Faculty of Engineering

80 The Faculty of Engineering

Since 1908, the Faculty of Engineering has been responding to the evolving needs of the engineering profession. Today, the Faculty of Engineering at the University of Alberta is one of the largest and most diverse in Canada. The Faculty offers nine accredited undergraduate engineering programs, as well as a full range of graduate programs, to over 4,200 students from around the world.

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

Engineering is a profession with a powerful and revered tradition of accountability and service. The completion of a BSc degree in Engineering from the U of A is your first step on the road to becoming a professional engineer. Following a specified period of work experience, graduates are able to register with their local professional engineering association, and practice engineering across Canada and around the world.

In final term, 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 success at this Faculty. It is through the efforts of Engineering professors that the Faculty is able to maintain our position on the leading edge of discovery and dissemination of engineering knowledge. Some awards and accomplishments of the Faculty in the past few years include:

- Three NSERC Steacie Fellowships held
- Rutherford Awards for Teaching Excellence
- Nine Industrial Research Chairs
- $12M per year in NSERC funding in 2004–2005
- Fourteen Canada Research Chairs awarded
- Over 50 NSERC postgraduate scholarships awarded annually
- Martha Cook Piper and J Gordon Kaplan Research Awards
- Canadian Academy of Engineering Fellowship
- Four Engineering Institute of Canada Fellowships; One KY Lo medal
- Two Canadian Society for Civil Engineers Fellowships
- Two Royal Society of Canada Fellowships
- Canada Council Killam Research Fellowship
- Four Institute of Electrical and Electronics Engineers Fellowships
- **Numerous APEGGA Awards:** Excellence in Education, Centennial Leadership, Project Achievement, Early Accomplishment, and Environmental Excellence Awards
- Canadian Council of Professional Engineers Young Engineer Achievement Award
- Nine Killam Annual Professorship Awards
- ASTech Science and Technology Community and Technology Leadership Awards

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

- CD Howe Foundation Award for the top first-year male and female engineering students in Canada. Our students have won seven times. No other university has ever won both male and female awards in the same year; the U of A won both awards in two consecutive years.
- Canadian Engineering Memorial Foundation Scholarship Award
- Governor General Silver and Gold Medals
- Nortel Award for Leadership and Innovation awarded to our Discover 'E' Science and Engineering Camp program
- Four student vehicle projects are active in the Faculty of Engineering and regularly rank among the best in North America in design and performance competitions
- Students in the Faculty of Engineering receive over $1.5 million in scholarships annually

81 The Professors

Members of the Faculty

Officers of the Faculty

Professor and Dean
DT Lynch, PhD, PEng, FCAE

Associate Deans
KC Porteous, PhD, PEng
SK Dew, PhD, PEng

Administrative Officers
ME Compton, BA
D Clark, BA
W Rabel
LE Swanson, MSc

Chemical and Materials Engineering

Professor and Chair
JF Forbes, PhD, PEng

University Professor
JH Masliyah, PhD, PEng, FRSC, FCAE (NSERC/Oilsands Industry/AERI Senior Industrial Research Chair in Oil Sands with and Canada Research Chair in Oilsands Engineering)

Professors Emeriti
SA Bradford, PhD, PEng
KT Chuang, PhD
IG Dalla Lana, PhD, PEng
DG Fisher, PhD, PEng
AE Mather, PhD, PEng
W Nader, DPhil
FD Otto, PhD, PEng, FCAE
BM Patchett, PhD, PEng
JT Ryan, PhD
ML Wayman, PhD, PEng
MC Williams, PhD
RK Wood, PhD, PEng

Professors
R Burrell, PhD (Canada Research Chair in Nanostructured Biomaterials and Westaim/ASRA Senior Industrial Research Chair in Biomaterials Engineering)
PYK Choi, PhD, PEng
RL Eadie, PhD, PEng
JAW Elliot, PhD, PEng (Canada Research Chair in Interfacial Thermodynamics)
TH Etsell, PhD
MR Gray, PhD, PEng (NSERC/Imperial Oil Senior Industrial Research Chair in Oil Sands Upgrading)
R Gupta, PhD
RE Hayes, PhD, PEng
H Henein, PhD, PEng, FCAE
B Huang, PhD, PEng
DG Ivey, PhD, PEng
SM Kresta, PhD, PEng
S Kuznicki, PhD (NSERC/Quest Air Technologies/NOVA Chemicals/Angstrom Power Senior Industrial Research Chair in New Microporous Molecular Sieves, and Alberta Ingenuity Scholar in Separation Technology for Oilsands Extraction and Upgrading and Canada Research Chair in Molecular Sieve Nanomaterials)
D-Y, Li, PhD, PEng
J Luo, PhD, PEng (Canada Research Chair in Alternative Fuel Cells)
DT Lynch, PhD, PEng, FCAE
WC McCaffrey, PhD, PEng
DJ McCutcheon, BSc, PEng (Industrial Professor, Safety and Loss Management)
K Nandakumar, PhD, PEng
KC Porteous, PhD, PEng
M Rao, PhD
SL Shah, PhD, PEng (NSERC/Matrikon/Suncor/iCORE Senior Industrial Research Chair in Computer Process Control)
JM Shaw, PhD, PEng (NSERC Industrial Research Chair in Petroleum Thermodynamics)
UT Sundararaj, PhD, PEng
SE Wanke, PhD, PEng
Z Xu, PhD, PEng (NSERC/EPCOR/AERI Senior Industrial Research Chair in Advanced Coal Cleaning and Combustion Technology)

Associate Professors
W Chen, PhD, PEng
Q Liu, PhD, PEng
S Sanders, PhD
H Uludag, PhD PEng
A Yeung, PhD

Assistant Professors
A Ben-Zvi
C Diaz-Goano, PhD
JM Lee, PhD
D Mitlin, PhD

Faculty Service Officers
A Afacan, BSc, PEng
DA Sharp, MSc, PEng

Administrative Officer
S McFadyen, MEd

Civil and Environmental Engineering

Professor and Chair
J-JR Cheng, PhD, PEng (CW Carry Chair in Steel Structures)

University Professors Emeriti
JG MacGregor, PhD, PEng, FRSC, FCAE
NR Morgenstern, PhD, PEng, FRSC, FCAE

Professors Emeriti
PF Adams, PhD, PEng, FCAE
KO Anderson, MSc, PEng
JJ Bakker, MSCE, PEng
K Barron, PhD, PEng
RG Bentsen, PhD
PH Bouthillier, MSc, PEng
DM Cruden, PhD, PGeol
SP Dozzi, MEng, PEng
PM Dranchuk, MSc, PEng
Z Eisenstein, PhD, PEng, FCAE
AE Elwi, PhD, PEng
SM Farouq Ali, PhD, PEng
DL Flock, PhD, PEng
EL Fowler, MSc, PEng
WH Griffin, MSc, PEng
TM Hrudey, PhD, PEng
DJL Kennedy, PhD, PEng
GL Kulak, PhD, PEng
J Longworth, MSc, PEng
DW Murray, PhD, PEng
TH Patching, BSc, PEng
AE Peterson, MSc, PEng
LR Plitt, MSc, PEng
WW Preston, BSc
N Rajaratnam, PhD, PEng
JD Scott, PhD, PEng
SH Simmonds, PhD, PEng
DW Smith, PhD, PEng
S Teply, PhD, PEng
S Thomson, PhD, PEng
J Warwaruk, PhD, PEng
WA Weir, BSc, PEng
JM Whiting, PhD, PEng
GT Wormsbecker, BSc, PEng

Professors
SM AbouRizk, PhD, PEng (NSERC/Alberta Construction Industry Senior Industrial Research Chair in Construction Engineering and Management, and Canada Research Chair in Operation Simulation)
T Babadagli, PhD, PEng
RJ Chalaturnyk, PhD, PEng
DH-K Chan, PhD, PEng
CV Deutsch, PhD, PEng (Alberta Chamber of Resources Industry Chair in Mining Engineering and Canada Research Chair in Natural Resources Uncertainty Management)
RG Driver, PhD, PEng
TY Gan, PhD, PEng
GY Grondin, PhD, PEng
FE Hicks PhD, PEng
MR Loewen, PhD, PEng
CD Martin, PhD, PEng
D McCartney, PhD, PEng
M Polikar, PhD, PEng
PK Robertson, PhD, PEng
A Robinson, PhD, PEng (NSERC/Alberta Construction Industry Associate Industrial Research Chair in Construction Engineering and Management)
DC Sego, PhD, PEng
PM Steffler, PhD, PEng
J Szymanski, PhD, PEng
DD Tannant, PhD, PEng
DZ Zhu, PhD, PEng

Associate Professors
ID Buchanan, PhD, PEng
JC Cunha, PhD, PEng
LB Cunha, PhD, PEng
M Gamal El-Din, PhD, PEng
SE Guigard, PhD
ES Kuru, PhD, PEng
T Yu, PhD

Assistant Professors
IY Akkutlu, PhD
M Al-Hussein, PhD, PEng
V Bindiganavile, PhD
R Donahue, PhD, PEng

T Joseph, PhD, PEng
O Leuangthong, PhD, PEng
A Lubell, MASc, PEng
Y Mohamed, PhD

Faculty Service Officer
DA Booth, BSc, PEng

Administrative Officer
ME Davison, BSc

Electrical and Computer Engineering

Professor and Chair
HJ Marquez, PhD, PEng

University Professor Emeritus
GB Walker, PhD, PEng

Professors Emeriti
KE Bollinger, MSc, PEng
CE Capjack, PhD, PEng
GS Christensen, PhD, PEng
FS Chute, PhD, PEng
GD Cormack, PhD, PEng
CG Englefield, PhD
I Filanovsky, PhD, PEng
PA Goud, PhD, PEng
V Gourishankar, PhD, PEng
PJR Harding, MASc, PEng
CR James, PhD, PEng
DH Kelly, PhD, PEng
RW King, BSc, PEng
YJ Kingma, Ir, PEng
DO Koval, PhD, PEng
RPW Lawson, PhD, PEng
RI MacDonald, PhD, PEng
AA Offenberger, PhD
RE Phillips, BSc, PEng
RE Rink, PhD, PEng
AM Robinson, PhD, PEng
D Routledge, PhD, PEng
HG Schmidt-Weinmar, PhD
HJJ Seguin, PhD, PEng
PR Smy, PhD, DSc, PEng
KA Stromsmoe, PhD, PEng
WR Tinga, PhD, PEng
JF Vaneldik, PhD, PEng
FE Vermeulen, PhD, PEng
WAG Voss, PhD

Professors
CJ Backhouse, PhD, PEng
NC Beaulieu, PhD, PEng, FRSC (iCORE Chair in Broadband Wireless Communication and Canada Research Chair in Broadband Wireless Communications)
MJ Brett, PhD, PEng (Micralyne/NSERC/iCORE Senior Industrial Research Chair in Thin Film Engineering and Canada Research Chair in Nanoengineered Films and iCORE Professor in Nanoengineered ICT Devices)
T Chen, PhD, PEng
SK Dew, PhD, PEng
NG Durdle, PhD, PEng
AY Elezzabi, PhD, PEng (Canada Research Chair in Ultrafast Photonics and Nano-optics)
IJ Fair, PhD, PEng
R Fedosejevs, PhD, PEng (MPBT/NSERC Senior Industrial Research Chair in Photonic tools for nanotechnology)
WD Grover, PhD, PEng
Z Koles, PhD, PEng
WA Krzymien, PhD, PEng (Rohit Sharma Professor in Communications and Signal Processing)
JN McMullin, PhD, PEng
J Miller, PhD
B Nowrouzian, PhD, PEng
W Pedrycz, PhD, PEng (Canada Research Chair In Computational Intelligence)
JC Salmon, PhD, PEng
C Schlegel, PhD (Canada Research Chair and iCORE Professor in High Capacity Digital Communications)
C Tellambura, PhD, PEng
J Tulip, PhD
WW Xu, PhD, PEng

Associate Professors
J Chen, PhD
BF Cockburn, PhD, PEng
R DeCorby, PhD, PEng
V Dinavahi, PhD, PEng
DG Elliott, PhD, PEng
AM Knight, PhD, PEng
MK Mandal, PhD, PEng
P Musilek, PhD
M Reformat, PhD, PEng
YY Tsui, PhD, PEng

Assistant Professors
M Ardakani, PhD
S Dick, PhD
S Evoy, PhD
V Gaudet, PhD, PEng
D Joseph, PhD
L Kurgan, PhD
A Lynch, PhD, PEng
K Rambabu, PhD
J Sit, PhD, PEng
M Vaidyanathan, PhD
V Van, PhD
S Vorobyov, PhD
HV Zhao, PhD
Q Zhao, PhD, PEng

Faculty Service Officers
P Iglinski, MSc
J O'Loughlin, MSc
K Westra, PhD, PEng
L Wyard-Scott, MSc, PEng

Administrative Officer
J MacLellan, BA, BSc

Mechanical Engineering

Professor and Chair
LW Kostiuk, PhD, PEng

Professors Emeriti
DG Bellow, PhD, PEng, FCAE
DR Budney, PhD, PEng
KC Cheng, PhD
JR Colbourne, PhD, PEng
A Craggs, PhD, PEng
JD Dale, PhD, PEng
F Ellyin, PhD, PEng
MG Faulkner, PhD, PEng
TW Forest, PhD, PEng
JB Haddow, PhD
GSH Lock, PhD, PEng
DJ Marsden, PhD, PEng
A Mioduchowski, PhD, PEng
CM Rodkiewicz, PhD
GW Sadler, MSc, PEng
JC Sprague, PhD, PEng
FH Vitovec, Dr TechSci, PEng
JD Whittaker, PhD, PEng
DJ Wilson, PhD, PEng

Professors
MD Checkel, PhD, PEng
WH Finlay, PhD, PEng
PC Flynn, PhD, PEng (Ernest E and Gertrude Poole Chair in Management for Engineers)
TR Heidrick, PhD, PEng (Ernest E and Gertrude Poole Professor in Technology Management)
P-YB Jar, PhD, PEng
SV Karapetrovic, PhD, PEng
M Lipsett, PhD, PEng
C Ru, PhD, PEng
P Schiavone, PhD, PEng
LW Sigurdson, PhD, PEng
X Wang, PhD, PEng
Z Xia, PhD, PEng
M Zuo, PhD, PEng

Associate Professors
A Amirfazli, PhD, PEng (Canada Research Chair in Surface Engineering)
S Bhattacharjee, PhD (Canada Research Chair in Colloids and Complex Fluids)
BA Fleck, PhD, PEng
CR Koch, PhD, PEng
WA Moussa, PhD, PEng
DW Raboud, PhD, PEng (Westaim/ASRA Junior Industrial Research Chair in Biomechanical Engineering)
RW Toogood, PhD, PEng

Assistant Professors
S Behzadipour, PhD
J Carey, PhD, PEng
J Doucette, PhD, PEng
F Fahimi, PhD
A Kumar, PhD
CF Lange, PhD
P Mertiny, PhD
B Nadler, PhD
D Nobes, PhD
P Rahimi, PhD, PEng

Faculty Service Officer
MY Ackerman, MSc, PEng

Administrative Officer
W Bryan, BA

Sessional Lecturer in Engineering
BR Touchings, LLB

Engineering Co-op Department

Professor and Director
KC Porteous, PhD, PEng

Assistant Director
S Concini, BSc, PEng

Administrative Officers
L Allisen, Coordinator
C Bjornson, BA, Coordinator
D Clark, BA, Coordinator
RC Kully, BEd, Coordinator
MT Marks, BCom, Coordinator
BJ Strang, BA, Coordinator
LJ Szekely, BEd, Coordinator
K Vande Vyvere, BA, Coordinator

Additional Members of Faculty Council

President and Vice-Chancellor
IV Samarasekera, OC

Registrar of the University
CP Byrne, MBA

Professors
D Bressler, PhD (Agricultural, Food, and Nutritional Sciences)
M Klobukowski, PhD (Chemistry)
JL Langdon, PhD (History and Classics)

Associate Professors
B Bucknell, PhD (English & Film Studies)
F Hegmann, PhD (Physics)
J Hoover, PhD (Computing Science)
MH MacGregor, PhD (Computing Science)

APEGGA Representative
VSV Rajan, PhD, PEng

Representatives from Engineering Students
K Mathewson (Undergraduate)
S McFetridge (Undergraduate)
J Mueller (Undergraduate)
A Farahaninia (Graduate)
V Sieben (Graduate)

82 General Information

82.1 BSc Engineering

The Faculty of Engineering offers undergraduate programs leading to BSc degrees in Chemical Engineering, Civil Engineering, Computer Engineering, Electrical Engineering, Engineering Physics, 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.

82.1.1 Engineering Instruction in French

In conjunction with Faculté Saint-Jean, most of the first-year curriculum can be taken in French on the Faculté Saint-Jean campus (see §180). Academic conditions and content of the courses are equivalent to their English counterparts. Note that only a few second-year and higher level courses for Engineering programs are available in French. See §184.10 for further details.

82.2 Cooperative Education Program

The Faculty of Engineering offers two types of degree programs: the traditional program and the cooperative education program. Students in the traditional program attend classes from September to April over 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 §84.4 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 Department 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.

82.3 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 chemistry, physics, mathematics 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 oil sands engineering, nanoscale engineering, mineral processing and extractive metallurgy, and polymer materials. See §§82.3.4 and 84.5.1 for more details.

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.

82.3.1 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.

82.3.2 Biomedical Option in Chemical Engineering

The application of engineering principles to biomedical sciences has been gaining significant momentum since the 1980s. Exploring a biomedical problem from an engineering perspective provides unique solutions to biomedical problems. Utilizing established chemical engineering principles, such as thermodynamics, mass transfer and reactor design, enables significant advances in human health and facilitates establishment of an industrial activity based on bioengineering principles. The Biomedical Option retains all of the core courses of the Chemical Engineering program. It then adds courses specific to the biomedical sciences to provide students with the necessary background for employment in the biomedical field. See §82.12 for more details. Enrolment is limited.

82.3.3 Oil Sands Engineering Elective Pattern in Chemical Engineering

With over 1.7 trillion barrels of oil in place, the oilsands of Alberta are an enormous resource to supply Canada's energy needs and support oil exports for many years in the future. Extracting the bitumen and upgrading it to synthetic crude oil presents exciting engineering challenges, including increasing yield and energy efficiency, reducing environmental impact and improving the quality of the oil product. The Oilsands Engineering Program retains all of the core courses of the Chemical Engineering program. It then adds courses specific to the oilsands to provide students with the necessary background for employment in the industry.

Enrolment is limited.

82.3.4 Elective Streams in Chemical Engineering

In addition to the required courses, students in Chemical Engineering may study certain fields in depth by choosing appropriate technical elective courses. The following lists elective streams that are currently available in Chemical Engineering:

Note: The following elective streams apply to Chemical Engineering Traditional Program and Co-op Plan II. Due to course scheduling difficulties, these elective streams do not apply to Co-op Plan I.

(1) **Mineral Processing and Extractive Metallurgy:** This Elective Stream is offered in collaboration with Materials Engineering. Metallic and non-metallic materials such as gold, copper, iron (steel) and ceramics are extracted from mineral resources. Mineral processing and extractive metallurgy is therefore an important engineering field that contributes to Canada's economy. The Mineral Processing and Extractive Metallurgy Elective Stream will introduce students to the fundamental theories of mineral processing, hydrometallurgy, electrometallurgy and pyrometallurgy, and current practices of unit operations of these processes. The graduates from this elective pattern will be able to find employment in Canadian resource sectors, especially in oil sands, coal, base metal, precious metal, potash and diamond ore processing industries. The recommended courses for this elective stream are CME 421, 422 and 472.

(2) **Nanoscale Engineering:** The Nanoscale Engineering Elective Stream consists of 4 courses which are taken in the four technical elective slots available in the Chemical Engineering program. The recommended courses for this stream are: MAT E 211 and three of CH E 487, CH E 583, CH E 584 and MAT E 458. These courses expose Chemical Engineering students to topics in which understanding of the small-scale structures of materials are necessary for understanding the macroscopic processes associated with these nanostructures. It also provides the students with an introduction to the tools available for probing the properties of these nanostructures.

(3) **Polymer Materials:** This Elective Stream is offered in collaboration with Materials Engineering. The Polymer Materials Elective Stream is designed for students who are interested in acquiring a basic knowledge in the field of polymers: structure-property relationships, polymerization reactions and polymer processing so that upon completion of the Stream, they will have the knowledge to embark on graduate level research in polymer science and engineering and will be employable by polymer manufacturers and polymer processing industry. The recommended courses for this elective stream are CME 482, 484 and 485.

82.4 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.

82.4.1 Disciplines in Civil Engineering

Construction Engineering

Construction engineers combine engineering and management disciplines to plan and execute projects. They apply their knowledge of construction methods and equipment to ensure that work is completed on time, within budget, safely, and in accordance with 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.

82.4.2 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.

82.4.3 Biomedical Engineering Option in Civil Engineering

This option is intended to provide students with the background necessary to start their career in Civil Engineering with a good basic understanding of the Biomedical Engineering disciplines. Core courses in the Civil Engineering Program (surveying, construction engineering and management, transportation engineering and engineering law) are replaced by fundamental courses in biology and medicine. This option is intended to better prepare students for graduate studies in biomedical engineering and for employment in the health care industry, especially in the area of biomechanical engineering, bone engineering and biological processes. The curriculum has also provided necessary requirements to allow successful students to apply to the MD program.

82.5 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 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 Department of Electrical and Computer Engineering.

82.5.1 Software Option in Computer Engineering

This option is concerned with the systematic and comprehensive development of software systems. The rapidly growing complexity of such systems along with their stringent requirements such as to their reliability, security, user-friendliness, maintainability, testability, portability, interoperability and cost effectiveness is a challenge to the software industry. To prepare for this challenging and rewarding reality, the software option provides a balanced curriculum including the theoretical and applied foundations in computing, mathematics, physical science, the engineering sciences and current technology.

Computer engineers in the software field specify, describe, and analyze digital systems bridging the gaps between the digital world and real world. They develop small (such as remote control software) and large (e.g., the Internet) software systems. Starting from user requirements, they use sound engineering practices to construct, test, and maintain software artifacts. Programming is a relatively small phase of the overall project lifecycle.

The Software Option provides students with comprehensive foundations for this rapidly evolving field by dwelling on engineering design principles, the discrete and continuous mathematics, logic and the theory of software. It incorporates the best practices of the software industry. The course material is tightly coupled with practical exercises and experiments, using up-to-date industrial software development tools.

The Software Option is offered jointly by the Department of Electrical and Computer Engineering and the Department of Computing Science. The option is administered by the Department of Electrical and Computer Engineering.

82.6 Electrical Engineering

Electrical engineering is the application of knowledge of electrical systems and phenomena for the benefit of society. The Electrical Engineering program builds an understanding of theoretical concepts early in the program and then gives students the tools to develop more in-depth knowledge in their fields of interest. Introductory courses explore the fundamentals of electricity and magnetism, the laws governing analog electric circuits, and introduce digital circuitry. In the third and fourth years of study, students are able to investigate specific areas of electrical engineering, while maintaining a broad outlook. Practical experience is integral to the program. Laboratory experiments form a required element of many courses while in the final year of study students must complete a capstone design project.

82.6.1 Areas of Study

Students are required to choose technical electives as part of the program. These courses allow students to study the following technical areas in greater depth.

Students should contact the Department of Electrical and Computer Engineering for advice regarding the selection of appropriate elective courses in their areas of interest.

Biomedical Engineering

Biomedical Engineering is the application of the principles of engineering to the solution of problems in medicine and biology. Applications of electrical engineering include bioelectromagnetism, physiological monitoring and related instrumentation, medical imaging and information systems. See §§82.6.2 and 82.12 for more information.

Communications Engineering

Communications engineering involves the movement of information from one point to another in analog or digital form, including transmitting, routing, receiving and processing these signals.

Control Systems Engineering

Control Systems Engineering is an interdisciplinary subject that cuts across many specialized engineering fields. Control system engineers are essential to the design of systems such as robotics, space vehicles, oil refineries, paper-making machines, power systems and automobiles.

Digital Systems Engineering

Digital systems engineers design hardware systems for a broad range of applications including process control, robotics, digital signal processing, computers, communications, instrumentation and data acquisition.

Electronic Materials and Nanotechnology

Electronic materials are central to many applications including electronic and photonic devices and biotechnology. Topics include growth of thin films and microfabrication of functional devices. Of increasing importance is nanotechnology, the science and engineering of materials and structures at the molecular level.

Electronics Engineering

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 digital, control, communications and power systems.

Electromagnetics and Photonics

Electromagnetic phenomena form the basis of electrical engineering. Further study of electromagnetics can aid understanding of systems such as photonics, microwaves, plasma processing, power distribution, lasers and wireless transmission.

Power Engineering

Power Engineering covers the generation, transmission, distribution and application of electrical power. It includes power systems, power electronics, motors generators and motor drives.

82.6.2 Biomedical Option in Electrical Engineering

This option is intended to provide a more intensive specialization in the biomedical engineering field than is possible by choosing only the relevant technical electives. Core courses in the Electrical Engineering Program are replaced by fundamental courses in medicine and biology. This option is intended to better prepare students for graduate studies in biomedical engineering and for employment in the health-care industry. It also provides the necessary academic qualifications to allow successful students to make application into the MD Program. See §§82.6.1, 82.12 and 15.9.9 for more information.

82.7 Engineering Physics

The Engineering Physics program, offered in cooperation with the Department of Physics, leads to the degree of BSc in Engineering Physics. It is more fundamental than the Electrical Engineering program and provides students with an extensive background in mathematics and physics. Within the program is the Nanoengineering Option which focuses on aspects of the emerging field of nanotechnology and provides a more interdisciplinary perspective appropriate to that field.

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 3.0 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.

82.7.1 Nanoengineering Option

The emerging field of nanotechnology crosses many disciplines, including engineering, biology, chemistry, and physics. Structures and devices engineered on the scale of less than 100nm will have significant impact on how we create materials, process information, sense the environment, use energy, manufacture goods and practice medicine. The Nanoengineering Option provides broad skills suitable for entry to the nanotechnology professions, combining core Electrical Engineering and Physics courses with additional instruction in biochemistry and chemistry, and specialized instruction in nanoelectronics, nanobioengineering, and nanofabrication.

82.8 Materials Engineering

Materials Engineering is the discipline in Engineering in which materials are engineered and designed for their function in society. This is done by selecting the scale of the material from molecular or atomic, to nano, micro and macro and by choosing the class of material from soft to hard to composites while integrating this knowledge through the processing, structure, properties and performance of materials. It is concerned with the production and engineering applications of metallic and non-metallic materials (polymers, ceramics, composites, electronic materials and biomaterials). 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 applications of 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 of the metals 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 specialities as corrosion, wear, fracture mechanics and failure investigation. This sector would also include the recycling industries.

The undergraduate Materials Engineering program, the only one of its kind in the prairie provinces, includes a set of core materials engineering courses emphasizing underlying principles and their engineering applications. With the technical electives it is possible for the students to go into more depth in particular areas of interest, e.g., biomaterials, functional materials, mineral processing and extractive metallurgy, polymer materials and structural materials. With a quota of 25 students, the class size is smaller than many other disciplines.

82.8.1 Biomedical Option in Materials Engineering

The utilization of novel materials for biomedical purposes has been finding increased acceptance. Novel materials specifically engineered for medical performance provide unique solutions to biomedical problems. Utilizing novel metallic alloys, molecularly designed polymers, and tailored composites has enabled significant progress in health care and medical diagnostics. The Biomedical Option retains all of the core courses of the Materials Engineering program. It then adds courses specific to the biomedical sciences to provide students with the necessary background for employment in the biomedical field. Enrolment is limited.

82.8.2 Elective Streams in Materials Engineering

Students in the Materials Engineering program can choose to specialize in a particular field of Materials Engineering by taking their technical electives from one of the four elective streams identified below.

Note: Not all the elective courses will be offered every year.

(1) **Mineral Processing and Extractive Metallurgy:** Metallic and non-metallic materials such as gold, copper, iron (steel) and ceramics are extracted from mineral resources. Mineral processing and extractive metallurgy is therefore an integral part of materials engineering and an important engineering field that contributes to Canada's economy. The Mineral Processing and Extractive Metallurgy elective stream will introduce students to the fundamental theories of mineral processing, hydrometallurgy, electrometallurgy and pyrometallurgy, and current practices of unit operations of these processes. The graduates from this elective stream will be able to find employment in Canadian resource sectors, especially in oil sands, coal, base metal, precious metal, potash and diamond ore processing industries. The recommended courses for this elective stream are CME 421 to be taken in Term 7 (Term 6 for Co-op students), CME 422 and 472 in Term 8. It is also recommended that students take either MAT E 470 or CH E 446 as the fourth technical elective.

(2) **Nano and Functional Materials:** Students entering this elective stream will be exposed to the exciting and emerging field of nano and functional materials. Subject areas covered include electronic, optical and magnetic materials, nanomaterials and their applications, and functional materials processing and fabrication. Employment opportunities exist in several sectors of Canadian industry, such as microelectronic/optoelectronic device fabrication, MEMS processing and fuel cell development. The recommended courses for this elective stream are MAT E 491 and either E E 459 or E E 457 to be taken in Term 7 (Term 6 for Co-op students), and MAT E 494 in Term 8.

(3) **Polymer Materials:** The polymer materials elective stream is designed for students who are interested in acquiring a basic knowledge in the field of polymers: structure-property relationships, polymerization reactions and polymer processing so that upon completion of the option, they will have the knowledge to embark on graduate level research in polymer science and engineering and will be employable by polymer manufacturers and polymer processing industry. The recommended courses for this elective stream are CH E 345 and CME 482 to be taken in Term 7 (Term 6 for Co-op students), CME 484 and 485 in Term 8.

(4) **Structural Materials:** Students completing this elective stream will be proficient in the traditional areas of metallurgical and materials engineering, i.e., physical metallurgy and materials processing. Employment opportunities exist in several sectors of Canadian industry including, but not restricted to, primary metal extraction, steel processing, oil and gas, automotive and consulting. The recommended courses for this elective stream are MAT E 470 to be taken in Term 7 (Term 6 for Co-op students), CME 472, MAT E 473 and 474 in Term 8. Students interested in this elective stream will need to take the ITS Elective in either Term 6 (Co-op students) or Term 7 (traditional students) to make room for the extra technical elective in Term 8.

82.9 Mechanical Engineering

Mechanical engineering covers a diverse range of engineering fields with five major areas of study: solid mechanics and dynamics, fluid mechanics, thermodynamics, mechanical design, and engineering management. 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.

82.9.1 Areas of Study

Solid Mechanics and Dynamics

Mechanical engineers are involved in the design of structures and mechanical components to safely withstand normal working stresses. Many structures and machines are also subjected to 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.

82.9.2 Biomedical Option in Mechanical Engineering

Applications of mechanical engineering to biomedical problems range from understanding the intricacies of fluid flows in the heart and lungs to the design of artificial joints, implants, orthopedic devices, and medical equipment and instrumentation. Exciting opportunities exist for innovative solutions to numerous health care problems by applying knowledge contained within the discipline of mechanical engineering. Such solutions typically require interdisciplinary teams for which the broad background in fundamentals obtained in mechanical engineering is an asset. Examples include the ever-increasing use of mechanical systems to assist or replace various portions of the anatomy, and the application of system modeling and design methods in areas from diagnosis to aids for rehabilitation.

For students considering a career in this expanding area, the Department of Mechanical Engineering offers two choices within its program. Both include all the broad core of mechanical engineering studies which are enhanced by the biomedical options. Both provide a good preparation for graduate studies in the biomedical engineering field. The first, which is available to all students, replaces the technical elective courses in the regular program with a stream of essential introductory courses in biomedical engineering and a course in biomechanics.

The second is a degree option, for a limited group of students in the cooperative engineering program, that includes a number of additional required courses and a four month clinical placement at a hospital or research institute. The overall length of the program is the same as for the regular co-op programs in the department. The additional courses are specified to provide a well-rounded introduction to biomedical engineering and biomechanics. Electives can be chosen from an approved list of courses to suit the interest of the individual student. Students completing this option will be granted a degree in Mechanical Engineering (Biomedical). With a suitable choice of electives (supplemented by at most two additional courses), students will also be qualified to apply to the Faculty of Medicine and Dentistry at the University of Alberta.

82.10 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.

82.11 Petroleum Engineering

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

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

82.12 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.

At the undergraduate level, there are formal biomedical engineering options and elective sequences in the Chemical, Mechanical, Materials and Electrical Engineering programs. 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, biomaterials and biomechanics. At the graduate level, there are programs in these departments as well as the Department of Biomedical Engineering in the Faculty of Medicine and Dentistry. This latter 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 Dentistry or a Faculty advisor in any Engineering department.

82.13 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.

82.14 Honors Mathematics Courses

Students with exceptionally high interest and ability in mathematics may replace certain engineering mathematics courses with honors mathematics courses. These students would follow the honors calculus sequence MATH 117, 118, and 217, instead of MATH 100, 101, and 209. 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.

82.15 Engineering Safety and Risk Management Courses

Safety, risk, and loss management principles applicable to all engineering activities 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.

82.16 Arrangements with Other Institutions

82.16.1 Engineering Transfer Programs at Alberta Colleges

Students may complete their first year of Engineering at any of the following Alberta postsecondary institutions: Grande Prairie Regional College, Keyano College (Fort McMurray), University of Lethbridge, Medicine Hat College, Grant MacEwan 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.

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

The first year engineering programs at the University of Alberta and the University of Calgary are similar but not identical. The first year program requirements at the two universities, effective with the 2002–2003 academic year, are indicated below. Where there is a course entry for both the University of Alberta and the University of Calgary, these courses are equivalent and qualify for transfer credit. Students who completed the first year program at the University of Calgary prior to the 2002–2003 academic year and are interested in a transfer to the University of Alberta should consult the Faculty of Engineering concerning transfer credit.

First Year Program Requirements	University of Alberta	University of Calgary
Two Chemistry Courses	CHEM 103	ENGG 201
	CHEM 105	CHEM 209
Engineering Statics (See Note 1)	ENGG 130	
Engineering Dynamics (See Note 1)	EN PH 131	
Engineering Statics/Dynamics (See Note 1)	-	ENGG 205
Two Calculus Courses	MATH 100	AMAT 217
	MATH 101	AMAT 219
Linear Algebra	MATH 102	MATH 221
Physics (Waves and Optics) (See Note 2)	PHYS 130	-
Physics (Electricity and Magnetism) (See Note 3)	-	PHYS 259
Computing	ENCMP 100	ENGG 233
Orientation To The Engineering	ENGG 100	-
Profession: 2 Courses	ENGG 101	-
Design and Communications (See Note 4)	-	ENGG 251
	-	ENGG 253
Complementary Studies Elective (See Note 5)	Yes	Yes

Notes:

(1) The University of Calgary offers a second Engineering Statics/Dynamics course in second year ENGG 349. ENGG 205 and ENGG 349 at the University of Calgary is equivalent to ENGG 130 and EN PH 131 at the University of Alberta.

(2) The University of Calgary offers an equivalent course, PHYS 369, as part of the second year program.

(3) The University of Alberta offers an equivalent course, PHYS 230, as part of the second year program. Students entering the Civil, Mining, Computer Process Control option in Chemical and Petroleum Engineering programs at the University of Alberta cannot receive degree credit for PHYS 259 from the University of Calgary or PHYS 230 from the University of Alberta.

(4) The University of Alberta offers no directly equivalent courses. Students completing ENGG 251/253 at the University of Calgary will only receive transfer credit for ENGG 100/101.

(5) Complementary studies electives in first year are courses selected from the humanities (excluding languages) or social sciences. English courses are acceptable.

82.16.3 Transfer from Alberta Technical Institutes

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

82.16.4 Geomatics Engineering at the University of Calgary

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.

82.16.5 BSc Program in Agricultural Engineering Bioresource Engineering

The University of Saskatchewan offers a four-year program leading to the Bachelor of Science in Engineering (BE) with Agricultural and Bioresource Engineering as a field of specialization. Students wanting to transfer to the Agricultural and Bioresource Engineering program at the University of Saskatchewan following one year of engineering at the University of Alberta may be eligible to receive scholarship funds from the University of Alberta (MacHardy-Stephanson Fund) to support their transfer. For additional information about the program, contact the Head, Agricultural and Bioresource Engineering, College of Engineering, University of Saskatchewan, Saskatoon, Saskatchewan, S7N 5A9 or access the website: http://www.engr.usask.ca/dept/age/

82.16.6 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.

82.17 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).

The TEC-ED program which allowed members of the Alberta Society of Engineering Technologists (ASET) to register as special students has been discontinued. Contact the Faculty for more information on its replacement.

82.18 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.

82.19 Professional Associations and Technical Societies

All Engineering programs listed in the Calendar are accredited by the Canadian Engineering Accreditation Board of the Canadian Council of Professional Engineers. Therefore, graduation from the Faculty of Engineering can lead to registration as a professional engineer in the provincial associations of professional engineers, in accordance with their individual policies.

The practice of engineering throughout Canada is regulated by professional associations in each province. The right to practise and accept professional responsibility is limited to those 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.

83 Faculty Regulations

83.1 Admission and Registration

General University admission requirements are set out in §§13 and 14. Specific admission information for the Faculty of Engineering is detailed in §15.7.

83.2 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 §§84.3 and 84.4. 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.

83.3 Academic Regulations

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

There are 680 entry places in the first year and 760 entry places in the second year of the Engineering program. The approved second-year entry places are shown below for the individual disciplines. The number of entry spaces within each discipline and the number allocated to the cooperative education program are reviewed annually and are subject to change. The bracketed numbers give some indication of the co-op admissions in each discipline over the past few years.

Chemical and Chemical-Computer Process Control	100	(66)
Civil	110	(36)
Civil–Environmental	30	(30)
Computer and Computer-Software Option	130	(71)
Electrical and Engineering Physics	155	(42)
Mechanical	160	(68)
Materials	25	(6)
Mining	20	(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 15.0 units of transfer credit, must normally qualify for a specialized program in not more than four terms (two years); those with 15.0 units or more of transfer credit must qualify in not more than two terms (one year). In order to qualify, a student must be in satisfactory standing after Fall/Winter and have credit in at least 30.0 units (excluding ENGG 100/101) of courses transferable to a specialized program. 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.

Students who are offered admission to one of the specialized programs must register in the Fall and/or Winter Term immediately following; otherwise they must re-apply and again compete for a space in these programs.

Spaces in each specialized program are reserved for students who do not have an undergraduate engineering degree. Students who already hold an undergraduate engineering degree are not eligible for admission to a second undergraduate program in the Faculty. Study of a different

engineering discipline can be done through registration as a Special Student or registration in a graduate program.

(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 70.0 units, additional terms will be included in the calculation of the EGA as required to reach a total of at least 70.0 units. The 70.0 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
   i) pass all courses required by the specific program;
   ii) have an Engineering Graduation Average of 2.0 or greater;
   iii) be in satisfactory academic standing, i.e., have a Fall/Winter GPA of 2.0 or greater.

A student who is otherwise eligible to graduate but has an EGA of less than 2.0 and/or a Fall/Winter GPA in the range 1.7 to 1.9 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 2.0 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 students from the Alberta Society of Engineering Technologists TEC-ED program) (see §82.17). 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**

a. Students in specialized degree programs are not required to meet any minimum course load requirement except as noted in §83.3(5)b, but must meet the degree time limit as specified in §83.3(3). A course load less than that required to maintain full time status, as defined in §265, may have scholarship eligibility, income tax and student loan implications.

b. Students in their qualifying year may not normally take a course load with fewer than 37.0 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 §§84.3 and 84.4. Evaluation is on the basis of the Fall/Winter GPA or Spring/Summer GPA [see §23.4(6)]

a. **Satisfactory Standing:** Fall/Winter or Spring/Summer GPA of 2.0 or greater. Promotion, repeating any failed course(s).

b. **Marginal Standing-Academic Warning:** Fall/Winter or Spring/Summer GPA of 1.7 to 1.9 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:
   i) Previously on academic warning on two or more occasions.
   ii) Previously required to withdraw and previously on academic warning.
   iii) 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 2.0 while carrying a minimum course load of 14.0 units.

c. **Unsatisfactory Standing-Required to Withdraw:** Fall/Winter or Spring/Summer GPA less than 1.7. Student must withdraw.

d. **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 (Credit/No Credit) basis. A student receiving a grade of Fail/No Credit 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 §83.3(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 §§84.2, 84.3, or 84.4 as appropriate. In the case of Faculty and Department awards, a full course load is defined as at least 35.0 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 3.5 or greater, calculated on a course load of not less than 35.0 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 3.5 or greater, and
   ii) carried at least 70.0 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 or any conditions imposed as part of the appeal decision within the Faculty may be carried to the General Faculties Council Academic Appeals Committee. See §23.8. The appeal of any conditions in an appeal decision by the Faculty must occur within the timelines set out for any appeal to the General Faculties Council Academic Appeals Committee. The consequences resulting from a subsequent failure to meet the conditions are not appealable.

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 §83.3(12)a.

A copy of the Faculty of Engineering Regulations regarding appeals may be obtained from the Faculty Office, E6-050 Engineering Teaching and Learning Complex.

83.4 Calculators in Examinations

Instructors must specify in the syllabus for each course, the course policy with respect to calculators in examinations. The policy choices are:

(1) no calculators

(2) approved non-programmable calculators

(3) approved programmable calculators or approved non-programmable calculators

A list of acceptable calculators in the non-programmable and programmable categories is available from the Faculty and Department offices. Only approved calculators may be taken into an exam. Approved calculators must bear a sticker that identifies it as to type and acceptability. Students must bring their calculator(s) to the Faculty or Department office to have the appropriate sticker affixed.

84 Programs of Study

84.1 Faculty Requirements for all BSc in Engineering Programs

Course requirements for Engineering programs are listed in §84.2 (First-Year) and §§84.3 through 84.4 (Second-Year and beyond). All Engineering programs include ENGG 400, MATH 201, 209, one of ENGG 310 or 401, and an ITS elective as described in §84.6.1.

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

84.2 First-Year Program

Students registering for first-year courses should consult the Registration and Courses menu at www.registrar.ualberta.ca for detailed registration procedures. Students interested in an equivalent curriculum given in French should consult §184.10.

Term 1

CHEM 103 (3-1s-3/2)
ENGG 100 (1-0-0)
ENGG 130 (3-0-2)
MATH 100 (3-0-2)
PHYS 130 (3-0-3/2)
Complementary Studies Elective (3-0-0)

Term 2

CHEM 105 (3-0-3/2)
ENCMP 100 (3-0-1.5)
ENGG 101 (1-0-0)
EN PH 131 (3-1s-3/2)
MATH 101 (3-0-1)
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 (one term) from the following subject areas (see §231 for course descriptions): Anthropologie, Anthropology, Art and Design (ART H only), Christian Theology, Classics, Comparative Literature, Economics, Etudes de la religion, Family Studies, Linguistics, Philosophie, Philosophy, Political Science, Psychologie, Psychology, Religious Studies, Science Politique, Slavic and East European Studies, Sociologie, and Sociology. See §84.6.

(2) Students accepted into the Honors Mathematics stream replace MATH 100 and 101 with MATH 117 and 118 (see §82.14).

84.2.1 Math and Applied Sciences Centre (MASC)

MASC, a department of University Student Services, offers mathematics preparation for students entering the Faculty of Engineering. Although all students can benefit from these courses, they are particularly recommended for students who scored less than 80% in Mathematics in 30/31 or who have been away from the study of mathematics for three years or more. Further information can be found at www.ualberta.ca/~masc.

84.3 Required Courses and Suggested Course Sequence for Traditional Programs

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

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

Note: For information on Complementary Studies Electives, Impact of Technology on Society (ITS) Electives and English Electives see §84.6.

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

Chemical

Year 2		Year 3		Year 4	
Term 3	**Term 4**	**Term 5**	**Term 6**	**Term 7**	**Term 8**
CH E 243 (3-1s-0)	E E 239 (3-0-3/2)	CH E 312 (3-1s-0)	CH E 314 (3-1s-0)	CH E 416 (3-0-2)	CH E 454 (1-0-4)
CHEM 261 (3-0-3)	MAT E 202 (3-0-3/2)	CH E 343 (3-1s-0)	CH E 318 (3-0-2)	CH E 445 (3-1s-0)	CH E 465 (4-0-4)
CME 200 (1-0-0)	MATH 201 (3-0-1)	CH E 351 (2-0-3)	CH E 345 (3-1s-0)	CH E 446 (3-1s-3/3)	CME 483 (1-0-0)
CME 265 (3-0-3)	STAT 235 (3-0-2)	CH E 374 (3-1s-0)	CH E 358 (3-0-4)	CH E 464 (3-0-3)	ENGG 400 (1-0-0)
English Elective (3-0-0)	Complementary Studies Elective (3-0-0)	Tech Elective (3-0-0)	ENGG 310 (3-0-0) or ENGG 401 (3-0-0)	CME 481 (1-0-0)	Tech Elective (3-1s-0)
MATH 209 (3-0-1)	ITS Elective (3-0-0)			Tech Elective (3-1s-0)	Tech Elective (3-1s-0)
Complementary Stuides Elective (3-0-0)					

Notes:

(1) See §84.5.1 for restrictions on the four technical electives.

(2) Students who are interested in taking Nanoscale Engineering, Mineral Processing and Extractive Metallurgy, or Polymer Materials Elective Streams should consult the Department for course schedules.

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

Chemical: Biomedical Option

Year 2		Year 3		Year 4	
Term 3	**Term 4**	**Term 5**	**Term 6**	**Term 7**	**Term 8**
BIOL 107 (3-1s-3)	BIOCH 200, BIOL 201, or CELL 201 (3-0-0)	BME 210 (3-0-0)	BME 211 (3-0-0)	CH E 446 (3-1s-3/3)	CH E 454 (1-0-4)
CH E 243 (3-1s-0)	E E 239 (3-0-3/2)	CH E 312 (3-1s-0)	CH E 314 (3-1s-0)	CH E 464 (3-0-3)	CH E 465 (4-0-4)
CME 200 (1-0-0)	MAT E 202 (3-0-3/2)	CH E 343 (3-1s-0)	CH E 318 (3-0-2)	CH E 416 (3-0-2)	CME 483 (1-0-0)
CME 265 (3-0-3)	MATH 201 (3-0-1)	CH E 351 (2-0-3)	CH E 345 (3-1s-0)	CME 481 (1-0-0)	ENGG 400 (1-0-0)
CHEM 261 (3-0-3)	STAT 235 (3-0-2)	CH E 374 (3-1s-0)	CH E 358 (3-0-4)	PHIL 386 (3-0-0)	Tech Elective (3-1s-0)
English Elective (3-0-0)	ITS Elective (3-0-0)		ENGG 310 (3-0-0) or 401 (3-0-0)	Tech Elective (3-1s-0)	Complementary Studies Elective (3-0-0)
MATH 209 (3-0-1)					

Notes:
(1) Students who are interested in applying for admission into the Faculty of Medicine and Dentistry should take BIOCH 200 and another 3 units of English Elective in addition to the English Elective listed in this grid. For more details please consult with the Advisor for Biomedical Options in the Department of Chemical and Materials Engineering.
(2) WKEXP 906 is required for this program. WKEXP 906 can be taken after Term 4, 6 or 8.
(3) See §84.5.1.1 for restrictions on the two electives.

Chemical: Computer Process Control Option

Year 2		Year 3		Year 4	
Term 3	**Term 4**	**Term 5**	**Term 6**	**Term 7**	**Term 8**
CHEM 261 (3-0-3)	CH E 243 (3-1s-0)	CH E 312 (3-1s-0)	CH E 314 (3-1s-0)	CH E 358 (3-0-4)	CH E 454 (1-0-4)
CME 200 (1-0-0)	CME 265 (3-0-3)	CH E 343 (3-1s-0)	CH E 318 (3-0-2)	CH E 416 (3-0-2)	CH E 465 (4-0-4)
E E 240 (3-1s-3/2)	English Elective (3-0-0)	CH E 351 (2-0-3)	CH E 345 (3-1s-0)	CH E 464 (3-0-3)	CH E 573 (3-0-3/2)
E E 280 (3-0-3/2)	MATH 201 (3-0-1)	CH E 374 (3-1s-0)	CH E 572 (3-1s-3/3)	CME 481 (1-0-0)	CH E 576 (3-0-3/2)
MAT E 202 (3-0-3/2)	STAT 235 (3-0-2)	CH E 446 (3-1s-3/3)	ENGG 310 (3-0-0) or ENGG 401 (3-0-0)	Tech Elective (3-1s-0)	CME 483 (1-0-0)
MATH 209 (3-0-1)	Complementary Studies Elective (3-0-0)	ITS Elective (3-0-0)		Tech Elective (3-1s-0)	ENGG 400 (1-0-0)
Complementary Studies Elective (3-0-0)					

Notes:
(1) MATH 201 must be taken in either Term 3 or 4.
(2) See §84.5.2 for restrictions on the technical electives.

Chemical: Oil Sands Elective

Year 2		Year 3		Year 4	
Term 3	**Term 4**	**Term 5**	**Term 6**	**Term 7**	**Term 8**
CH E 243 (3-1s-0)	MAT E 202 (3-0-3/2)	CH E 312 (3-1s-0)	CH E 314 (3-1s-0)	CH E 416 (3-0-2)	CH E 435 (4-0-4)
CME 200 (1-0-0)	E E 239 (3-0-3/2)	CH E 343 (3-1s-0)	CH E 318 (3-0-2)	CH E 445 (3-1s-0)	CH E 454 (1-0-4)
CME 265 (3-0-3)	MATH 201 (3-0-1)	CH E 351 (2-0-3)	CH E 345 (3-1s-0)	CH E 446 (3-1s-3/3)	CH E 534 (3-1s-3/3)
CHEM 261 (3-0-3)	STAT 235 (3-0-2)	CH E 374 (3-1s-0)	CH E 358 (3-0-4)	CH E 464 (3-0-3)	CME 483 (1-0-0)
English Elective (3-0-0)	Complementary Studies Elective (3-0-0)	ENGG 310 (3-0-0) or ENGG 401 (3-0-0)	CH E 522 (3-1s-0)	CME 481 (1-0-2)	ENGG 400 (1-0-0)
MATH 209 (3-0-1)	ITS Elective (3-0-0)			Technical Elective (3-0-0)	Technical Elective (3-0-0)
Complementary Studies Elective (3-0-0)					

Note: See §84.5.3 for restrictions on the technical electives.

Civil

Year 2		Year 3		Year 4	
Term 3	**Term 4**	**Term 5**	**Term 6**	**Term 7**	**Term 8**
CIV E 265 (2-0-3)	CIV E 221 (3-0-3/2)	CIV E 330 (3-ls-0)	CIV E 303 (3-0-3/2)	Tech Elective (See Note 1)	ENGG 310 (3-0-0) or ENGG 401 (3-0-0)
CIV E 270 (3-0-3)	CIV E 240 (1-2s-0)	CIV E 372 (3-2s-0)	CIV E 315 (3-0-2)	Tech Elective (See Note 1)	ENGG 400 (1-0-0)
EAS 210 (3-0-3)	CIV E 250 (3-0-3)	CIV E 391 (3-0-3)	CIV E 321 (3-0-3/2)	Tech Elective (See Note 1)	ENGG 420 (3-0-0)
MATH 209 (3-0-1)	CIV E 251 (1 week)*	CIV E 395 (3-0-2/2)	CIV E 331 (3-0-3/2)	One of E E 239, MEC E 250 or CH E 243	Tech Elective (See Note 1)
MAT E 202 (3-0-3/2)	CIV E 290 (3-0-0)	CIV E 398 (3-1s-0)	CIV E 374 (3-0-3)	Complementary Studies Elective (3-0-0)	Tech Elective (See Note 1)
	CIV E 295 (3-0-2)	English Elective (3-0-0)	CIV E 381 (3-0-3)		ITS Elective (3-0-0)
	MATH 201 (3-0-1)				
	*Held in Spring/Summer (Spring Term)				

Note: See §84.5.4 for restrictions on the technical electives.

Civil: Biomedical Engineering Option

Year 2		Year 3		Year 4	
Fall Term 3	**Winter Term 4**	**Fall Term 5**	**Winter Term 6**	**Fall Term 7**	**Winter Term 8**
BIOL 107 (3-1s-3)	CHEM 261 (3-0-3)	CIV E 330 (3-1s-0)	BME 211 (3-0-0)	One of E E 239, MEC E 250 or CH E 243	ENGG 310 (3-0-0) or ENGG 401 (3-0-0)
CIV E 265 (2-0-3)	CIV E 221 (3-0-3/2)	CIV E 372 (3-2s-0)	ENV E 351 (3-0-3/2)	Complementary Studies Elective (3-0-0)	ENGG 400 (1-0-0)
CIV E 270 (3-0-3)	CIV E 240 (1-2s-0)	BIOCH 200 (3-0-0)	CIV E 321 (3-0-3/2)	English Elective	Tech Elective (See Note 1)
EAS 210 (3-0-3)	CIV E 290 (3-0-0)	CIV E 395 (3-0-2/2)	CIV E 331 (3-0-3/2)	Tech Elective (See Note 1)	Tech Elective (See Note 1)
MATH 209 (3-0-1)	CIV E 295 (3-0-2)	CIV E 398 (3-1s-0)	CIV E 374 (3-0-3)	Tech Elective (See Note 1)	CIV E 459 (3-0-3)
MAT E 202 (3-0-3/2)	MATH 201 (3-0-1)	BME 210 (3-0-0)	CIV E 381 (3-0-3)	Tech Elective (See Note 1)	ITS Elective (3-0-0)

Note: See §84.5.4.1 for restrictions on the technical electives.

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

Civil: Environmental Engineering Option

Year 2		Year 3		Year 4	
Fall Term 3	**Winter Term 4**	**Fall Term 5**	**Winter Term 6**	**Fall Term 7**	**Winter Term 8**
CIV E 265 (2-0-3)	CIV E 240 (1-2s-0)	CH E 243 (3-1s-0)	CIV E 331 (3-0-3/2)	CIV E 374 (3-0-3)	ENGG 310 (3-0-0) or ENGG 401 (3-0-0)
CIV E 270 (3-0-3)	CIV E 250 (3-0-3)	CIV E 330 (3-1s-0)	CIV E 381 (3-0-3)	ENV E 320 (3-0-3/2)	ENGG 400 (1-0-0)
EAS 210 (3-0-3)	CIV E 251 (1 week)*	CIV E 372 (3-2s-0)	ENV E 302 (2-1s-0)	ENV E 323 (3-0-0)	ENV E 434 (3-0-0)
ENV E 220 (3-0-3/2)	CIV E 290 (3-0-0)	CIV E 395 (3-0-2/2)	ENV E 351 (3-0-3/2)	ENV E 400 or 401 (3-0-0)*	ENV E 440 (3-0-3)
MATH 209 (3-0-1)	CIV E 295 (3-0-2)	ENV E 322 (3-0-0)	Complementary Studies Elective (3-0-0)	ENV E 421 (3-0-3/2)	LAW 399 (3-0-0)
	ENV E 222 (3-0-3/2)	ENV E 324 (3-0-3/2)		ENV E 432 (3-0-0)	ITS Elective (3-0-0)
	MATH 201 (3-0-1)			*Both courses may not be offered every year.	One of E E 239, MEC E 250 or MAT E 252
	*Held in Spring/Summer (Spring Term)				

Computer

Year 2		Year 3		Year 4	
Term 3	**Term 4**	**Term 5**	**Term 6**	**Term 7**	**Term 8**
CMPUT 114 (3-0-3)	CMPUT 115 (3-0-3)	CMPE 300 (3-0-3/2)	CMPE 382 (3-0-0)	CMPE 401 (3-0-3/2)	CMPE 490 (1-0-6)
ECE 200 (2-0-0)	CMPUT 272 (3-1s-3)	CMPUT 201 (3-0-3)	CMPUT 379 (3-0-3)	CMPE 480 (3-0-3/2)	ENGG 310 (3-0-0) or ENGG 401 (3-0-0)
E E 240 (3-1s-3/2)	E E 231 (3-0-3/2)	CMPUT 204 (3-1s-0)	E E 351 (3-1s-3/2)	CMPUT 313 (3-0-3)	ENGG 400 (1-0-0)
E E 280 (3-0-3/2)	E E 238 (3-1s-0)	E E 338 (3-1s/2-1/2)	E E 387 (3-1s-0)	Tech Elective	Tech Elective
MATH 201 (3-0-1)	E E 250 (3-1s-3/2)	E E 340 (3-1s-3/2)	ITS Elective (3-0-0)	Tech Elective	Tech Elective
MATH 209 (3-0-1)	English Elective (3-0-0)	E E 380 (3-0-3/2)	PHYS 230 (3-0-3/2)	Complementary Studies Elective (3-0-0)	Tech Elective
					Complementary Studies Elective (3-0-0)

Note: See §84.5.5 for restrictions on the five technical electives.

Computer: Software Option

Year 2		Year 3		Year 4	
Term 3	**Term 4**	**Term 5**	**Term 6**	**Term 7**	**Term 8**
CMPUT 114 (3-0-3)	CMPE 210 (3-0-3)	CMPE 300 (3-0-3/2)	CMPE 320 (3-0-3/2)	CMPE 382 (3-0-0)	CMPE 440 (1-0-6)
ECE 200 (2-0-0)	CMPUT 115 (3-0-3)	CMPE 310 (2-0-3)	CMPUT 301 (3-0-3)	CMPE 401 (3-0-3/2)	ENGG 310 (3-0-0) or ENGG 401 (3-0-0)
E E 240 (3-1s-3/2)	CMPUT 272 (3-1s-3)	CMPUT 201 (3-0-3)	CMPUT 379 (3-0-3)	CMPE 410 (2-0-3)	ENGG 400 (1-0-0)
E E 280 (3-0-3/2)	E E 231 (3-0-3/2)	CMPUT 204 (3-1s-0)	ITS Elective (3-0-0)	CMPE 420 (3-0-0)	Tech Elective
MATH 201 (3-0-1)	English Elective (3-0-0)	CMPUT 291 (3-0-3)	STAT 235 (3-0-2)	CMPUT 313 (3-0-3)	Tech Elective
MATH 209 (3-0-1)	PHYS 230 (3-0-3/2)	E E 380 (3-0-3/2)	Tech Elective	Complementary Studies Elective (3-0-0)	Tech Elective
					Complementary Studies Elective (3-0-0)

Note: See §84.5.5.1 for restrictions on the four technical electives.

Electrical

Year 2		Year 3		Year 4	
Term 3	**Term 4**	**Term 5**	**Term 6**	**Term 7**	**Term 8**
ECE 200 (2-0-0)	CH E 243 (3-1s-0)	E E 315 (3-1s-0)	E E 332 (3-0-3/2)	E E 400 (1-0-3)	ENGG 310 (3-0-0) or ENGG 401 (3-0-0)
E E 240 (3-1s-3/2)	E E 231 (3-0-3/2)	E E 330 (3-0-0)	E E 350 (3-1s-3/2)	Complementary Studies Elective (3-0-0)	ENGG 400 (1-0-0)
E E 280 (3-0-3/2)	E E 238 (3-1s-0)	E E 338 (3-1s/2-1/2)	E E 351 (3-1s-3/2)	Complementary Studies Elective (3-0-0)	E E 401 (1-0-3)
MATH 201 (3-0-1)	E E 250 (3-1s-3/2)	E E 340 (3-1s-3/2)	E E 357 (3-0-3/2)	Tech Elective	Tech Elective
MATH 209 (3-0-1)	PHYS 230 (3-0-3/2)	E E 380 (3-0-3/2)	E E 387 (3-1s-0)	Tech Elective	Tech Elective
MEC E 250 (3-1s-0)	English Elective (3-0-0)	MATH 309 (3-0-0)	E E 390 (3-0-3/2)	Tech Elective	Tech Elective
					ITS Elective (3-0-0)

Note: See §84.5.6 for restrictions on the six technical electives.

Electrical: Biomedical Engineering Option

Year 2		Year 3		Year 4	
Term 3	**Term 4**	**Term 5**	**Term 6**	**Term 7**	**Term 8**
ECE 200 (2-0-0)	CH E 243 (3-1s-0)	BIOL 107 (3-1s-3)	BIOL 207 (3-1s-3)	E E 400 (1-0-3)	E E 401 (1-0-3)
E E 240 (3-1s-3/2)	E E 231 (3-0-3/2)	BME 210 (3-0-0)	BME 211 (3-0-0)	EE BE 512 (3-0-0)	EE BE 540 (3-0-3/2)
E E 280 (3-0-3/2)	E E 238 (3-1s-0)	E E 315 (3-1s-0)	E E 350 (3-1s-3/2)	E E 380 (3-0-3/2)	Tech Elective - II
MATH 201 (3-0-1)	E E 250 (3-1s-3/2)	E E 338 (3-1s/2-1/2)	E E 357 (3-0-3/2)	Tech Elective - I	Tech Elective - III
MATH 209 (3-0-1)	PHYS 230 (3-0-3/2)	E E 340 (3-1s-3/2)	E E 387 (3-1s-0)	Complementary Studies Elective (3-0-0)	Tech Elective - IV
MEC E 250 (3-1s-0)	English Elective (3-0-0)	MATH 309 (3-0-0)	ENGG 310 (3-0-0) or ENGG 401 (3-0-0)	Complementary Studies Elective (3-0-0)	ITS Elective (3-0-0)
					ENGG 400 (1-0-0)

Note: See §84.5.6.1 for restrictions on the electives

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

Engineering Physics

Year 2		Year 3		Year 4	
Term 3	**Term 4**	**Term 5**	**Term 6**	**Term 7**	**Term 8**
E E 240 (3-1s-3/2)	E E 231 (3-0-3/2)	E E 280 (3-0-3/2)	E E 323 (3-1s-0)	E E 494 (0-1s-0)	E E 462 (3-0-3/2)
MAT E 201 (3-0-0)	E E 238 (3-1s-0)	E E 338 (3-1s/2-1/2)	E E 350 (3-1s-3/2)	PHYS 415 (3-0-0)	E E 495 (0-0-6)
MATH 201 (3-0-1)	E E 250 (3-1s-3/2)	E E 340 (3-1s-3/2)	PHYS 372 (3-0-0)	PHYS 481 (3-0-0)	ENGG 310 (3-0-0) or ENGG 401 (3-0-0)
MATH 209 (3-0-1)	PHYS 211 (3-0-0)	MATH 311 (3-0-0)	PHYS 381 (3-0-0)	Tech Elective	ENGG 400 (1-0-0)
PHYS 281 (3-0-0)	PHYS 244 (3-0-0)	PHYS 311 (3-0-0)	PHYS 397 (0-0-6)	Tech Elective	Tech Elective
PHYS 292 (0-0-3)	PHYS 271 (3-0-0)	PHYS 362 (3-0-0)	ITS Elective (3-0-0)	Tech Elective	Tech Elective
English Elective (3-0-0)	PHYS 292 (0-0-3)			Complementary Studies Elective (3-0-0)	Complementary Studies Elective (3-0-0)

Notes:
(1) See §84.5.7 for restrictions on the five technical electives.
(2) Students may take an extra course per term if their GPA is at least 3.3.

Engineering Physics: Nanoengineering Option

Year 2		Year 3		Year 4	
Term 3	**Term 4**	**Term 5**	**Term 6**	**Term 7**	**Term 8**
E E 240 (3-1s-3/2)	CH E 243 (3-1s-0)	E E 280 (3-0-3/2)	E E 323 (3-1s-0)	CHEM 261 (3-0-3)	BIOCH 200 (3-0-0)
MATE 201 (3-0-0)	E E 231 (3-0-3/2)	E E 457 (2-0-2)	E E 350 (3-1s-3/2)	E E 496 (0-1s-0)	E E 497 (0-0-6)
MATH 201 (3-0-1)	E E 238 (3-1s-0)	E E 340 (3-1s-3/2)	E E 459 (3-0-0)	PHYS 415 (3-0-0)	ENGG 310 (3-0-0) or 401 (3-0-0)
MATH 209 (3-0-1)	E E 250 (3-1s-3/2)	MATH 311 (3-0-0)	PHYS 372 (3-0-0)	PHYS 481 (3-0-0)	ENGG 400 (1-0-0)
PHYS 281 (3-0-0)	PHYS 244 (3-0-0)	PHYS 311 (3-0-0)	PHYS 381 (3-0-0)	ITS Elective (3-0-0)	E E 454 (3-0-0)
PHYS 292 (0-0-3)	PHYS 271 (3-0-0)	PHYS 362 (3-0-0)	PHYS 397 (0-0-6)	Tech Elective	E E 455 (3-0-0)
English Elective (3-0-0)	PHYS 292 (0-0-3)			Complementary Studies Elective (3-0-0)	Complementary Studies Elective (3-0-0)

Notes:
(1) See §84.5.7.1 for restrictions on the technical electives.
(2) Students may take an extra course per term if their GPA is at least 3.3

Materials

Year 2		Year 3		Year 4	
Term 3	**Term 4**	**Term 5**	**Term 6**	**Term 7**	**Term 8**
CH E 243 (3-1s-0)	CIV E 270 (3-0-3)	CH E 312 (3-1s-0)	Complementary Studies Elective (3-0-0)	CH E 314 (3-1s-0)	CME 483 (1-0-0)
CHEM 261 (3-0-3)	CME 265 (3-0-3)	CH E 374 (3-1s-0)	MAT E 336 (3-1s-0)	CME 481 (1-0-0)	ENGG 400 (1-0-0)
CME 200 (1-0-0)	ENGG 310 (3-0-0) or ENGG 401 (3-0-0)	MAT E 335 (3-1s-0)	MAT E 341 (3-1s-0)	MAT E 464 (3-0-3)	MAT E 461 (1-1-4)
MAT E 202 (3-0-3/2)	MATH 201 (3-0-1)	MAT E 340 (3-0-0)	MAT E 351 (3-1s-0)	Tech Elective (3-0-0)	MAT E 465 (2-1s-3)
MATH 209 (3-0-1)	MAT E 211 (3-1s-3/4)	MAT E 361 (1-1-3/2)	MAT E 362 (1-1-3/2)	Tech Elective (3-0-0)	ITS Elective (3-0-0)
STAT 235 (3-0-2)	MAT E 221 (3-1s-0)			Tech Elective (3-0-0)	Tech Elective (3-0-0)
English Elective (3-0-0)					Tech Elective (3-0-0)

Notes
(1) See §84.5.8 for restrictions on five technical electives.
(2) Students who are interested in Structural Materials, Mineral Processing and Extractive Metallurgy, Polymer Materials, or Nano and Functional Materials Elective Streams should consult the Department for course schedules.

Materials: Biomedical Option

Year 2		Year 3		Year 4	
Term 3	**Term 4**	**Term 5**	**Term 6**	**Term 7**	**Term 8**
BIOL 107 (3-1-3)	CIV E 270 (3-0-3)	BIOCH 200, or BIOL 201, or CELL 201 (3-0-0)	ENGG 310 (3-0-0) or ENGG 401 (3-0-0)	BME 210 (3-0-0)	BME 211 (3-0-0)
CH E 243 (3-1s-0)	CME 265 (3-0-3)	CH E 312 (3-1s-0)	MAT E 336 (3-1s-0)	CH E 314 (3-1s-0)	CH E 582 (3-1s-0) or MAT E 458 (3-1-0)
CHEM 261 (3-0-3)	MATH 201 (3-0-1)	MAT E 335 (3-1s-0)	MAT E 341 (3-1s-0)	CH E 374 (3-1s-0)	CME 483 (1-0-0)
CME 200 (1-0-0)	MAT E 211 (3-1s-3/4)	MAT E 340 (3-0-0)	MAT E 351 (3-1s-0)	CME 481 (1-0-0)	ENGG 400 (1-0-0)
MAT E 202 (3-0-3/2)	MAT E 221 (3-1s-0)	MAT E 361 (1-1-3/2)	MAT E 362 (1-1-3/2)	MAT E 464 (3-0-3)	MAT E 461 (1-1-4)
MATH 209 (3-0-1)	English Elective (3-0-0)			PHIL 386 (3-0-0)	MAT E 465 (2-1s-3)
STAT 235 (3-0-2)					ITS Elective (3-0-0)

Notes:
(1) Students who are interested in applying for admission into the Faculty of Medicine and Dentistry should take BIOCH 200 and another 3 units of English Elective in addition to the English Elective listed in this grid. For more details please consult with the Advisor for Biomedical Options in the Department of Chemical and Materials Engineering.
(2) WKEXP 906 is required for this program. WKEXP 906 can be taken after Term 4, 6 or 8.

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

Mechanical

Year 2		Year 3		Year 4	
Term 3 CIV E 270 (3-0-3) MATH 209 (3-0-1) PHYS 230 (3-0-3/2) **Course Group 2A** CH E 243 (3-1s-0) MEC E 200 (0-2-0) MEC E 250 (3-1s-0) **or** **Course Group 2B** MEC E 260 (2-0-3) MEC E 265 (2-0-3)	**Term 4** E E 239 (3-0-3/2) MATH 201 (3-0-1) MAT E 202 (3-0-3/2) STAT 235 (3-0-2) **Course Group 2A** CH E 243 (3-1s-0) MEC E 200 (0-2-0) MEC E 250 (3-1s-0) **or** **Course Group 2B** MEC E 260 (2-0-3) MEC E 265 (2-0-3)	**Term 5** **Course Group 3A** MATH 300 (3-0-0) MEC E 300 (3-1-0) MEC E 301 (1-0-3) MEC E 330 (3-0-1) MEC E 370 (3-1s-0) MEC E 380 (3-1s-0) **or** **Course Group 3B** ENGG 310 (3-0-0) or 401 (3-0-0) English Elective (3-0-0) MEC E 340 (3-0-0) MEC E 360 (3-0-3/2) MEC E 362 (3-0-3/2) MEC E 390 (3-0-1)	**Term 6** **Course Group 3A** MATH 300 (3-0-0) MEC E 300 (3-1-0) MEC E 301 (1-0-3) MEC E 330 (3-0-1) MEC E 370 (3-1s-0) MEC E 380 (3-1-0) **or** **Course Group 3B** ENGG 310 (3-0-0) or 401 (3-0-0) English Elective (3-0-0) MEC E 340 (3-0-0) MEC E 360 (3-0-3/2) MEC E 362 (3-0-3/2) MEC E 390 (3-0-1)	**Term 7** Tech Elective (3-0-0) Tech Elective (3-0-0) **Course Group 4A** MEC E 430 (3-0-0) or 480 (3-0-0) MEC E 463 (3-0-2) Tech Electives (3-0-0) Complementary Studies Elective (3-0-0) **or** **Course Group 4B** MEC E 403 (1-0-3) MEC E 451 (3-0-1) MEC 460 (1-0-4) ITS Elective (3-0-0)	**Term 8** CH E 448 (3-1s-3/3) or E E 462 (3-0-3/2) or MEC E 420 (3-0-3/2) ENGG 400 (1-0-0) Tech Elective (3-0-0) **Course Group 4A** MEC E 430 (3-0-0) or 480 (3-0-0) MEC E 463 (3-0-2) Tech Elective (3-0-0) Complementary Studies Elective (3-0-0) **or** **Course Group 4B** MEC E 403 (1-0-3) MEC E 451 (3-0-1) MEC E 460 (1-0-4) ITS Elective (3-0-0)

Note:
(1) See §84.5.9 for restrictions on the four technical electives.
(2) In each year, students take either (Group A in Fall, Group B in Winter) or (Group B in Fall, Group A in Winter).

Mining

Year 2		Year 3		Year 4	
Term 3 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)	**Term 4** CH E 243 (3-1s-0) CIV E 250 (3-0-3) CIV E 251 (1 week)* CIV E 270 (3-0-3) MATH 201 (3-0-1) MIN E 310 (3-0-3) ITS Elective (3-0-0) *Held in Spring/Summer (Spring Term)	**Term 5** CIV E 330 (3-1s-0) ENGG 310 (3-0-0) or ENGG 401 (3-0-0) MIN E 323 (3-0-3) MIN E 325 (3-0-3) MIN E 428 (0-4s-0)** Elective (3-0-0) (See §84.5.10)	**Term 6** CIV E 381 (3-0-3) MIN E 324 (3-0-0) MIN E 330 (3-3s/2-0) English Elective (3-0-0) Complementary Studies Elective (3-0-0) (See §84.6) **Held prior to start of Terms 5 or 7	**Term 7** CME 421 (3-0-3/2) 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 (0-4s-0)** Elective (3-0-0) (See §84.5.10)	**Term 8** ENGG 400 (1-0-0) ENV E 302 (2-1s-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)

Petroleum

Year 2		Year 3		Year 4	
Term 3 CH E 243 (3-1s-0) EAS 210 (3-0-3) E E 239 (3-0-3/2) MAT E 202 (3-0-3/2) MATH 209 (3-0-1) English Elective (3-0-0)	**Term 4** CH E 312 (3-1s-0) CIV E 270 (3-0-3) MATH 201 (3-0-1) PET E 295 (3-0-3/2) STAT 235 (3-0-2) Complementary Studies (3-0-0)	**Term 5** CHEM 371 (3-0-3) ENGG 310 (3-0-0) or 401 (3-0-0) PET E 362 (3-0-3/2) PET E 364 (3-1s-0) PET E 365 (3-1s-0) Elective (3-0-0) (See §84.5.11)	**Term 6** CH E 374 (3-1s-0) EAS 222 (3-0-3) PET E 366 (3-0-0) PET E 367 (1-0-3/2) PET E 368 (3-0-3/2) Elective (3-0-0) (See §84.5.11)	**Term 7** CH E 314 (3-1s-0) 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)	**Term 8** 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) ITS Elective (3-0-0) Elective (3-0-0) (See §84.5.11)

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

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

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

Note: For information on Complementary Studies Electives, Impact of Technology on Society (ITS) Electives and English Electives, see §84.6.

84.5 Technical Electives

84.5.1 Chemical

(1) Of the four single-term technical electives, one must be a "Science" elective selected from: BIOL 107, 108; CHEM 211, 263, 311; EAS 100, 210; PHYS 230, 244, 271.

(2) At least two must be Engineering Science and/or Engineering Design courses selected from:
BME 210, 211, 310
CME 421, 422, 472, 482, 484, 485
CH E 458, 459, 482, 484, 485, 487, 512, 520, 522, 534, 555, 572, 573, 576, 580, 581, 582, 583, 584, 594, 596
CIV E 270, 321, 521
ENGG 404, 406
E E 250, 280, 380

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

Chemical Plan I

Year 2	Year 3	Year 4	Year 5
Fall Term 3 CH E 243 (3-1s-0) CME 200 (1-0-0) MAT E 202 (3-0-3/2) CHEM 261 (3-0-3) ENGG 299 (1-1s-0) MATH 209 (3-0-1) English Elective (3-0-0) Complementary Studies Elective (3-0-0) **Winter Term 4** CME 265 (3-0-3) E E 239 (3-0-3/2) MATH 201 (3-0-1) ITS Elective (3-0-0) STAT 235 (3-0-2) Complementary Studies Elective (3-0-0) **Summer** WKEXP 901	**Fall** WKEXP 902 **Winter Term 5** CH E 312 (3-1s-0) CH E 343 (3-1s-0) CH E 351 (2-0-3) CH E 374 (3-1s-0) Tech Elective (3-0-0) **Summer Term 6** CH E 314 (3-1s-0) CH E 318 (3-0-2) CH E 345 (3-1s-0) CH E 358 (3-0-4) ENGG 310 (3-0-0) or ENGG 401 (3-0-0)	**Fall** WKEXP 903 **Winter Term 7** CH E 416 (3-0-2) CH E 445 (3-1s-0) CH E 446 (3-1s-3/3) CH E 464 (3-0-3) CME 481 (1-0-0) Tech Elective (3-1s-0) **Summer** WKEXP 904	**Fall** WKEXP 905 **Winter Term 8** CH E 454 (1-0-4) CH E 465 (4-0-4) CME 483 (1-0-0) ENGG 400 (1-0-0) Tech Elective (3-1s-0) Tech Elective (3-1s-0)

Note: See §84.5.1 for restrictions on the four technical electives.

Chemical Plan II

Year 2	Year 3	Year 4	Year 5
Fall Term 3 CH E 243 (3-1s-0) CHEM 261 (3-0-3) CME 200 (1-0-0) CME 265 (3-0-3) ENGG 299 (1-1s-0) English Elective (3-0-0) MATH 209 (3-0-1) Complementary Studies Elective (3-0-0) **Winter** WKEXP 901 **Summer Term 4** E E 239 (3-0-3/2) MAT E 202 (3-0-3/2) MATH 201 (3-0-1) ENGG 310 (3-0-0) or ENGG 401 (3-0-0) STAT 235 (3-0-2) Complementary Studies Elective (3-0-0)	**Fall Term 5** CH E 312 (3-1s-0) CH E 343 (3-1s-0) CH E 351 (2-0-3) CH E 374 (3-1s-0) Tech Elective (3-0-0) **Winter** WKEXP 902 **Summer** WKEXP 903	**Fall Term 6** CH E 314 (3-1s-0) CH E 318 (3-0-2) CH E 345 (3-1s-0) CH E 358 (3-0-4) ITS Elective (3-0-0) **Winter Term 7** CH E 416 (3-0-2) CH E 445 (3-1s-0) CH E 446 (3-1s-3/3) CH E 464 (3-0-3) CME 481 (1-0-0) Tech Elective (3-1s-0) **Summer** WKEXP 904	**Fall** WKEXP 905 **Winter Term 8** CH E 454 (1-0-4) CH E 465 (4-0-4) CME 483 (1-0-0) ENGG 400 (1-0-0) Tech Elective (3-1s-0) Tech Elective (3-1s-0)

Notes
(1) See §84.5.1 for restrictions on the four technical electives.
(2) Students who are interested in taking the Nanoscale Engineering, Mineral Processing and Extractive Metallurgy, or Polymer Materials Elective Streams should consult the Department for course schedules.

Chemical Plan II: Biomedical Option

Year 2	Year 3	Year 4	Year 5
Fall Term 3 BIOL 107 (3-1s-3) CH E 243 (3-1s-0) CHEM 261 (3-0-3) CME 200 (1-0-0) CME 265 (3-0-3) ENGG 299 (1-1s-0) English Elective (3-0-0) MATH 209 (3-0-1) **Winter** WKEXP 901 **Summer Term 4** E E 239 (3-1s-3/2) ENGG 310 (3-0-0) or 401 (3-0-0) MAT E 202 (3-0-3/2) MATH 201 (3-0-1) STAT 235 (3-0-2) Complementary Studies Elective (3-0-0)	**Fall Term 5** BIOCH 200, BIOL 201, or CELL 201 (3-0-0) CH E 312 (3-1s-0) CH E 343 (3-1s-0) CH E 351 (2-0-3) CH E 374 (3-1s-0) **Winter** WKEXP 902 **Summer** WKEXP 903	**Fall Term 6** BME 210 (3-0-0) CH E 314 (3-1s-0) CH E 318 (3-0-2) CH E 345 (3-1s-0) CH E 358 (3-0-4) PHIL 386 (3-0-0) **Winter Term 7** BME 211 (3-0-0) CH E 416 (3-0-2) CH E 446 (3-1s-3/3) CH E 464 (3-0-3) CME 481 (1-0-0) ITS Elective (3-0-0) **Summer** WKEXP 904	**Fall** WKEXP 906 **Winter Term 8** CH E 454 (1-0-4) CH E 465 (4-0-4) CME 483 (0-1-0) ENGG 400 (1-0-0) Technical Elective (3-1s-0) Technical Elective (3-1s-0)

Notes:
(1) Students who are interested in applying for admission into the Faculty of Medicine and Dentistry should take BIOCH 200 and another 3 units of English Elective in addition to the English Elective listed in this grid. Please consult with the Advisor for Biomedical Options in the Department of Chemical and Materials Engineering.
(2) See §84.5.1.1 for restrictions on the two technical electives.

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

Chemical: Computer Process Control

Year 2	Year 3	Year 4	Year 5
Fall Term 3 CHEM 261 (3-0-3) CME 200 (1-0-0) E E 240 (3-1s-3/2) E E 280 (3-0-3/2) ENGG 299 (1-1s-0) MAT E 202 (3-0-3/2) MATH 209 (3-0-1) Complementary Studies Elective (3-0-0) **Winter Term 4** CH E 243 (3-1s-0) CME 265 (3-0-3) MATH 201 (3-0-1) STAT 235 (3-0-2) English Elective (3-0-0) ITS Elective (3-0-0) **Summer** WKEXP 901	**Fall** WKEXP 902 **Winter Term 5** CH E 312 (3-1s-0) CH E 343 (3-1s-0) CH E 351 (2-0-3) CH E 374 (3-1s-0) CH E 446 (3-1s-3/3) Complementary Studies Elective (3-0-0) **Summer Term 6** CH E 314 (3-1s-0) CH E 318 (3-0-2) CH E 345 (3-1s-0) CH E 358 (3-0-4) ENGG 310 (3-0-0) or ENGG 401 (3-0-0)	**Fall** WKEXP 903 **Winter Term 7** CH E 416 (3-0-2) CH E 464 (3-0-3) CH E 572 (3-1s-3/3) CME 481 (1-0-0) Tech Elective (3-1s-0) Tech Elective (3-1s-0) **Summer** WKEXP 904	**Fall** WKEXP 905 **Winter Term 8** CH E 454 (1-0-4) CH E 465 (4-0-4) CH E 573 (3-0-3/2) CH E 576 (3-0-3/2) CME 483 (1-0-0) ENGG 400 (1-0-0)

Notes:
(1) MATH 201 must be taken in either Term 3 or 4.
(2) See §84.5.2 for restrictions on technical electives.

Chemical: Oil Sands Elective

Year 2	Year 3	Year 4	Year 5
Fall Term 3 CH E 243 (3-1s-0) CHEM 261 (3-0-3) CME 200 (1-0-0) CME 265 (3-0-3) ENGG 299 (1-1s-0) MATH 209 (3-0-1) English Elective (3-0-0) Complementary Studies Elective (3-0-0) **Winter** WKEXP 901 **Summer Term 4** E E 239 (3-0-3/2) MAT E 202 (3-0-3/2) MATH 201 (3-0-1) ENGG 310 (3-0-0) or ENGG 401 (3-0-0) STAT 235 (3-0-2) Complementary Studies Elective (3-0-0)	**Fall Term 5** CH E 312 (3-1s-0) CH E 343 (3-1s-0) CH E 351 (2-0-3) CH E 374 (3-1s-0) Tech Elective (3-0-0) **Winter** WKEXP 902 **Summer** WKEXP 903	**Fall Term 6** CH E 314 (3-1s-0) CH E 318 (3-0-2) CH E 345 (3-1s-0) CH E 358 (3-0-4) ITS Elective (3-0-0) **Winter Term 7** CH E 416 (3-0-2) CH E 445 (3-1s-0) CH E 446 (3-1s-3/3) CH E 464 (3-0-3) CH E 522 (3-1s-3/3) CME 481 (1-0-0) **Summer** WKEXP 904	**Fall** WKEXP 905 **Winter Term 8** CH E 435 (4-0-4) CH E 454 (1-0-4) CH E 534 (3-1s-3/3) CME 483 (1-0-0) ENGG 400 (1-0-0) Tech Elective (3-1s-0)

Note: See §84.5.3 for restrictions on the technical electives.

Civil

Year 2	Year 3	Year 4	Year 5
Fall Term 3 CIV E 265 (2-0-3) CIV E 270 (3-0-3) ENGG 299 (1-1s-0) EAS 210 (3-0-3) MAT E 202 (3-0-3/2) MATH 209 (3-0-1) **Winter Term 4** CIV E 221 (3-0-3/2) CIV E 240 (1-2s-0) CIV E 250 (3-0-3) CIV E 251 (1 week)* CIV E 290 (3-0-0) CIV E 295 (3-0-2) MATH 201 (3-0-1) *Held in Spring/Summer (Spring Term) **Summer** WKEXP 901	**Fall** WKEXP 902 **Winter Term 5** CIV E 303 (3-0-3/2) CIV E 315 (3-0-2) CIV E 321 (3-0-3/2) CIV E 330 (3-1s-0) CIV E 372 (3-2s-0) CIV E 381 (3-0-3) **Summer** WKEXP 903	**Fall Term 6** CIV E 331 (3-0-3/2) CIV E 374 (3-0-3) CIV E 391 (3-0-3) CIV E 395 (3-0-2/2) CIV E 398 (3-1s-0) English Elective (3-0-0) **Winter** WKEXP 904 **Summer** WKEXP 905	**Fall Term 7** Tech Elective (See Note) Tech Elective (See Note) Tech Elective (See Note) One of E E 239, MEC E 250 or CH E 243 Complementary Studies Elective (3-0-0) **Winter Term 8** ENGG 310 (3-0-0) or ENGG 401 (3-0-0) ENGG 400 (1-0-0) ENGG 420 (3-0-0) Tech Elective (See Note) Tech Elective (See Note) ITS Elective (3-0-0)

Note: See §84.5.4 for restrictions on the technical electives.

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

Civil: Environmental Engineering Option

Year 2

Fall Term 3
CIV E 265 (2-0-3)
CIV E 270 (3-0-3)
ENGG 299 (1-1s-0)
ENV E 220 (3-0-3/2)
EAS 210 (3-0-3)
MATH 209 (3-0-1)

Winter Term 4
CIV E 240 (1-2s-0)
CIV E 250 (3-0-3)
CIV E 251 (1 week)*
CIV E 290 (3-0-0)
CIV E 295 (3-0-2)
ENV E 222 (3-0-3/2)
MATH 201 (3-0-1)
*Held in Spring/Summer (Spring Term)

Summer
WKEXP 901

Year 3

Fall
WKEXP 902

Winter Term 5
CIV E 330 (3-1s-0)
CIV E 381 (3-0-3)
ENV E 302 (2-1s-0)
ENV E 351 (3-0-3/2)
Complementary Studies Elective (3-0-0)

Summer
WKEXP 903

Year 4

Fall Term 6
CH E 243 (3-1s-0)
CIV E 331 (3-0-3/2)
CIV E 372 (3-2s-0)
CIV E 395 (3-0-2/2)
ENV E 322 (3-0-0)
ENV E 324 (3-0-3/2)

Winter
WKEXP 904

Summer
WKEXP 905

Year 5

Fall Term 7
CIV E 374 (3-0-3)
ENV E 320 (3-0-3/2)
ENV E 323 (3-0-0)
ENV E 400 or 401 (3-0-0)*
ENV E 421 (3-0-3/2)
ENV E 432 (3-0-0)
*Both courses may not be offered every year.

Winter Term 8
ENGG 310 (3-0-0) or 401 (3-0-0)
ENGG 400 (1-0-0)
ENV E 434 (3-0-0)
ENV E 440 (3-0-3)
LAW 399 (3-0-0)
One of E E 239, MEC E 250 or MAT E 252
ITS Elective (3-0-0)

Computer

Year 2

Fall Term 3
CMPUT 114 (3-0-3)
ECE 200 (2-0-0)
E E 240 (3-1s-3/2)
E E 280 (3-0-3/2)
ENGG 299 (1-1s-0)
MATH 201 (3-0-1)
MATH 209 (3-0-1)

Winter
WKEXP 901

Summer Term 4
CMPUT 115 (3-0-3)
CMPUT 272 (3-1s-3)
E E 231 (3-0-3/2)
E E 238 (3-1s-0)
E E 250 (3-1s-3/2)
PHYS 230 (3-0-3/2)

Year 3

Fall Term 5
CMPUT 201 (3-0-3)
CMPUT 204 (3-1s-0)
E E 338 (3-1s/2-1/2)
E E 340 (3-1s-3/2)
E E 380 (3-0-3/2)
English Elective (3-0-0)

Winter
WKEXP 902

Summer
WKEXP 903

Year 4

Fall Term 6
CMPE 300 (3-0-3/2)
CMPE 401 (3-0-3/2)
CMPUT 379 (3-0-3)
E E 351 (3-1s-3/2)
Tech Elective
Complementary Studies Elective (3-0-0)

Winter Term 7
CMPE 382 (3-0-0)
CMPE 480 (3-0-3/2)
E E 387 (3-1s-0)
Tech Elective
Tech Elective
ITS Elective (3-0-0)

Summer
WKEXP 904

Year 5

Fall
WKEXP 905

Winter Term 8
CMPE 490 (1-0-6)
CMPUT 313 (3-0-3)
ENGG 310 (3-0-0) or ENGG 401 (3-0-0)
ENGG 400 (1-0-0)
Tech Elective
Tech Elective
Complementary Studies Elective (3-0-0)

Note: See §84.5.5 for restrictions on the five technical electives.

Computer: Software Option

Year 2

Fall Term 3
CMPUT 114 (3-0-3)
ECE 200 (2-0-0)
E E 240 (3-1s-3/2)
E E 280 (3-0-3/2)
ENGG 299 (1-1s-0)
MATH 201 (3-0-1)
MATH 209 (3-0-1)

Winter Term 4
CMPE 210 (3-0-3)
CMPUT 115 (3-0-3)
CMPUT 272 (3-1s-3)
E E 231 (3-0-3/2)
English Elective (3-0-0)
PHYS 230 (3-0-3/2)

Summer
WKEXP 901

Year 3

Fall Term 5
CMPE 300 (3-0-3/2)
CMPE 310 (2-0-3)
CMPUT 201 (3-1s-0)
CMPUT 204 (3-0-3)
CMPUT 291 (3-0-3)
E E 380 (3-0-3/2)

Winter
WKEXP 902

Summer
WKEXP 903

Year 4

Fall Term 6
CMPE 320 (3-0-3/2)
CMPE 401 (3-0-3/2)
CMPUT 301 (3-0-3)
CMPUT 379 (3-0-3)
STAT 235 (3-0-2)
Complementary Studies Elective (3-0-0)

Winter
WKEXP 904

Summer
WKEXP 905

Year 5

Fall Term 7
CMPE 382 (3-0-0)
CMPE 410 (2-0-3)
CMPE 420 (3-0-0)
CMPUT 313 (3-0-3)
Tech Elective
Complementary Studies Elective (3-0-0)

Winter Term 8
CMPE 440 (1-0-6)
ENGG 310 (3-0-0) or ENGG 401 (3-0-0)
ENGG 400 (1-0-0)
Tech Elective
Tech Elective
Tech Elective
ITS Elective (3-0-0)

Note: See §84.5.5 for restrictions on the four technical electives.

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

Electrical

Year 2	Year 3	Year 4	Year 5
Fall Term 3 ECE 200 (2-0-0) E E 240 (3-1s-3/2) E E 280 (3-0-3/2) ENGG 299 (1-1s-0) MATH 201 (3-0-1) MATH 209 (3-0-1) MEC E 250 (3-1s-0) **Winter Term 4** CH E 243 (3-1s-0) E E 231 (3-0-3/2) E E 238 (3-1s-0) E E 250 (3-1s-3/2) PHYS 230 (3-0-3/2) English Elective (3-0-0) **Summer** WKEXP 901	**Fall Term 5** E E 315 (3-1s-0) E E 330 (3-0-0) E E 338 (3-1s/2-1/2) E E 340 (3-1s-3/2) E E 380 (3-0-3/2) MATH 309 (3-0-0) **Winter** WKEXP 902 **Summer** WKEXP 903	**Fall Term 6** E E 350 (3-1s-3/2) E E 351 (3-1s-3/2) E E 390 (3-0-3/2) E E 400 (1-0-3) Tech Elective Complementary Studies Elective (3-0-0) **Winter Term 7** E E 332 (3-0-3/2) E E 357 (3-0-3/2) E E 387 (3-1s-0) E E 401 (1-0-3) Complementary Studies Elective (3-0-0) Tech Elective **Summer** WKEXP 904	**Fall** WKEXP 905 **Winter Term 8** ENGG 310 (3-0-0) or ENGG 401 (3-0-0) ENGG 400 (1-0-0) Tech Elective Tech Elective Tech Elective Tech Elective ITS Elective (3-0-0)

Note: See §84.5.6 for restrictions on the six technical electives.

Materials

Year 2	Year 3	Year 4	Year 5
Fall Term 3 CH E 243 (3-1s-0) CHEM 261 (3-0-3) CME 200 (1-0-0) ENGG 299 (1-1s-0) MAT E 202 (3-0-3/2) MATH 209 (3-0-1) STAT 235 (3-0-2) English Elective (3-0-0) **Winter Term 4** CIV E 270 (3-0-3) CME 265 (3-0-3) ENGG 310 (3-0-0) or ENGG 401 MATH 201 (3-0-1) MAT E 211 (3-1s-3/4) MAT E 221 (3-1s-0) **Summer** WKEXP 901	**Fall Term 5** CH E 312 (3-1s-0) CH E 374 (3-1s-0) MAT E 335 (3-1s-0) MAT E 340 (3-0-0) MAT E 361 (1-1-3/2) **Winter** WKEXP 902 **Summer** WKEXP 903	**Fall Term 6** CH E 314 (3-1s-0) CME 481 (1-0-0) MAT E 464 (3-0-3) Tech Elective (3-1s-0) Tech Elective (3-0-0) Tech Elective (3-0-0) **Winter Term 7** Complementary Studies Elective (3-0-0) MAT E 341 (3-1s-0) MAT E 336 (3-1s-0) MAT E 351 (3-1s-0) MAT E 362 (1-1-3/2) **Summer** WKEXP 904	**Fall** WKEXP 905 **Winter Term 8** CME 483 (1-0-0) ENGG 400 (1-0-0) MAT E 461 (1-1-4) MAT E 465 (2-1s-3) ITS Elective (3-0-0) Tech Elective (3-0-0) Tech Elective (3-0-0)

Note:
(1) See §84.5.8 for restrictions on the five technical electives.
(2) Students who are in or are interested in Structural Materials, Mineral Processing and Extractive Metallurgy, Polymer Materials, or Nano and Functional Materials Elective Streams should consult the Department for course schedules.

Materials: Biomedical Option

Year 2	Year 3	Year 4	Year 5
Fall Term 3 BIOL 107 (3-1-3) CH E 243 (3-1s-0) CHEM 261 (3-0-3) CME 200 (1-0-0) ENGG 299 (1-1s-0) MAT E 202 (3-0-3/2) MATH 209 (3-0-1) STAT 235 (3-0-2) **Winter Term 4** CIV E 270 (3-0-3) CME 265 (3-0-3) MATH 201 (3-0-1) MAT E 211 (3-1s-3/4) MAT E 221 (3-1s-0) English Elective (3-0-0) **Summer** WKEXP 901	**Fall Term 5** BIOCH 200, or BIOL 201, or CELL 201 (3-0-0) CH E 312 (3-1s-0) MAT E 335 (3-1s-0) MAT E 340 (3-0-0) MAT E 361 (1-1-3/2) **Winter** WKEXP 902 **Summer** WKEXP 903	**Fall Term 6** BME 210 (3-0-0) CH E 314 (3-1s-0) CH E 374 (3-1s-0) CME 481 (1-0-0) ENGG 310 (3-0-0) or ENGG 401 (3-0-0) MAT E 464 (3-0-3) **Winter Term 7** MAT E 341 (3-1s-0) MAT E 336 (3-1s-0) MAT E 351 (3-1s-0) MAT E 362 (1-1-3/2) PHIL 386 (3-0-0) **Summer** WKEXP 904	**Fall** WKEXP 906 **Winter Term 8** BME 211 (3-0-0) CH E 582 (3-1s-0) or MAT E 458 (3-1-0) CME 483 (1-0-0) ENGG 400 (1-0-0) MAT E 461 (1-1-4) MAT E 465 (2-1s-3) ITS Elective (3-0-0)

Note: Students who are interested in applying for admission into the Faculty of Medicine and Dentistry should take BIOCH 200 and another 3 units of English Elective in addition to the English Elective listed in this grid. Please consult with the Advisor for Biomedical Options in the Department of Chemical and Materials Engineering.

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

Mechanical Plan I

Year 2	Year 3	Year 4	Year 5
Fall Term 3 CH E 243 (3-1s-0) CIV E 270 (3-0-3) ENGG 299 (1-1s-0) MATH 209 (3-0-1) MEC E 200 (0-2-0) MEC E 250 (3-1s-0) PHYS 230 (3-0-3/2) **Winter Term 4** E E 239 (3-0-3/2) MATH 201 (3-0-1) MAT E 252 (3-0-3/2) MEC E 260 (2-0-3) MEC E 265 (2-0-3) STAT 235 (3-0-2) **Summer** WKEXP 901	**Fall** WKEXP 902 **Winter Term 5** **Course Group 3A** 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 370 (3-1s-0) MEC E 380 (3-0-0) **or** **Course Group 3B** ENGG 310 (3-0-0) or 401 (3-0-0) English Elective (3-0-0) MEC E 340 (3-0-0) MEC E 360 (3-0-3/2) MEC E 362 (3-0-3/2) MEC E 390 (3-0-1) **Summer** WKEXP 903	**Fall Term 6** **Course Group 3A** MATH 300 (3-0-0) MEC E 300 (3-1-0) MEC E 301 (1-0-3) MEC E 330 (3-0-1) MEC E 370 (3-1s-0) MEC E 380 (3-1-0) **or** **Course Group 3B** ENGG 310 (3-0-0) or 401 (3-0-0) English Elective (3-0-0) MEC E 340 (3-0-0) MEC E 360 (3-0-3/2) MEC E 362 (3-0-3/2) MEC E 390 (3-0-1) **Winter** WKEXP 904 **Summer** WKEXP 905	**Fall Term 7** Tech Elective (3-0-0) Tech Elective (3-0-0) **Course Group 4A** MEC E 430 (3-0-0) or 480 (3-0-0) MEC E 463 (3-0-2) Tech Elective (3-0-0) Complementary Studies Elective (3-0-0) **or** **Course Group 4B** MEC E 403 (1-0-3) MEC E 460 (1-0-4) MEC E 451 (3-0-1) ITS Elective (3-0-0) **Winter Term 8** ENGG 400 (1-0-0) CH E 448 (3-1s-3/3) or E E 462 (3-0-3/2) or MEC E 420 (3-0-3/2) Tech Elective (3-0-0) **Course Group 4A** MEC E 430 (3-0-0) or 480 (3-0-0) MEC E 463 (3-0-2) Tech Elective (3-0-0) Complementary Studies Elective (3-0-0) **or** **Course Group 4B** MEC E 403 (1-0-3) MEC E 460 (1-0-4) MEC E 451 (3-0-1) ITS Elective (3-0-0)

Notes:
(1) See §84.5.9 for restrictions on the four technical electives.
(2) In Years 3,4, and 5, students take either (Group A in Fall, Group B in Winter) or (Group B in Fall, Group A in Winter).

Mechanical Plan II

Year 2	Year 3	Year 4	Year 5
Fall Term 3 CIV E 270 (3-0-3) ENGG 299 (1-1s-0) MATH 209 (3-0-1) MEC E 260 (2-0-3) MEC E 265 (2-0-3) PHYS 230 (3-0-3/2) **Winter** WKEXP 901 **Summer Term 4** CH E 243 (3-1s-0) E E 239 (3-0-3/2) MATH 201 (3-0-1) MAT E 252 (3-0-3/2) MEC E 200 (0-2-0) MEC E 250 (3-1s-0) STAT 235 (3-0-2)	**Fall Term 5** **Course Group 3A** 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 370 (3-1s-0) MEC E 380 (3-0-0) **Winter** WKEXP 902 **Summer** WKEXP 903	**Fall Term 6** **Course Group 3B** ENGG 310 (3-0-0) or 401 (3-0-0) English Elective (3-0-0) MEC E 340 (3-0-0) MEC E 360 (3-0-3/2) MEC E 362 (3-0-3/2) MEC E 390 (3-0-1) **Winter** WKEXP 904 **Summer** WKEXP 905	**Fall Term 7** Tech Elective (3-0-0) Tech Elective (3-0-0) **Course Group 4A** MEC E 430 (3-0-0) or 480 (3-0-0) MEC E 463 (3-0-2) Tech Elective (3-0-0) Complementary Studies Elective (3-0-0) **or** **Course Group 4B** MEC E 403 (1-0-3) MEC E 451 (3-0-1) MEC E 460 (1-0-4) ITS Elective (3-0-0) **Winter Term 8** ENGG 400 (1-0-0) CH E 448 (3-1s-3/3) or E E 462 (3-0-3/2) or MEC E 420 (3-0-3/2) Tech Elective (3-0-0) **Course Group 4A** MEC E 430 (3-0-0) or 480 (3-0-0) MEC E 463 (3-0-2) Tech Elective (3-0-0) Complementary Studies Elective (3-0-0) **or** **Course Group 4B** MEC E 403 (1-0-3) MEC E 451 (3-0-1) MEC E 460 (1-0-4) ITS Elective (3-0-0)

Notes:
(1) See §84.5.9 for restrictions on the four technical electives.
(2) In Year 5, students take either (Group A in Fall, Group B in Winter) or (Group B in Fall, Group A in Winter).

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

Mechanical Plan III : Biomedical Option

Year 2

Fall Term 3
CIV E 270 (3-0-3)
ENGG 299 (1-1s-0)
MATH 209 (3-0-1)
PHYS 230 (3-0-3/2)

Course Group 2A
CH E 243 (3-1s-0)
MEC E 200 (0-2s-0)
MEC E 250 (3-1s-0)

or

Course Group 2B
MEC E 260 (2-0-3)
MEC E 265 (2-0-3)

Winter Term 4
E E 239 (3-0-3/2)
MATH 201 (3-0-1)
MAT E 202 (3-0-3/2)
STAT 235 (3-0-2)

Course Group 2B
MEC E 260 (2-0-3)
MEC E 265 (2-0-3)

or

Course Group 2A
CH E 243 (3-1s-0)
MEC E 200 (0-2s-0)
MEC E 250 (3-1s-0)

Summer
WKEXP 902

Year 3

Fall Term 5
BME 210 (3-0-0)
MEC E 340 (3-0-0)
MEC E 360 (3-0-3/2)
MEC E 362 (3-0-3/2)
MEC E 390 (3-0-1)
STAT 337 (3-0-2)

Winter Term 6
BME 211 (3-0-0)
MATH 300 (3-0-0)
MEC E 300 (3-0-0)
MEC E 301 (1-0-3)
MEC E 330 (3-0-1)
MEC E 380 (3-0-0)

Summer
WKEXP 903

Year 4

Fall Term 7
Complementary Studies Elective (3-0-0)
ENGG 310 or 401 (3-0-0)
English Elective (3-0-0)
INT D 570 (3-0-0)
MEC E 370 (3-1-0)
MEC E 563/568 (3-0-3)

Winter
WKEXP 906

Summer
WKEXP 904

Year 5

Fall Term 8
Tech Elective (3-0-0)
ITS Elective (3-0-0)

Course Group 4A
MEC E 430 (3-0-0)
MEC E 463 (3-0-2)
Tech Elective (3-0-0)

or

Course Group 4B
MEC E 403 (1-0-3)
MEC E 451 (3-0-1)
MEC E 460 (2-0-6)

Winter Term 9
CH E 448 (3-1s-3/3) or E E 462 (3-0-3/2) or MEC E 420 (3-0-3/2)
ENGG 400 (1-0-0)
MEC E 585 (3-0-0)
Tech Elective (3-0-0)

Course Group 4B
MEC E 403 (1-0-3)
MEC E 451 (3-0-1)
MEC E 460 (2-0-6)

or

Course Group 4A
MEC E 480 (3-0-0)
MEC E 463 (3-0-2)
Tech Elective (3-0-0)

Notes:
(1) See §84.5.9.1 for restrictions on the technical electives.
(2) In Year 2 and Year 5, students take either (Group A in Fall and Group B in Winter) or (Group B in Fall and Group A in Winter)
(3) The order of WKEXP 904 and 906 may be switched. See the program advisor.
(4) Fall Term 8 and WKEXP 906 as indicated may be switched. See the program advisor.
(5) Students wishing to apply for admission to the Faculty of Medicine and Dentistry should see §84.5.9.1 and also consult the program advisor.

Mining

Year 2

Fall Term 3
CIV E 265 (2-0-3)
EAS 210 (3-0-3)
E E 239 (3-0-3/2)
ENGG 299 (1-1s-0)
MATH 209 (3-0-1)
MIN E 295 (3-0-3/2)
STAT 235 (3-0-2)

Winter Term 4
CH E 243 (3-1s-0)
CIV E 250 (3-0-3)
CIV E 251 (1 week)*
CIV E 270 (3-0-3)
MATH 201 (3-0-1)
MIN E 310 (3-0-3)
ITS Elective (3-0-0)

Summer
WKEXP 901
*Held in Spring/Summer (Spring Term)

Year 3

Fall
WKEXP 902

Winter Term 5
CIV E 381 (3-0-3)
MIN E 324 (3-0-0)
MIN E 330 (3-3/2s-0)
English Elective (3-0-0)
Elective (3-0-0) (See §84.5.10)

Summer
WKEXP 903

Year 4

Fall Term 6
CIV E 330 (3-1s-0)
CME 421 (3-0-3/2)
ENGG 310 (3-0-0) or ENGG 401 (3-0-0)
MIN E 323 (3-0-3)
MIN E 325 (3-0-3)
MIN E 428 (0-4s-0)**

Winter
WKEXP 904

Summer
WKEXP 905
**Held prior to start of Terms 6 or 7.

Year 5

Fall Term 7
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 (0-4s-0)
Complementary Studies Elective (3-0-0)
Elective (3-0-0) (See §84.5.10)

Winter Term 8
ENGG 400 (1-0-0)
ENV E 302 (2-1s-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)

Petroleum

Year 2

Fall Term 3
CH E 243 (3-1s-0)
EAS 210 (3-0-3)
E E 239 (3-0-3/2)
ENGG 299 (1-1s-0)
MAT E 202 (3-0-3/2)
MATH 209 (3-0-1)
English Elective (3-0-0)

Winter Term 4
CH E 312 (3-1s-0)
CIV E 270 (3-0-3)
MATH 201 (3-0-1)
PET E 295 (3-0-3/2)
STAT 235 (3-0-2)
Complementary Studies (3-0-0)

Summer
WKEXP 901

Year 3

Fall
WKEXP 902

Winter Term 5
CH E 374 (3-1s-0)
EAS 222 (3-0-3)
PET E 366 (3-0-0)
PET E 367 (1-0-3/2)
PET E 368 (3-0-3/2)
Elective (3-0-0) (See §84.5.11)

Summer
WKEXP 903

Year 4

Fall Term 6
CHEM 371 (3-0-3)
ENGG 310 (3-0-0) or 401 (3-0-0)
PET E 362 (3-0-3/2)
PET E 364 (3-1s-0)
PET E 365 (3-1s-0)
Elective (3-0-0) (See §84.5.11)

Winter
WKEXP 904

Summer
WKEXP 905

Year 5

Fall Term 7
CH E 314 (3-1s-0)
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)

Winter Term 8
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)
ITS Elective (3-0-0)
Elective (3-0-0) (See §84.5.11)

ENV E 302
MAT E 211, 221, 335, 336, 341, 345, 351, 458, 471, 473, 474, 491, 494
MEC E 250, 443, 513
MIN E 310
PET E 364, 365, 366, 368, 470, 473, 475

(3) No more than one single-term technical elective may be selected from the following approved list:
BIOCH 200
BIOL 201, 208, 381
BOT 240
CELL 201
CHEM 211, 213, 303, 333, 479, 495
CMPE 402
EAS 201, 209
ENCS 455, 475
FOREN 355
MATH 225, 241, 300, 309, 311, 337, 373, 374
MGTSC 352, 404, 405, 422, 426
MICRB 265, 311, 316
SOILS 210, 430, 440, 450

Note: Credit will be granted in only one of MATH 373, MGTSC 352, CH E 555, MEC 513, or CIV E 592.

Students may also take other courses not listed here as technical electives but in this case written permission from the Department is required.

(4) Nanoscale Engineering Elective Stream

One of the four technical electives should be MAT E 211. The remaining three technical electives can be selected from CH E 487, 583, 584 and MAT E 458.

Students interested in this elective stream should consult the Department for a course schedule.

(5) Mineral Processing and Extractive Metallurgy Elective Stream

Three of the four technical electives should be CME 421, 422 and 472. The fourth technical elective can be selected from the above lists (1), (2) and (3), and must be approved by the Department.

Students interested in this elective stream should consult the Department for a course schedule.

(6) Polymer Materials Elective Stream

Three of the four technical electives should be CME 482, 484 and 485. The fourth technical elective can be selected from the above lists (1), (2) and (3), and must be approved by the Department.

Students interested in this elective stream should consult the Department for a course schedule.

84.5.1.1 Chemical: Biomedical Option

The two single-term technical electives must be selected from the following: CH E 484, CH E 582 and MAT E 458.

84.5.2 Chemical: Computer Process Control Option

The two single-term technical electives can be selected from lists (1), (2) and (3) in §84.5.1 in consultation with the Department. At least one of these electives must be Engineering Science and/or Engineering Design.

84.5.3 Chemical: Oil Sands Elective

The two single-term technical electives can be selected from lists (1), (2) and (3) in §84.5.1 in consultation with the Department. At least one of these electives must be Engineering Science and/or Engineering Design.

84.5.4 Civil

Five technical electives are required from (1) and (2). Three must be selected from (1) and two from (2).

(1) CIV E 406, 431, 474, 481 and ENV E 421

(2) CIV E 409, 429, 439, 479, 489

84.5.4.1 Civil: Biomedical Engineering Option

Five technical electives are required from groups (1), (2), (3) and (4). One elective must be selected from (1), one elective from (2), one elective from (3) and two electives from (4).

(1) CIV E 431, 474, 481 and ENV E 421

(2) CIV E 429, 439, 479 and 489

(3) BIOL 207, BME 310, BME 513, BME 530, CHEM 263, E E 238

(4) BME 553, CH E 484, CH E 582, E E 338, MAT E 458, MEC E 563, 585

Students who are interested in applying for admission to the Faculty of Medicine and Dentistry should take BIOL 207, CHEM 263 as technical electives and another ★3 of English elective as one of their Complimentary Studies Electives.

84.5.5 Computer

Of the five single-term technical electives, two electives must be from CH E 243, MAT E 353 and MEC E 250. The three remaining technical electives must be selected from the list below, of which at least one must be a CMPUT course.

Complete list of Computer Engineering approved Technical Electives:
CMPE 420, 449, 498, 499
CMPUT 291, 304, 325, 366, 391, 411, 414, 415, 422, 425, 466, 474
E E 317, 350, 390, 404, 441, 451, 452, 453, 459, 462, 488, 489
EE BE 512, 540

Other courses, including 500-level graduate EC E courses, may be taken with Departmental approval.

84.5.5.1 Computer Engineering: Software Option

Of the four single-term technical electives, two electives must be from CH E 243, MAT E 353 and MEC E 250. The remaining two technical electives must be selected from the list below.

Complete list of Computer Engineering (Software Option) approved Technical Electives:
CMPE 449, 498, 499
CMPUT 304, 325, 366, 391, 410, 411, 414, 415, 422, 425, 466, 474
E E 238, 317, 338, 390, 404, 441, 462, 488, 489
EE BE 512, 540

Other courses, including 500-level graduate ECE courses, may be taken with Departmental approval.

84.5.6 Electrical

Of the six single-term technical electives, at least one must be from E E 323, 404, 430, 452, 456, 459, 472, 473, 474, 486, 489, 498 or 499 and at least two must be from E E 431, 432, 433, 441, 451, 453, 457, 460, 461, 470, 471, 485 and EE BE 540.

The other technical electives are normally chosen from the following list of approved courses:
BME 513, 553, 564
CMPE 402, 449, 480, 487, 490
EE BE 512

Other courses, including 500-level graduate ECE courses, may be taken with Departmental approval.

Recommendations regarding selection of technical electives in various areas of study in electrical engineering are available from the Department.

84.5.6.1 Electrical (Biomedical Option)

The four technical electives must be chosen from the following list. At least one must be an E E course with a lab component.
BIOCH 200
BME 513, 553, 564
CHEM 261,263
E E 351, 390, 441, 459, 460, 461, 470, 471

To be eligible for admission to the MD program, students should choose BIOCH 200, CHEM 261 and 263 as technical electives and a second English elective as one of their Complementary Studies Electives.

84.5.7 Engineering Physics

Of the five technical electives at least one must be from EE 332, 380, 390. The other technical electives are normally chosen from the following approved list of courses:
CMPE 402, 480
E E 431, 432, 441, 451, 452, 453, 457, 459, 461, 470, 472, 473, 474, 488, 489
EE BE 512, 540

In each case, approval of the Department must be obtained in order to ensure that the electives chosen from this list include at least 9.2 units of Engineering Science and Design. Other courses, including graduate level ECE courses, may be taken with Departmental approval.

84.5.7.1 Engineering Physics (Nanoengineering Option)

The technical elective must be chosen from the following list. Other electives may be substituted with the written permission of the Department.
E E 351, 452, 470, 472, 474, MAT E 458

84.5.8 Materials

(1) Students in the general Materials Engineering program are required to take five technical electives from the following list of courses. At least three of the five must be CME and/or MAT E courses.
BIOCH 200
BIOL 107, 201
BME 210, 211, 310, 541
CELL 201
CME 421, 422, 472, 482, 484, 485
CH E 343, 446, 482, 484, 485, 582
CHEM 211, 213, 263, 303, 311, 333, 371, 373
CIV E 221, 321, 372, 374, 421
CMPE 402
EAS 210, 224, 320
E E 239, 452, 457, 459
ENGG 404, 406
ENG M 514
ENV E 351
GEOPH 223
MAT E 345, 454, 456, 468, 469, 470, 471, 473, 474, 491, 494
MATH 300
MEC E 250, 260, 360, 380, 513, 514, 543
MGTSC 352, 404, 405, 422, 426
MIS 311
PHYS 230, 264, 271
STAT 265, 335, 368, 378
Other courses that are not listed may be taken as technical electives, but departmental approval must be obtained first.

(2) Mineral Processing and Extractive Metallurgy Elective Stream
Three of the five technical electives should be CME 421, 422 and 472. Of the remaining two technical electives, one should be either CH E 446 or MAT E 470, and the other can be selected from the above list.
Students interested in this elective stream should consult the Department for a course schedule.

(3) Nano and Functional Materials Elective Stream
Three of the five technical electives should be either E E 457 or 459, MAT E 491 and MAT E 494. The remaining two technical electives can be selected from the above list.
Students interested in this elective stream should consult the Department for a course schedule.

(4) Polymer Materials Elective Stream
Four of the five technical electives should be CH E 345, CME 482, 484 and 485. The fifth technical elective can be selected from the above list.
Students interested in this elective stream should consult the Department for a course schedule.

(5) Structural Materials Elective Stream
Four of the five technical electives should be CME 472, MAT E 470, 473 and 474. The fifth technical elective can be selected from the above list.
Students interested in this elective stream should consult the Department for a course schedule.

84.5.9 Mechanical

(1) One technical elective must be chosen from the following:
MEC E 563, 564, or 568

(2) The remaining three technical electives must be chosen from the following:
ACCTG 300
B LAW 301
BME 210, 211, 310, 513, 530, 553
CH E 582
CMPE 402, 449
EE BE 512, 540
ENGG 404, 406, 420
ENG M 514 or E E 404
FIN 301
MARK 301
MATH 311
MAT E 345
MEC E 364, 409, 430, 439, 443, 469, 480, 494/495, 512, 513, 520, 537, 539, 541, 551, 553, 563, 564, 565, 567, 568, 569, 583, 585
MGTSC 352
PET E 362, 364, 365, 366, 444, 465, 473
SMO 301, 321
Other courses, including graduate-level MEC E courses, may be taken with Department approval. Technical elective courses (including transfer courses) must be at 300-level or above unless cleared in advance by the Department or specified for particular streams.

(3) Biomedical Engineering Elective Stream
Students wishing to specialize in the area of biomedical engineering should choose their three technical electives from the following courses: BME 210, 211, 310, 513, 530, 553, EE BE 512, 540, MEC E 409, 469, 585. In particular BME 210, 211, and MEC E 585 are especially recommended.
Note: Some of these courses may not be offered every year. See department for details.

(4) Business and Management Elective Stream
Students wishing to obtain an introduction to business and management principles should take ENGG 401 instead of ENGG 310, ENGG 405 as their ITS elective, and ECON 204 as their complementary studies elective in Term 8. In addition, they can choose their technical electives from the following:

a. **Within the Faculty of Engineering:** CIV E 592, E E 404, ENGG 402, 420, MEC E 513, ENG M 514, 530. Note that some of these courses may not be offered every year. See department for details.
b. **Within the Faculty of Business:** ACCTG 300, B LAW 301, FIN 301, MARK 301, MGTSC 352, SMO 301, 321. Note that admission to FIN 301, MARK 301, SMO 301, 321 is preferentially reserved for students within that Faculty, and is available to engineering students only on a space-available basis.

Credit will only be given for one of E E 404 and MEC E 514, and for one of CIV E 592 and MGTSC 352.
Specific selection of electives should reflect the student's specific interests and needs.

(5) Aerospace Engineering Elective Stream
Students wishing to specialize in the area of aerospace engineering should choose their three technical electives from the following courses: MEC E 439, 514, 520, 537, 539, 541, 569.

84.5.9.1 Mechanical (Biomedical Option)

(1) The three technical electives must be chosen from the following:
BIOCH 200
BIOL 107, 108
BME 310, 513, 530, 553
CH E 582
CHEM 261, 263
EE BE 512
MEC E 409/469, 539, 551, 563/568

(2) For students wishing to qualify for application to the Faculty of Medicine and Dentistry, the following technical elective courses are required (this requires two courses in addition to those in the normal biomedical option program):
BIOL 107, 108
BIOCH 200
CHEM 261, 263

In addition, students must complete ★6 of English. This means that for the normal program in addition to ENGL 1XX, the second complementary studies course must be an English course.

84.5.10 Mining

The two technical electives should be chosen from the following:
CH E 374
CIV E 221, 303, 321, 331, 391, 431, 481
CMPE 402
EAS 205, 224, 233, 321, 424, 433
ECON 355, 365, 366
ENGG 406
ENG M 514
FIN 301, 422
GEOPH 223, 224
MAT E 533
MEC E 513
MGTSC 352, 422, 426
SMO 402

Note: That some of these courses may have prerequisites. Other courses may be taken with Department approval.

84.5.11 Petroleum

The three technical electives should be chosen from the following:
ACCTG 300
B LAW 301
CH E 343, 522
CME 265
EAS 204, 205, 323, 424
ECON 355, 365, 366
E E 323
ENGG 406, 420
FIN 301, 422
GEOPH 224, 326
MAT E 345
MATH 253, 300, 311, 337, 436, 438
MGTSC 352, 422, 426
PET E 470
SMO 321, 402, 404, 412
STAT 361, 368

Credit will only be given for one of B LAW 301 and ENGG 420, and for one of EAS 204 and EAS 205. ACCTG 300 and B LAW 301 can be used as either a technical or complementary elective.

Note: That some of these courses may have prerequisites. Other courses may be taken with Department approval.

84.6 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 §82.13), Canadien-Français, Christian Theology, Classics, Comparative Literature, Economics, Engineering (ENGG 401, 402, 403, 405 and 420 only), English, Etudes de Religion, 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. Courses outside Business and Engineering must also include a 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.

Foreign-language courses may not be taken by qualifying year students. Under certain circumstances language courses may be taken by students after their qualifying 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.

Consult with your Department for a list of suggested courses.

84.6.1 Impact of Technology on Society (ITS) Elective

A specific requirement of the Canadian Engineering Accreditation Board is study of the impact of technology on society. To meet this requirement, students must take one of the following: ENGG 403, ENGG 405, HIST 391, STS 200, SOC 366 or SOC 363.

84.6.2 English Electives

Most engineering programs require a single-term (3-0-0) English course. ENGL 104, 105 and 199 are acceptable. Two-term ENGL 101 will be accepted as the English Elective plus an additional Complementary Studies Elective. Other English courses may be accepted with the approval of the Department or Faculty for qualifying year students.

85 Courses

85.1 Course Listings

Faculty of Engineering courses are listed in §231, Course Listings, under the following subject headings:

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

85.2 Registration in Engineering Courses by Students in Other Faculties

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.