

# Faculty of Engineering

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## 70 The Faculty of Engineering

The University of Alberta's Faculty of Engineering has a long and illustrious history. Since 1908, when we offered our first engineering program, the Faculty of Engineering has been responding to the changing needs of the world around us. Today, the Faculty of Engineering at the University of Alberta is one of the largest and most diverse in Canada. We offer nine accredited undergraduate engineering programs, as well as a full range of graduate programs, to over 3,300 students from around the world.

The mission of the Faculty of Engineering, which has remained virtually unchanged since our inception, is

- to produce engineering graduates of choice for employers and postgraduate schools and to produce graduates who can carry out forefront engineering design and research
- to produce nationally and internationally recognized engineering research
- to provide high-quality service to the engineering profession and the external community

### The Engineering Profession

We are proud of the role we play in educating future professional engineers. In Canada, engineering is a profession with a powerful and revered tradition of ethics, accountability, and service. The completion of a BSc degree in Engineering from the U of A is the first step on the road to becoming a professional engineer. Following a specified period of work experience, our graduates are able to register with their local professional engineering association, and practise engineering across Canada and around the world.

In their final term, all U of A students take part in "The Ritual of the Calling of an Engineer," or, the Iron Ring Ceremony. Written by Rudyard Kipling specifically for the first Canadian Iron Ring Ceremony in 1925, "The Ritual of the Calling of an Engineer," is the obligation and traditional ceremony meant to symbolize and enforce the ethics of professional engineers. This ceremony is purely Canadian, and the iron ring, worn on the little finger of the working hand, is the unique identifier of a Canadian engineer.

### Faculty Awards and Accomplishments

Talented, successful teachers and researchers are key to our success as a Faculty. It is through the efforts of our professors that we are able to maintain our position on the leading edge of discovery and dissemination of engineering knowledge. Some

awards and accomplishments of our faculty in the past year include

- Six Natural Sciences and Engineering Research Council (NSERC) Industrial Chairs and Senior Fellowships
- Natural Sciences and Engineering Research Council (NSERC) Doctoral Prize
- Premier's Award of Excellence
- Canadian Council of Professional Engineers Young Engineering Achievement Award
- Association of Professional Engineers Geologists and Geophysicists of Alberta (APEGGA) Early Accomplishment Award
- (APEGGA) Project Achievement Award
- YWCA Women with Distinction in Science and Technology Award
- Kapitsa Gold Medal from the Russian Academy of Natural Science
- Keefer Medal from the Canadian Society for Civil Engineering
- Wighton Fellowship from the Sanford Fleming Foundation
- Hydraulic Structures Medal from the American Society of Civil Engineering
- Katz Award from the Gas Processors Association
- Canadian Catalysis Lectureship Award from the Chemical Institute of Canada

### Student Awards and Accomplishments

The Faculty of Engineering builds on the strengths of our students. High-quality programs, outstanding faculty, and top-notch facilities means that we have been able to attract exceptional students who are realizing their full potential. Some recent student awards and accomplishments include

- Both CD Howe Foundation Awards for the top female first-year engineering student and the top male first-year engineering student in the country. No other university has ever won both awards in the same year; the U of A won both awards in 1997 and again in 1998.
- Alberta Science and Technology Award for Improved Public Awareness of Science and Technology, awarded to the Discover "E" Science Camp program.
- Major victories in International Competitions for our Hybrid Electric Vehicle, our Liquid Petroleum Gas Vehicle, our Autonomous Robotics Vehicle, and Aero Design aircraft. Students are preparing to enter many of these competitions again in 1999, as well as new entries in the *Formula SAE* competition vehicle project and the *Sunrayce '99 Solar Vehicle* competition.
- Students in the Faculty of Engineering received over \$1 million in scholarships in the past year.

# 71 The Professors

## Members of the Faculty

### Officers of the Faculty

**Professor and Dean**  
DT Lynch, PhD, PEng

**Associate Deans**  
KC Porteous, PhD, PEng  
PK Robertson, PhD, PEng

**Administrative Officers**  
RM Green, MA  
LE Swanson, MSC

### Chemical and Materials Engineering

**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  
JT Ryan, PhD  
RK Wood, PhD, PEng

**Professors**  
KT Chuang, PhD, PEng  
RL Eadie, PhD, PEng  
TH Etsell, PhD, PEng  
MR Gray, PhD, PEng  
RE Hayes, PhD, PEng  
H Henein, PhD, PEng  
DG Ivey, PhD, PEng  
DT Lynch, PhD, PEng  
JH Masliyah, PhD, PEng, FRSC  
(NSERC Senior Industrial Research Chair in Oil Sands with Syncrude Canada Ltd)  
AE Mather, PhD, PEng  
K Nandakumar, PhD, PEng  
BM Patchett, PhD, PEng  
KC Porteous, PhD, PEng  
M Rao, PhD  
SL Shah, PhD, PEng  
ML Wayman, PhD, PEng  
MC Williams, PhD

**Associate Professors**  
SM Kresta, PhD, PEng  
Z Xu, PhD

**Assistant Professors**  
PYK Choi, PhD, PEng  
JAW Elliott, PhD, PEng  
JF Forbes, PhD, PEng  
M Guay, PhD  
B Huang, PhD  
D-Y Li, PhD  
Q Liu, PhD  
S Liu, PhD, PEng  
J Luo, PhD  
WC McCaffrey, PhD  
PAJ Mees, PhD

**Industrial Professors, Safety and Loss Management**  
AL Wilson, BSc, PEng  
DJ McCutcheon, BSc, PEng  
W Chen, PhD, (NOVA/NSERC Junior Industrial Research Chair in Welding and Corrosion)

### Civil and Environmental Engineering

**Professor and Chair**  
TM Hrudev, PhD, PEng

**University Professors Emeriti**

JG MacGregor, PhD, PEng, FRSC, FCAE  
NR Morgenstern, PhD, PEng, FRSC, FCAE

**Professors Emeriti**  
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KO Anderson, MSc, PEng  
JJ Baker, MSCE, PEng  
K Barron, PhD, PEng  
RG Bentsen, PhD  
PH Bouthillier, MSc, PEng  
SP Dozzi, MEng, 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  
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 Teply, 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)  
DH-K Chan, PhD, PEng  
J-J Cheng, PhD, PEng (CW Carry Chair in Steel Structures)  
DM Cruden, PhD, PEngol (Joint Appointment with Geology)  
AE Elwi, PhD, PEng  
SM Farouq Ali, PhD, PEng  
GR Finch, PhD, PEng  
FE Hicks 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

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S Frimpong, PhD, PEng  
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DD Tannant, PhD, PEng  
CA Zeiss, PhD, PEng

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RJ Chalaturnyk, PhD, PEng  
QT Doan, PhD, PEng  
A Fayek, PhD  
GY Grondin, PhD, PEng  
SE Guigard, PhD  
WB Kindzierski, PhD, PEng  
B Lepski, PhD  
T Yu, PhD  
DZ Zhu, PhD

**Faculty Service Officer**  
DA Booth, BSc, PEng  
GS Hoye, PhD

**Administrative Officer**  
L Padgham, BSc

**Director, Construction Research Institute for Canada (CRIC)**  
IWA Kermack, MSc, PEng

### Electrical and Computer Engineering

**Professor and Chair**  
CE Capjack, PhD, PEng

**University Professor Emeritus**  
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**Professors Emeriti**  
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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  
WB Joerg, Dipl Math  
DH Kelly, PhD, PEng  
RW King, BSc, PEng  
YJ Kingma, Ir, PEng  
RI MacDonald, PhD, 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  
JF Vaneldik, PhD, PEng  
WAG Voss, PhD

**Professors**  
MJ Brett, PhD, PEng (AMC/NSERC Senior Industrial Research Chair in Thin Film Engineering)  
SK Dew, PhD, PEng  
NG Durdle, PhD, PEng  
R Fedosejevs, PhD, PEng (MPBT/NSERC Senior Industrial Research Chair in Laser and Spectroscopic Techniques Applied to the Natural Resources Industry)  
I Filanovsky, PhD, PEng

WD Grover, PhD, PEng  
DO Koval, PhD, PEng  
WA Krzymien, PhD, PEng  
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W Pedrycz, PhD, PEng  
AM Robinson, PhD, PEng  
D Routledge, PhD, PEng  
JC Salmon, PhD  
HJJ Seguin, PhD, PEng  
WR Tinga, PhD, PEng  
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WW Xu, PhD, PEng

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### Mechanical Engineering

**Professor and Chair**  
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KC Cheng, PhD  
JR Colbourne, PhD, PEng  
A Craggs, PhD, PEng  
G Ford, DSc, PEng  
JB Haddow, PhD  
JS Kennedy, PhD, PEng  
GSH Lock, PhD, PEng  
DJ Marsden, PhD, PEng  
CM Rodkiewicz, PhD  
GW Sadler, MSc, PEng  
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FH Vitovec, Dr TechSci, PEng

**Professors**  
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JD Dale, PhD, PEng  
F Ellyin, PhD, PEng (NOVA/NSERC Senior Industrial Research Chair in Advanced Pipeline Materials)  
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WH Finlay, PhD, PEng  
AW Lipsett, PhD, PEng  
A Mioduchowski, PhD, PEng  
JD Whittaker, PhD, PEng  
JD Wilson, PhD, PEng

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LW Kostiuik, PhD, PEng  
D Li, PhD  
P Schiavone, PhD  
LW Sigurdson, PhD, PEng  
RW Toogood, PhD, PEng  
JW Yokota, PhD  
M Zuo, PhD, PEng

**Assistant Professors**  
A Bhattacharyya, PhD  
DW Raboud, PhD  
C Ru, PhD  
XD Wang, PhD  
Z Xia, PhD, PEng

**Faculty Service Officer**  
MY Ackerman, MSc, PEng

**Sessional Lecturer in Engineering**  
BR Touchings, LLB

### Engineering Co-op Centre

**Professor and Director**  
KC Porteous, PhD, PEng

**Assistant Director and Coordinator**  
CJ Ottosen, BEd

**Administrative Officers**  
L Allisen, Coordinator  
C Bjornson, BA, Coordinator/  
Systems Administrator  
C DiCurzio, BCom, Coordinator  
CM Ens, BCom, Coordinator  
JL Esdale, BEd, Coordinator  
RC Kully, BEd, Coordinator  
BJ Strang, BA, Coordinator  
LJ Szekely, BEd, Coordinator

### Additional Members of Faculty Council

**President and Vice-Chancellor**  
RW Fraser, PhD

**Registrar of the University**  
BJ Silzer, MEd

**Professors**  
JJ Leonard, PhD, PEng (Agricultural, Food, and Nutritional Sciences)  
GH Cliff, PhD (Mathematical Sciences)  
TA Marsland, PhD (Computing Science)  
TJT Spanos, PhD (Physics)

**Associate Professors**  
UM Maydell, MSc (Computing Science)  
JD Mulvihill, PhD (English)  
L Trimble, PhD (Political Science)

**APEGGA Representative**  
VSV Rajan, PhD, PEng

**Representatives from Engineering Students**  
W Rushton (Undergraduate)  
T Poon (Undergraduate)  
J Carr (Undergraduate)  
D Giannitsios (Graduate)  
K Harris (Graduate)

## 72 General Information

### 72.1 BSc Engineering

The Faculty of Engineering offers undergraduate programs leading to BSc degrees in Chemical Engineering, Civil Engineering, Computer Engineering, Electrical Engineering, Engineering Physics, Materials Engineering, Mechanical 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 choose 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, common to all departments, as well as courses specific to the chosen discipline. As students progress through the program, courses become more specialized. Also, exposure to basic business concepts is important to 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.

### 72.2 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 four years (eight academic terms) to obtain their degree. In the cooperative education program, students complement their academic studies with five four-month 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 four years, so a degree with the Cooperative Program designation requires five years.

The Cooperative Program is offered in all Engineering programs except 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). See §74.4 for the sequence of academic and work terms. Because of the year-round nature of the Cooperative Program, Co-op students are considered full-time students of the University of Alberta for the full 12 months of any academic year (July 1 to June 30).

Students accepted into the Co-op Program must successfully complete the following six courses and the regular requirements for an Engineering degree within their specialization: ENGG 299, WKEXP 901, WKEXP 902, WKEXP 903, WKEXP 904, and WKEXP 905.

Because work experience is required, the Engineering Co-op Centre in the Faculty helps students find suitable employment. Most jobs are in Alberta, but some jobs are elsewhere in Canada or overseas. The ultimate responsibility for obtaining work-term employment is the student's. Co-op students pay a modest administrative fee for each work term. Visa students (student visitors) are not eligible for the Cooperative Education program.

### 72.3 Chemical Engineering

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 daily. Chemical engineers 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 and many other skills.

The chemical engineer must understand the physics and mathematics behind the problems of heat and mass flow when large quantities of reacting material must 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 tolerate high pressures and temperatures; and how they resist corrosion and wear. In the design and operation of biotechnology or environmental protection processes, the chemical engineer also needs to understand basic biological principles.

Students study the fundamentals of chemistry, physics, and mathematics, then learn engineering science and design. Selecting appropriate electives

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

#### 72.3.1 Computer Process Control Option in Chemical Engineering

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

Enrolment is limited.

#### 72.3.2 Elective Patterns in Chemical Engineering

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

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

- (1) **Advanced Materials and Polymers:** Advances in current technology are supported by new materials with unique properties, fabricated from metals, ceramics, semiconductors, and synthetic organic polymers. Developing 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 contribute significantly 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 in combination 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 on the design, development, and operation of product and separation processes. 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 unexpected disturbances, such as changes in raw materials. Process control addresses the development of control systems ranging from schemes that use simple instruments to sophisticated distributed digital computer systems that keep industrial units operating at the desired conditions. An introduction to some of the more advanced concepts in process control is available by selecting one or more of the appropriate elective courses given by the Department. Students interested in a career in the control and instrumentation field should consider the "Computer Process Control Option" described in §72.3.1.
- (4) **Environmental Engineering:** Because 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 Departments of Civil and Environmental Engineering and Mechanical Engineering and by faculties outside Engineering, help students become aware of environmental technology and also serve as appropriate background for those who want to specialize in the environmental field.
- (5) **Engineering Management:** Chemical engineers are frequently employed in positions with a primary function of technical management. For engineers involved in production or design, many tasks involve establishing optimal operating conditions. The Department elective course in optimization, taken with courses offered by the Department of Mechanical Engineering in the operations management area, provides

pertinent background material for students interested in technical management.

By choosing proper electives, students may, depending on their academic standing, be able to select courses that may be applied for advance credit toward a Master of Business Administration (MBA) or Master of Arts (MA) in Economics.

- (6) **Oil and Natural Gas:** Chemical Engineering graduates are often employed in industries that 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.

## 72.4 Civil Engineering

Civil engineers apply science in planning, designing, constructing, operating, or managing airports, buildings, bridges, harbors, highways, flood control structures, transit systems, water supply and distribution systems, waste collection and storm drainage, and other public works. Today, civil engineers are asked to meet the challenges of pollution, deteriorating urban infrastructure, traffic congestion, energy needs, urban development, and community planning.

Civil engineering offers an 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 that 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 specialization in these disciplines.

### 72.4.1 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 design specifications. Construction engineers lead a team of financial planners, technicians, tradespeople, and professional engineers from other disciplines.

#### Environmental Engineering

Environmental engineers incorporate principles of chemistry, biology, microbiology, mathematics, chemical engineering, and civil engineering to provide technological solutions to environmental problems such as water pollution control, providing 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, in the field and in the laboratory, the properties of soils and rock that support and affect the behavior of structures, pavement, and underground facilities. They evaluate potential settlement of buildings, stability of slopes and fills, analysis of landslides, groundwater seepage, 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 various 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, boring tunnels, plotting flood control and irrigation projects, and for all other areas of civil engineering.

#### Transportation Engineering

Transportation engineers plan and design the safe and efficient movement of people and goods. They construct and manage all types of transportation facilities.

#### 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, and 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.

### 72.4.2 Environmental Engineering Option in Civil Engineering

Interest in design, construction, operation, and maintenance of developments with minimal effect 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 safe drinking water provision, water pollution control, solid and hazardous wastes disposal and recycling, and air quality control in industrial and municipal environments. Environmental engineers are also involved in providing municipal components such as water mains, sewers, storm sewers, and solid waste collection.

Enrolment is limited.

## 72.5 Computer Engineering

Computer engineering is concerned with the design of computer systems for their many applications.

A computer system consists of hardware and software components, and the computer engineer must be knowledgeable in the design of both. 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 in the key application areas of computers, namely control systems and communication systems. Students may take 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 design's success. 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) headed by the Director of Computer Engineering.

## 72.6 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 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 courses, and various design projects are offered in the final year of study.

Students should contact the Department of Electrical and Computer Engineering for advice regarding selecting appropriate elective courses.

## 72.6.1 Elective Patterns in Electrical Engineering

### Electric Power Engineering

Power engineers use 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.

### Communications

Communications addresses the transmission of information from one point to another, using wires, coaxial cable, fibre-optics, or radio. Designing communications systems requires knowledge in such areas as network theory and statistical analysis, while designing elements that make up these systems draws 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 as one of the most promising fields, and its growth potentials are unlimited.

Senior undergraduate students in Electrical or Computer Engineering wanting 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 Materials 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 range of applications, including process control, robotics, digital signal processing, computers, communications, instrumentation, and analog/digital conversion. The electives that make up the digital systems stream deal with low-level hardware design issues such as microprocessor system design, digital system design, and analog/digital electronics.

### Electronics

Electronics is an area of Electrical Engineering that may be applied to all fields of technology. It overlaps 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. Electronics engineers use these devices and techniques to design and analyze systems that can be used in various applications from radio frequency or microwave systems to solving instrumentation problems. Electronics 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 their uses.

## 72.7 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 more fundamental than the Electrical Engineering program and provides students with an extensive background in mathematics and physics.

Students who want to take Engineering Physics must have a high standing in mathematics and physics and normally are 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 chosen to meet the student's requirements. Some of these areas are lasers, plasmas, communications, microelectronics, microwave, and high vacuum.

## 72.8 Materials Engineering

Materials engineering has evolved from dealing only with metals and alloys to being concerned with the production and engineering applications of metallic and non-metallic materials (polymers, ceramics, composites and electronic materials). Materials engineers develop, modify, and use processes to convert raw materials to 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 applying materials. Graduates of the program find employment in all sectors of the materials cycle. The primary sector is raw materials processing and includes such industries as mineral processing, aluminium 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 various engineered products in the aerospace, automotive, electronics, photonics, and petrochemical industries. The final sector includes the service industries with such specialties 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.

## 72.9 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. Examples of more specialized areas of work are 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. Advanced courses and technical electives provide more specialized knowledge and emphasize 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 to mechanical engineering design. Working on individual and group projects, students apply engineering principles to challenging design projects and develop 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; students are involved in programming and in using engineering analysis and design packages.

### 72.9.1 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 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 component's performance.

#### Fluid Mechanics

Fluid mechanics is concerned with the motions of liquids and gases and the machinery that 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, design, and improve a wide range of fluids-related equipment as well as investigate 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 energy conversion from one form to another. A typical application is electricity production. 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 design and improve power plants, engines, heat exchangers, and 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

The design process starts with recognizing a need for a new product, device, or industrial process and then carries on to defining the problem to be solved, gathering 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 different designs may 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 bridges the gap between engineering and management. These engineers deal with areas such as management of engineering processes, engineering economics, operations management, quality improvement, quality control, and the use of computers in business.

## 72.10 Mining Engineering

Mining engineers deal with the application of science and technology in the planning, design, development, optimization, operation and management of surface and underground mining and mineral exploration projects. A particularly important challenge that faces mining engineers in today's environment is to design and implement mining systems to extract minerals with sound environmental technology while maximizing the return on investors' capital. The major employers of mining engineers include surface and underground mining companies, mineral exploration companies, equipment manufacturers and dealerships, consulting companies, and teaching and research institutions.

The Mining Engineering curriculum at the University of Alberta covers the following core areas of study: ore reserve modelling and grade control, computerized mine planning and design using commercial software packages, mineral economics, mine production engineering, rock and soil mechanics, rock fragmentation, mine ventilation, mine environmental technology, surface and underground mining technology, mine survey, and economic and structural geology. The curriculum is designed to prepare prospective mining engineers with the tools to succeed in a variety of career opportunities including ore reserve analyst, mine planning engineer, mine production engineer, mineral economist, mine systems engineer, mine maintenance engineer, mine geotechnical engineer, mine reclamation engineer and mine manager.

Ore reserve analysts apply geometric, statistical, probabilistic and geostatistical methods for ore reserve modelling and grade control required for investment decisions, mine planning, design and production. Mine planning engineers use analytical and computer-aided design tools to design and optimize surface and underground mine layouts for efficient extraction processes. Mine production engineers supervise labor and mine equipment to achieve short and long range production targets using efficient and safe operating standards. Mineral economists apply the principles of mathematics, economics and finance in evaluating the economic potential of mining projects, analysis of investment risk and uncertainty and commodity markets analysis and pricing.

Mine systems engineers apply operation research techniques for efficient unit mining operations in the development-production networks. Mine maintenance engineers design and implement preventive, breakdown and repair maintenance programs for the efficient and safe use of mine equipment in production. Mine geotechnical engineers design and implement programs to ensure the stability of underground mine openings, surface mine slopes, and waste and tailings dumps. Mine reclamation engineers design and monitor reclamation of landscapes after mine closure. Mine managers use management and engineering principles to manage the overall mining operations to meet short- and long-term goals.

## 72.11 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 is the only accredited petroleum engineering program in Canada.

## 72.12 Biomedical Engineering

Biomedical engineering is concerned with the application of engineering and the basic sciences to the solution of problems arising in medicine and biology. In its application to human physiology, biomedical engineering involves the understanding of body processes, the diagnosis of different body conditions and the rehabilitation of bodily functions. The tremendous complexity and variety of problems associated with the aforementioned areas require the involvement of engineers of all backgrounds.

While the University of Alberta does not offer a formal undergraduate program in biomedical engineering, to help students understand and prepare for employment in this area, a series of undergraduate technical electives is available in areas such as physiology, medical instrumentation, medical imaging, modelling of biological systems and biomechanics. In addition, an enhanced graduate program is offered jointly by the Universities of Alberta and Calgary.

For further information contact the Chair, Department of Biomedical Engineering, Faculty of Medicine and Oral Health Sciences or a Faculty advisor in any Engineering department.

## 72.13 Business Course Electives for Engineering Students

The Faculty of Engineering has an agreement with the Faculty of Business to permit a limited number of Engineering students to take Business courses. Areas include accounting, finance, industrial relations, and management science. Interested students should contact their Program Advisor for referral to the Engineering-Business Advisor.

## 72.14 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. Students should contact the Honors Chair of the Department of Mathematics for an interview and approval to register immediately after receiving notification of their admission to the first-year Engineering program.

## 72.15 Industrial Safety and Loss Management Courses

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

## 72.16 Arrangements with Other Institutions

### 72.16.1 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 (Edmonton), Mount Royal College (Calgary), 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.

## 72.16.2 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 1 below)
Introduction to Engineering/Writing	ENGG 215 (see Note 2 below)	ENGG 100, ENGG 101, and ENGL 199 (see Note 2 below)
One Elective	As chosen by the student in accordance with the regulations of the Faculty involved (see Note 3 below)	As chosen by the student in accordance with the regulations of the Faculty involved (see Note 3 below)

### Notes

- (1) 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.
- (2) 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.
- (3) A student may wish to take a Complementary Studies course or
  - a. 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.
  - b. 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 Engineering at the University of Alberta to Engineering 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 Engineering at the University of Calgary to Engineering at the University of Alberta are assured full course-by-course credit for all required courses with a grade of C- or higher.

## 72.16.3 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.

## 72.16.4 Geomatics Engineering at the University of Calgary

The University of Calgary offers a four-year program leading to a BSc in Geomatics Engineering. 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 Engineering at the University of Alberta. On 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.

## 72.16.5 BSc Program in Agricultural Engineering

The University of Saskatchewan offers a four-year program leading to the BSc in Agricultural Engineering. Students wanting 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.

## 72.16.6 Exchange Program with École 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 École Polytechnique in Montréal. École 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 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 except Petroleum Engineering. Please consult the Associate Dean (Student Services), Faculty of Engineering, for more information.

## 72.16.7 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 must have demonstrated superior academic ability and be fluent in German. Programs are available in various engineering disciplines. Consult the Associate Dean (Student Services), Faculty of Engineering, for more information.

## 72.17 Special Students

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

Members of the Alberta Society of Engineering Technologists (ASET) who have an engineering technology diploma and the required Alberta Grade 12 or equivalent subjects for admission to the Faculty (see §15.6.1) may register as special students to take courses in the TEC-ED program. For more information, contact ASET.

## 72.18 Graduate Studies

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.

## 72.19 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 registered with the professional organization in the province concerned. In Alberta, this is the Association of Professional Engineers, Geologists, and Geophysicists of Alberta (APEGGA). 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; SChE; CSCE; IEEE; CSME; CIM; ISA; SPE; SAE; SME; ASHRAE) have active chapters on campus. Engineering students are encouraged to join the society closest to their specialty.



## 73 Faculty Regulations

### 73.1 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.

### 73.2 Residence Requirements

A student proceeding toward a BSc degree in Engineering is expected to complete at least half of the credits required through courses offered by the University of Alberta (either “on” or “off” campus in Fall/Winter or Spring/Summer). Normally, at least half of these “University of Alberta” courses will be courses from Terms 5 through 8, as shown in §§74.3 and 74.4. Credits obtained by special assessment at the University of Alberta may be included in the count of courses used to satisfy the residence requirements. (See §14.2.5 Credit by Special Assessment.)

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, reducing the residence requirement to one academic year consisting of two full terms may be considered.

### 73.3 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. The second-year entry places are shown below for the individual disciplines. The number of entry spaces within each discipline allocated to the cooperative education program is reviewed annually and is subject to change. The bracketed numbers give some indication of the co-op admissions in each discipline over the past few years.

Chemical	75	(60)
Civil	110	(36)
Civil-Environmental	30	(30)
Computer	65	(45)
Electrical (including Engineering Physics)	115	(32)
Mechanical	115	(45)
Materials	25	(6)
Mining	15	(5)
Petroleum	30	(7)

Entry to a specialized program is based on the student’s academic performance in the first, or qualifying, year. All students in the 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 are provided to qualifying year students in ENGG 101. Program Selection Forms are mailed to other applicants by the Registrar’s Office on 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. Students who fail to qualify within the indicated number of terms are required to withdraw and are not normally readmitted to the Faculty.

(2) **Engineering Graduation Average**

a. The Engineering Graduation Average (EGA) is 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 Spring/Summer are not included in the EGA unless this is a scheduled term within the student’s degree program.

- b. **Requirements to Graduate:** To graduate, a student must
- pass all courses required by the specific program;
  - have an Engineering Graduation Average of 5.0 or greater;
  - be in satisfactory academic standing, i.e., have a Fall/Winter GPA of 5.0 or greater.

A student who is otherwise eligible to graduate but has an EGA of less than 5.0 and/or a Fall/Winter GPA in the range 4.5 to 4.9 is permitted to return for one additional term to take courses as specified by the Dean. If the student’s EGA and Fall/Winter GPA following this term are not both 5.0 or greater, the student will not qualify for a degree and will not be allowed to continue in the Faculty.

(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 except former TEC-ED students (see §72.18). Students admitted from the TEC-ED program have a degree time limit of four years.

The time measurement starts at the beginning of the term following a student’s initial admission to a specialized degree program in Engineering. This time limit includes all time during which a student is not in attendance either by personal choice or as a result of suspension or a requirement to withdraw. When a student encounters special circumstances that necessitate an absence from the University for an extended period of time, the student may apply to the Faculty for an extension to the degree time limit. Such an application must be made prior to the absence or at the earliest opportunity. Extensions are not granted for cases where a student has spent time on withdrawal or suspension.

(4) **Course Load**

- Students in specialized degree programs are not required to meet any minimum course load requirement except as noted in §73.3(5)b, but must meet the degree time limit as specified in §73.3(3). A course load less than that required to maintain full time status, as defined in §261, may have scholarship eligibility, income tax and student loan implications.
- Students in their qualifying year may not normally take a course load with fewer than 37 units in Fall/Winter, excluding the 2.0 units for ENGG 100/101.

(5) **Promotion:** A student’s progress is evaluated on completion of academic studies for Fall/Winter and on completion of any academic term occurring in Spring/Summer that is a scheduled term within the student’s degree program. Scheduled terms are those shown in §§74.3 and 74.4. Evaluation is on the basis of the Fall/Winter GPA or Spring/Summer GPA (see §23.4(7)).

- Satisfactory Standing:** Fall/Winter or Spring/Summer GPA of 5.0 or greater. Promotion, repeating any failed course(s).
- Marginal Standing-Academic Warning:** Fall/Winter or Spring/Summer GPA of 4.5 to 4.9 inclusive. Proceed to next term on academic warning, 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.
  - Already on academic warning or probation.

Students on academic warning or probation will be evaluated at the end of each term. Spring/Summer is not considered a term unless it is a scheduled term within the student’s degree program. To clear academic warning or probation, a student must achieve an engineering term average of at least 5.0 while carrying a minimum course load of 14 units.

- Unsatisfactory Standing-Required to Withdraw:** Fall/Winter or Spring/Summer GPA less than 4.5. Student must withdraw.
- Probation:** Students who have been required to withdraw and who have successfully appealed that decision will be placed on probation.

(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, 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 if Faculty approval is first received to do so.

- (8) **Readmission after a Requirement to Withdraw:** A student required to withdraw must stay out for two terms before being eligible for readmission. In this context, Spring/Summer is not counted as a term unless it is a scheduled term within the student's degree program.

All students are readmitted on probation and must take all the previously failed courses and other courses as specified by the Dean. For students in the co-op program, readmission must coincide with the start of an academic term. A student required to withdraw a second time is not normally readmitted to the Faculty of Engineering.

The requirements to clear probation are explained in §73.3(5)b.

- (9) **Withdrawal from Courses:** (See §11 Academic Schedule for deadline dates.)
- (10) **Reexaminations:** See §23.5.5.
- (11) **Academic Awards and Recognition**

a. **Awards and Scholarships**

Information about awards and scholarships is available in the University of Alberta Awards Publication. A number of scholarship competitions are open to high school students who plan to study Engineering at the University. Students who are continuing in the Faculty may apply for various awards. In addition, a number of awards are made by Faculty or Department nomination. Awards and scholarships are awarded after the second, fourth, sixth, and eighth academic terms and require a student to carry a full course load. For University-wide award competitions, this is the course load calculated from §§74.2, 74.3, or 74.4 as appropriate. In the case of Faculty and Department awards, a full course load is defined as at least 35 units. Because of their course load requirements co-op students are not eligible for awards in the third year of their program.

b. **First-Class Standing**

First-class standing is awarded following the second, fourth, sixth, and eighth academic terms based on a GPA of 7.5 or greater, calculated on a course load of not less than 35 units in the two preceding academic terms.

c. **Graduation "With Distinction"**

To graduate "With Distinction," a student must have

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

(12) **Appeals**

- a. **Academic Standing:** A student wanting 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 appeal to the Faculty of Engineering Academic Appeals Committee. To do so, 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 should first be discussed with the instructor. If the problem is not resolved, the student should 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 appeal to this committee, the student must submit the appeal in writing to the Dean within 60 calendar days after the final examination period.

- c. **Work Term Status:** Faculty initiated withdrawal from a work term, denial of work term or disciplinary decisions related to a work term are appealable to the GFC Practice Review Board (see Calendar §23.8.2). Failure of a work term which results from lack of performance

and/or termination of employment by the employer is an academic standing decision and is appealable as described in §73.3(12)a.

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

## 74 Programs of Study

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

Course requirements for Engineering programs are listed in §74.2 (First-Year) and §§74.3 through 74.4 (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).

### 74.2 First-Year Program

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)	ENCMPL 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 §201 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 §74.6.
- (2) Students accepted into the Honors Mathematics stream replace MATH 100, 101, and 102 with MATH 117, 118, and 127 (see §72.14).

### 74.3 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 (e.g., the expression 3/2 means 3 hours of laboratory every second week).

**Note:** For information on Complementary Studies Electives see §74.6.

**Engineering Chart 1** Required Courses and Suggested Course Sequence for Traditional Programs

Chemical	Year 2	Year 3	Year 4
	<p><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)</p> <p><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)</p>	<p><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)                      MEC E 310 (3-0-0)</p> <p><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) or CH E 436 (3-1s-0)                      Tech Elective (3-1s-0)</p>	<p><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)</p> <p><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 §74.5.1 for restrictions on the five technical electives.</p>
<b>Chemical: Computer Process Control Option</b>	<p><b>Term 3</b>                      CH E 243 (3-1s-0)                      CH E 285 (1-0-0)                      CHEM 261 (3-0-3)                      E E 240 (3-1s-3/2)                      MATE 252 (3-0-3/2)                      MATH 209 (3-0-1)                      Tech Elective (3-1s-0) or MATH 201 (3-0-1)</p> <p><b>Term 4</b>                      CH E 265 (3-0-3)                      E E 250 (3-1s-3/2)                      ENGL 199 (3-0-0)                      MATH 201 (3-0-1) or Tech Elective (3-1s-0)                      STAT 235 (3-0-2)                      Tech Elective (3-1s-0)</p>	<p><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)                      SOC 366 (3-0-0)</p> <p><b>Term 6</b>                      CH E 418 (3-0-2)                      CH E 434 (3-1s-0)                      CH E 446 (3-0-3/2)                      MEC E 310 (3-0-0)                      Tech Elective (3-1s-0)                      Complementary Studies Elective (3-0-0)</p>	<p><b>Term 7</b>                      CH E 316 (3-0-2)                      CH E 365 (3-0-3)                      CH E 474 (3-1s-0)                      CH E 481 (0-1-0)                      CH E 540 (3-0-3/2)                      Tech Elective (3-1s-0)                      Complementary Studies Elective (3-0-0)</p> <p><b>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)                      ENGG 400 (1-0-0)  <b>Note:</b> MATH 201 must be taken in either Term 3 or 4</p>
<b>Civil</b>	<p><b>Term 3</b>                      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)</p> <p><b>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 Spring/Summer (Spring Term)</p>	<p><b>Term 5</b>                      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)</p> <p><b>Term 6</b>                      CIV E 303 (3-0-3/2)                      CIV E 312 (3-0-0)                      CIV E 321 (3-0-3/2)                      CIV E 331 (3-0-3/2)                      CIV E 374 (3-0-3)                      CIV E 381 (3-0-3)</p>	<p><b>Term 7</b>                      Tech Elective (3-0-3/2) (See Note 1)                      Tech Elective (3-0-3/2) (See Note 1)                      Tech Elective (3-0-3/2) (See Note 1)                      One of E E 239, MEC E 250 or CH E 243                      Complementary Studies Elective (3-0-0) (See Note 2)</p> <p><b>Term 8</b>                      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 (3-0-0) (See Note 1)                      Tech Elective (3-0-0) (See Note 1)  <b>Notes:</b>                      (1) See §74.5.3 for restrictions on the technical electives.                      (2) See §74.6 for restrictions on complementary electives.</p>
<b>Computer</b>	<p><b>Term 3</b>                      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)</p> <p><b>Term 4</b>                      CMPUT 272 (3-1s-3)                      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)</p>	<p><b>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)</p> <p><b>Term 6</b>                      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 (3-0-0)                      Complementary Studies Elective (3-0-0)</p>	<p><b>Term 7</b>                      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)</p> <p><b>Term 8</b>                      E E 462 (3-0-3/2)                      E E 582 (1-0-6)                      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 §74.5.4 for restrictions on the five technical electives.</p>

## Engineering Chart 1 Required Courses and Suggested Course Sequence for Traditional Programs (cont'd)

Electrical	Year 2	Year 3	Year 4
	<p><b>Term 3</b> 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)</p> <p><b>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)</p>	<p><b>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)</p> <p><b>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)</p>	<p><b>Term 7</b> E E 387 (3-1s-0) E E 401 (1-0-6) E E 438 (3-0-3/4) E E 458 (3-0-3/2) Tech Elective (3-0-0) Complementary Studies Elective (3-0-0)</p> <p><b>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 \$74.5.5 for restrictions on the eight technical electives.</p>
Engineering Physics	<p><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)</p> <p><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)</p>	<p><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)</p> <p><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)</p>	<p><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)</p> <p><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) <b>Notes</b> (1) See \$74.5.6 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.</p>
Materials	<p><b>Term 3</b> CH E 243 (3-1-0) CH E 285 (1-0-0) CHEM 261 (3-0-3) E E 239 (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)</p> <p><b>Term 4</b> 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)</p>	<p><b>Term 5</b> 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) or Tech Elective (3-0-0)</p> <p><b>Term 6</b> CH E 314 (3-1-4/4) MATE 331 (3-0-3/2) MATE 332 (3-0-3/2) MATE 345 (3-0-0) MATE 358 (3-0-3/2) Tech Elective (3-0-0) or MATE 343 (2-0-3)</p>	<p><b>Term 7</b> CH E 481 (0-1-0) MATE 365 (3-0-3) or Tech Elective (3-0-0) MATE 430 (3-0-3/2) MATE 448 (0-1s-0) MATE 452 (3-0-3) MATE 467 (3-1-0) MATE 480 (3-0-0)</p> <p><b>Term 8</b> CH E 446 (3-0-3/2) CH E 483 (0-1-0) ENGG 400 (1-0-0) MATE 440 (3-0-0) MATE 443 (2-1-3) or MATE 465 (1-0-6) Tech Elective (3-0-0) or MEC E 310 (3-0-0) Tech Elective (3-0-0) <b>Notes</b> (1) One of MATE 365 or 343 must be taken in Terms 6 or 7. See \$74.5.7 for restrictions on three technical electives. (2) MEC E 310 must be taken in either Term 5 or Term 8.</p>

**Engineering Chart 1** Required Courses and Suggested Course Sequence for Traditional Programs (cont'd)

Mechanical	Year 2	Year 3	Year 4
	<p><b>Term 3</b> 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)</p> <p><b>Term 4</b> CH E 243 (3-1s-0) E E 239 (3-0-3/2) MATH 201 (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)</p>	<p><b>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>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>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>Term 8</b> CH E 446 (3-0-3/2) or E E 469 (3-0-3/2) ENGG 400 (1-0-0) MEC E 463 (3-0-2) MEC E 465 (1-0-4) SOC 366 (3-0-0) Tech Elective (3-0-0) <b>Note:</b> See §74.5.8 for restrictions on the two technical electives. Students must have credit in either MEC E 402 or MEC E 200.</p>
Mining	Year 2	Year 3	Year 4
	<p><b>Term 3</b> CIV E 265 (2-0-3) EAS 210 (3-0-3) E E 239 (3-0-3/2) MATH 209 (3-0-1) MIN E 295 (3-0-3/2) STAT 235 (3-0-2)</p> <p><b>Term 4</b> CH E 243 (3-1s-0) CIV E 250 (3-0-2) CIV E 251 (2 weeks)* CIV E 270 (3-0-3) ENGL 199 (3-0-0) MATH 201 (3-0-1) MIN E 310 (3-0-3)</p> <p>*Held in Spring/Summer (Spring Term)</p>	<p><b>Term 5</b> CH E 312 (3-1s-0) CIV E 381 (3-0-3) MEC E 310 (3-0-0) MIN E 323 (3-0-3) MIN E 325 (3-0-3) MIN E 428 (0-1s-0)**</p> <p><b>Term 6</b> ENGG 405 (3-0-0) MATE 331 (3-0-3/2) MIN E 324 (3-0-0) MIN E 330 (3-3s/2-0) MP E 322 (3-1s-0) Tech Elective (3-0-0)</p> <p>**Held prior to start of Terms 5 or 7</p>	<p><b>Term 7</b> ENGG 404 (3-3s/2-0) MIN E 402 (1-0-6) MIN E 413 (3-0-3/2) MIN E 414 (3-0-3/2) MIN E 428 (0-1s-0)** Complementary Studies Elective (3-0-0) Tech Elective (3-0-0)</p> <p><b>Term 8</b> ENGG 400 (1-0-0) MATE 408 (3-0-0) MIN E 403 (1-0-6) MIN E 407 (3-0-3/2) MIN E 408 (2-0-2) MIN E 420 (3-0-0) <b>Note:</b> §See 74.5.9 for restrictions on electives.</p> <p>**Held prior to start of Terms 5 or 7</p>
Petroleum	Year 2	Year 3	Year 4
	<p><b>Term 3</b> EAS 210 (3-0-3) E E 239 (3-0-3/2) ENGL 199 (3-0-0) MATE 252 (3-0-3/2) MEC E 310 (3-0-0) Complementary Studies Elective (3-0-0)</p> <p><b>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>Term 5</b> CH E 312 (3-1s-0) CH E 474 (3-1s-0) or MATE 390 (3-1s-0) 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>Term 6</b> EAS 222 (3-0-3) MP E 322 (3-1s-0) PET E 366 (3-0-0) PET E 368 (3-0-3/2) Tech Elective (3-0-0) Tech Elective (3-0-0)</p>	<p><b>Term 7</b> CH E 314 (3-1-4/4) ENGG 404 (3-3s/2-0) PET E 444 (3-0-0) PET E 471 (3-0-0) PET E 473 (3-0-3/2) PET E 484 (2-0-3) PET E 488 (0-1s-0)</p> <p><b>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) <b>Note:</b> See §74.5.10 for restrictions on the technical electives.</p>

Engineering

## 74.4 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 see §74.6.

## Engineering Chart 2 Required Courses and Suggested Course Sequence for Co-op Programs

Chemical Plan I	Year 2	Year 3	Year 4	Year 5
	<p><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)</p> <p><b>Winter Term 4</b> CH E 265 (3-0-3) or MATE 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)</p> <p><b>Summer</b> WKEXP 901</p>	<p><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) MEC E 310 (3-0-0)</p> <p><b>Winter</b> WKEXP 902</p> <p><b>Summer</b> WKEXP 903</p>	<p><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)</p> <p><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) or CH E 436 (3-1s-0) Tech Elective (3-1s-0) Tech Elective (3-0-0)</p> <p><b>Summer</b> WKEXP 904</p>	<p><b>Fall</b> WKEXP 905</p> <p><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 §74.5.1 for restrictions on the five technical electives.</p>
Chemical Plan II	<p><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)</p> <p><b>Winter 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).</p> <p><b>Summer</b> WKEXP 901</p>	<p><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) MEC E 310 (3-0-0)</p> <p><b>Winter</b> WKEXP 902</p> <p><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)</p>	<p><b>Fall</b> WKEXP 903</p> <p><b>Winter</b> WKEXP 904</p> <p><b>Summer Term 7</b> CH E 418 (3-0-2) CH E 434 (3-1s-0) CH E 436 (3-1s-0) or CHEM 275 (3-0-3/2) CH E 446 (3-0-3/2) Tech Elective (3-1s-0) Tech Elective (3-0-0)</p>	<p><b>Fall</b> WKEXP 905</p> <p><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 §74.5.1 for restrictions on the five technical electives</p>
Chemical: Computer Process Control Option Plan I	<p><b>Fall Term 3</b> CH E 243 (3-1s-0) CH E 285 (1-0-0) CHEM 261 (3-0-3) E E 240 (3-1s-3/2) ENGG 299 (1-0-0) MATE 252 (3-0-3/2) MATH 209 (3-0-1) Tech Elective (3-1s-0) or MATH 201 (3-0-1)</p> <p><b>Winter Term 4</b> CH E 265 (3-0-3) E E 250 (3-1s-3/2) ENGL 199 (3-0-0) MATH 201 (3-0-1) or Tech Elective (3-1s-0) STAT 235 (3-0-2) Tech Elective (3-1s-0)</p> <p><b>Summer</b> WKEXP 901</p>	<p><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) MEC E 310 (3-0-0)</p> <p><b>Winter</b> WKEXP 902</p> <p><b>Summer</b> WKEXP 903</p>	<p><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 481 (0-1-0) CH E 540 (3-0-3/2) Tech Elective (3-1s-0) Complementary Studies Elective (3-0-0)</p> <p><b>Winter Term 7</b> CH E 418 (3-0-2) CH E 434 (3-1s-0) CH E 446 (3-0-3/2) SOC 366 (3-0-0) Tech Elective (3-1s-0) Complementary Studies Elective (3-0-0)</p> <p><b>Summer</b> WKEXP 904</p>	<p><b>Fall</b> WKEXP 905</p> <p><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) ENGG 400 (1-0-0) <b>Note:</b> MATH 201 must be taken in either Term 3 or 4</p>

**Engineering Chart 2** Required Courses and Suggested Course Sequence for Co-op Programs (cont'd)

<b>Chemical: Computer Process Control Option Plan II</b>	<b>Year 2</b>	<b>Year 3</b>	<b>Year 4</b>	<b>Year 5</b>
	<p><b>Fall Term 3</b>                      CH E 243 (3-1s-0)                      MATE 252 (3-0-3/2)                      CH E 285 (1-0-0)                      CHEM 261 (3-0-3)                      E E 240 (3-1s-3/2)                      ENGG 299 (1-0-0)                      MATH 209 (3-0-1)                      Tech Elective (3-1s-0) or                      MATH 201 (3-0-1)</p> <p><b>Winter Term 4</b>                      CH E 265 (3-0-3)                      E E 250 (3-1s-3/2)                      ENGL 199 (3-0-0)                      MATH 201 (3-0-1) or Tech                      Elective (3-0-1)                      STAT 235 (3-0-2)                      Tech Elective (3-0-3/2)</p> <p><b>Summer</b>                      WKEXP 901</p>	<p><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)                      CH E 540 (3-0-3/2)                      MEC E 310 (3-0-0)</p> <p><b>Winter</b>                      WKEXP 902</p> <p><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)                      Tech Elective (3-1s-0)                      Complementary Studies Elective                      (3-0-0)</p>	<p><b>Fall</b>                      WKEXP 903</p> <p><b>Winter</b>                      WKEXP 904</p> <p><b>Summer Term 7</b>                      CH E 418 (3-0-2)                      CH E 434 (3-1s-0)                      CH E 481 (0-1-0)                      SOC 363 (3-0-0)                      Complementary Studies Elective                      (3-0-0)                      Tech Elective (3-1s-0)</p>	<p><b>Fall</b>                      WKEXP 905</p> <p><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)                      ENGG 400 (1-0-0)  <b>Note:</b> MATH 201 must be taken                      in either Term 3 or 4.</p>
<b>Civil</b>	<b>Year 2</b>	<b>Year 3</b>	<b>Year 4</b>	<b>Year 5</b>
	<p><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)                      MATE 252 (3-0-3/2)                      MATH 209 (3-0-1)</p> <p><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 Spring/Summer                      (Spring Term)</p> <p><b>Summer</b>                      WKEXP 901</p>	<p><b>Fall</b>                      WKEXP 902</p> <p><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)</p> <p><b>Summer</b>                      WKEXP 903</p>	<p><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)</p> <p><b>Winter</b>                      WKEXP 904</p> <p><b>Summer</b>                      WKEXP 905</p>	<p><b>Fall Term 7</b>                      Tech Elective (3-0-3/2)                      (See Note 1)                      Tech Elective (3-0-3/2)                      (See Note 1)                      Tech Elective (3-0-3/2)                      (See Note 1)                      One of E E 239, MEC E 250 or                      CH E 243                      Complementary Studies Elective                      (3-0-0) (See Note 2)</p> <p><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) (See Note 1)                      Tech Elective (3-0-0) (See Note 1)  <b>Notes:</b>                      (1) See §74.5.3 for restrictions on                      the technical electives.                      (2) See §74.6 for restrictions on the                      complementary electives.</p>
<b>Civil: Environmental Engineering Option</b>	<b>Year 2</b>	<b>Year 3</b>	<b>Year 4</b>	<b>Year 5</b>
	<p><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)</p> <p><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 Spring/Summer                      (Spring Term)</p> <p><b>Summer</b>                      WKEXP 901</p>	<p><b>Fall</b>                      WKEXP 902</p> <p><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)</p> <p><b>Summer</b>                      WKEXP 903</p>	<p><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 239, MEC E 250 or                      MATE 252</p> <p><b>Winter</b>                      WKEXP 904</p> <p><b>Summer</b>                      WKEXP 905</p>	<p><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)</p> <p><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 §74.6 for restrictions on                      complementary electives.</p>

## Engineering Chart 2 Required Courses and Suggested Course Sequence for Co-op Programs (cont'd)

Computer	Year 2	Year 3	Year 4	Year 5
	<p><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)</p> <p><b>Winter Term 4</b>            CMPUT 272 (3-1s-3)            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)</p> <p><b>Summer</b>            WKEXP 901</p>	<p><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)</p> <p><b>Winter</b>            WKEXP 902</p> <p><b>Summer</b>            WKEXP 903</p>	<p><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)</p> <p><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)</p> <p><b>Summer</b>            WKEXP 904</p>	<p><b>Fall</b>            WKEXP 905</p> <p><b>Winter Term 8</b>            E E 462 (3-0-3/2)            E E 582 (1-0-6)            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)</p> <p><b>Note:</b> See \$74.5.4 for restrictions on the five technical electives.</p>
Electrical	Year 2	Year 3	Year 4	Year 5
	<p><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)</p> <p><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)</p> <p><b>Summer</b>            WKEXP 901</p>	<p><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)</p> <p><b>Winter</b>            WKEXP 902</p> <p><b>Summer</b>            WKEXP 903</p>	<p><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)</p> <p><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)</p> <p><b>Summer</b>            WKEXP 904</p>	<p><b>Fall</b>            WKEXP 905</p> <p><b>Winter Term 8</b>            E E 401 (1-0-6)            ENGG 400 (1-0-0)            MEC E 310 (3-0-0)            Tech Elective (3-0-0)            Tech Elective (3-0-0)            Tech Elective (3-0-3/2)            Tech Elective (3-0-3/2)</p> <p><b>Note:</b> See \$74.5.5 for restrictions on the eight technical electives.</p>
Materials	Year 2	Year 3	Year 4	Year 5
	<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 239 (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)            MEC E 310 (3-0-0)            Complementary Studies Elective (3-0-0) or ENGL 199 (3-0-0)</p> <p><b>Summer</b>            WKEXP 901</p>	<p><b>Fall Term 5</b>            CH E 312 (3-1s-0)            CH E 314 (3-0-2)            MATE 340 (3-0-0)            MATE 357 (3-0-3)            MATE 390 (3-1-0)            STAT 235 (3-0-2)</p> <p><b>Winter</b>            WKEXP 902</p> <p><b>Summer</b>            WKEXP 903</p>	<p><b>Fall Term 6</b>            CH E 481 (0-1-0)            MATE 365 (3-0-3) or Technical Elective (3-0-0)            MATE 430 (3-0-3/2)            MATE 448 (0-1s-0)            MATE 452 (3-0-3)            MATE 467 (3-1-0)            MATE 480 (3-0-0)</p> <p><b>Winter Term 7</b>            MATE 331 (3-0-3/2)            MATE 332 (3-0-3/2)            MATE 345 (3-0-0)            MATE 358 (3-0-3/2)            MATE 343 (2-0-3) or Technical Elective (3-0-0)            SOC 366 (3-0-0)</p> <p><b>Summer</b>            WKEXP 904</p>	<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)            Technical Elective (3-0-0)            MATE 440 (3-0-0)            MATE 443 (2-1-3) or MATE 465 (1-0-6)            Technical Elective (3-0-0)</p> <p><b>Note:</b> One of MATE 365 or MATE 343 must be taken in Terms 6 or 7. See \$74.5.7 for restrictions on three technical electives.</p>



**Engineering Chart 2** Required Courses and Suggested Course Sequence for Co-op Programs (cont'd)

Mechanical	Year 2	Year 3	Year 4	Year 5
	<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</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 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 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> E E 469 (3-0-3/2) or CH E 446 (3-0-3/2) ENGG 400 (1-0-0) MEC E 463 (3-0-2) MEC E 465 (1-0-4) SOC 366 (3-0-0) Tech Elective (3-0-0) <b>Note:</b> See §74.5.8 for restrictions on the two technical electives. Students must have credit in either MEC E 402 or MEC E 200.</p>
Mining	Year 2	Year 3	Year 4	Year 5
	<p><b>Fall Term 3</b> EAS 210 (3-0-3) CIV E 265 (2-0-3) E E 239 (3-0-3/2) ENGG 299 (1-0-0) MATH 209 (3-0-1) MIN E 295 (3-0-3/2) STAT 235 (3-0-2)</p> <p><b>Winter Term 4</b> CH E 243 (3-1s-0) CIV E 250 (3-0-2) CIV E 251 (2 weeks)* CIV E 270 (3-0-3) ENGL 199 (3-0-0) MATH 201 (3-0-1) MIN E 310 (3-0-3)</p> <p><b>Summer</b> WKEXP 901</p> <p>*Held in Spring/Summer Spring Term.</p>	<p><b>Fall</b> WKEXP 902</p> <p><b>Winter Term 5</b> ENGG 405 (3-0-0) 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)</p> <p><b>Summer</b> WKEXP 903</p>	<p><b>Fall Term 6</b> CH E 312 (3-1s-0) CIV E 381 (3-0-3) MEC E 310 (3-0-0) MIN E 323 (3-0-3) MIN E 325 (3-0-3) MIN E 428 (0-1s-0)**</p> <p><b>Winter</b> WKEXP 904</p> <p><b>Summer</b> WKEXP 905</p> <p>**Held prior to start of Terms 6 or 7.</p>	<p><b>Fall Term 7</b> ENGG 404 (3-3s/2-0) MIN E 402 (1-0-6) MIN E 413 (3-0-3/2) MIN E 414 (3-0-3/2) MIN E 428 (0-1s-0)** Complementary Studies Elective (3-0-0) Tech Elective (3-0-0)</p> <p><b>Winter Term 8</b> ENGG 400 (1-0-0) MIN E 403 (1-0-6) MIN E 407 (3-0-3/2) MIN E 408 (2-0-2) MIN E 420 (3-0-0) MATE 408 (3-0-0) <b>Note:</b> See §74.5.9 for restrictions on the two technical electives.</p> <p>**Held prior to start of Terms 6 or 7.</p>
Petroleum	Year 2	Year 3	Year 4	Year 5
	<p><b>Fall Term 3</b> EAS 210 (3-0-3) E E 239 (3-0-3/2) ENGG 299 (1-0-0) ENGL 199 (3-0-0) MATE 252 (3-0-3/2) MEC E 310 (3-0-0) Complementary Studies 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>	<p><b>Fall</b> WKEXP 902</p> <p><b>Winter Term 5</b> EAS 222 (3-0-3) MPE 322 (3-0-0) PET E 366 (3-0-0) PET E 368 (3-0-3/2) Tech Elective (3-0-0) Tech Elective (3-0-0)</p> <p><b>Summer</b> WKEXP 903</p>	<p><b>Fall Term 6</b> CH E 312 (3-1s-0) CH E 474 (3-1s-0) or MATE 390 (3-1s-0) 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>	<p><b>Fall Term 7</b> CH E 314 (3-1-4/4) ENGG 404 (3-3s/2-0) PET E 444 (3-0-0) PET E 471 (3-0-0) PET E 473 (3-0-3/2) PET E 484 (2-0-3) PET E 488 (0-1s-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) <b>Note:</b> See §74.5.10 for restrictions on the two technical electives.</p>

## 74.5 Technical Electives

### 74.5.1 Chemical

- (1) Of the five 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 depth. Subject only to feasibility of scheduling 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, and MATE 256, 331, 332, 345, 357, 358, 430

or courses offered by other Departments such as

BIOCH 203  
BIOL 107  
CHEM 311  
CIV E 321  
CMPUT 115  
EAS 210  
E E 280, 305, 380, 514  
ENGG 404, 406  
MEC E 412, 443, 513  
MICRB 265  
PET E 364, 366, 465, 470, 473, 475

A complete list of technical electives is available from the department.

### 74.5.2 Chemical: Computer Process Control Option

The four technical electives must follow one of two program streams:

- (1) Signal processing: MATH 309 and E E 438, either CMPUT 115 or a departmentally approved computing course, and one more departmentally approved technical elective.
- (2) Computer Systems: E E 280 and E E 380, either CMPUT 115 or a departmentally approved computing course, and one more departmentally approved technical elective.

### 74.5.3 Civil

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

- (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.

### 74.5.4 Computer

Of the five single-term technical electives, one elective must be a 300- or 400-level Computing Science course, and two 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 and Computer Engineering (see §74.5.5(2)) and the Department of Computing Science.

### 74.5.5 Electrical

- (1) The eight technical electives must include one of the six program streams:
  - a. **Communications:** E E 316, 588, 589 and one of E E 570 or 571 and two of E E 445, 480, 514, 539, 582, 586, 591 or 597 and two more E E approved technical electives.

- b. **Controls:** E E 480, 539, 561, 565 and two of E E 445, 514, 524, 531, 550, 570, 582 and two more E E approved technical electives.
- c. **Digital:** E E 480, 552, 570, 582 and two of E E 445, 539, 571, 572, 653, CMPUT 115, 204, EE BE 540 and two more E E approved technical electives.
- d. **Electronics:** E E 316, 570, 571, 572 and two of E E 480, 524, 530, 531, 550, 552, 561, 641, 653, EE BE 512 and two more E E approved technical electives.
- e. **Power:** E E 521, 531 and three of E E 445, 514, 524, 525, 527, 528, 529, 530, 545 and two more E E approved technical electives.
- f. **Biomedical:** BME 210, 310, 513, EE BE 512 and 540; one of E E 316, 480, 550, 563, PHS 709; one of E E 323, PHS 570; and one of E E 539, 561, 565, 570, 571, 582, 588.

**Note:** E E 563 is offered every second year, alternating with E E 565.

- (2) Complete list of Electrical and Computer Engineering approved Technical Electives:

BME 210, 310, 513, 553  
E E 316, 323, 401, 445, 480, 513, 514, 521, 524, 525, 527, 528, 529, 530, 531, 539, 545, 550, 552, 561, 562, 563, 565, 570, 571, 572, 582, 583, 586, 588, 589, 591, 596, 597, 598, 599, 628, 641, 653  
E E BE 512, 540  
CMPUT 115, 204, 272, 366, 466  
PHS 570, 709

In addition to this list, other courses may be taken with Departmental approval.

**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.

### 74.5.6 Engineering Physics

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

### 74.5.7 Materials

The three technical electives must be chosen from the approved list of courses. Students 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.

### 74.5.8 Mechanical

- (1) Two technical electives must be chosen from the following:
 

BME 210, 310, 513, 553, 563  
CH E 540, 555  
EAS 210  
E E 280, 305, 445 (380, 480 may be taken with approval of the Department of Electrical and Computer Engineering), E E 528, 563  
EE BE 512, 540  
ENGG 404, 406  
MATH 311  
MATE 256, 357, 345, 358, 467  
MEC E 351, 364, 409, 412, 439, 443, 469, 513, 523, 535, 537, 539, 541, 542, 553, 563, 565, 582  
MEC E 514 or E E 514  
MEC E 555 or E E 565  
MGTS 352 or CIV E 592  
PET E 362, 364, 366, 444, 465, 473
- (2) Undergraduate students 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 §175.34 for additional details.

### 74.5.9 Mining

Electives must be chosen from an approved list prepared by the School of Mining and Petroleum Engineering. This list includes courses offered by the School, the Faculty of Engineering, and the Faculties of Arts, Science, and Business. School approval is required for all elective courses.

### 74.5.10 Petroleum

Electives must be chosen from an approved list prepared by the School of Mining and Petroleum Engineering. This list includes courses offered by the School, the Faculty of Engineering, and the Faculty of Arts, Science, and Business. School approval is required for all elective courses.

## 74.6 Complementary Studies Electives

The Canadian Engineering Accreditation Board requires engineering programs to have a complementary studies component composed of courses that 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 §72.13), Canadian Studies, Canadien-Français, Christian Theology, Classics, Comparative Literature, Economics, 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 that 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 wanting 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 are only accepted as complementary studies electives if 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 are not accepted as complementary studies electives if prior knowledge of the language exists. Students with matriculation-level credit in a language must select courses appropriate to their ability.

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

Although the Faculty of Engineering is a restricted enrolment faculty, it is possible for students registered in other faculties to enrol in a limited number of Engineering courses. However, students 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 in programs that include Engineering courses as a formal part of the program.

## 75 Courses

### 75.1 Course Listings

Faculty of Engineering courses are listed in §201, 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)