document deadline noted in §12. Forms will be provided to qualifying year students in ENGG 101. Program Selection Forms will be mailed to other applicants by the Registrar's Office upon application. All applicants with previous postsecondary education must submit a PSF. Applicants who do not have sufficient transfer credit for a second year program (to be determined by the Faculty) may be considered for a qualifying year.

A student entering the Faculty directly from high school, or with fewer than 15 units of transfer credit, must normally qualify for a specialized program in not more than four terms (two years); those

with 15 units or more of transfer credit must qualify in not more than two terms (one year). A student who is offered admission to a specialized program after two terms has qualified and may not continue as a qualifying student. If a student fails to qualify within the indicated number of terms, the student will be required to withdraw and will not normally be readmitted to the Faculty.

(2) **Engineering Graduation Average:**

a. The Engineering Graduation Average (EGA) will be based on the final four academic terms. If the course load in these terms totals less than 70 units, additional terms will be included in the calculation of the EGA as required to reach a total of at least 70 units. The 70 units include courses designated as extra to degree. Grades for courses taken in the summer period (May through August) are not included in the EGA unless this is a scheduled term within the student's degree program.

b. **Requirements to Graduate:** In order to graduate a student must

- pass all courses required by the specific program.
- have an Engineering Graduation Average of 5.0 or greater. A student who is otherwise eligible to graduate but has an EGA less than 5.0 will be permitted to return for one additional term to take courses as specified by the Dean in order to raise his/her Engineering Graduation Average (EGA).
- be in satisfactory academic standing, i.e., have a Session GPA of 5.0 or greater.

(3) **Time Limit for Completion of Degree:** All students must complete their degree requirements within six calendar years from the time of their initial admission to a specialized degree program in engineering.

(4) **Course Load:**

a. Students in specialized degree programs may not normally take a course load with fewer than 28 units per session (or 14 units per term).

b. Students in their qualifying year may not normally take a course load with fewer than 37 units per session, excluding the 2.0 units for ENGG 100/101.

(5) **Promotion to Next Session:** A student's progress will be evaluated on completion of academic studies for the Winter Session and on completion of any academic term occurring in the summer period (May through August) which is a scheduled term within the student's degree program. Scheduled terms are those shown in §§84.3 and 84.4. Evaluation is on the basis of Session GPA (see §23.4(7)) or its equivalent based on all courses taken during the summer period (May through August).

a. **Satisfactory:** Session GPA of 5.0 or greater. Proceed to next session, repeating any failed course(s).

b. **Marginal:** Session GPA of 4.5 to 4.9 inclusive. Proceed to next term on academic warning (also known as probation) repeating any failed course(s) and other courses as specified by the Dean, unless one of the following conditions applies, in which case the student must withdraw:

- previously on academic warning on two or more occasions.
- previously required to withdraw and previously on academic warning.
- the session course load was less than 28 units.
- already on academic warning.

Students on academic warning will be evaluated at the end of each term. The summer period (May through August) is not considered to be a term unless it is a scheduled term within the student's degree program. To clear academic warning a student must achieve an engineering term average of at least 5.0 while carrying a minimum course load of 14 units.

If a student is in his/her final session and has achieved a Session GPA of 4.5 to 4.9 inclusive, then one more term will be allowed in which the student must complete the degree requirements by carrying a course load of at least 14 units (courses to be specified by the Dean) and obtaining an engineering term average of at least 5.0.

c. **Unsatisfactory:** Session GPA less than 4.5. Student must withdraw.

(6) **Work Experience Credit:** Work Experience (WKEXP) courses in the cooperative education program are graded on a Pass/Fail basis. A student receiving a grade of Fail is normally required to withdraw from the cooperative program and the Faculty of Engineering.

(7) **Deficiencies from a Previous Term:** Where a student is deficient in credits in a course (or courses) from a previous term either through failure or otherwise, that student must normally clear that deficiency the next time the course (or courses) is (are) offered.

Where the deficiency is the result of failure or withdrawal from an elective course, another course may be substituted provided that Faculty approval is first received to do so.

(8) **Readmission after a Requirement to Withdraw:** A student who is required to withdraw must stay out for two terms before being eligible for readmission. In this context, the summer period (May through August) is not counted as a term unless it is a scheduled term within the student's degree program. When readmitted a student must take all the previously failed courses and other courses as specified by the Dean. For students in the co-op program the readmission must coincide with the commencement of an academic term. A student who is required to withdraw a second time will not normally be readmitted to the Faculty of Engineering.

(9) **Withdrawal from Courses:** (See §11 Academic Schedule for deadline dates.)

(10) **Reexaminations:** See §23.5.5.

(11) **Part-Time Students:** A student unable, for acceptable reasons, to carry the course load required in §83.3(4) above, may enrol on a part-time basis but must meet the normal Faculty residence requirements and time limits specified in §83.2 and §83.3(3).

(12) **Academic Awards and Recognition:**

a. **Awards and Scholarships**

There are a number of scholarship competitions open to high school students who plan to study engineering at the University (See §30.2 through 30.9). Students who are continuing in the Faculty may apply for various awards (See §31 through 31.6). In addition, there are a number of awards which are made by Faculty or Department nomination (See §31.7.18). Awards and scholarships will be awarded on the basis of the work of an academic session (two terms), in which a student has carried a full course load. For University wide award competitions, this is the course load calculated from §§84.2, 84.3, or 84.4 as appropriate. In the case of Faculty and Department awards, a full course load is defined as at least 35 units.

Co-op students are eligible for awards and scholarships after the 4th, 6th and 8th academic terms. Awards will be based on the work taken in the previous two academic terms. A student must carry a minimum of 35 units in the two combined academic terms. This means that normally co-op students are not eligible for awards in the third year of their program.

b. **First Class Standing**

First Class Standing is awarded on the basis of a Session GPA of 7.5 or greater, while carrying a course load of not less than 35 units in an academic session (two terms). For students following the traditional program, the academic session comprises the two terms of the Winter Session which is the period between September and April. Co-op students will be awarded First Class standing on completion of the 4th, 6th and 8th academic terms.

c. **Graduation "With Distinction"**

To graduate "With Distinction" a student must have

- an Engineering Graduation Average of 7.5 or greater.
- carried at least 70 units in the final four academic terms.

(13) **Appeals:**

a. **Academic Standing:** A student wishing to appeal an academic standing decision must first attempt to resolve the issue with the Faculty of Engineering, Associate Dean (Student and Co-op Services). If the matter remains unresolved the student may then make an appeal to the Faculty of Engineering Academic Appeals Committee. To make such an appeal, the student must make his/her decision known to the Dean in writing within 28 calendar days from the decision date. This is the date of the letter in which the student was first advised of the academic standing decision. The 28 days include mailing time and all time spent in attempting to resolve the matter with the Associate Dean (Student and Co-op Services). Note: Letters are mailed to the student's mailing address of record as maintained by the Registrar's Office and are deemed to be delivered when mailed. An unsuccessful appeal within the Faculty may be carried to the General Faculties Council Academic Appeals Committee. See §23.8.

b. **Grievances Concerning Grades:** The assignment of marks and grades is the initial responsibility of an instructor. Any grievances concerning grades would first be discussed with the instructor. If the problem is not resolved, the student is encouraged to talk with the Chair of the Department where the course is taught.

For courses taught in the Faculty of Engineering, final recourse is to the Faculty of Engineering Academic Appeals Committee. To make an appeal to this committee the student must submit the appeal in writing to the Dean within 60 calendar days after the end of the final examination period.



A copy of the Faculty of Engineering Regulations regarding appeals may be obtained from the Faculty Office, 5-1 Mechanical Engineering Building.

## 84 Programs of Study

### 84.1 Faculty Requirements for All BSc in Engineering Programs

The course requirements for engineering programs are listed in §84.2 (First Year) and §§84.3 through 84.4 (Second Year and beyond). All engineering programs must include ENGG 400, ENGL 199, MATH 201, MATH 209, SOC 366, and a single-term course in Engineering Economics (e.g. MEC E 310, CH E 365). A limited number of students will be permitted to replace SOC 366 with ENGG 405 or INT D 200.

All engineering programs must also include at least three units at the 200-level in each of at least three of the following five areas: (1) Strength of Materials, (2) Thermodynamics, (3) Materials Science, (4) Fundamental Electrical Engineering, and (5) Engineering Mechanics (Dynamics).

## 84.2 First-Year Program

The following list of courses represents the first-year program for all engineering students. Students registering for first-year courses should consult the Registration Procedures Booklet.

Term 1	Term 2
CHEM 103 (3-1s-3/2)	CHEM 105 (3-0-3/2)
ENGG 100 (1-0-0)	ENCMP 100 (3-0-1.5)
ENGG 130 (3-0-2)	ENGG 101 (1-0-0)
MATH 100 (3-0-2)	EN PH 131 (3-1s-3/2)
PHYS 130 (3-0-3/2)	MATH 101 (3-0-1)
Complementary Studies Elective (3-0-0)	MATH 102 (3-0-1)

**Notes:**

- (1) The Complementary Studies Elective listed in the first term should be selected from any 100-level course with a 3 weight (one term) from the following subject areas (see §211 for course descriptions): Anthropologie, Anthropology, Art and Design (ART H only), Canadian Studies (200-level), Christian Theology, Classics, Comparative Literature, Etudes de la religion, Family Studies, Linguistics, Philosophie, Philosophy, Political Science, Psychologie, Psychology, Religious Studies, Science Politique, Slavic and East European Studies, Sociologie, and Sociology. See §84.6
- (2) Students accepted into the Honors Mathematics stream replace MATH 100, 101, and 102 with MATH 117, 118, and 127 (see §82.14).

### 84.3 Required Courses and Suggested Course Sequence for Traditional Programs

The required program of studies leading to the various BSc in Engineering degrees (traditional programs) are noted below. While all courses listed below are compulsory, the sequencing of courses may differ. All programs require Departmental approval.

Engineering Chart 1 details a suggested course sequence for each Engineering degree program by year and term. Course numbers are followed by the hours of instruction in parentheses. The first number indicates lecture hours, the second number seminar hours, and the third number laboratory hours. Laboratory hours often appear as two numbers separated by a slash, which indicates hours and weeks (eg. the expression 3/2 means 3 hours of laboratory every second week).

**Note:** For information on Complementary Studies Electives see §84.6.

	Chemical	Chemical: Computer Process Control Option	Civil	Computer	Electrical
<b>Year 2</b>					
<b>Term 3</b>	CH E 243 (3-1s-0) CH E 265 (3-0-3) or MATE 252 (3-0-3/2) CH E 285 (1-0-0) CHEM 261 (3-0-3) ENGL 199 (3-0-0) or Complementary Studies Elective (3-0-0) MATH 209 (3-0-1) Complementary Studies Elective (3-0-0)	CH E 243 (3-1s-0) CH E 265 (3-0-3) or MATE 252 (3-0-3/2) CH E 285 (1-0-0) CHEM 261 (3-0-3) E E 240 (3-1s-3/2) E E 280 (3-0-3/2) MATH 209 (3-0-1)	CIV E 265 (2-0-3) CIV E 270 (3-0-3) EAS 210 (3-0-3) MATH 209 (3-0-1) MATE 252 (3-0-3/2)	CMPUT 115 (3-0-3) E E 240 (3-1s-3/2) E E 280 (3-0-3/2) ENGL 199 (3-0-0) MATH 209 (3-0-1) SOC 366 (3-0-0)	E E 240 (3-1s-3/2) E E 280 (3-0-3/2) MATH 201 (3-0-1) MATH 209 (3-0-1) MEC E 250 (3-1s-0) SOC 366 (3-0-0)
<b>Term 4</b>	MATE 252 (3-0-3/2) or CH E 265 (3-0-3) E E 239 (3-0-3/2) MATH 201 (3-0-1) SOC 366 (3-0-0) STAT 235 (3-0-2) Complementary Studies Elective (3-0-0) or ENGL 199 (3-0-0)	CMPUT 115 (3-0-3) E E 250 (3-1s-3/2) E E 380 (3-0-3/2) ENGL 199 (3-0-0) MATH 201 (3-0-1) MATE 252 (3-0-3/2) or CH E 265 (3-0-3)	CIV E 221 (3-0-3/2) CIV E 250 (3-0-2) CIV E 251 (2 weeks)* CIV E 290 (3-0-0) CIV E 295 (3-0-2) MATH 201 (3-0-1) *Held in Intercession (Spring Term)	CMPUT 272 (3-1s-1) E E 231 (3-1s-0) E E 250 (3-0-3/2) E E 380 (3-0-3/2) MATH 201 (3-0-1) PHYS 230 (3-0-3/2)	CH E 243 (3-1s-0) E E 231 (3-1s-0) E E 250 (3-1s-3/2) ENGL 199 (3-0-0) MATH 309 (3-0-0) PHYS 230 (3-0-3/2)
<b>Year 3</b>	<b>(See the 1995/96 edition of the Calendar if you entered a second year in September 1994 or earlier.)</b>				
<b>Term 5</b>	CH E 312 (3-1s-0) CH E 314 (3-1s-4/4) CH E 343 (3-1s-0) CH E 351 (2-0-3) CH E 375 (3-1s-0) Tech Elective (3-1s-0)	CH E 312 (3-1s-0) CH E 314 (3-1s-4/4) CH E 343 (3-1s-0) CH E 351 (2-0-3) E E 387 (3-1s-0) SOC 366 (3-0-0)	CIV E 330 (3-1s-0) CIV E 372 (3-2s-0) CIV E 391 (3-0-3) CIV E 395 (3-0-2/2) CIV E 398 (3-1s-0) ENGL 199 (3-0-0)	CMPUT 201 (3-0-3) CMPUT 204 (3-0-1) E E 335 (3-1s-0) E E 340 (3-1s-3/2) E E 387 (3-1s-0) E E 480 (3-0-3/2)	E E 315 (3-1s-0) E E 330 (3-0-0) E E 335 (3-1s-0) E E 340 (3-1s-3/2) E E 380 (3-0-3/2) Tech Elective (3-0-0)
<b>Term 6</b>	CH E 418 (3-0-2) CH E 434 (3-1s-0) CH E 446 (3-0-3/2) CHEM 275 (3-0-3/2) Tech Elective (3-1s-0)	CH E 418 (3-0-2) CH E 434 (3-1s-0) CH E 446 (3-0-3/2) CHEM 275 (3-0-3/2) Complementary Studies Elective (3-0-0)	CIV E 303 (3-0-3/2) CIV E 312 (3-0-0) CIV E 321 (3-1-3/2) CIV E 331 (3-0-3/2) CIV E 374 (3-0-3) CIV E 381 (3-0-3)	CMPE 313 (3-0-3) CMPE 382 (3-0-0) E E 317 (3-0-0) E E 350 (3-1s-3/2) Tech Elective (3-1-0) Complementary Studies Elective (3-0-0)	E E 332 (3-0-3/2) E E 350 (3-1s-3/2) E E 358 (3-0-0) E E 390 (3-0-0) Tech Elective (3-0-0) and one of: ENGG 402 (3-0-0) or Complementary Studies Elective (3-0-0)

Engineering Chart 1

### 84.3 Required Courses and Suggested Course Sequence for Traditional Programs (cont'd)

The required program of studies leading to the various BSc in Engineering degrees (traditional programs) are noted below. While all courses listed below are compulsory, the sequencing of courses may differ. All programs require Departmental approval.

Engineering Chart 1 details a suggested course sequence for each Engineering degree program by year and term. Course numbers are followed by the hours of instruction in parentheses. The first number indicates lecture hours, the second number seminar hours, and the third number laboratory hours. Laboratory hours often appear as two numbers separated by a slash, which indicates hours and weeks (eg. the expression 3/2 means 3 hours of laboratory every second week).

**Note:** For information on Complementary Studies Electives see §84.6.

	Chemical	Chemical: Computer Process Control Option	Civil	Computer	Electrical
<b>Year 4</b>	<b>(See the 1995/96 edition of the Calendar if you entered a second year in September 1994 or earlier.)</b>				
<b>Term 7</b>	CH E 316 (2-0-2) CH E 365 (3-0-3) CH E 453 (1-0-4) CH E 474 (3-1s-0) CH E 481 (0-1-0) Tech Elective (3-1s-0) Tech Elective (3-1s-0)	CH E 316 (3-0-2) CH E 365 (3-0-3) CH E 453 (1-0-4) CH E 481 (0-1-0) CH E 540 (3-0-3/2) Tech Elective (3-0-0) Complementary Studies Elective (3-0-0)	Tech Elective Tech Elective Tech Elective One of E E 201, MEC E 250 or CH E 243 Complementary Studies Elective (3-0-0)	CMPE 401 (3-0-3/2) CMPUT 379 (3-0-3) E E 390 (3-0-0) E E 438 (3-0-3/4) Tech Elective (3-0-0) Tech Elective (3-0-0)	E E 387 (3-1s-0) E E 438 (3-0-3/4) E E 458 (3-0-3/2) Tech Elective (3-0-0) Tech Elective (3-0-3/2) Complementary Studies Elective (3-0-0)
<b>Term 8</b>	CH E 454 (1-0-4) CH E 465 (1-0-6) CH E 483 (0-1-0) ENGG 400 (1-0-0) Tech Elective (3-0-3) Tech Elective (3-1s-0) <b>Note:</b> See §84.5.1 for restrictions on the six technical electives.	CH E 454 (1-0-4) CH E 465 (1-0-6) CH E 483 (0-1-0) CH E 562 (3-0-3/2) CH E 564 (3-0-3/2) CHEM 311 (3-0-3) ENGG 400 (1-0-0) <b>Note:</b> See §84.5.2 for restrictions on the two technical electives.	CIV E 490 (1-2s-0) ENGG 400 (1-0-0) ENGG 420 (3-0-0) MEC E 310 (3-0-0) SOC 366 (3-0-0) Tech Elective Tech Elective <b>Notes:</b> 1. See §84.5.3 for restrictions on the technical electives. 2. See §84.6 for restrictions on complementary electives	E E 462 (3-0-3/2) E E 582 (1-0-4) ENGG 400 (1-0-0) MEC E 310 (3-0-0) Tech Elective (3-0-0) Tech Elective (3-0-0) Complementary Studies Elective (3-0-0) <b>Note:</b> See §84.5.4 for restrictions on the five technical electives.	ENGG 400 (1-0-0) MEC E 310 (3-0-0) Tech Elective (3-0-0) Tech Elective (3-0-0) Tech Elective (3-0-3/2) Tech Elective (3-0-3/2) Tech Elective (3-0-3/2) <b>Note:</b> See §84.5.5 for restrictions on the nine technical electives.
	Engineering Physics	Materials Engineering	Mechanical	Mining	Petroleum
<b>Year 2</b>					
<b>Term 3</b>	E E 240 (3-1s-3/2) MATE 251 (3-0-0) MATH 201 (3-0-1) MATH 209 (3-0-1) PHYS 281 (3-0-0) PHYS 292 (0-0-3) SOC 366 (3-0-0)	CH E 243 (3-1-0) CH E 285 (1-0-0) CHEM 261 (3-0-3) E E 201 (3-0-3/2) ENGL 199 (3-0-0) or Complementary Studies Elective (3-0-0) MATE 252 (3-0-3/2) MATH 209 (3-0-1)	CIV E 270 (3-0-3) ENGL 199 (3-0-0) MATH 209 (3-0-1) MEC E 250 (3-1s-0) MEC E 265 (2-0-3) PHYS 230 (3-0-3/2)	CIV E 265 (2-0-3) EAS 210 (3-0-3) E E 201 (3-0-3/2) ENGL 199 (3-0-0) MATE 252 (3-0-3/2) STAT 235 (3-0-3/2)	EAS 210 (3-0-3) E E 201 (3-0-3/2) ENGL 199 (3-0-0) MATE 252 (3-0-3/2) MATE 390 (3-1-0) Tech Elective (3-0-0)
<b>Term 4</b>	E E 231 (3-1s-0) E E 250 (3-1s-3/2) ENGL 199 (3-0-0) PHYS 211 (3-0-0) PHYS 244 (3-0-0) PHYS 271 (3-0-0) PHYS 292 (0-0-3)	CH E 265 (3-0-3) CIV E 270 (3-0-3) MATH 201 (3-0-1) SOC 366 (3-0-0) MATE 256 (3-0-3/2) Complementary Studies Elective (3-0-0) or ENGL 199 (3-0-0)	CH E 243 (3-1s-0) E E 239 (3-0-3/2) MATH 201 (3-0-1) MATH 209 (3-0-1) MEC E 200 (0-2-0) MEC E 260 (2-0-3) MATE 252 (3-0-3/2) STAT 235 (3-0-2)	CH E 243 (3-1s-0) CIV E 270 (3-0-3) MATH 201 (3-0-1) MATH 209 (3-0-1) MEC E 310 (3-0-0) MIN E 295 (3-0-3/2)	CH E 243 (3-1s-0) CIV E 270 (3-0-3) MATH 201 (3-0-1) MATH 209 (3-0-1) PET E 295 (3-0-3/2) STAT 235 (3-0-2)
<b>Year 3</b>	<b>(See the 1995/96 edition of the Calendar if you entered a second year in September 1994 or earlier.)</b>				
<b>Term 5</b>	E E 335 (3-1s-0) E E 340 (3-1s-3/2) MATH 311 (3-0-0) PHYS 311 (3-0-0) Complementary Studies Elective (3-0-0) one of: PHYS 362 (3-0-0) or Complementary Studies Elective (3-0-0)	CH E 312 (3-1s-0) MATE 340 (3-0-0) MATE 357 (3-0-3) MATE 390 (3-1-0) STAT 235 (3-0-2) MEC E 310 (3-0-0)	MATH 300 (3-0-0) MEC E 300 (3-0-0) MEC E 301 (1-0-3) MEC E 330 (3-0-1) MEC E 380 (3-0-0) MEC E 390 (3-0-1)	CH E 312 (3-1s-0) CIV E 381 (3-0-3) MATE 390 (3-1s-0) MIN E 310 (3-0-0) MIN E 323 (3-0-3) MIN E 325 (3-0-0) MIN E 428 (0-1s-0)	CH E 312 (3-1s-0) CH E 314 (3-1-4/4) CHEM 271 (3-0-3) PET E 362 (3-0-3/2) PET E 364 (3-1s-0) PET E 465 (3-1s-0)
<b>Term 6</b>	E E 323 (3-1s-0) E E 350 (3-1s-3/2) PHYS 372 (3-0-0) PHYS 381 (3-0-0) PHYS 397 (0-0-6) one of: E E 332 (3-0-3/2) E E 380 (3-0-3/2) E E 390 (3-0-0)	CH E 314 (3-1-4/4) MATE 331 (3-0-3/2) MATE 332 (3-0-3/2) MATE 358 (3-0-3) MATE 408 (3-0-0) MATE 445 (3-0-0)	MEC E 303 (1-0-3) MEC E 310 (3-0-0) MEC E 340 (3-0-0) MEC E 360 (3-0-3/2) MEC E 362 (3-0-3/2) Complementary Studies Elective (3-0-0)	CIV E 250 (2-0-2) CIV E 251 (2 weeks*) MIN E 324 (3-0-0) MIN E 330 (3-3/2-0) MP E 322 (3-1s-0) MATE 331 (3-0-3/2) Tech Elective (3-0-0) *Held in Intersession (spring term)	EAS 222 (3-0-3) MEC E 310 (3-0-0) MP E 322 (3-1s-0) PET E 366 (3-0-0) PET E 368 (3-0-3/2) PET E 488 (0-1s-0) Complementary Studies Elective (3-0-0)

### 84.3 Required Courses and Suggested Course Sequence for Traditional Programs (cont'd)

The required program of studies leading to the various BSc in Engineering degrees (traditional programs) are noted below. While all courses listed below are compulsory, the sequencing of courses may differ. All programs require Departmental approval.

Engineering Chart 1 details a suggested course sequence for each Engineering degree program by year and term. Course numbers are followed by the hours of instruction in parentheses. The first number indicates lecture hours, the second number seminar hours, and the third number laboratory hours. Laboratory hours often appear as two numbers separated by a slash, which indicates hours and weeks (eg. the expression 3/2 means 3 hours of laboratory every second week).

**Note:** For information on Complementary Studies Electives see §84.6.

	Engineering Physics	Materials Engineering	Mechanical	Mining	Petroleum
<b>Year 4</b>	<b>(See the 1995/96 edition of the Calendar if you entered a second year in September 1994 or earlier.)</b>				
<b>Term 7</b>	E E 438 (3-0-3/4) E E 494 (0-1s-0) E E 570 (3-0-3) PHYS 415 (3-0-0) PHYS 481 (3-0-0) Tech Elective (3-0-0) one of: PHYS 362 (3-0-0) or Complementary Studies Elective (3-0-0)	CH E 365 (3-0-3) CH E 446 (3-0-3/2) or Tech Elective (3-0-0) CH E 481 (0-1-0) MATE 430 (3-0-3/2) MATE 441 (0-1-1) MATE 448 (0-1s-0) MATE 452 (3-0-3) MATE 467 (3-1-0)	MEC E 430 (3-0-0) MEC E 451 (3-0-1) MEC E 465 (1-0-4) MEC E 470 (3-1s-0) MEC E 480 (3-0-0) Tech Elective (3-0-0)	ENGG 404 (3-3s/2-0) MIN E 402 (0-3/2-6) MIN E 408 (2-0-0) MIN E 413 (3-0-3/2) MIN E 414 (3-0-3/2) MIN E 428 (0-1s-0) MP E 499 (1-0-0) Complementary Studies Elective (3-0-0)	ENGG 402 (3-0-0) MP E 497 (3-1s-0) MP E 499 (1-0-0) PET E 473 (3-0-3/2) PET E 484 (2-0-3) Tech Elective (3-0-0) Tech Elective (3-0-0)
<b>Term 8</b>	E E 462 (3-0-3/2) E E 495 (0-0-6) ENGG 400 (1-0-0) MEC E 310 (3-0-0) Tech Elective (3-0-0) Tech Elective (3-0-0) Tech Elective (3-0-0) <b>Notes:</b> (1) See §84.5.6 for restrictions on the four technical electives. (2) Students may take an extra course per term if their GPA is at least 7.0. (3) PHYS 362 may be offered every second year and must be taken when available.	CH E 483 (0-1-0) ENGG 400 (1-0-0) MATE 380 (3-0-0) MATE 443 (2-1-3) or CH E 465 (1-0-6) MATE 442 (0-0-6) or Tech Elective (3-0-0) Tech Elective (3-0-0) or CH E 446 (3-0-3/2) Tech Elective (3-0-0) <b>Notes:</b> (1) CH E 446 must be taken in either term 7 or term 8. (2) See §84.5.7 for restrictions on the three (or four) technical electives.	MEC E 463 (3-0-2) MEC E 465 (1-0-4) E E 469 (3-0-3/2) or CH E 446 (3-0-3/2) ENGG 400 (1-0-0) SOC 366 (3-0-0) Tech Elective (3-0-0) <b>Note:</b> See §84.5.8 for restrictions on the two technical electives. Students must have credit in either MEC E 402 or MEC E 200.	ENGG 400 (1-0-0) ENGG 405 (3-0-0) MATE 408 (3-0-0) MIN E 403 (0-3/2-6) MIN E 407 (3-0-3/2) MIN E 420 (3-0-0) Tech Elective (3-0-0) <b>Note:</b> §84.5.9 for restrictions on electives.	ENGG 400 (1-0-0) PET E 475 (3-0-3/2) PET E 477 (3-0-0) PET E 489 (1-0-0) PET E 496 (1-6s-0) SOC 366 (3-0-0) Tech Elective (3-0-0) <b>Note:</b> See §84.5.10 for restrictions on the technical electives.

Engineering Chart 1 (cont'd)

### 84.4 Required Courses and Suggested Course Sequence for Co-op Programs

The required program of studies leading to the various BSc in Engineering degrees (Cooperative Education programs) are noted below. While all courses listed below are compulsory, the sequencing of courses may differ. All programs require Departmental approval.

Engineering Chart 2 details a suggested course sequence for each Engineering degree program by year and term. Course numbers are followed by the hours of instruction in parentheses. The first number indicates lecture hours, the second number seminar hours, and the third number laboratory hours. Laboratory hours often appear as two numbers separated by a slash, which indicates hours and weeks (eg. the expression 3/2 means 3 hours of laboratory every second week).

**Note:** For information on Complementary Studies Electives, §84.6.

	Chemical Plan I	Chemical Plan II	Chemical: Computer Process Control Option Plan I	Chemical: Computer Process Control Option Plan II
<b>Year 2</b>	<b>Fall Term 3</b> CH E 243 (3-1s-0) CH E 265 (3-0-3) or MATE 252 (3-0-3/2) CH E 285 (1-0-0) CHEM 261 (3-0-3) ENGG 299 (1-0-0) ENGL 199 (3-0-0) or Complementary Studies Elective (3-0-0) MATH 209 (3-0-1) Complementary Studies Elective (3-0-0)  <b>Winter Term 4</b> CH E 265 (3-0-3) or MET E 252 (3-0-3/2) E E 239 (3-0-3/2) MATH 201 (3-0-1) SOC 366 (3-0-0) STAT 235 (3-0-2) Complementary Studies Elective (3-0-0) or ENGL 199 (3-0-0)  <b>Summer</b> WKEXP 901	<b>Fall Term 3</b> CH E 243 (3-1s-0) CH E 265 (3-0-3) or MATE 252 (3-0-3/2) CH E 285 (1-0-0) CHEM 261 (3-0-3) ENGG 299 (1-0-0) ENGL 199 (3-0-0) or Complementary Studies Elective (3-0-0) MATH 209 (3-0-1) Complementary Studies Elective (3-0-0)  <b>Winter Term 4</b> MET E 252 (3-0-3/2) or CH E 265 (3-0-3) E E 239 (3-0-3/2) MATH 201 (3-0-1) SOC 366 (3-0-0) STAT 235 (3-0-2) Complementary Studies Elective (3-0-0) or ENGL 199 (3-0-0).  <b>Summer</b> WKEXP 901	<b>Fall Term 3</b> CH E 243 (3-1s-0) CH E 265 (3-0-3) or MATE 252 (3-0-3/2) CH E 285 (1-0-0) CHEM 261 (3-0-3) E E 240 (3-1s-3/2) E E 280 (3-0-3/2) ENGG 299 (1-0-0) MATH 209 (3-0-1)  <b>Winter Term 4</b> CMPUT 115 (3-0-3) E E 250 (3-1s-3/2) E E 380 (3-0-3/2) ENGL 199 (3-0-0) MATH 201 (3-0-1) MATE 252 (3-0-3/2) or CH E 265 (3-0-3)  <b>Summer</b> WKEXP 901	<b>Fall Term 3</b> CH E 243 (3-1s-0) CH E 265 (3-0-3) or MATE 252 (3-0-3/2) CH E 285 (1-0-0) CHEM 261 (3-0-3) E E 240 (3-1s-3/2) E E 280 (3-0-3/2) ENGG 299 (1-0-0) MATH 209 (3-0-1)  <b>Winter Term 4</b> CMPUT 115 (3-0-3) E E 250 (3-1s-3/2) E E 380 (3-0-3/2) ENGL 199 (3-0-0) MATH 201 (3-0-1) MATE 252 (3-0-3/2) or CH E 265 (3-0-3)  <b>Summer</b> WKEXP 901

Engineering Chart 2

### 84.4 Required Courses and Suggested Course Sequence for Co-op Programs (cont'd)

The required program of studies leading to the various BSc in Engineering degrees (Cooperative Education programs) are noted below. While all courses listed below are compulsory, the sequencing of courses may differ. All programs require Departmental approval.

Engineering Chart 2 details a suggested course sequence for each Engineering degree program by year and term. Course numbers are followed by the hours of instruction in parentheses. The first number indicates lecture hours, the second number seminar hours, and the third number laboratory hours. Laboratory hours often appear as two numbers separated by a slash, which indicates hours and weeks (eg. the expression 3/2 means 3 hours of laboratory every second week).

**Note:** For information on Complementary Studies Electives, §84.6.

	Chemical Plan I	Chemical Plan II	Chemical: Computer Process Control Option Plan I	Chemical: Computer Process Control Option Plan II
<b>Year 3</b>	(See the 1995/96 edition of the Calendar if you entered a second year in September 1994 or earlier.) <b>Fall Term 5</b> CH E 312 (3-1s-0) CH E 343 (3-1s-0) CH E 351 (2-0-3) CH E 375 (3-1s-0) CH E 474 (3-1s-0) Tech Elective (3-1s-0) <b>Winter</b> WKEXP 902 <b>Summer</b> WKEXP 903	(See the 1995/96 edition of the Calendar if you entered a second year in September 1994 or earlier.) <b>Fall Term 5</b> CH E 312 (3-1s-0) CH E 343 (3-1s-0) CH E 351 (2-0-3) CH E 375 (3-1s-0) CH E 474 (3-1s-0) Tech Elective (3-1s-0) <b>Winter</b> WKEXP 902 <b>Summer Term 6</b> CH E 314 (3-1s-4/4) CH E 316 (3-0-2) CH E 365 (3-0-3) CH E 453 (1-0-4) CH E 481 (0-1-0) Tech Elective (3-1s-0)	(See the 1995/96 edition of the Calendar if you entered a second year in September 1994 or earlier.) <b>Fall Term 5</b> CH E 312 (3-1s-0) CH E 343 (3-1s-0) CH E 351 (2-0-3) E E 387 (3-1s-0) SOC 366 (3-0-0) Complementary Studies Elective (3-0-0) <b>Winter</b> WKEXP 902 <b>Summer</b> WKEXP 903	(See the 1995/96 edition of the Calendar if you entered a second year in September 1994 or earlier.) <b>Fall Term 5</b> CH E 312 (3-1s-0) CH E 343 (3-1s-0) CH E 351 (2-0-3) CH E 540 (3-0-3/2) E E 387 (3-1s-0) Tech Elective (3-0-0) <b>Winter</b> WKEXP 902 <b>Summer Term 6</b> CH E 314 (3-1s-4/4) CH E 316 (3-0-2) CH E 365 (3-0-3) CH E 446 (3-0-3/2) CH E 453 (1-0-4) Complementary Studies Elective (3-0-0)
<b>Year 4</b>	(See the 1995/96 edition of the Calendar if you entered a second year in September 1994 or earlier.) <b>Fall Term 6</b> CH E 314 (3-1s-4/4) CH E 316 (3-0-2) CH E 365 (3-0-3) CH E 453 (1-0-4) CH E 481 (0-1-0) Tech Elective (3-1s-0) <b>Winter Term 7</b> CH E 418 (3-0-2) CH E 434 (3-1s-0) CH E 446 (3-0-3/2) CHEM 275 (3-0-3/2) Tech Elective (3-1s-0) Tech Elective (3-0-0) <b>Summer</b> WKEXP 904	(See the 1995/96 edition of the Calendar if you entered a second year in September 1994 or earlier.) <b>Fall</b> WKEXP 903 <b>Winter</b> WKEXP 904 <b>Summer Term 7</b> CH E 418 (3-0-2) CH E 434 (3-1s-0) CH E 436 (3-1s-0) CH E 446 (3-0-3/2) Tech Elective (3-1s-0) Tech Elective (3-0-0)	(See the 1995/96 edition of the Calendar if you entered a second year in September 1994 or earlier.) <b>Fall Term 6</b> CH E 314 (3-1s-4/4) CH E 316 (3-0-2) CH E 365 (3-0-3) CH E 453 (1-0-4) CH E 481 (0-1-0) CH E 540 (3-0-3/2) <b>Winter Term 7</b> CH E 418 (2-0-2) CH E 434 (3-1s-0) CH E 446 (3-0-3/2) CHEM 275 (3-0-3/2) Tech Elective (3-1s-0) Complementary Studies Elective (3-0-0) <b>Summer</b> WKEXP 904	(See the 1995/96 edition of the Calendar if you entered a second year in September 1994 or earlier.) <b>Fall</b> WKEXP 903 <b>Winter</b> WKEXP 904 <b>Summer Term 7</b> CH E 418 (3-0-2) CH E 434 (3-1s-0) CH E 436 (3-1s-0) CH E 481 (0-1-0) SOC 363 (3-0-0) Complementary Studies Elective (3-0-0)
<b>Year 5</b>	(See the 1995/96 edition of the Calendar if you entered a second year in September 1994 or earlier.) <b>Fall</b> WKEXP 905 <b>Winter Term 8</b> CH E 454 (1-0-4) CH E 465 (1-0-6) CH E 483 (0-1-0) ENGG 400 (1-0-0) Tech Elective (3-0-3) Tech Elective (3-1s-0) <b>Note:</b> See §84.5.1 for restrictions on the six technical electives.	(See the 1995/96 edition of the Calendar if you entered a second year in September 1994 or earlier.) <b>Fall</b> WKEXP 905 <b>Winter Term 8</b> CH E 454 (1-0-4) CH E 465 (1-0-6) CH E 483 (0-1-0) ENGG 400 (1-0-0) Tech Elective (3-0-3) Tech Elective (3-1s-0) <b>Note:</b> See §84.5.1 for restrictions on the six technical electives.	(See the 1995/96 edition of the Calendar if you entered a second year in September 1994 or earlier.) <b>Fall</b> WKEXP 905 <b>Winter Term 8</b> CH E 454 (1-0-4) CH E 465 (1-0-6) CH E 483 (0-1-0) CH E 562 (3-0-3/2) CH E 564 (3-0-3/2) CHEM 311 (3-0-3) ENGG 400 (1-0-0) <b>Note:</b> See §84.5.2 for restrictions on the technical elective.	(See the 1995/96 edition of the Calendar if you entered a second year in September 1994 or earlier.) <b>Fall</b> WKEXP 905 <b>Winter Term 8</b> CH E 454 (1-0-4) CH E 465 (1-0-6) CH E 483 (0-1-0) CH E 562 (3-0-3/2) CH E 564 (3-0-3/2) CHEM 311 (3-0-3) ENGG 400 (1-0-0) <b>Note:</b> See §84.5.2 for restrictions on the technical elective.
	<b>Civil</b>	<b>Civil: Environmental Engineering Option</b>	<b>Computer</b>	<b>Electrical</b>
<b>Year 2</b>	<b>Fall Term 3</b> CIV E 265 (2-0-3) CIV E 270 (3-0-3) ENGG 299 (1-0-0) EAS 210 (3-0-3) MATH 209 (3-0-1) MATE 252 (3-0-3/2) <b>Winter Term 4</b> CIV E 221 (3-0-3/2) CIV E 250 (3-0-2) CIV E 251 (2 weeks*) CIV E 290 (3-0-0) CIV E 295 (3-0-2) MATH 201 (3-0-1) *Held in Intercession (Spring Term) <b>Summer</b> WKEXP 901	<b>Fall Term 3</b> CIV E 265 (2-0-3) CIV E 270 (3-0-3) ENGG 299 (1-0-0) ENV E 220 (3-0-3/2) EAS 210 (3-0-3) MATH 209 (3-0-1) <b>Winter Term 4</b> BIOL 108 (3-0-3) CIV E 250 (3-0-2) CIV E 295 (3-0-2) CIV E 251 (2 weeks*) ENV E 222 (3-0-0) MATH 201 (3-0-1) *Held in Intercession (Spring Term) <b>Summer</b> WKEXP 901	<b>Fall Term 3</b> CMPUT 115 (3-0-3) E E 240 (3-1s-3/2) E E 280 (3-0-3/2) ENGG 299 (1-0-0) ENGL 199 (3-0-0) MATH 209 (3-0-1) SOC 366 (3-0-0) <b>Winter Term 4</b> CMPUT 272 (3-1s-1) E E 231 (3-1s-0) E E 250 (3-1s-3/2) E E 380 (3-0-3/2) MATH 201 (3-0-1) PHYS 230 (3-0-3/2) <b>Summer</b> WKEXP 901	<b>Fall Term 3</b> E E 240 (3-1s-3/2) E E 280 (3-0-3/2) ENGG 299 (1-0-0) MATH 201 (3-0-1) MATH 209 (3-0-1) MEC E 250 (3-1s-0) SOC 366 (3-0-0) <b>Winter Term 4</b> CH E 243 (3-1s-0) E E 231 (3-1s-0) E E 250 (3-1s-3/2) ENGL 199 (3-0-0) MATH 309 (3-0-0) PHYS 230 (3-0-3/2) <b>Summer</b> WKEXP 901

### 84.4 Required Courses and Suggested Course Sequence for Co-op Programs (cont'd)

The required program of studies leading to the various BSc in Engineering degrees (Cooperative Education programs) are noted below. While all courses listed below are compulsory, the sequencing of courses may differ. All programs require Departmental approval.

Engineering Chart 2 details a suggested course sequence for each Engineering degree program by year and term. Course numbers are followed by the hours of instruction in parentheses. The first number indicates lecture hours, the second number seminar hours, and the third number laboratory hours. Laboratory hours often appear as two numbers separated by a slash, which indicates hours and weeks (eg. the expression 3/2 means 3 hours of laboratory every second week).

**Note:** For information on Complementary Studies Electives, §84.6.

	Civil	Civil: Environmental Engineering Option	Computer	Electrical
<b>Year 3</b>	(See the 1995/96 edition of the Calendar if you entered a second year in September 1994 or earlier.) <b>Fall</b> WKEXP 902  <b>Winter Term 5</b> CIV E 312 (3-0-0) CIV E 321 (3-0-3/2) CIV E 330 (3-1s-0) CIV E 372 (3-2s-0) CIV E 391 (3-0-3) CIV E 395 (3-0-2/2)  <b>Summer</b> WKEXP 903	<b>Fall</b> WKEXP 902  <b>Winter Term 5</b> CH E 243 (3-1s-0) CIV E 290 (3-0-0) CIV E 330 (3-1s-0) CIV E 372 (3-2s-0) CIV E 395 (3-0-2/2) ENV E 351 (3-0-3/2)  <b>Summer</b> WKEXP 903	<b>Fall Term 5</b> CMPUT 201 (3-0-3) CMPUT 204 (3-0-1) E E 335 (3-1s-0) E E 340 (3-1s-3/2) E E 387 (3-1s-0) E E 480 (3-0-3/2)  <b>Winter</b> WKEXP 902  <b>Summer</b> WKEXP 903	<b>Fall Term 5</b> E E 315 (3-1s-0) E E 330 (3-0-0) E E 335 (3-1s-0) E E 340 (3-1s-3/2) E E 380 (3-0-3/2) Tech Elective (3-0-0)  <b>Winter</b> WKEXP 902  <b>Summer</b> WKEXP 903
<b>Year 4</b>	(See the 1995/96 edition of the Calendar if you entered a second year in September 1994 or earlier.) <b>Fall Term 6</b> CIV E 303 (3-0-3/2) CIV E 331 (3-0-3/2) CIV E 374 (3-0-3) CIV E 381 (3-0-3) CIV E 398 (3-1s-0) ENGL 199 (3-0-0)  <b>Winter</b> WKEXP 904  <b>Summer</b> WKEXP 905	<b>Fall Term 6</b> CIV E 303 (3-0-3/2) CIV E 331 (3-0-3/2) CIV E 381 (3-0-3) CIV E 398 (3-1s-0) ENV E 320 (3-0-3/2) One of E E 201, MEC E 250 or MATE 252  <b>Winter</b> WKEXP 904  <b>Summer</b> WKEXP 905	<b>Fall Term 6</b> CMPE 401 (3-0-3/2) CMPUT 379 (3-0-3) E E 350 (3-1s-3/2) E E 390 (3-0-0) Tech Elective (3-0-0) Tech Elective (3-0-0)  <b>Winter Term 7</b> CMPE 313 (3-0-3) CMPE 382 (3-0-0) E E 317 (3-0-0) E E 438 (3-0-3/4) Tech Elective (3-0-0) Complementary Studies Elective (3-0-0)  <b>Summer</b> WKEXP 904	<b>Fall Term 6</b> E E 332 (3-0-3/2) E E 350 (3-1s-3/2) E E 358 (3-0-0) E E 390 (3-0-0) Tech Elective (3-0-0) and one of: ENGG 402 (3-0-0) or Complementary Studies Elective (3-0-0)  <b>Winter Term 7</b> E E 387 (3-1s-0) E E 438 (3-0-3/4) E E 458 (3-0-3/2) Tech Elective (3-0-0) Tech Elective (3-0-3/2) Complementary Studies Elective (3-0-0)  <b>Summer</b> WKEXP 904
<b>Year 5</b>	(See the 1995/96 edition of the Calendar if you entered a second year in September 1994 or earlier.) <b>Fall Term 7</b> Tech Elective (3-0-0) (See Note 1) Tech Elective (3-0-0) (See Note 1) Tech Elective (3-0-0) (See Note 1) One of E E 201, MEC E 250 or CH E 243 Complementary Studies Elective (3-0-0) (See Note 2)  <b>Winter Term 8</b> CIV E 490 (1-2s-0) ENGG 400 (1-0-0) ENGG 420 (3-0-0) SOC 366 (3-0-0) MEC E 310 (3-0-0) Tech Elective (3-0-0) Tech Elective (3-0-0) <b>Notes:</b> (1) See §84.5.3 for restrictions on the technical electives. (2) See §84.6 for restrictions on complementary electives.	<b>Fall Term 7</b> ENV E 400 (3-0-0) ENV E 402 (2-1s-0) ENV E 421 (3-0-3/2) ENV E 422 (3-0-0) ENV E 471 (3-0-3/2) Complementary Studies Elective (3-0-0) (See Note)  <b>Winter Term 8</b> ENGG 400 (1-0-0) ENV E 432 (3-0-0) ENV E 434 (3-0-0) ENV E 440 (3-0-3) LAW 559 (3-0-0) MEC E 310 (3-0-0) SOC 366 (3-0-0) <b>Note:</b> See §84.6 for restrictions on complementary electives.	<b>Fall</b> WKEXP 905  <b>Term 8</b> E E 462 (3-0-3/2) E E 582 (1-0-4) ENGG 400 (1-0-0) MEC E 310 (3-0-0) Tech Elective (3-0-0) Tech Elective (3-0-0) Complementary Studies Elective (3-0-0)  <b>Note:</b> See §84.5.4 for restrictions on the five technical electives.	<b>Fall</b> WKEXP 905  <b>Winter Term 8</b> ENGG 400 (1-0-0) MEC E 310 (3-0-0) Tech Elective (3-0-0) Tech Elective (3-0-0) Tech Elective (3-0-3/2) Tech Elective (3-0-3/2) Tech Elective (3-0-3/2)  <b>Note:</b> See §84.5.5 for restrictions on the nine technical electives.

## 84.4 Required Courses and Suggested Course Sequence for Co-op Programs (cont'd)

The required program of studies leading to the various BSc in Engineering degrees (Cooperative Education programs) are noted below. While all courses listed below are compulsory, the sequencing of courses may differ. All programs require Departmental approval.

Engineering Chart 2 details a suggested course sequence for each Engineering degree program by year and term. Course numbers are followed by the hours of instruction in parentheses. The first number indicates lecture hours, the second number seminar hours, and the third number laboratory hours. Laboratory hours often appear as two numbers separated by a slash, which indicates hours and weeks (eg. the expression 3/2 means 3 hours of laboratory every second week).

**Note:** For information on Complementary Studies Electives, §84.6.

	Materials Engineering	Mechanical	Mining	Petroleum
<b>Year 2</b>	<p><b>Fall Term 3</b> CH E 243 (3-1-0) CH E 285 (1-0-0) CHEM 261 (3-0-3) E E 201 (3-0-3/2) ENGG 299 (1-0-0) ENGL 199 (3-0-0) or Complementary Studies Elective (3-0-0) MATE 252 (3-0-3/2) MATH 209 (3-0-1)</p> <p><b>Winter Term 4</b> CH E 265 (3-0-3) CIV E 270 (3-0-3) MATE 256 (3-0-3/2) MATH 201 (3-0-1) Complementary Studies Elective (3-0-0) or ENGL 199 (3-0-0) SOC 366 (3-0-0)</p> <p><b>Summer</b> WKEXP 901</p>	<p><b>Fall Term 3</b> CIV E 270 (3-0-3) ENGG 299 (1-0-0) ENGL 199 (3-0-0) MATH 209 (3-0-1) MEC E 250 (3-1s-0) MEC E 265 (2-0-3) PHYS 230 (3-0-3/2)</p> <p><b>Winter Term 4</b> CH E 243 (3-1s-0) E E 239 (3-0-3/2) MATH 201 (3-0-1) MATE 252 (3-0-3/2) MEC E 200 (0-2-0) MEC E 260 (2-0-3) STAT 235 (3-0-2)</p> <p><b>Summer</b> WKEXP 901</p>	<p><b>Fall Term 3</b> CIV E 265 (2-0-3) E E 201 (3-0-3/2) ENGG 299 (1-0-0) ENGL 199 (3-0-0) EAS 210 (3-0-3) MATE 252 (3-0-3/2) STAT 235 (3-0-3/2)</p> <p><b>Winter Term 4</b> CH E 243 (3-1s-0) CIV E 270 (3-0-3) MATH 201 (3-0-1) MATH 209 (3-0-1) MEC E 310 (3-0-0) MIN E 295 (3-0-3/2)</p> <p><b>Summer</b> WKEXP 901</p>	<p><b>Fall Term 3</b> E E 201 (3-0-3/2) ENGG 299 (1-0-0) ENGL 199 (3-0-0) EAS 210 (3-0-3) MATE 252 (3-0-3/2) MATE 390 (3-1-0) Tech Elective (3-0-0)</p> <p><b>Winter Term 4</b> CH E 243 (3-1s-0) CIV E 270 (3-0-3) MATH 201 (3-0-1) MATH 209 (3-0-1) PET E 295 (3-0-3/2) STAT 235 (3-0-2)</p> <p><b>Summer</b> WKEXP 901</p>
<b>Year 3</b>	(See the 1995/96 edition of the Calendar if you entered a second year in September 1994 or earlier.)			
	<p><b>Fall Term 5</b> CH E 312 (3-1-0) MATE 340 (3-0-0) MATE 357 (3-0-3) MATE 390 (3-1-0) MEC E 310 (3-0-0) STAT 235 (3-0-2)</p> <p><b>Winter Term</b> WKEXP 902</p> <p><b>Summer</b> WKEXP 903</p>	<p><b>Fall</b> WKEXP 902</p> <p><b>Winter Term 5</b> MATH 300 (3-0-0) MEC E 300 (3-0-0) MEC E 301 (1-0-3) MEC E 330 (3-0-1) MEC E 380 (3-0-0) MEC E 390 (3-0-1)</p> <p><b>Summer</b> WKEXP 903</p>	<p><b>Fall</b> WKEXP 902</p> <p><b>Winter Term 5</b> CIV E 250 (2-0-2) CIV E 251 (2 weeks*) MATE 331 (3-0-3/2) MIN E 324 (3-0-0) MIN E 330 (3-3/2s-0) MP E 322 (3-1s-0) Tech Elective (3-0-0) (*Held in Intersession Spring Term)</p> <p><b>Summer</b> WKEXP 903</p>	<p><b>Fall</b> WKEXP 902</p> <p><b>Winter Term 5</b> EAS 221 (3-0-3) MEC E 310 (3-0-0) MP E 322 (3-1s-0) PET E 366 (3-0-0) PET E 368 (3-0-3/2) PET E 488 (0-1s-0) Complementary Studies Elective (3-0-0)</p> <p><b>Summer</b> WKEXP 903</p>
<b>Year 4</b>	(See the 1995/96 edition of the Calendar if you entered a second year in September 1994 or earlier.)			
	<p><b>Fall Term 7</b> CH E 314 (3-1s-4/4) CH E 365 (2-0-3) CH E 481 (0-1-0) MATE 430 (3-0-3/2) MATE 448 (0-1s-0) MATE 452 (3-0-3) MATE 467 (3-1-0)</p> <p><b>Winter Term 7</b> MATE 331 (3-0-3/2) MATE 332 (3-0-3/2) MATE 358 (3-0-3) MATE 408 (3-0-0) MATE 445 (3-0-0) Tech Elective (3-0-0)</p> <p><b>Summer</b> WKEXP 904</p>	<p><b>Fall Term 6</b> MEC E 303 (1-0-3) MEC E 310 (3-0-0) MEC E 340 (3-0-0) MEC E 360 (3-0-3/2) MEC E 362 (3-0-3/2) Complementary Studies Elective (3-0-0)</p> <p><b>Winter</b> WKEXP 904</p> <p><b>Summer</b> WKEXP 905</p>	<p><b>Fall Term 6</b> CH E 312 (3-1s-0) CIV E 381 (3-0-3) MATE 390 (3-1s-0) MIN E 310 (3-0-0) MIN E 323 (3-0-3) MIN E 325 (3-0-0) MIN E 428 (0-1s-0)</p> <p><b>Winter</b> WKEXP 904</p> <p><b>Summer</b> WKEXP 905</p>	<p><b>Fall Term 6</b> CH E 312 (3-1s-0) CH E 314 (3-1-4/4) CHEM 271 (3-0-3) PET E 362 (3-0-3/2) PET E 364 (3-1s-0) PET E 465 (3-1s-0)</p> <p><b>Winter</b> WKEXP 904</p> <p><b>Summer</b> WKEXP 905</p>
<b>Year 5</b>	(See the 1995/96 edition of the Calendar if you entered a second year in September 1994 or earlier.)			
	<p><b>Fall</b> WKEXP 905</p> <p><b>Winter Term 8</b> ENGG 400 (1-0-0) CH E 446 (3-0-3/2) CH E 483 (0-1-0) MATE 380 (3-0-0) Technical Elective (3-0-0) MATE 443 (2-1-3) or CH E 465 (1-0-6) Technical Elective (3-0-0)</p> <p><b>Note:</b> See §84.5.7 for restrictions on the three (or four) technical electives.</p>	<p><b>Fall Term 7</b> MEC E 430 (3-0-0) MEC E 451 (3-0-1) MEC E 465 (1-0-4) MEC E 470 (3-1s-0) MEC E 480 (3-0-0) Tech Elective (3-0-0)</p> <p><b>Winter Term 8</b> MEC E 463 (3-0-2) MEC E 465 (1-0-4) E E 469 (3-0-3/2) or CH E 446 (3-0-3/2) ENGG 400 (1-0-0) SOC 366 (3-0-0) Tech Elective (3-0-0)</p> <p><b>Note:</b> See §84.5.8 for restrictions on the two technical electives. Students must have credit in either MEC E 402 or MEC E 200.</p>	<p><b>Fall Term 7</b> ENGG 404 (3-3s/2-0) MIN E 402 (0-3/2-6) MIN E 408 (2-0-0) MIN E 413 (3-0-3/2) MIN E 414 (3-0-3/2) MIN E 428 (0-1s-0) MP E 499 (1-0-0) Complementary Studies Elective (3-0-0)</p> <p><b>Winter Term 8</b> ENGG 400 (1-0-0) ENGG 405 (3-0-0) MIN E 403 (0-3/2-6) MIN E 407 (3-0-3/2) MIN E 420 (3-0-0) MATE 408 (3-0-0) Tech Elective (3-0-0)</p> <p><b>Note:</b> See §84.5.9 for restrictions on electives.</p>	<p><b>Fall Term 7</b> ENGG 402 (3-0-0) MP E 497 (3-1s-0) MP E 499 (1-0-0) PET E 473 (3-0-3/2) PET E 484 (2-0-3) Tech Elective (3-0-0) Tech Elective (3-0-0)</p> <p><b>Winter Term 8</b> ENGG 400 (1-0-0) PET E 475 (3-0-3/2) PET E 477 (3-0-0) PET E 489 (1-0-0) PET E 496 (1-6s-0) SOC 366 (3-0-0) Tech Elective (3-0-0)</p> <p><b>Note:</b> See §84.5.10 for restrictions on the two technical electives.</p>

## 84.5 Technical Electives

### 84.5.1 Chemical

- (1) Of the six, single-term, technical electives two must be Engineering Science and/or Engineering Design courses with a combined course weight of 7 units or more, and one elective must be an approved Chemistry course.
- (2) In addition to required courses, programs in Chemical Engineering offer considerable flexibility through electives to develop interdisciplinary interests or to study certain fields in some depth. Subject only to feasibility of timetabling and course availability, a student may choose from technical elective courses offered by the Department.

CH E 390, 458, 502, 522, 536, 538, 539, 540, 555, 562 and 564 or courses offered by other Departments such as:

BIOCH 201  
CHEM 311  
CIV E 420  
CMPUT 169, 201, 272  
EAS 210  
E E 280, 305, 380, 514  
ENGG 404, 406

NU SC 587  
MATE 256, 332, 357, 358, 430, 445  
MEC E 412, 443, 513, 565  
MICRB 265  
PET E 364, 366, 465, 470, 473, 475, 477

### 84.5.2 Chemical: Computer Process Control Option

- (1) For the technical elective select any of: CH E 474, E E 335, E E 438 (E E 335 is a prerequisite for E E 438), or a Department approved Computing Science course (eg. CMPUT 201).
- (2) Department of Computing Science quotas exist for computing science courses at and beyond the 200-level. Students should discuss scheduling courses required for this option with the Department of Chemical Engineering advisor.

### 84.5.3 Civil

The five technical electives must be selected from at least three of the following areas. Following are available elective courses:

- (1) **Construction Engineering:** CIV E 404, 506
- (2) **Environmental Engineering:** CIV E 421, 521
- (3) **Geotechnical Engineering:** CIV E 481, 591
- (4) **Structural Engineering:** CIV E 474, 574
- (5) **Transportation Engineering:** CIV E 412, 511
- (6) **Water Resources Engineering:** CIV E 433, 540

**Note:** A maximum of one technical elective may be taken from another program, but only with prior written approval of the Department of Civil and Environmental Engineering. The requirement for electives from three areas of Civil and Environmental Engineering is not negotiable.

### 84.5.4 Computer

Of the five, single-term, technical electives, one elective must be a 300- or 400-level Computing Science course, and two of the electives must be from the group of courses CH E 243, MATE 353 and MEC E 250. The remaining two technical electives must be selected from the technical courses offered by the Department of Electrical Engineering and the Department of Computing Science.

### 84.5.5 Electrical

- (1) The nine technical electives must include one of the five program streams:
  - a. **Communications:** E E 316, 588, 589; one of E E 570 or 571; two of E E 445, 480, 514, 539, 582, 586, 591 or 597; and three more E E approved technical electives.
  - b. **Controls:** E E 480, 539, 561, 565; two of E E 445, 514, 524, 531, 550, 570, 582; and three more E E approved technical electives.
  - c. **Digital:** E E 480, 552, 570, 582; two of E E 445, 539, 571, 572, 653, CMPUT 115, 204, EE BE 540; and three more E E approved technical electives.

d. **Electronics:** E E 316, 570, 571, 572; two of E E 480, 524, 530, 531, 550, 552, 561, 641, 653, EE BE 512; and three more E E approved technical electives.

e. **Power:** E E 521, 525, 531; and four of E E 445, 514, 524, 527, 528, 529, 530, 545; and three more E E approved technical electives.

- (2) Complete list of Electrical Engineering approved Technical Electives: E E 316, 323, 445, 480, 514, 521, 524, 525, 527, 528, 529, 530, 531, 539, 545, 550, 552, 561, 565, 570, 571, 572, 582, 583, 586, 588, 589, 591, 596, 597, 598, 599, 641, 653.

E E BE 512, 540  
CMPUT 115, 272, 204.

In addition to this list, other courses may be taken on approval of the Department.

**Note:** Undergraduate students should be aware that they can take technical elective courses as extra to their BSc degree. It may be possible to use these extra courses as partial credit toward a graduate degree.

### 84.5.6 Engineering Physics

The four technical electives must be chosen, with the consent of the Department, such that the electives include at least 9.2 units of Engineering Science and Design.

### 84.5.7 Materials

The three technical electives must be chosen from the approved list of courses. The student may choose to develop a technical interest within elements of the discipline or to develop interdisciplinary interests in business, materials design (with Mechanical Engineering), polymers (with Chemical Engineering or Chemistry), biomaterials, etc. Department approval is required for all elective courses.

### 84.5.8 Mechanical

- (1) The two technical electives must be chosen from the following approved list:
  - BME 553, 563
  - CH E 540
  - EAS 210
  - E E 280, 305, 445 (380, 480 may be taken with approval of the Department of Electrical and Computer Engineering)
  - EE BE 512, 540
  - ENGG 404, 406
  - MATH 311
  - MATE 256, 358, 380, 445, 452, 467
  - MEC E 351, 364, 409, 412, 443, 469, 513, 523, 537, 541, 553, 563, 565
  - MEC E 514 or E E 514
  - MEC E 555 or E E 565
  - MGTS 352 or CIV E 592
  - MP E 497
  - PET E 362, 364, 366, 465, 473
- (2) Undergraduate students should be aware that they can take technical elective courses as extra to their BSc degree. It may be possible to use these extra courses as partial credit toward a graduate degree. See §184.33 for additional details.

### 84.5.9 Mining

Elective courses for all programs in the School of Mining and Petroleum Engineering may be chosen from those offered by the School, the Faculty of Engineering, or by the Faculties of Arts, Science, and Business. School approval is required for all elective courses.

### 84.5.10 Petroleum

The three (or four) technical electives must be chosen from an approved list of technical or business electives.

Elective courses for all programs in the School of Mining and Petroleum Engineering may be chosen from those offered by the School, the Faculty of Engineering, or by the Faculties of Arts, Science, and Business. School approval is required for all elective courses.

## 84.6 Complementary Studies Electives

The Canadian Engineering Accreditation Board requires that all engineering programs have a complementary studies component comprised of courses which expose students to the thought processes and practices in arts, communication, engineering economics, humanities and management. The complementary studies elective courses within each engineering

program may be selected from any of the following subject areas: Anthropology, Art and Design (ART H only), Business (not Management Information System courses, also see §82.12 and §82.13), Canadian Studies, Canadien-Français, Christian Theology, Classics, Comparative Literature, Engineering (ENGG 402, 405 and 420 only), English, Etudes de Religion, Family Studies, History, Interdisciplinary Studies (Departmental approval required), Linguistics, Philosophie, Philosophy, Political Science, Psychologie, Psychology, Religious Studies, Rural Economy, Science Politique, Slavic and East European Studies, Sociologie, Sociology, Women's Studies, and Writing. Courses from other subject areas may be acceptable with approval of an advisor. Complementary studies courses must be graded (not pass-fail), three lecture-hour courses with a written component and final exam. Courses which teach the application of a particular skill (such as courses in physical education and music) are not eligible as complementary studies electives.

Language courses (other than English) may also be taken as complementary studies electives in certain circumstances. Foreign language courses may not be taken in first year. Students wishing to take foreign language courses as Complementary Studies Electives must obtain prior department approval. Students may only register in courses appropriate to their level of proficiency. Beginner-level language courses will only be accepted as complementary studies electives in cases where the student has no prior experience in that language and where equivalent 30-level matriculation courses do not exist. Students who are familiar with a foreign language must receive an assessment of their level of proficiency and register appropriately: introductory or beginner-level courses will not be accepted as complementary studies electives in cases where a prior knowledge of the language exists. Students with matriculation-level credit in a language must select courses which are appropriate for their level of ability.

## 85 Courses

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### 85.1 Course Listings

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Faculty of Engineering courses are listed in §211, Course Listings, under the following subject headings:

- Bioresource Engineering (BIOEN) (offered by the Faculty of Agriculture, Forestry and Home Economics)
- Chemical Engineering (CH E)
- Civil Engineering (CIV E)
- Computer Engineering (CMPE) (offered jointly with the Faculty of Science)
- Electrical Engineering (E E)
- Electrical Engineering/Biomedical Engineering (EE BE)
- Engineering, Computing (ENCMP) (offered jointly with the Faculty of Science)
- Engineering, General (ENGG)
- Engineering, Management (ENG M)
- Engineering, Physics (EN PH) (offered jointly with the Faculty of Science)
- Environmental Engineering (ENV E)
- Materials Engineering (MATE)
- Mechanical Engineering (MEC E)
- Mineral Engineering (MNL E)
- Mining Engineering (MIN E)
- Mining and Petroleum Engineering (MP E)
- Petroleum Engineering (PET E)
- Work Experience (WKEXP)

### 85.2 Registration in Engineering Courses by Students in Other Faculties

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Although the Faculty of Engineering is a restricted enrolment faculty, it is possible for students who are registered in other faculties to enrol in a limited number of Engineering courses. However, students who are not registered in the Faculty of Engineering must obtain permission to enrol in engineering courses. The appropriate Department Chair in the Faculty of Engineering is authorized to grant permission.

**Note:** This requirement does not apply to students who are in programs which include Engineering courses as a formal part of the program.