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## Faculty of Engineering

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## The Faculty of Engineering

Engineers are designers, creators, inventors, thinkers and dreamers. They are responsible for anticipating and providing for the changing needs of society. They are creative problem solvers who help turn ideas into reality while making our world a better place.

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. As a graduate, you may register with a professional engineering association, and following a period of recognized work experience, practice engineering around the world. Our graduates include:

- Lorenzo Donadeo (co-founder, CEO and director of Vermilion Energy Inc.)
- Bryan Erb (lead engineer NASA Apollo Program - Heat Shields)
- Louis Grimble (co-founder of engineering giant Stantec)
- Douglas Hamilton (former NASA Flight Surgeon)
- Garry Lindberg (lead Engineer on the Canadarm Project)
- Gwyn Morgan (founder of EnCana Corp)
- Frederick W. Pheasey (co-founded Dresco Energy Services ULC, Chairman, Executive Vice President of National Oilwell Varco Incorporated)
- John Poole (co-chairman PCL Construction)
- Ray Rajotte (member of the Edmonton Protocol Diabetes Treatment research group)
- Lubomyr Romankiw (IBM researcher who invented modern computer memory technology)
- Anne Marie Toutant (Vice President Mining Operation Suncor Energy)

Our recent graduates include:

- Graham Buksa (founder Rayne Longboards)
- Casey Hudson (producer Mass Effect and Knights of the Old Republic video game franchises)
- Michael Sikorsky (founder Robots and Pencils)
- Benjamin Sparrow (founder and CEO of Saltworks Technology)
- Andrew Usenik (former lead singer 10 Second Epic)

Our Faculty is focused on providing students with the best education possible. Our professors encourage passion and creativity while instilling in students a sense of resilience and responsibility. Innovative teaching methods are encouraged and this is reflected in the fact that during the last 10 years, our professors have won five APEGA awards for Excellence in Education, three Engineers Canada Medals for Distinction in Engineering Education, seven U of A Rutherford Teaching Awards for Excellence in Undergraduate Teaching and four U of A Provost's Awards for Early Achievement of Excellence in Undergraduate Teaching.

Our students are part of a creative, vibrant campus community. They have opportunities to discover and pursue their passions through classes and extracurricular activities such as our Dean's Research Awards program. Many of our students choose to participate in our Co-operative Education Program, which integrates 20 months of paid engineering work experience into a five-year engineering degree. Opportunities abound both inside and outside the classroom for students to further develop their technical and leadership skills. By getting involved with extracurricular projects and clubs, students develop their professional and technical abilities but and build friendships and connections that will last a lifetime.

## The Professors

### Members of the Faculty

#### Officers of the Faculty

##### Professor and Dean

JF Forbes, PhD, PEng

##### Associate Deans

A Ulrich, PhD, PEng

J Carey, PhD, PEng

T Joseph, PhD, PEng

DW Raboud, PhD, PEng

YY Tsui, PhD, PEng

##### Faculty Service Officer

E Flaim, PhD

**Administrative Officers**

K Amrhein, BA, MA  
A Anthony, CPA, CGA  
V Belisle, PEng  
R Cairney  
L Currie, CPA-CGA, PhD  
T Dance, BA  
K Edwards, BA, BEd, MEd  
K Franklin  
J Lewyk  
B MacMillan, BBA  
K Maher, MSc  
R Matthias, BA  
K Shelley, MEd  
B Woronuk, BCom  
I Young, BEd

**Biomedical Engineering****Professor and Chair**

R Burrell, PhD (Canada Research Chair in Nanostructured Biomaterials)

**Professors Emeriti**

PS Allen, PhD  
DJ Griffiths, PhD  
TR Overton, PhD  
RE Snyder, PhD

**Professors**

C Beaulieu, PhD  
MA Gorassini, PhD  
AH Wilman, PhD

**Associate Professors**

N Malykhin, PhD  
RB Thompson, PhD

**Faculty Service Officer**

C Hanstock, PhD

**Chemical and Materials Engineering****Professor and Interim Chair**

K Cadien, PhD, PEng (Canada Research Chair in Nanofabrication and Ingenuity Scholar in Nanofabrication)

**University Professor Emeritus**

JH Masliyah, OC, PhD, PEng, FRSC, FCAE

**Professors Emeriti**

KT Chuang, PhD

IG Dalla Lana, PhD, PEng

RL Eadie, PhD, PEng

DG Fisher, PhD, PEng

MR Gray, PhD, PEng, FCAE

AE Mather, PhD, PEng

K Nandakumar, PhD, PEng, FCAE

FD Otto, PhD, PEng, FCAE

BM Patchett, PhD, PEng

KC Porteous, PhD, PEng

SL Shah, PhD, PEng

SE Wanke, PhD, PEng

ML Wayman, PhD, PEng

MC Williams, PhD

RK Wood, PhD, PEng

**Professors**

R Burrell, PhD (Canada Research Chair in Nanostructured Biomaterials)

K Cadien, PhD, PEng (Canada Research Chair in Nanofabrication and Ingenuity Scholar in Nanofabrication)

W Chen, PhD, PEng

PYK Choi, PhD, PEng

J Cocchio, MBA, PEng (Industrial Professor of Engineering Safety and Risk Management)

A de Klerk, PhD, PEng

JAW Elliott, PhD, PEng (Canada Research Chair in Interfacial Thermodynamics)

TH Etsell, PhD, PEng

JF Forbes, PhD, PEng

R Gupta, PhD, PEng

RE Hayes, PhD, PEng

H Henein, PhD, PEng, FCAE, FCIM

B Huang, PhD, PEng (NSERC Senior Industrial Research Chair in Control of Oil Sands Processes)

DG Ivey, PhD, PEng

M Jamieson, PhD (Industrial Professor of Chemical Process Design)

D-Y Li, PhD, PEng

L Li, PhD, PEng  
Qi Liu, PhD, PEng (Ron Nolan/Hatch Professor in Sustainable Energy and Mineral Process Technologies)  
Qingxia Liu, PhD, PEng  
J Luo, PhD, PEng (Canada Research Chair in Alternative Fuel Cells)  
DT Lynch, PhD, PEng, FCAE  
R Macciotta Pulisci, PhD (Industrial Professor of Engineering Safety & Risk Management)  
WC McCaffrey, PhD, PEng  
P Mendez, PhD, PEng (Welco-Beales/Industry Chair in Welding and Joining)  
R Narain, PhD, PEng  
P Nikrityuk, PhD, PEng  
J Nychka, PhD, PEng  
V Prasad, PhD, PEng  
A Rajendran, PhD, PEng  
S Sanders, PhD, PEng (NSERC Associate Industrial Research Chair in Pipeline Transport Processes)  
N Semagina, PhD, PEng  
JM Shaw, PhD, PEng (NSERC/Petroleum Industry Senior Industrial Research Chair in Petroleum Thermodynamics)  
J Soares, PhD, PEng, FCIC (Canada Research Chair in Advanced Polymer Reaction Engineering and Campus Alberta Innovates Program Chair in Interfacial Polymer Engineering for Oilsands Processing)  
T Thundat, PhD (Canada Excellence Research Chair in Oil Sands Molecular Engineering)  
H Uludag, PhD, PEng  
L White, PhD, PEng (Industrial Professor of Engineering Safety & Risk Management)  
G Winkel, PEng (Industrial Professor of Safety & Risk Management)  
Z Xu, PhD, PEng, FCAE (Teck Cominco Professor, NSERC/Oilsands Industry Senior Industrial Research Chair in Oil Sands Engineering and Canada Research Chair in Mineral Processing)  
L Unsworth, PhD, PEng  
A Yeung, PhD, PEng (NSERC/Imperial Oil Associate Industrial Research Chair in Non-Aqueous Bitumen Extraction)  
H Zhang, PhD, PEng  
X Zhang, PhD  
H Zeng, PhD, PEng (Canada Research Chair in Intermolecular Forces and Interfacial Science)

### Associate Professors

H-J Chung, PhD, PEng  
S Dubljevic, PhD, PEng  
A Elias, PhD, PEng  
Z Li, PhD, PEng  
J Liu, PhD, PEng  
S Mushrif, PhD  
N Nazemifard, PhD, PEng  
JD Sauvageau, PhD, PEng

### Assistant Professors

H-J Choi, PhD, PEng  
L Lefsrud, PhD, PEng

**Faculty Service Officers**

A Afacan, BSc, PEng  
DA Sharp, MSc, PEng

**Administrative Officer**

S McFadyen, MEd

**Civil and Environmental Engineering****Professor and Interim Chair**

SM AbouRizk, PhD, PEng

**University Professor Emeriti**

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  
DM Cruden, PhD, PGeol  
SP Dozzi, MEng, PEng  
AE Elwi, PhD, PEng  
SM Farouq Ali, PhD, PEng  
DL Flock, PhD, PEng  
WH Griffin, MSc, PEng  
F Hicks, PhD, PEng  
TM Hruday, PhD, PEng

AE Peterson, MSc, PEng  
LR Plitt, MSc, PEng  
WW Preston, BSc  
N Rajaratnam, PhD, PEng  
JD Scott, PhD, PEng  
DC Sego, PhD, PEng  
SH Simmonds, PhD, PEng  
DW Smith, PhD, PEng, FRSC, FCAE  
PM Steffler, PhD, PEng  
S Tepley, PhD, PEng  
S Thomson, PhD, 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)  
SM Adeeb, PhD, PEng  
M Al-Hussein, PhD, PEng (NSERC Senior Industrial Research Chair in Industrialization of Building Construction)  
D Apel, PhD, PEng  
H Askari-Nasab, PhD, PEng

T Babadagli, PhD, PEng (NSERC Senior Industrial Research Chair in Unconventional Oil Recovery)  
A Bayat, PhD, PEng  
MY Boluk, PhD, PEng (Nanofibre Chair in Forest Products)  
RJ Chalaturnyk, PhD, PEng  
DH-K Chan, PhD, PEng  
J-JR Cheng, PhD, PEng (CW Carry Chair in Steel Structures)  
YH Chui, 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  
M Gamal El-Din, PhD, PEng (NSERC Senior Industrial Research Chair in Oil Sands Tailings Water Treatment)  
TY Gan, PhD, PEng  
RA Hall, PhD, PEng  
Z Hashisho, PhD, PEng  
T Joseph, PhD, PEng  
SC Kang, PhD  
ES Kuru, PhD, PEng  
Y Liu, PhD, PEng (Canada Research Chair in Future Water Services)  
MR Loewen, PhD, PEng  
M Lu, PhD, PEng  
CD Martin, PhD, PEng (NSERC Industrial Research Chair in Railway Geomechanics)  
D McCartney, PhD, PEng  
Y Mohamed, PhD, PEng  
A Nouri, PhD, PEng  
A Robinson, PhD, PEng (NSERC Senior Industrial Research Chair in Strategic Construction Modeling and Delivery; Ledcor Professor in Construction Engineering and Management and Canada Research Chair in Fuzzy Hybrid Decision Support Systems for Construction)  
A Ulrich, PhD, PEng  
GW Wilson, PhD, PEng, PGeol (NSERC/COSIA Industrial Research Chair in Oil Sands Tailings Geotechnique)  
DZ Zhu, PhD, PEng

### Associate Professors

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J Boisvert, PhD, PEng  
ID Buchanan, PhD, PEng  
C Cruz Noguez, PhD, PEng  
E Davies, PhD, PEng  
H Dehghanpour, PhD, PEng  
L Deng, PhD, PEng  
K El-Basyouny, PhD, PEng  
SE Guigard, PhD, PEng  
M Gul, PhD, PEng  
A Hammad, PhD, PEng  
M Hendry, PhD, PEng  
A Kim, PhD, PEng



J Leung, PhD, PEng  
H Li, PhD, PEng  
N Maeda, PhD  
Y Pourrahimian, PhD, PEng  
Z Qiu, PhD, PEng (Canada Research Chair in Cooperative Transportation Systems)  
Y She, PhD, PEng  
J Trivedi, PhD  
T Yu, PhD, PEng

**Assistant Professors**

N Beier, PhD, PEng	T-J Kwon, PhD
Y Chen, PhD, PEng	Y Li, PhD
B Dhar, PhD	WV Liu, PhD, PEng
L Hashemian, PhD	D Tomlinson, PhD
A Imanpour, PhD, PEng	W Zhang, PhD
Z Jin, PhD	

**Faculty Service Officer**

DA Booth, BSc, PEng

**Administrative Officers**

K Schweiger

**Electrical and Computer Engineering****Professor and Chair**

IJ Fair, PhD, PEng

**Professors Emeriti**

KE Bollinger, MSc, PEng	B Nowrouzian, PhD, PEng
M Brett, PhD, PEng	AA Offenberger, PhD
CE Capjack, PhD, PEng	RE Rink, PhD, PEng
FS Chute, PhD, PEng	AM Robinson, PhD, PEng
I Filanovsky, PhD, PEng	D Routledge, PhD, PEng
WD Grover, PhD, PEng, FRSC	HG Schmidt-Weinmar, PhD
PJR Harding, MAsc, PEng	HJJ Seguin, PhD, PEng
CR James, PhD, PEng	PR Smy, PhD, DSc, PEng
DH Kelly, PhD, PEng	KA Stromsmoe, PhD, PEng

RW King, BSc, PEng  
YJ Kingma, Ir, PEng  
Z Koles, PhD, PEng  
RPW Lawson, PhD, PEng  
RI MacDonald, PhD, PEng

WR Tinga, PhD, PEng  
JF Vaneldik, PhD, PEng  
FE Vermeulen, PhD, PEng  
WAG Voss, PhD

### Professors

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J Chen, PhD, PEng  
T Chen, PhD, PEng (Canada Research Chair in Intelligent Monitoring and Control)  
BF Cockburn, PhD, PEng  
M Daneshmand, PhD, PEng (Canada Research Chair in Radio Frequency Microsystems for Communication and Sensing)  
R DeCorby, PhD, PEng  
SK Dew, PhD, PEng  
S Dick, PhD, PEng  
V Dinavahi, PhD, PEng  
AY Elezabi, PhD, PEng  
D Elliott, PhD, PEng  
S Evoy, PhD, PEng  
IJ Fair, PhD, PEng  
R Fedosejevs, PhD, PEng (MPBT/NSERC Senior Industrial Research Chair in Laser and Spectroscopic Techniques applied to the Natural Resources Industry)  
H Jiang, PhD, PEng  
Y Jing, PhD, PEng  
R Karumudi, PhD, PEng  
WA Krzymien, PhD, PEng (Rohit Sharma Professor in Communications and Signal Processing)  
Y Li, PhD, PEng  
A Lynch, PhD, PEng  
MK Mandal, PhD, PEng  
HJ Marquez, PhD, PEng  
J Miller, PhD, PEng  
YA-RI Mohamed, PhD, PEng  
P Musilek, PhD, PEng  
J Myatt, PhD  
W Pedrycz, PhD, PEng (Canada Research Chair in Computational Intelligence)  
S Pramanik, PhD, PEng  
M Reformat, PhD, PEng  
JC Salmon, PhD, PEng  
K Shankar, PhD, PEng  
M Tavakoli Afshari, PhD, PEng  
C Tellambura, PhD, PEng  
YY Tsui, PhD, PEng  
M Vaidyanathan, PhD, PEng  
V Van, PhD, PEng

WW Xu, PhD, PEng (NSERC/iCORE/Alberta Power Companies Senior Industrial Research Chair in Power Quality)

R Zemp, PhD, PEng

Q Zhao, PhD, PEng

### Associate Professors

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J Han, PhD, PEng

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D Joseph, PhD, PEng

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S Khajehoddin, PhD, PEng

E Lou, PhD, PEng

K Moez, PhD, PEng

D Niu, PhD, PEng

J Sit, PhD, PEng

X Wang, PhD, PEng

### Assistant Professors

C-P Bezemer, PhD

B Gholipour, PhD

M Gupta, PhD, PEng

M Hossain, PhD

H Khazaei, PhD

G Kish, PhD

H Liang, PhD (Canada Research Chair in Intelligent Energy Systems)

G Porat, PhD

### Faculty Service Officer

L Wyard-Scott, MSc, PEng

### Administrative Officers

W Barton, BSc, PEng

A Rao, BEd, BCom

## Mechanical Engineering

### Professor and Chair

J Doucette, PhD, PEng

### Professors Emeriti

DG Bellow, PhD, PEng, FCAE

DR Budney, PhD, PEng

GSH Lock, PhD, PEng

DJ Marsden, PhD, PEng

MD Checkel, PhD, PEng  
A Craggs, PhD, PEng  
JD Dale, PhD, PEng  
MG Faulkner, PhD, PEng  
TW Forest, PhD, PEng  
TR Heidrick, PhD, PEng

A Mioduchowski, PhD, PEng  
L Sigurdson, PhD, PEng  
JC Sprague, PhD, PEng  
RW Toogood, PhD, PEng  
JD Whittaker, PhD, PEng  
DJ Wilson, PhD, PEng  
Z Xia, PhD, PEng

### Professors

B Alsayed Ahmad, PhD, PEng (Industrial Professor)  
J Carey, PhD, PEng  
Z Chen, PhD, PEng  
J Doucette, PhD, PEng  
WH Finlay, PhD, PEng (Canada Research Chair in Aerosol Mechanics)  
BA Fleck, PhD, PEng  
P-YB Jar, PhD, PEng  
SV Karapetrovic, PhD, PEng  
CR Koch, PhD, PEng  
LW Kostiuk, PhD, PEng  
A Kumar, PhD, PEng (NSERC/Cenovus/Alberta Innovates Associate Industrial Research Chair in Energy & Environmental Systems Engineering)  
M Lipsett, PhD, PEng (Ernest and Gertrude Poole Chair in Management for Engineers)  
Y Ma, PhD, PEng  
A McDonald, PhD, PEng  
P Mertiny, PhD, PEng  
P Mousavi, PhD, PEng (NSERC/ITF Associate Industrial Research Chair in Intelligent Integrated Sensors & Antennas)  
WA Moussa, PhD, PEng  
D Nobes, PhD, PEng  
J Olfert, PhD, PEng  
C Ru, PhD, PEng  
P Schiavone, PhD  
M Secanell, PhD, PEng  
T Tang, PhD, PEng (Canada Research Chair in Nano-biomolecular Hybrid Materials)  
R Vehring, PhD, PEng (George Ford Chair in Materials Engineering), PEng  
X Wang, PhD, PEng  
M Zuo, PhD, PEng

### Associate Professors

C Ayranci, PhD, PEng  
C Dennison, PhD, PEng (Canada Research Chair in Biomedical Instrumentation)  
K Duke, PhD, PEng  
M Flynn, PhD, PEng  
S Ghaemi, PhD

CF Lange, PhD, PEng  
DW Raboud, PhD, PEng  
M Sadrzadeh, PhD, PEng  
D Sameoto, PhD, PEng  
Z Tian, PhD, PEng  
A Vette, PhD, PEng

**Assistant Professors**

R Ahmad, PhD, PEng  
M Barczyk, PhD, PEng  
A Hemmati, PhD  
J Hogan, PhD, PEng  
Cl Kim, PhD, PEng  
A Komrakova, PhD, PEng  
X Li, PhD  
A Martin, PhD, PEng  
AJ Qureshi, PhD, PEng  
D Romanyk, PhD, PEng  
H Rouhani, PhD, PEng  
PA Tsai, PhD, PEng (Canada Research Chair in Fluids and Interfaces)  
P Waghmare, PhD, PEng  
L Westover, PhD, PEng  
J Wong, PhD  
L Zhong, PhD

**Administrative Officer**

Vacant

**Sessional Lecturer in Engineering**

R Krushelnitsky, PhD, LLB  
P Ryzuk, BSc, MEng, PEng, LLB  
BR Touchings, BA, LLB

**Engineering Co-op Department****Professor and Director**

D Raboud, PhD, PEng

**Administrative Officers**

C Bjornson, BA, Coordinator  
A Dapaah, MEd, Coordinator  
C Ens, Coordinator, BCom  
A Khan, BSc, Coordinator  
RC Kully, BEd, Coordinator  
S Kuss, Coordinator, BEd  
MT Marks, BCom, Coordinator  
A Rumsby, Coordinator, BBA  
S Saylor, BA, Coordinator  
R Sisson, Coordinator, BA  
LJ Szekely, BEd, Coordinator  
K Vande Vyvere, BA, Coordinator

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

DH Turpin, CM, LLD, FRSC

**Vice-Provost & University Registrar**

LM Collins

**Professor**

F Trovato, PhD (Sociology)  
Y Xu, PhD (Chemistry)

**Associate Professors**

J Davis, PhD (Physics)  
MA Saldana, PhD (Agric, Food & Nutritional Science)  
G Tardif, PhD (Music)  
K Wong, PhD (Computing Science)

**Assistant Professor**

V Bouchard, PhD (Math & Statistical Science)

**APEGA Representative**

TBA

## Representatives from Engineering Students

W Dew (Undergraduate)  
I Roeber (Undergraduate)  
R Vander Meulen (Undergraduate)  
S Chatumal Perera (Graduate)  
A Noamani (Graduate)

## General Information

### 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.

### 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 Faculté Saint-Jean (En Français), Faculté Saint-Jean (English)). 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 Baccalauréat ès science en génie, Bachelor of Science in Engineering for further details.

### Cooperative Education Program

The Faculty of Engineering offers two types of degree programs to which all students can apply: the traditional program and the cooperative education program. Students in the traditional program typically 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 the Biomedical Options in Civil Engineering and Electrical Engineering. Most programs include one fall work term (September to December), one winter work term (January to April) and three summer work terms (May to August). See Required Courses and Suggested Course Sequence for Co-op Programs 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.

**Spoken English Requirement:** Applicants to all Engineering Co-op Specialization programs must meet a Spoken English Requirement (see Spoken English Requirement).

## 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.

Although the Department of Biomedical Engineering does not offer an undergraduate degree, offering only the MSc and PhD degrees, there are formal undergraduate biomedical engineering options and elective sequences in the Departments of Chemical and Materials Engineering, Electrical and Computer Engineering, and Mechanical Engineering. To help students understand and prepare for employment in this area, a series of undergraduate 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 which is in both the Faculty of Engineering and 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 Engineering and Faculty of Medicine and Dentistry, or a Faculty advisor in any Engineering department.

## 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.

## 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, MATH 118, and MATH 217, instead of MATH 100, MATH 101, and MATH 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.

## 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.



## Arrangements with Other Institutions

### Alberta Engineering Transfer Programs

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, MacEwan University (Edmonton), 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.

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

Both the Universities of Alberta and Calgary offer undergraduate degree programs in Engineering.

The first year of the programs is similar but not identical. A transfer student may obtain complete or partial credit towards first year depending on the courses selected and the university to which admission is sought.

Complete information for transfer of credits between these programs is provided by the Alberta Learning Information Service through Transfer Alberta. The information is reviewed and updated annually by the Alberta Council on Admissions and Transfer and can be found here: [alis.alberta.ca/pdf/transferralberta/Engineering.pdf](http://alis.alberta.ca/pdf/transferralberta/Engineering.pdf).

Students who complete the first year program at the University of Calgary and are interested in a transfer to the University of Alberta should consult the Faculty of Engineering concerning transfer of credit.

### Transfer from Alberta Technical Institutes

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

### 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.

### Special Students

Students with a BSc in Engineering may register as special students in the Faculty as part time students. For further information regarding admissibility, see Special Student.

## 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.

## Professional Associations and Technical Societies

All Engineering programs listed in the Calendar are accredited by the Canadian Engineering Accreditation Board of Engineers Canada. 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 and Geoscientists of Alberta (APEGA). 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.

## Faculty Regulations

### Admission and Registration

General University admission requirements are set out in Admission to Undergraduate Programs and General Admission Requirements. Specific admission information for the Faculty of Engineering is detailed in Faculty of Engineering.

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

### 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. High school students are only admitted into the qualifying (first) year. All admissions are on a competitive basis.

Admissions into the first or qualifying year program include students who are coming directly from high school and students with less than 30.0 engineering units of postsecondary transfer credit. On an annual basis, the minimum high school average for students entering directly from high school is reviewed and may be adjusted to reflect demand and space availability. This average is calculated across the five required admission subjects (Alberta Grade 12 Chemistry 30, English 30-1, Mathematics 30-1, Mathematics 31 and Physics 30 or their equivalent), and for the past several years it has been 85.0% or above.

There is a maximum number of students which can be accommodated in the first or qualifying year program. Spaces available after all eligible applicants from high school have been admitted are offered to students with postsecondary transfer credit. Factors in selecting students from this group for admission are academic performance and the specific courses which earn transfer credit.

The Faculty offers a number of engineering degree program choices as indicated below:

- Chemical
- Chemical Process Control Option
- Chemical Biomedical Option
- Civil
- Civil Environmental Option
- Civil Biomedical Option\*
- Computer
- Computer Software Option
- Computer Nanoscale System Design Option
- Electrical
- Electrical Biomedical Option\*
- Electrical Nanoengineering Option
- Engineering Physics\*
- Engineering Physics Nanoengineering Option\*
- Mechanical
- Mechanical Biomedical Option\*\*
- Materials
- Materials Biomedical Option
- Materials Nano and Functional Materials Option
- Mining
- Petroleum

Most of these programs are offered in both the Traditional and Co-op formats except as indicated by the asterisks - \*Traditional only, \*\*Co-op only. All of the specialized or discipline specific programs start in second year and each has a limited number of spaces. On an annual basis the Faculty reviews the number of spaces in all disciplines and may change the number of spaces in specific degree programs to reflect student demand and the market demand for these disciplines subject to the availability of Faculty resources.

Students admitted to the qualifying year must normally qualify for a specialized program in not more than two terms (one year). Students entering directly from high school or with less than 15.0 units of transfer credit may, subject to space availability, be allowed an additional two terms (one year) to qualify. Students entering with 15.0 or more units 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/ENGG 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 are admitted to a specialized program based first of all on academic performance in the first or qualifying year and secondly on their program

preferences. These preferences are communicated by completing a Program Selection Form (PSF). All students in the qualifying year, and new applicants, must complete the PSF which is accessed through the Faculty web site. All applicants with previous postsecondary education must submit a PSF. Applicants who do not have sufficient transfer credit for admission to a second year program (to be determined by the Faculty) may be considered for a qualifying year.

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 reapply 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
  - i. mandated, graded program courses including Faculty of Engineering approved electives in an engineering program taken at the University of Alberta. Courses not required to complete the degree will not be considered in EGA calculations.
  - ii. a minimum of the last ★70 in an engineering program as defined in (i). As many full terms as required will be included in the calculation of the EGA to reach the total of at least ★70.
- 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 provided this term falls within the 72 month degree time limit as specified in Time Limit for Completion of Degree. Courses to be taken during this additional term are 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.

The preceding paragraph also applies to any student who has completed all course requirements and chooses to return for an extra term. The courses which the student takes in this subsequent term are to be specified by the Dean.

3. **Time Limit for Completion of Degree:** All students must complete their degree requirements within 72 months from the time of their initial admission to a specialized degree program in Engineering.

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 Marginal Standing-Academic Warning, but must meet the degree time limit as specified in Time Limit for Completion of Degree. A course load less than that required to maintain full time status, as defined in Glossary, 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/ENGG 101.

## 5. Courses Outside of Degree Requirements

Courses which are taken in addition to a student's degree requirements are designated "Not for Degree Credit" or "Extra to Degree". Since GPA calculations include the grades earned in these non degree courses, students must obtain prior written approval from their Department before registering in such courses unless it is a requirement imposed by the Faculty. Only students whose GPA in the immediately preceding term is 2.5 or above will receive approval from their Department. These courses must be at the 200-level or above. Not all courses will be considered. See [www.engineering.ualberta.ca](http://www.engineering.ualberta.ca) for more information. Students who have registered in courses outside their degree program without formal approval will be withdrawn from these courses and are responsible for any associated fees.

6. **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 Required Courses and Suggested Course Sequence for Traditional Programs and Required Courses and Suggested Course Sequence for Co-op Programs. Evaluation is on the basis of the Fall/Winter GPA or Spring/Summer GPA [see Additional Grades and Remarks]. A student registered in Co-op Work Experience for the Winter Term and simultaneously registered in one or more courses is considered to have completed their academic studies for Fall/Winter after the Fall Term.

- 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. occurs immediately upon completion of the qualifying year [also see Time Limit for Completion of Degree with respect to students who entered directly from high school or with less than 15.0 units of transfer credit].
  - ii. previously on academic warning on two or more occasions.
  - iii. previously required to withdraw and previously on academic warning.
  - iv. 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.

Students who meet all Fresh Start admission criteria (Fresh Start Program) and were registered in the first qualifying year (students directly from high school or with less than 15.0 engineering units of transfer credit) may be recommended to Fresh Start. Such a recommendation is dependent on the student's agreement that by entering Fresh Start they will not be eligible for readmission to the Faculty of Engineering and must apply to another Faculty.

7. **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.
8. **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.

9. **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.

If a student receives a suspension for academic misconduct which overlaps the period of withdrawal resulting from poor academic performance, the periods of withdrawal and suspension will run sequentially. The total length of the required absence is to be equal to the period of the suspension plus the period of withdrawal for academic reasons.

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 Marginal Standing-Academic Warning.

10. **Withdrawal from Courses:** (See Academic Schedule for deadline dates.)
11. **Missed Term and Final Exams:** Refer to Attendance and Evaluation Procedures and Grading System. There are no deferred term exams for courses offered in the Faculty of Engineering. In instances where a student has a documented reason for missing a term exam(s) and at the discretion of the instructor, the value of a missed term exam(s) can be added to the value of the final exam. A missed term exam(s) is considered assigned term work which has not been completed in determining eligibility for a deferred final exam. If the resulting final exam weight exceeds that allowed under Weighting of Term Work and Final Examinations, (no more than 70%), then the office of the Dean shall be notified.
12. **Transfer Credit:** Students planning to earn transfer credit for a course(s) taken elsewhere should obtain Department and Faculty approval in the form of a Letter of Permission prior to taking the course(s). The Faculty is under no obligation to grant transfer credit without such preapproval. Letters of Permission are not given to students who have been required to withdraw until they have been readmitted. Students returning for a second qualifying year who have successfully completed a qualifying year course(s) which was (were) not taken or not passed in their first qualifying year will automatically receive credit for such courses and cannot retake them.
13. **Reexaminations:** See Reexaminations.
14. **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 First-Year Program, Required Courses and Suggested Course Sequence for Traditional Programs, or Required Courses and Suggested Course Sequence for Co-op Programs 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 an Engineering Graduation Average of 3.5 or greater.
15. **Communication with Students Re Academic and Discipline Matters:** Pursuant to Electronic Communication Policy for Students and Applicants, the Faculty of Engineering will communicate all academic standing decisions and all decisions relating to charges under the Code of Student Behaviour electronically. The decision letter will be an electronic document attached to an e-mail forwarded to the student's campus e-mail address which includes the ualberta.ca extension or available through Bear Tracks.
16. **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 provide a written letter of appeal addressed to the Dean which outlines the basis for the appeal. The letter of appeal must be received by the Dean 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:** 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 Appeals and Grievances. 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 Practicum Intervention Policy). 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 Academic Standing.

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

17. **Engineering Ethics, Practice and Profession:** Students will be afforded only one opportunity to meet the required criteria for achieving credit in scheduled ENGG 100, ENGG 101, or ENGG 400 courses. Students failing any of ENGG 100, ENGG 101, or ENGG 400 will be required to complete alternative replacement courses (one replacement course for each instance of ENGG 100, ENGG 101, or ENGG 400 graded as No Credit, NC) at the discretion of the Dean. Such alternative courses will only be approved by the Dean if a student has previously failed to achieve credit in scheduled courses.

Criteria for achieving credit in ENGG 100 or ENGG 101: Proven completion of required safety training through the Office of the Dean, plus successful completion of equivalent course(s) nominated solely at the discretion of the Dean.

Criteria for achieving credit in ENGG 400: Successful completion of an ethics course nominated solely at the discretion of the Dean.

## 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.

## Programs of Study

### Faculty Requirements for all BSc in Engineering Programs

Course requirements for Engineering programs are listed in First-Year Program and Required Courses and Suggested Course Sequence for Traditional Programs through Required Courses and Suggested Course Sequence for Co-op Programs (Second-Year and beyond). All Engineering programs include ENGG 400, ENGG 404, MATH 201, MATH 209, one of ENG M 310 or ENG M 401, an ITS elective as described in Impact of Technology on Society (ITS) Elective, and a capstone design course.

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).

## 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 further descriptions of the requirements on the Program Electives, see fields of study. For information on Complementary Studies Electives, Impact of Technology on Society (ITS) Electives and English Electives see Complementary Studies Electives .

## 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 further descriptions of the requirements on the Program Electives, see fields of study. For information on Complementary Studies Electives, Impact of Technology on Society (ITS) Electives and English Electives, see Complementary Studies Electives .

## BSc Minor Requirements

### Minors [Engineering]

**Application to a minor:** At any time following completion of all courses of their academic terms five and six, engineering students may apply to the Faculty of Engineering to complete a minor in an area of concentration in other Faculties to expand their breadth of knowledge if they have a minimum cumulative GPA of 3.0. The concentration department and the Faculty of Engineering may impose quotas on the number of students that will be allowed in the minor. In these cases students with the highest cumulative GPA applying to this minor will be allocated their preferred minor choices first.

**Completion of minors:** Students are responsible to ensure that they meet all the area requirements of the minors. In some minor areas, listed courses may not always be offered or open to all; students should contact the specific department for additional information. Courses taken to satisfy the requirements of the engineering program can be used to satisfy the requirements of the minor program.

Engineering programs are rigid in their timetabling; minors will usually extend the length of an engineering program which must be completed within 72 months of starting a program (requirements to graduate), including additional courses from a minor. Minors should be undertaken after completing all engineering degree requirements; it is the responsibility of the student to ensure that their schedule allows for timetabling courses of their minor if they choose to complete them earlier. It is recommended that students plan their entire program prior to starting a minor and have the sequence approved by a student advisor.



Students registering in a minor are subject to the minor-related rules and requirements of the granting Faculty.

## Minor in Arts

Engineering students may obtain a minor in a Faculty of Arts subject area of concentration (with the exception of Arts Cultural Management). All Arts minors require at least ★12 senior, including at least ★6 in 300-level or higher courses, though some minors require specific courses, or more credits than the minimum. See BA Honors and BA Major/Minor Requirements for specific requirements for each minor.

## Minor in Business

The minor in Business seeks to provide students in Engineering with introductory training in a variety of choice business areas. The Engineering Profession is unique in that it is highly analytical, yet requires consideration of business, social, and legal issues. The minor in Business was designed with a view to enabling engineering students to develop an analytical framework within which various organizational and business problems are addressed. It is envisaged that, with an ability to create solutions to these organizational and business challenges, engineering students will be better prepared and informed to serve the Profession.

Engineering students must take ECON 204 as the complementary studies elective if they choose to pursue a minor in Business. A minor in Business may be created in the following way:

1. Engineering students must complete ★34 to receive a minor in Business. Students must complete five mandatory primary core business courses (★15) or equivalent: ACCTG 311, ENGG 420 **OR** B LAW 301, FIN 301, MARK 301, SMO 301 **OR** SMO 310.
2. ★3 in ENG M 402;
3. ★12 in senior-level (300- or 400-level) courses in the Faculty of Business. Students should select senior-level coursework in accordance with the concentration that they have chosen. Students must have prerequisites for the courses chosen.
4. ★4 in ENGG 490
5. Students may wish to focus their minor in Business in a particular area. A minor in an area of Business may be satisfied by taking any one of the following suggested lists of courses:
  - a. **Business Economics and Law:** BUEC 311, B LAW 402 or B LAW 403, ★6 of any 400-level BLAW or BUEC courses;
  - b. **Business Studies:** ACCTG 322, ★9 of any 300- or 400-level Business courses in at least two different subject areas. Subject areas include Accounting (ACCTG), Business Economics (BUEC), Business Law (B LAW), Finance (FIN), Management Information Systems (MIS), Management Science (MGTSC), Marketing (MARK), Operations Management (OM), and Strategic Management and Organization (SMO). MIS 311, OM 352, SMO 441 are recommended;
  - c. **Finance:** FIN 412, ★9 of any 400-level FIN course;
  - d. **International Business:** ★12 of B LAW 442, B LAW 444; FIN 442; MARK 442; SMO 417, SMO 435;
  - e. **Marketing:** MARK 312, MARK 320 and ★6 of any 400-level MARK course; or
  - f. **Strategic Management and Organization:** SMO 441, ★9 of any 300- or 400-level SMO course.

Students must complete these business minor courses after completing all the requirements of their engineering program.

## Minor in Science

Engineering students may obtain a minor in a Faculty of Science concentration area subject to the requirements and pre-requisites of that area. Engineering students may not take a minor in Bioinformatics. Computer Engineering students may not take a minor in Computing Science. Engineering Physics students may not take a minor in Physics. All Science minors must have at least ★24 with at least ★6 in 300-level or higher courses. Acceptance into any minors in Science is contingent on course availability and may be restricted or closed some years.

In cases where Engineering students wish to pursue a minor in mathematics they are required to take:

## Additional Information

Engineering students undertaking areas of concentration other than Mathematics must follow the course requirements provided by the concentration program (see Minors [Science]). Students should consult with advisors about course equivalencies. Students selecting areas of concentration other than Mathematics and must complete these other Science minors after completing all the requirements of their engineering program.

## Minor in Mathematics for Engineers consists of

- MATH 100 - Calculus I **OR**
- MATH 117 - Honors Calculus I
  
- MATH 101 - Calculus II **OR**
- MATH 118 - Honors Calculus II
  
- MATH 209 - Calculus III **OR**
- MATH 217 - Honors Advanced Calculus I
  
- MATH 102 - Applied Linear Algebra **OR**
- MATH 127 - Honors Linear Algebra I
  
- MATH 201 - Differential Equations
  
- MATH 225 - Linear Algebra II **OR**
- MATH 227 - Honors Linear Algebra II
  
- MATH 300 - Advanced Boundary Value Problems I **OR**
- MATH 337 - Introduction to Partial Differential Equations
  
- MATH 311 - Theory of Functions of a Complex Variable **OR**
- MATH 309 - Mathematical Methods for Electrical Engineers **OR**
- MATH 411 - Honors Complex Variables

## Courses

### Course Listings

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

Biomedical Engineering (BME)

Bioresource Engineering (BIOEN) (offered by the Faculty of Agricultural, Life and Environmental Sciences)

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 (ENCOMP)  
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)

## 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.

## Programs

### Common Core

### Complementary Studies Electives

To better understand the role of Engineering within a broader social context, all programs require an element of complementary studies consisting of the humanities, social sciences, arts, management, engineering economics and communications. Aspects of these topics are covered in mandatory courses, but each program contains complementary studies electives so that students may explore areas of particular interest. Notwithstanding this, the Canadian Engineering Accreditation Board requires that programs include exposure to the central thought processes of the humanities and social sciences. Students must take the number of complementary studies electives as required by their program. Students can take a maximum of one list 1 complementary studies elective. Note that in some cases, a course may appear both on a complementary studies list and as a program required or program elective course. A single course cannot be used to satisfy multiple course requirements under Programs of Study.

Students interested in taking a minor should select their first complementary studies courses with this in mind. For the Business minor, student should take ECON 204; for an Arts minor, students should select a course in a possible area of concentration of interest, see minors for specific requirements for each minor.

### List 1

- ANTHR 101 - Introductory Anthropology
- ANTHR 110 - Gender, Age, and Culture
- ANTHR 150 - Race and Racism
- CLASS 102 - Greek and Roman Mythology
- CLASS 103 - Introduction to Ancient Greece
- CLASS 104 - Introduction to Ancient Rome
- CLASS 110 - The Ancient World
- ECON 101 - Introduction to Microeconomics
- ECON 102 - Introduction to Macroeconomics
- ENGL 125 - Aboriginal Writing \*
- HIST 110 - The Pre-Modern World
- HIST 111 - The Early Modern World
- HIST 112 - The Modern World
- HIST 114 - The History of the World in the Last 10 Years
- HIST 116 - The Emergence of the Atlantic World
- LING 101 - Introduction to Linguistic Analysis
- PHIL 120 - Symbolic Logic I
- PHIL 125 - Practical Logic
- POL S 101 - Introduction to Politics
- PSYCO 104 - Basic Psychological Processes
- SOC 100 - Introductory Sociology

### List 2

- ACCTG 300 - Introduction to Accounting
- ACCTG 311 - Introduction to Accounting for Financial Performance
- ANTHR 230 - Anthropology of Science, Technology, and Environment
- AREC 365 - Natural Resource Economics
- B LAW 301 - Legal Foundations of the Canadian Economy \*\*
- B LAW 422 - Law of Business Organizations
- B LAW 428 - Natural Resource and Environmental Law \*\*\*
- B LAW 432 - The Legal Regulation of Business
- CHRTC 350 - Science and Religion: Christian Perspectives
- CLASS 254 - Introduction to Greek Art and Archaeology
- CLASS 255 - Introduction to Roman Art and Archaeology
- CLASS 283 - Introductory Roman History II
- CLASS 294 - Ancient Science, Technology, and Medicine
- CLASS 376

- ECON 204 - Principles of Economics
- ECON 281 - Intermediate Microeconomic Theory I
- ECON 282 - Intermediate Macroeconomic Theory I
- ENGG 420 - Engineering Law
- ENG M 402 - Project Management and Entrepreneurship
- ENG M 406
- HECOL 211 - Human Sexuality
- HIST 260 - Pre-Confederation Canada
- HIST 261 - Post-Confederation Canada
- HIST 295 - 20th-Century Warfare
- HIST 397 - History of Science I
- HIST 398 - History of Science II
- INT D 303 - Economics of World Food and Agriculture
- LA ST 210 - South America
- LING 204 - English Syntax
- LING 205 - Phonetics
- MARK 301 - Introduction to Marketing
- OM 352 - Operations Management
- PHIL 205 - Philosophy of Mind
- PHIL 220 - Symbolic Logic II
- PHIL 250 - Contemporary Ethical Issues
- PHIL 325 - Risk, Choice, and Rationality
- PHIL 355 - Environmental Ethics
- POL S 223 - City Government and Politics
- PSYCO 258 - Cognitive Psychology
- PSYCO 275 - Brain and Behavior
- R SOC 355 - Rural Communities and Global Economies
- R SOC 365 - Sociology of Environment and Development
- SMO 200 - Introduction to Management for Non-Business Students
- SMO 301 - Behavior in Organizations
- SMO 330 - Introduction to Entrepreneurship
- SOC 212 - Classical Social Theory
- SOC 224 - Sociology of Deviance and Conformity
- SOC 225 - Criminology
- SOC 241 - Social Psychology
- SOC 242 - Biologically Coordinated Social Psychology
- SOC 251 - Population and Society
- SOC 301 - Sociology of Gender
- WGS 220 - Feminism and Popular Culture

## Notes:

\*\*Not available to Civil students

\*\*\*Not available to Civil (Environmental Engineering Option) students.

A second course from the ITS List may be taken as part of List 2. However, a single course cannot be used to satisfy both the ITS and Complementary Studies requirements. This list is updated annually. Courses that teach a language or the application of a particular skill (such as courses in physical education, music and art) do not meet the intent of the Accreditation Board with respect to complementary studies and are therefore not eligible.

## 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:

- ENG M 403
- ENG M 405
- HIST 115 - Technology and History
- HIST 391 - History of Technology
- HGP 250 - Natural Resources and Environmental Management
- INT D 361
- PHIL 265 - Philosophy of Science
- PHIL 366 - Computers and Culture
- PHIL 375
- STS 200 - Introduction to Studies in Science, Technology and Society
- SOC 366 - People in Industry
- SOC 363 - Sociology of Work and Industry

## English Electives

Engineering programs require ENGL 199.

## First-Year Program

Students registering for first-year courses should consult the Registration and Courses menu at [www.registraroffice.ualberta.ca](http://www.registraroffice.ualberta.ca) for detailed registration procedures.

Students interested in an equivalent curriculum given in French should consult Baccalauréat ès science en génie.

## Term 1

- CHEM 103 - Introductory University Chemistry I
- ENGG 100 - Orientation to the Engineering Profession I
- ENGG 130 - Engineering Mechanics
- ENGL 199 - English for Engineering Students

- MATH 100 - Calculus I
- PHYS 130 - Wave Motion, Optics, and Sound

## Term 2

- CHEM 105 - Introductory University Chemistry II
- ENCMP 100 - Computer Programming for Engineers
- ENGG 160 - Introduction to Engineering Design, Communication, and Profession
- EN PH 131 - Mechanics
- MATH 101 - Calculus II
- MATH 102 - Applied Linear Algebra

## Note

1. Students accepted into the Honors Mathematics stream replace MATH 100 and MATH 101 with MATH 117 and MATH 118.

## Field of Study

### 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. The chemical engineer 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 below and Program and Technical Electives 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.

### 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.

## 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 Biomedical Engineering for more details. Enrolment is limited.

## 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.

## Elective Streams in Chemical Engineering

In addition to the required courses, students in Chemical Engineering may study certain fields in depth by choosing appropriate program 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 nonmetallic 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, CME 422 and CME 472.
2. **Nanoscale Engineering:** The Nanoscale Engineering Elective Stream consists of 4 courses which are taken in the four program 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 495. 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, CME 484 and CME 485.



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## Required Courses and Suggested Course Sequence for Traditional Programs

- Chemical
- Chemical: Biomedical Option
- Chemical: Computer Process Control Option
- Chemical: Oil Sands Elective

### Chemical [Engineering]

#### Year 2

##### Term 3

- CH E 243 - Engineering Thermodynamics
- CHEM 261 - Organic Chemistry I
- CME 200 - Introduction to Chemical and Materials Engineering
- CME 265 - Process Analysis
- MATH 209 - Calculus III
- Complementary Studies Elective (3-0-0)
- Complementary Studies Elective (3-0-0)

##### Term 4

- CH E 312 - Fluid Mechanics
- ECE 209 - Fundamentals of Electrical Engineering
- MATH 201 - Differential Equations
- MAT E 202 - Materials Science II
- STAT 235 - Introductory Statistics for Engineering
- ITS Elective (3-0-0)

#### Year 3

##### Term 5

- CH E 314 - Heat Transfer
- CH E 343 - Chemical Engineering Thermodynamics
- CH E 351 - Chemical Engineering Laboratory
- CH E 374 - Computational Methods in Engineering
- Program Elective (3-0-0)

## Term 6

- CH E 316 - Equilibrium Stage Process
- CH E 318 - Mass Transfer
- CH E 345 - Chemical Reactor Analysis I
- CH E 358 - Process Data Analysis
  
- ENG M 310 - Engineering Economy **OR**
- ENG M 401 - Financial Management for Engineers
  
- ENGG 404 - Engineering Safety and Risk Management-Leadership in Risk Management

## Year 4

### Term 7

- CH E 445 - Chemical Reactor Analysis II
- CH E 446 - Process Dynamics and Control
- CH E 464 - Chemical Engineering Design I
- CME 481 - Colloquium I
- Complementary Studies Elective (3-0-0)
- Program Elective (3-1s-0)

### Term 8

- CH E 454 - Chemical Engineering Project Laboratory
- CH E 465 - Chemical Engineering Design II
- CME 483 - Colloquium II
- ENGG 400 - The Practice of the Engineering Profession
- Program Elective (3-1s-0)
- Program Elective (3-1s-0)

## Notes

1. See Program and Technical Electives for restrictions on the four program 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.

## Chemical: Biomedical Option [Engineering]

### Year 2

#### Term 3

- BIOL 107 - Introduction to Cell Biology
- CH E 243 - Engineering Thermodynamics
- CME 200 - Introduction to Chemical and Materials Engineering
- CME 265 - Process Analysis
- CHEM 261 - Organic Chemistry I
- Complementary Studies Elective (3-0-0)
- MATH 209 - Calculus III

#### Term 4

- BIOCH 200 - Introductory Biochemistry **OR**
- BIOL 201 - Eukaryotic Cellular Biology **OR**
- CELL 201 - Introduction to Molecular Cell Biology
- ECE 209 - Fundamentals of Electrical Engineering
- MATH 201 - Differential Equations
- MAT E 202 - Materials Science II
- STAT 235 - Introductory Statistics for Engineering
- CH E 312 - Fluid Mechanics

### Year 3

#### Term 5

- BME 320 - Human Anatomy and Physiology: Cells and Tissue
- CH E 314 - Heat Transfer
- CH E 343 - Chemical Engineering Thermodynamics
- CH E 351 - Chemical Engineering Laboratory
- CH E 374 - Computational Methods in Engineering
- ENGG 404 - Engineering Safety and Risk Management-Leadership in Risk Management

## Term 6

- BME 321 - Human Anatomy and Physiology: Systems
- CH E 316 - Equilibrium Stage Process
- CH E 318 - Mass Transfer
- CH E 345 - Chemical Reactor Analysis I
- CH E 358 - Process Data Analysis
  
- ENG M 310 - Engineering Economy **OR**
- ENG M 401 - Financial Management for Engineers

## Year 4

### Term 7

- CH E 446 - Process Dynamics and Control
- CH E 464 - Chemical Engineering Design I
- CME 481 - Colloquium I
- PHIL 386 - Health Care Ethics
- Complementary Studies Elective (3-0-0)
- ITS Elective (3-0-0)

### Term 8

- CH E 454 - Chemical Engineering Project Laboratory
- CH E 465 - Chemical Engineering Design II
- CME 483 - Colloquium II
- ENGG 400 - The Practice of the Engineering Profession
- Program Elective (3-1s-0)
- Program Elective (3-1s-0)

## Notes

1. Students who are interested in applying for admission into the Faculty of Medicine and Dentistry MD program should refer to Program and Technical Electives.
2. WKEXP 906 is required for this program. WKEXP 906 can be taken after Term 4, 6 or 8.
3. See Program and Technical Electives for restrictions on the two program electives.

## Chemical: Computer Process Control Option [Engineering]

### Year 2

#### Term 3

- CH E 243 - Engineering Thermodynamics
- CHEM 261 - Organic Chemistry I
- CME 200 - Introduction to Chemical and Materials Engineering
- ECE 202 - Electrical Circuits I
- ECE 210 - Introduction to Digital Logic Design
- MATH 209 - Calculus III
- Complementary Studies Elective (3-0-0)

#### Term 4

- CME 265 - Process Analysis
- CH E 312 - Fluid Mechanics
- Complementary Studies Elective (3-0-0)
- MAT E 202 - Materials Science II
- MATH 201 - Differential Equations
- STAT 235 - Introductory Statistics for Engineering

### Year 3

#### Term 5

- CH E 314 - Heat Transfer
- CH E 343 - Chemical Engineering Thermodynamics
- CH E 351 - Chemical Engineering Laboratory
- CH E 374 - Computational Methods in Engineering
- CH E 446 - Process Dynamics and Control
- ENGG 404 - Engineering Safety and Risk Management-Leadership in Risk Management

#### Term 6

- CH E 316 - Equilibrium Stage Process
- CH E 318 - Mass Transfer
- CH E 345 - Chemical Reactor Analysis I
- CH E 358 - Process Data Analysis

- CH E 472 - Modelling Process Dynamics
- ENG M 310 - Engineering Economy **OR**
- ENG M 401 - Financial Management for Engineers

## Year 4

### Term 7

- CH E 464 - Chemical Engineering Design I
- CME 481 - Colloquium I
- ITS Elective (3-0-0)
- Program Elective (3-1s-0)
- Program Elective (3-1s-0)
- Complementary Studies Elective (3-0-0)

### Term 8

- CH E 454 - Chemical Engineering Project Laboratory
- CH E 465 - Chemical Engineering Design II
- CH E 573 - Digital Signal Processing for Chemical Engineers
- CH E 576 - Intermediate Process Control
- CME 483 - Colloquium II
- ENGG 400 - The Practice of the Engineering Profession

## Notes

1. MATH 201 must be taken in either Term 3 or 4.
2. See Program and Technical Electives for restrictions on the program electives.

## Chemical: Oil Sands Elective [Engineering]

## Year 2

### Term 3

- CH E 243 - Engineering Thermodynamics
- CME 200 - Introduction to Chemical and Materials Engineering
- CME 265 - Process Analysis

- CHEM 261 - Organic Chemistry I
- MATH 209 - Calculus III
- Complementary Studies Elective (3-0-0)
- Complementary Studies Elective (3-0-0)

#### Term 4

- CH E 312 - Fluid Mechanics
- ECE 209 - Fundamentals of Electrical Engineering
- MAT E 202 - Materials Science II
- MATH 201 - Differential Equations
- STAT 235 - Introductory Statistics for Engineering
- ITS Elective (3-0-0)

#### Year 3

#### Term 5

- CH E 314 - Heat Transfer
- CH E 343 - Chemical Engineering Thermodynamics
- CH E 351 - Chemical Engineering Laboratory
- CH E 374 - Computational Methods in Engineering
  
- ENG M 310 - Engineering Economy **OR**
- ENG M 401 - Financial Management for Engineers

#### Term 6

- CH E 316 - Equilibrium Stage Process
- CH E 318 - Mass Transfer
- CH E 345 - Chemical Reactor Analysis I
- CH E 358 - Process Data Analysis
- Program Elective (3-0-0)
- ENGG 404 - Engineering Safety and Risk Management-Leadership in Risk Management

## Year 4

### Term 7

- CH E 445 - Chemical Reactor Analysis II
- CH E 446 - Process Dynamics and Control
- CH E 464 - Chemical Engineering Design I
- CME 481 - Colloquium I
- Program Elective (3-0-0)
- Complementary Studies Elective (3-0-0)

### Term 8

- CH E 435 - Oilsands Engineering Design
- CH E 454 - Chemical Engineering Project Laboratory
- CH E 522 - Fundamentals of Oil Sands Upgrading
- CH E 534 - Fundamentals of Oilsands Extraction
- CME 483 - Colloquium II
- ENGG 400 - The Practice of the Engineering Profession

### Note:

See Program and Technical Electives for restrictions on the program electives.

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

- Chemical Plan I
- Chemical Plan II
- Chemical Plan II: Biomedical Option
- Chemical: Computer Process Control Option (Co-op)
- Chemical: Oil Sands Elective (Co-op)

## **Chemical Plan I [Engineering]**

### Year 2

#### Fall Term 3

- CH E 243 - Engineering Thermodynamics
- CME 200 - Introduction to Chemical and Materials Engineering



- CHEM 261 - Organic Chemistry I
- ENGG 299 - Orientation to Cooperative Education
- MAT E 202 - Materials Science II
- MATH 209 - Calculus III
- Complementary Studies Elective (3-0-0)
- Complementary Studies Elective (3-0-0)

### Winter Term 4

- CME 265 - Process Analysis
- CH E 312 - Fluid Mechanics
- ECE 209 - Fundamentals of Electrical Engineering
- MATH 201 - Differential Equations
- ITS Elective (3-0-0)
- STAT 235 - Introductory Statistics for Engineering

### Summer

- WKEXP 901 - Engineering Work Experience I

### Year 3

#### Fall

- WKEXP 902 - Engineering Work Experience II

#### Winter Term 5

- CH E 314 - Heat Transfer
- CH E 343 - Chemical Engineering Thermodynamics
- CH E 351 - Chemical Engineering Laboratory
- CH E 374 - Computational Methods in Engineering
- Program Elective (3-0-0)

#### Summer Term 6

- CH E 316 - Equilibrium Stage Process
- CH E 318 - Mass Transfer
- CH E 345 - Chemical Reactor Analysis I
- CH E 358 - Process Data Analysis

- ENG M 310 - Engineering Economy **OR**
- ENG M 401 - Financial Management for Engineers
  
- ENGG 404 - Engineering Safety and Risk Management-Leadership in Risk Management

## Year 4

### Fall

- WKEXP 903 - Engineering Work Experience III

### Winter Term 7

- CH E 445 - Chemical Reactor Analysis II
- CH E 446 - Process Dynamics and Control
- CH E 464 - Chemical Engineering Design I
- CME 481 - Colloquium I
- Program Elective (3-1s-0)
- Complementary Studies Elective (3-0-0)

### Summer

- WKEXP 904 - Engineering Work Experience IV

## Year 5

### Fall

- WKEXP 905 - Engineering Work Experience V

### Winter Term 8

- CH E 454 - Chemical Engineering Project Laboratory
- CH E 465 - Chemical Engineering Design II
- CME 483 - Colloquium II
- ENGG 400 - The Practice of the Engineering Profession
- Program Elective (3-1s-0)
- Program Elective (3-1s-0)

### Note:

See Program and Technical Electives for restrictions on the four program electives.

## Chemical Plan II [Engineering]

### Year 2

#### Fall Term 3

- CH E 243 - Engineering Thermodynamics
- CHEM 261 - Organic Chemistry I
- CME 200 - Introduction to Chemical and Materials Engineering
- CME 265 - Process Analysis
- ENGG 299 - Orientation to Cooperative Education
- MATH 209 - Calculus III
- Complementary Studies Elective (3-0-0)
- Complementary Studies Elective (3-0-0)

#### Winter

- WKEXP 901 - Engineering Work Experience I

#### Summer Term 4

- CH E 312 - Fluid Mechanics
- ECE 209 - Fundamentals of Electrical Engineering
- MAT E 202 - Materials Science II
- MATH 201 - Differential Equations
  
- ENG M 310 - Engineering Economy **OR**
- ENG M 401 - Financial Management for Engineers
  
- STAT 235 - Introductory Statistics for Engineering

### Year 3

#### Fall Term 5

- CH E 314 - Heat Transfer
- CH E 343 - Chemical Engineering Thermodynamics
- CH E 351 - Chemical Engineering Laboratory
- CH E 374 - Computational Methods in Engineering
- Program Elective (3-0-0)

#### Winter

- WKEXP 902 - Engineering Work Experience II

#### Summer

- WKEXP 903 - Engineering Work Experience III

### Year 4

#### Fall Term 6

- CH E 316 - Equilibrium Stage Process
- CH E 318 - Mass Transfer
- CH E 345 - Chemical Reactor Analysis I
- CH E 358 - Process Data Analysis
- ITS Elective (3-0-0)
- ENGG 404 - Engineering Safety and Risk Management-Leadership in Risk Management

#### Winter Term 7

- CH E 445 - Chemical Reactor Analysis II
- CH E 446 - Process Dynamics and Control
- CH E 464 - Chemical Engineering Design I
- CME 481 - Colloquium I
- Program Elective (3-1s-0)
- Complementary Studies Elective (3-0-0)

## Summer

- WKEXP 904 - Engineering Work Experience IV

## Year 5

### Fall

- WKEXP 905 - Engineering Work Experience V

### Winter Term 8

- CH E 454 - Chemical Engineering Project Laboratory
- CH E 465 - Chemical Engineering Design II
- CME 483 - Colloquium II
- ENGG 400 - The Practice of the Engineering Profession
- Program Elective (3-1s-0)
- Program Elective (3-1s-0)

## Notes

1. See Program and Technical Electives for restrictions on the four program 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 [Engineering]

## Year 2

### Fall Term 3

- BIOL 107 - Introduction to Cell Biology
- CH E 243 - Engineering Thermodynamics
- CHEM 261 - Organic Chemistry I
- CME 200 - Introduction to Chemical and Materials Engineering
- CME 265 - Process Analysis
- ENGG 299 - Orientation to Cooperative Education
- MATH 209 - Calculus III
- Complementary Studies Elective (3-0-0)

## Winter

- WKEXP 901 - Engineering Work Experience I

## Summer Term 4

- CH E 312 - Fluid Mechanics
- ECE 209 - Fundamentals of Electrical Engineering
  
- ENG M 310 - Engineering Economy **OR**
- ENG M 401 - Financial Management for Engineers
  
- MAT E 202 - Materials Science II
- MATH 201 - Differential Equations
- STAT 235 - Introductory Statistics for Engineering

## Year 3

### Fall Term 5

- BIOCH 200 - Introductory Biochemistry **OR**
- BIOL 201 - Eukaryotic Cellular Biology **OR**
- CELL 201 - Introduction to Molecular Cell Biology
  
- CH E 314 - Heat Transfer
- CH E 343 - Chemical Engineering Thermodynamics
- CH E 351 - Chemical Engineering Laboratory
- CH E 374 - Computational Methods in Engineering
- ENGG 404 - Engineering Safety and Risk Management-Leadership in Risk Management

## Winter

- WKEXP 902 - Engineering Work Experience II

## Summer

- WKEXP 903 - Engineering Work Experience III

## Year 4

### Fall Term 6

- BME 320 - Human Anatomy and Physiology: Cells and Tissue
- CH E 316 - Equilibrium Stage Process
- CH E 318 - Mass Transfer
- CH E 345 - Chemical Reactor Analysis I
- CH E 358 - Process Data Analysis
- PHIL 386 - Health Care Ethics

### Winter Term 7

- BME 321 - Human Anatomy and Physiology: Systems
- CH E 446 - Process Dynamics and Control
- CH E 464 - Chemical Engineering Design I
- CME 481 - Colloquium I
- ITS Elective (3-0-0)
- Complementary Studies Elective (3-0-0)

### Summer

- WKEXP 904 - Engineering Work Experience IV

## Year 5

### Fall

- WKEXP 906 - Engineering Work Experience VI

### Winter Term 8

- CH E 454 - Chemical Engineering Project Laboratory
- CH E 465 - Chemical Engineering Design II
- CME 483 - Colloquium II
- ENGG 400 - The Practice of the Engineering Profession
- Program Elective (3-1s-0)
- Program Elective (3-1s-0)

## Notes

(1) Students who are interested in applying for admission into the Faculty of Medicine and Dentistry MD program should refer to Program and Technical Electives.

(2) See Program and Technical Electives for restrictions on the two program electives.

## Chemical: Computer Process Control Option (Co-op) [Engineering]

### Year 2

#### Fall Term 3

- CH E 243 - Engineering Thermodynamics
- CHEM 261 - Organic Chemistry I
- CME 200 - Introduction to Chemical and Materials Engineering
- ECE 202 - Electrical Circuits I
- ECE 210 - Introduction to Digital Logic Design
- ENGG 299 - Orientation to Cooperative Education
- MATH 209 - Calculus III
- Complementary Studies Elective (3-0-0)

#### Winter Term 4

- CH E 312 - Fluid Mechanics
- CME 265 - Process Analysis
- MAT E 202 - Materials Science II
- MATH 201 - Differential Equations
- STAT 235 - Introductory Statistics for Engineering
- Complementary Studies Elective (3-0-0)

#### Summer

- WKEXP 901 - Engineering Work Experience I

### Year 3

#### Fall

- WKEXP 902 - Engineering Work Experience II



### Winter Term 5

- CH E 314 - Heat Transfer
- CH E 343 - Chemical Engineering Thermodynamics
- CH E 351 - Chemical Engineering Laboratory
- CH E 374 - Computational Methods in Engineering
- CH E 446 - Process Dynamics and Control
- Complementary Studies Elective (3-0-0)

### Summer Term 6

- CH E 316 - Equilibrium Stage Process
- CH E 318 - Mass Transfer
- CH E 345 - Chemical Reactor Analysis I
- CH E 358 - Process Data Analysis
  
- ENG M 310 - Engineering Economy **OR**
- ENG M 401 - Financial Management for Engineers
  
- ENGG 404 - Engineering Safety and Risk Management-Leadership in Risk Management

## Year 4

### Fall

- WKEXP 903 - Engineering Work Experience III

### Winter Term 7

- CH E 464 - Chemical Engineering Design I
- CH E 472 - Modelling Process Dynamics
- CME 481 - Colloquium I
- Program Elective (3-1s-0)
- Program Elective (3-1s-0)
- ITS Elective (3-0-0)

### Summer

- WKEXP 904 - Engineering Work Experience IV

## Year 5

### Fall

- WKEXP 905 - Engineering Work Experience V

### Winter Term 8

- CH E 454 - Chemical Engineering Project Laboratory
- CH E 465 - Chemical Engineering Design II
- CH E 573 - Digital Signal Processing for Chemical Engineers
- CH E 576 - Intermediate Process Control
- CME 483 - Colloquium II
- ENGG 400 - The Practice of the Engineering Profession

## Notes

1. MATH 201 must be taken in either Term 3 or 4.
2. See Program and Technical Electives for restrictions on the program electives.

## **Chemical: Oil Sands Elective (Co-op) [Engineering]**

## Year 2

### Fall Term 3

- CH E 243 - Engineering Thermodynamics
- CHEM 261 - Organic Chemistry I
- CME 200 - Introduction to Chemical and Materials Engineering
- CME 265 - Process Analysis
- ENGG 299 - Orientation to Cooperative Education
- MATH 209 - Calculus III
- Complementary Studies Elective (3-0-0)
- Complementary Studies Elective (3-0-0)

### Winter

- WKEXP 901 - Engineering Work Experience I

### Summer Term 4

- CH E 312 - Fluid Mechanics
- ECE 209 - Fundamentals of Electrical Engineering
  
- ENG M 310 - Engineering Economy **OR**
- ENG M 401 - Financial Management for Engineers
  
- MAT E 202 - Materials Science II
- MATH 201 - Differential Equations
- STAT 235 - Introductory Statistics for Engineering

### Year 3

#### Fall Term 5

- CH E 314 - Heat Transfer
- CH E 343 - Chemical Engineering Thermodynamics
- CH E 351 - Chemical Engineering Laboratory
- CH E 374 - Computational Methods in Engineering
- Program Elective (3-0-0)

#### Winter

- WKEXP 902 - Engineering Work Experience II

#### Summer

- WKEXP 903 - Engineering Work Experience III

### Year 4

#### Fall Term 6

- CH E 316 - Equilibrium Stage Process
- CH E 318 - Mass Transfer
- CH E 345 - Chemical Reactor Analysis I
- CH E 358 - Process Data Analysis
- ITS Elective (3-0-0)
- ENGG 404 - Engineering Safety and Risk Management-Leadership in Risk Management

### Winter Term 7

- CH E 445 - Chemical Reactor Analysis II
- CH E 446 - Process Dynamics and Control
- CH E 464 - Chemical Engineering Design I
- CME 481 - Colloquium I
- Complementary Studies Elective (3-0-0)
- Program Elective (3-0-0)

### Summer

- WKEXP 904 - Engineering Work Experience IV

### Year 5

#### Fall

- WKEXP 905 - Engineering Work Experience V

### Winter Term 8

- CH E 435 - Oilsands Engineering Design
- CH E 454 - Chemical Engineering Project Laboratory
- CH E 522 - Fundamentals of Oil Sands Upgrading
- CH E 534 - Fundamentals of Oilsands Extraction
- CME 483 - Colloquium II
- ENGG 400 - The Practice of the Engineering Profession

### Note:

See Program and Technical Electives for restrictions on the program electives.

### Program and Technical Electives

- Chemical
- Chemical: Biomedical Option
- Chemical: Computer Process Control Option
- Chemical: Oil Sands Elective

## Chemical (Program and Technical Electives) [Engineering]

### Of the four single-term program electives

Exactly one must be a "Science" elective selected from:

- BIOL 107 - Introduction to Cell Biology
- BIOL 108 - Introduction to Biological Diversity
- CHEM 211 - Quantitative Analysis I
- CHEM 263 - Organic Chemistry II
- EAS 100 - Planet Earth
- EAS 210 - Engineering Earth Science
- PHYS 230 - Electricity and Magnetism
- PHYS 244 - Mechanics
- PHYS 271 - Introduction to Modern Physics

At least two must be Engineering Science and/or Engineering Design courses selected from:

- BME 320 - Human Anatomy and Physiology: Cells and Tissue
- BME 321 - Human Anatomy and Physiology: Systems
- CME 421 - Mineral Processing
- CME 422
- CME 458 - Special Projects in Chemical and Materials Engineering I (see Note)
- CME 459 - Special Projects in Chemical and Materials Engineering II (see Note)
- CME 472 - Extractive Metallurgy
- CME 482 - Fundamentals of Polymers
- CME 484
- CME 485
- CME 494 - Special Topics in Chemical and Materials Engineering
- CME 496
- CH E 420 - Mixing in the Process Industries
- CH E 472 - Modelling Process Dynamics
- CH E 482
- CH E 484 - Introduction to Biochemical Engineering
- CH E 485 - Fuel Cells and Their Applications
- CH E 487
- CH E 494 - Special Topics in Chemical Engineering
- CH E 496
- CH E 512 - Introduction to Fluid-Particle Systems
- CH E 522 - Fundamentals of Oil Sands Upgrading
- CH E 534 - Fundamentals of Oilsands Extraction
- CH E 572

- CH E 573 - Digital Signal Processing for Chemical Engineers
- CH E 576 - Intermediate Process Control
- CH E 580
- CH E 582 - Introduction to Biomaterials
- CH E 594
- CH E 596
- CH E 583
- CH E 584
- CIV E 270 - Mechanics of Deformable Bodies I
- CIV E 321 - Principles of Environmental Modeling and Risk
- ECE 203 - Electrical Circuits II
- ECE 210 - Introduction to Digital Logic Design
- ECE 212 - Introduction to Microprocessors
- ENGG 406 - Engineering Safety and Risk Management - Methodologies and Tools
- ENG M 501 - Production and Operations Management
- ENG M 530 - Engineering Project Management
- ENV E 302 - Environmental Impact Assessment
- MAT E 335 - Phase Transformations I
- MAT E 336 - Phase Transformations II
- MAT E 341 - Applied Electrochemistry
- MAT E 345 - Corrosion, Oxidation, and Degradation
- MAT E 351 - Mechanical Properties
- MAT E 466 - Special Topics in Materials Engineering
- MAT E 471 - Ceramics
- MAT E 473 - Processing of Materials
- MAT E 474 - Performance of Materials
- MAT E 491 - Solid State Physics of Materials
- MAT E 494 - Nanostructured Materials
- MAT E 495 - Nanomaterials and Biomedical Applications
- MEC E 250 - Engineering Mechanics II
- MEC E 443 - Energy Conversion
- MGTSC 405 - Forecasting for Planners and Managers
- MIN E 310 - Ore Reserve Estimation
- PET E 364 - Drilling Engineering
- PET E 365 - Well Logging and Formation Evaluation
- PET E 366 - Petroleum Production Operations
- PET E 475 - Applied Reservoir Engineering

Note:

CME 458 or CME 459 may only be taken with an appropriate project approved by the department.

No more than one single-term program elective may be selected from the following approved list:

- BIOCH 200 - Introductory Biochemistry
- BIOL 201 - Eukaryotic Cellular Biology
- BIOL 208 - Principles of Ecology
- BIOL 381 - A Planet in Crisis
- BOT 340 - Plant Physiology
- CELL 201 - Introduction to Molecular Cell Biology
- CHEM 211 - Quantitative Analysis I
- CHEM 213 - Quantitative Analysis II
- CHEM 303 - Environmental Chemistry I
- CHEM 333 - Inorganic Materials Chemistry
- CHEM 479 - Molecular Kinetics
- CHEM 495 - Molecular Dynamics and its Applications
- EAS 201 - Earth Science I
- EAS 209 - Geology of Western Canada and the National and Provincial Parks
- MATH 225 - Linear Algebra II
- MATH 241 - Geometry
- MATH 300 - Advanced Boundary Value Problems I
- MATH 309 - Mathematical Methods for Electrical Engineers
- MATH 311 - Theory of Functions of a Complex Variable
- MATH 337 - Introduction to Partial Differential Equations
- MATH 371 - Mathematical Modelling in the Life Sciences
- MATH 373 - Mathematical Programming and Optimization I
- math 374
- MGTSC 405 - Forecasting for Planners and Managers
- MICRB 265 - General Microbiology
- MICRB 311 - Microbial Physiology
- MICRB 316 - Molecular Microbiology
- OM 352 - Operations Management
- OM 404
- OM 422 - Simulation and Computer Modelling Techniques in Management
- OM 426
- REN R 210 - Introduction to Soil Science
- REN R 355
- REN R 442 - Soil Biogeochemistry
- REN R 443 - Soil Physics
- REN R 444 - Environmental Soil Chemistry
- REN R 482 - Soil Remediation
- REN R 483 - Waste Management and Utilization

#### Note:

Other courses may be taken as program electives with written permission from the Department.

### Nanoscale Engineering Elective Stream

One of the four program electives should be MAT E 211. The remaining three program electives can be selected from CH E 487, CH E 583, CH E 584 and MAT E 495.

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

### Mineral Processing and Extractive Metallurgy Elective Stream

Three of the four program electives should be CME 421, CME 422 and CME 472. The fourth program elective can be selected from the above lists and must be approved by the Department.

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

### Polymer Materials Elective Stream

Three of the four program electives should be CME 482, CME 484 and CME 485. The fourth program elective can be selected from the above lists and must be approved by the Department.

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

## **Chemical: Biomedical Option (Program and Technical Electives) [Engineering]**

The two single-term program electives must be selected from the following: CH E 484, CH E 582, CME 458 or CME 459, MAT E 495 with appropriate project approved by department.

Admission requirements for the Doctor of Medicine (MD) degree program include a specific number of course units in various core subjects. This information can be found in Academic Requirements. Students in the Biomedical Option who plan to apply to the MD degree program must select their electives carefully to obtain the necessary credit for required subjects. It may also be necessary to take courses over and above those included in the Biomedical Option to meet the course unit requirements in all of the core subjects required for Medicine. Students in the Biomedical Option who plan to apply for admission to the MD degree program should contact their program advisor in the Fall term of second year for guidance on the selection of appropriate electives and any specific courses which would be in addition to those required for the engineering degree.

## **Chemical: Computer Process Control Option (Program and Technical Electives) [Engineering]**

The two single-term program electives must be selected from lists in Chemical. At least one of these electives must be Engineering Science and/or Engineering Design in Chemical. Other courses may be taken with written permission from the current Computer Process Control Advisor **prior** to enrollment.



## Chemical: Oil Sands Elective (Program and Technical Electives) [Engineering]

The two single-term program electives can be selected from lists in Chemical. At least one of these electives must be Engineering Science and/or Engineering Design in Chemical. Other courses may be taken with written permission from the current Oil Sands Advisor **prior** to enrollment.

### Complementary Studies Electives

- Complementary Studies Electives

## Complementary Studies Electives

To better understand the role of Engineering within a broader social context, all programs require an element of complementary studies consisting of the humanities, social sciences, arts, management, engineering economics and communications. Aspects of these topics are covered in mandatory courses, but each program contains complementary studies electives so that students may explore areas of particular interest. Notwithstanding this, the Canadian Engineering Accreditation Board requires that programs include exposure to the central thought processes of the humanities and social sciences. Students must take the number of complementary studies electives as required by their program. Students can take a maximum of one list 1 complementary studies elective. Note that in some cases, a course may appear both on a complementary studies list and as a program required or program elective course. A single course cannot be used to satisfy multiple course requirements under Programs of Study.

Students interested in taking a minor should select their first complementary studies courses with this in mind. For the Business minor, student should take ECON 204; for an Arts minor, students should select a course in a possible area of concentration of interest, see minors for specific requirements for each minor.

### List 1

- ANTHR 101 - Introductory Anthropology
- ANTHR 110 - Gender, Age, and Culture
- ANTHR 150 - Race and Racism
- CLASS 102 - Greek and Roman Mythology
- CLASS 103 - Introduction to Ancient Greece
- CLASS 104 - Introduction to Ancient Rome
- CLASS 110 - The Ancient World
- ECON 101 - Introduction to Microeconomics
- ECON 102 - Introduction to Macroeconomics
- ENGL 125 - Aboriginal Writing \*
- HIST 110 - The Pre-Modern World
- HIST 111 - The Early Modern World
- HIST 112 - The Modern World
- HIST 114 - The History of the World in the Last 10 Years
- HIST 116 - The Emergence of the Atlantic World
- LING 101 - Introduction to Linguistic Analysis
- PHIL 120 - Symbolic Logic I

- PHIL 125 - Practical Logic
- POL S 101 - Introduction to Politics
- PSYCO 104 - Basic Psychological Processes
- SOC 100 - Introductory Sociology

## List 2

- ACCTG 300 - Introduction to Accounting
- ACCTG 311 - Introduction to Accounting for Financial Performance
- ANTHR 230 - Anthropology of Science, Technology, and Environment
- AREC 365 - Natural Resource Economics
- B LAW 301 - Legal Foundations of the Canadian Economy \*\*
- B LAW 422 - Law of Business Organizations
- B LAW 428 - Natural Resource and Environmental Law \*\*\*
- B LAW 432 - The Legal Regulation of Business
- CHRTC 350 - Science and Religion: Christian Perspectives
- CLASS 254 - Introduction to Greek Art and Archaeology
- CLASS 255 - Introduction to Roman Art and Archaeology
- CLASS 283 - Introductory Roman History II
- CLASS 294 - Ancient Science, Technology, and Medicine
- CLASS 376
- ECON 204 - Principles of Economics
- ECON 281 - Intermediate Microeconomic Theory I
- ECON 282 - Intermediate Macroeconomic Theory I
- ENGG 420 - Engineering Law
- ENG M 402 - Project Management and Entrepreneurship
- ENG M 406
- HECOL 211 - Human Sexuality
- HIST 260 - Pre-Confederation Canada
- HIST 261 - Post-Confederation Canada
- HIST 295 - 20th-Century Warfare
- HIST 397 - History of Science I
- HIST 398 - History of Science II
- INT D 303 - Economics of World Food and Agriculture
- LA ST 210 - South America
- LING 204 - English Syntax
- LING 205 - Phonetics
- MARK 301 - Introduction to Marketing
- OM 352 - Operations Management
- PHIL 205 - Philosophy of Mind
- PHIL 220 - Symbolic Logic II
- PHIL 250 - Contemporary Ethical Issues
- PHIL 325 - Risk, Choice, and Rationality

- PHIL 355 - Environmental Ethics
- POL S 223 - City Government and Politics
- PSYCO 258 - Cognitive Psychology
- PSYCO 275 - Brain and Behavior
- R SOC 355 - Rural Communities and Global Economies
- R SOC 365 - Sociology of Environment and Development
- SMO 200 - Introduction to Management for Non-Business Students
- SMO 301 - Behavior in Organizations
- SMO 330 - Introduction to Entrepreneurship
- SOC 212 - Classical Social Theory
- SOC 224 - Sociology of Deviance and Conformity
- SOC 225 - Criminology
- SOC 241 - Social Psychology
- SOC 242 - Biologically Coordinated Social Psychology
- SOC 251 - Population and Society
- SOC 301 - Sociology of Gender
- WGS 220 - Feminism and Popular Culture

### Notes:

\*\*Not available to Civil students

\*\*\*Not available to Civil (Environmental Engineering Option) students.

A second course from the ITS List may be taken as part of List 2. However, a single course cannot be used to satisfy both the ITS and Complementary Studies requirements. This list is updated annually. Courses that teach a language or the application of a particular skill (such as courses in physical education, music and art) do not meet the intent of the Accreditation Board with respect to complementary studies and are therefore not eligible.

### 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:

- ENG M 403
- ENG M 405
- HIST 115 - Technology and History
- HIST 391 - History of Technology
- HGP 250 - Natural Resources and Environmental Management
- INT D 361
- PHIL 265 - Philosophy of Science
- PHIL 366 - Computers and Culture
- PHIL 375
- STS 200 - Introduction to Studies in Science, Technology and Society
- SOC 366 - People in Industry
- SOC 363 - Sociology of Work and Industry

## English Electives

Engineering programs require ENGL 199.

## 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.

## 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 apply principles of chemistry, physics, biology, microbiology, mathematics, civil engineering, and chemical engineering to provide technological solutions to environmental challenges. Environmental engineers are active in such areas as water and air pollution control, water treatment, industrial and municipal wastewater treatment, disposal or recycling of solid wastes, hazardous waste management, remediation of contaminated soil and groundwater, waste to energy, as well as environmental and health risk assessment.

### 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.

## Environmental Engineering Option in Civil Engineering

This option will prepare students to work as environmental engineers, civil engineers or at the cross roads of both disciplines. Environmental Engineering Option courses in the Civil Engineering Program cover topics such as drinking water supply, environmental systems modelling, water and wastewater treatment, contaminated soil and groundwater remediation, air quality engineering, and exposure and risk assessment. These courses apply principles of chemistry, physics, biology, microbiology, mathematics, civil engineering, and chemical engineering to provide a solid foundation in environmental engineering. This option will better prepare students to work in areas of safe drinking water provision, water pollution control, industrial and municipal wastewater treatment, solid and hazardous waste management and treatment disposal and recycling, soil and groundwater remediation, air quality assessment, and air pollution control in industrial and municipal environments.

Enrolment is limited.

## Required Courses and Suggested Course Sequence for Traditional Programs

- Civil
- Civil: Environmental Engineering Option

## Civil [Engineering]

### Year 2

### Term 3

- CIV E 265 - Engineering Drawing and Computer Graphics
- CIV E 270 - Mechanics of Deformable Bodies I
- EAS 210 - Engineering Earth Science

- MAT E 202 - Materials Science II
- MATH 209 - Calculus III

#### Term 4

- CIV E 221 - Environmental Engineering Fundamentals
- CIV E 240 - Technical Communications
- CIV E 250 - Plane Surveying
- CIV E 251 - Survey School \*
- CIV E 295 - Civil Engineering Analysis II
- MATH 201 - Differential Equations
- STAT 235 - Introductory Statistics for Engineering

#### Note:

\*Held in Spring/Summer (Spring Term)

### Year 3

#### Term 5

- CIV E 330 - Introduction to Fluid Mechanics
- CIV E 372 - Structural Analysis I
- CIV E 391 - Civil Engineering Materials
- CIV E 395 - Civil Engineering Analysis III
- CIV E 398 - Introduction to Continuum Mechanics
- Complementary Studies Elective (3-0-0)

#### Term 6

- CIV E 303 - Project Management
- CIV E 315 - Transportation Engineering
- CIV E 321 - Principles of Environmental Modeling and Risk
- CIV E 331 - Applied Hydraulics
- CIV E 374 - Structural Design I
- CIV E 381 - Soil Mechanics

## Year 4

### Term 7

- Program Elective (See Note)
- Program Elective (See Note)
- Program Elective (See Note)
- ENGG 404 - Engineering Safety and Risk Management-Leadership in Risk Management

### One of

- ECE 209 - Fundamentals of Electrical Engineering
- MEC E 250 - Engineering Mechanics II
- CH E 243 - Engineering Thermodynamics

### Term 8

- ENG M 310 - Engineering Economy **OR**
- ENG M 401 - Financial Management for Engineers
  
- ENGG 400 - The Practice of the Engineering Profession
- ENGG 420 - Engineering Law
- Program Elective (See Note)
- Program Elective (See Note)
- ITS Elective (3-0-0)

## Note:

See Program and Technical Electives for restrictions on the program electives.

## Civil: Environmental Engineering Option [Engineering]

## Year 2

### Term 3

- CIV E 265 - Engineering Drawing and Computer Graphics
- CIV E 270 - Mechanics of Deformable Bodies I
- EAS 210 - Engineering Earth Science
- ENV E 220 - Environmental Chemistry for Engineering

- MATH 209 - Calculus III

#### Term 4

- CIV E 240 - Technical Communications
- CIV E 250 - Plane Surveying
- CIV E 251 - Survey School \*
- CIV E 295 - Civil Engineering Analysis II
- ENV E 251 - Properties of Environmental Engineering Materials
- MATH 201 - Differential Equations
- STAT 235 - Introductory Statistics for Engineering

#### Note:

\*Held in Spring/Summer (Spring Term)

### Year 3

#### Term 5

- CH E 243 - Engineering Thermodynamics
- CIV E 330 - Introduction to Fluid Mechanics
- CIV E 372 - Structural Analysis I
- CIV E 395 - Civil Engineering Analysis III
- ENV E 322 - Environmental Protection
- ENV E 324 - Biological Processes

#### Term 6

- CIV E 331 - Applied Hydraulics
- CIV E 381 - Soil Mechanics
- ENV E 302 - Environmental Impact Assessment
- ENV E 325 - Chemical and Physical Processes
- ENGG 404 - Engineering Safety and Risk Management-Leadership in Risk Management
- Complementary Studies Elective (3-0-0)

### Year 4

#### Term 7

- CIV E 374 - Structural Design I



- ENV E 320 - Environmental Hydrology
- ENV E 421 - Municipal Systems
- ENV E 423 - Principles of Air Quality Management and Control
- ENV E 432 - Solid Waste Management

One of

- CIV E 524 - Environmental Biotechnology
- CIV E 526 - Soil Remediation

Note:

\*All courses may not be offered every year.

Winter Term 8

- ENG M 310 - Engineering Economy **OR**
- ENG M 401 - Financial Management for Engineers
  
- ENGG 400 - The Practice of the Engineering Profession
- ENV E 434 - Environmental Geotechnics
- ENV E 440 - Facility Design
- LAW 399 - Introduction to Environmental Law
- ITS Elective (3-0-0)

One of

- ECE 209 - Fundamentals of Electrical Engineering
- MAT E 202 - Materials Science II
- MEC E 250 - Engineering Mechanics II

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

- Civil
- Civil: Environmental Engineering Option

## Civil (Co-op) [Engineering]

### Year 2

#### Fall Term 3

- CIV E 265 - Engineering Drawing and Computer Graphics
- CIV E 270 - Mechanics of Deformable Bodies I
- ENGG 299 - Orientation to Cooperative Education
- EAS 210 - Engineering Earth Science
- MAT E 202 - Materials Science II
- MATH 209 - Calculus III

#### Winter Term 4

- CIV E 221 - Environmental Engineering Fundamentals
- CIV E 240 - Technical Communications
- CIV E 250 - Plane Surveying
- CIV E 251 - Survey School \*
- CIV E 295 - Civil Engineering Analysis II
- MATH 201 - Differential Equations
- STAT 235 - Introductory Statistics for Engineering

#### Note:

\*Held in Spring/Summer (Spring Term)

#### Summer

- WKEXP 901 - Engineering Work Experience I

### Year 3

#### Fall

- WKEXP 902 - Engineering Work Experience II

#### Winter Term 5

- CIV E 303 - Project Management

- CIV E 315 - Transportation Engineering
- CIV E 321 - Principles of Environmental Modeling and Risk
- CIV E 330 - Introduction to Fluid Mechanics
- CIV E 372 - Structural Analysis I
- CIV E 395 - Civil Engineering Analysis III

### Summer

- WKEXP 903 - Engineering Work Experience III

### Year 4

#### Fall Term 6

- CIV E 331 - Applied Hydraulics
- CIV E 374 - Structural Design I
- CIV E 381 - Soil Mechanics
- CIV E 391 - Civil Engineering Materials
- CIV E 398 - Introduction to Continuum Mechanics
- Complementary Studies Elective (3-0-0)

### Winter

- WKEXP 904 - Engineering Work Experience IV

### Summer

- WKEXP 905 - Engineering Work Experience V

### Year 5

#### Fall Term 7

- Program Elective (See Note)
- Program Elective (See Note)
- Program Elective (See Note)
- ENGG 404

One of

- ECE 209 - Fundamentals of Electrical Engineering
- MEC E 250 - Engineering Mechanics II
- CH E 243 - Engineering Thermodynamics

Winter Term 8

- ENG M 310 - Engineering Economy **OR**
- ENG M 401 - Financial Management for Engineers
  
- ENGG 400 - The Practice of the Engineering Profession
- ENGG 420 - Engineering Law
- Program Elective (See Note)
- Program Elective (See Note)
- ITS Elective (3-0-0)

Note:

See Program and Technical Electives for restrictions on the program electives.

## Civil: Environmental Engineering Option (Co-op) [Engineering]

Year 2

Fall Term 3

- CIV E 265 - Engineering Drawing and Computer Graphics
- CIV E 270 - Mechanics of Deformable Bodies I
- ENGG 299 - Orientation to Cooperative Education
- ENV E 220 - Environmental Chemistry for Engineering
- EAS 210 - Engineering Earth Science
- MATH 209 - Calculus III

Winter Term 4

- CIV E 240 - Technical Communications
- CIV E 250 - Plane Surveying
- CIV E 251 - Survey School \*
- CIV E 295 - Civil Engineering Analysis II

- ENV E 251 - Properties of Environmental Engineering Materials
- MATH 201 - Differential Equations
- STAT 235 - Introductory Statistics for Engineering

Note:

\*Held in Spring/Summer (Spring Term)

### Summer

- WKEXP 901 - Engineering Work Experience I

### Year 3

#### Fall

- WKEXP 902 - Engineering Work Experience II

#### Winter Term 5

- CIV E 330 - Introduction to Fluid Mechanics
- CIV E 395 - Civil Engineering Analysis III
- ENV E 302 - Environmental Impact Assessment
- ENV E 325 - Chemical and Physical Processes
- ENGG 404 - Engineering Safety and Risk Management-Leadership in Risk Management
- Complementary Studies Elective (3-0-0)

#### Summer

- WKEXP 903 - Engineering Work Experience III

### Year 4

#### Fall Term 6

- CH E 243 - Engineering Thermodynamics
- CIV E 331 - Applied Hydraulics
- CIV E 372 - Structural Analysis I
- CIV E 381 - Soil Mechanics
- ENV E 322 - Environmental Protection

- ENV E 324 - Biological Processes

### Winter

- WKEXP 904 - Engineering Work Experience IV

### Summer

- WKEXP 905 - Engineering Work Experience V

## Year 5

### Fall Term 7

- CIV E 374 - Structural Design I
- ENV E 320 - Environmental Hydrology
- ENV E 421 - Municipal Systems
- ENV E 423 - Principles of Air Quality Management and Control
- ENV E 432 - Solid Waste Management

### One of

- CIV E 524 - Environmental Biotechnology
- CIV E 526 - Soil Remediation

### Note:

\*All courses may not be offered every year.

### Winter Term 8

- ENG M 310 - Engineering Economy **OR**
- ENG M 401 - Financial Management for Engineers
  
- ENGG 400 - The Practice of the Engineering Profession
- ENV E 434 - Environmental Geotechnics
- ENV E 440 - Facility Design
- LAW 399 - Introduction to Environmental Law
- ITS Elective (3-0-0)

One of

- ECE 209 - Fundamentals of Electrical Engineering
- MAT E 202 - Materials Science II
- MEC E 250 - Engineering Mechanics II

### Program and Technical Electives

- Civil

## Civil (Program and Technical Electives) [Engineering]

Five program electives are required

### Three must be selected from

- CIV E 406 - Construction Estimating, Planning, and Control
- CIV E 411 - Transportation Engineering II
- CIV E 431 - Water Resources Engineering
- CIV E 474 - Structural Design II
- CIV E 481 - Soil Engineering
- ENV E 421 - Municipal Systems

### and two from

- CIV E 409 - Construction Methods
- CIV E 419 - Transportation Engineering: Highway Planning and Design
- CIV E 429 - Environmental Engineering Design
- CIV E 439 - Water Resources Engineering Design
- CIV E 479 - Structural Design III
- CIV E 489 - Geotechnical Design

### Complementary Studies Electives

- Complementary Studies Electives

## Complementary Studies Electives

To better understand the role of Engineering within a broader social context, all programs require an element of complementary studies consisting of the humanities, social sciences, arts, management, engineering economics and communications. Aspects of these topics are covered in mandatory courses, but each program contains complementary studies electives so that students may explore areas of particular interest. Notwithstanding this, the Canadian Engineering Accreditation Board requires that programs include exposure to the central thought processes of the humanities and social sciences. Students must take the number of complementary studies electives as required by their program. Students can take a maximum of one list 1 complementary studies elective. Note that in some cases, a course may appear both on a complementary studies list and as a program required or program elective course. A single course cannot be used to satisfy multiple course requirements under Programs of Study.

Students interested in taking a minor should select their first complementary studies courses with this in mind. For the Business minor, student should take ECON 204; for an Arts minor, students should select a course in a possible area of concentration of interest, see minors for specific requirements for each minor.

### List 1

- ANTHR 101 - Introductory Anthropology
- ANTHR 110 - Gender, Age, and Culture
- ANTHR 150 - Race and Racism
- CLASS 102 - Greek and Roman Mythology
- CLASS 103 - Introduction to Ancient Greece
- CLASS 104 - Introduction to Ancient Rome
- CLASS 110 - The Ancient World
- ECON 101 - Introduction to Microeconomics
- ECON 102 - Introduction to Macroeconomics
- ENGL 125 - Aboriginal Writing \*
- HIST 110 - The Pre-Modern World
- HIST 111 - The Early Modern World
- HIST 112 - The Modern World
- HIST 114 - The History of the World in the Last 10 Years
- HIST 116 - The Emergence of the Atlantic World
- LING 101 - Introduction to Linguistic Analysis
- PHIL 120 - Symbolic Logic I
- PHIL 125 - Practical Logic
- POL S 101 - Introduction to Politics
- PSYCO 104 - Basic Psychological Processes
- SOC 100 - Introductory Sociology

### List 2

- ACCTG 300 - Introduction to Accounting
- ACCTG 311 - Introduction to Accounting for Financial Performance
- ANTHR 230 - Anthropology of Science, Technology, and Environment



- AREC 365 - Natural Resource Economics
- B LAW 301 - Legal Foundations of the Canadian Economy \*\*
- B LAW 422 - Law of Business Organizations
- B LAW 428 - Natural Resource and Environmental Law \*\*\*
- B LAW 432 - The Legal Regulation of Business
- CHRTC 350 - Science and Religion: Christian Perspectives
- CLASS 254 - Introduction to Greek Art and Archaeology
- CLASS 255 - Introduction to Roman Art and Archaeology
- CLASS 283 - Introductory Roman History II
- CLASS 294 - Ancient Science, Technology, and Medicine
- CLASS 376
- ECON 204 - Principles of Economics
- ECON 281 - Intermediate Microeconomic Theory I
- ECON 282 - Intermediate Macroeconomic Theory I
- ENGG 420 - Engineering Law
- ENG M 402 - Project Management and Entrepreneurship
- ENG M 406
- HECOL 211 - Human Sexuality
- HIST 260 - Pre-Confederation Canada
- HIST 261 - Post-Confederation Canada
- HIST 295 - 20th-Century Warfare
- HIST 397 - History of Science I
- HIST 398 - History of Science II
- INT D 303 - Economics of World Food and Agriculture
- LA ST 210 - South America
- LING 204 - English Syntax
- LING 205 - Phonetics
- MARK 301 - Introduction to Marketing
- OM 352 - Operations Management
- PHIL 205 - Philosophy of Mind
- PHIL 220 - Symbolic Logic II
- PHIL 250 - Contemporary Ethical Issues
- PHIL 325 - Risk, Choice, and Rationality
- PHIL 355 - Environmental Ethics
- POL S 223 - City Government and Politics
- PSYCO 258 - Cognitive Psychology
- PSYCO 275 - Brain and Behavior
- R SOC 355 - Rural Communities and Global Economies
- R SOC 365 - Sociology of Environment and Development
- SMO 200 - Introduction to Management for Non-Business Students
- SMO 301 - Behavior in Organizations
- SMO 330 - Introduction to Entrepreneurship
- SOC 212 - Classical Social Theory
- SOC 224 - Sociology of Deviance and Conformity

- SOC 225 - Criminology
- SOC 241 - Social Psychology
- SOC 242 - Biologically Coordinated Social Psychology
- SOC 251 - Population and Society
- SOC 301 - Sociology of Gender
- WGS 220 - Feminism and Popular Culture

### Notes:

\*\*Not available to Civil students

\*\*\*Not available to Civil (Environmental Engineering Option) students.

A second course from the ITS List may be taken as part of List 2. However, a single course cannot be used to satisfy both the ITS and Complementary Studies requirements. This list is updated annually. Courses that teach a language or the application of a particular skill (such as courses in physical education, music and art) do not meet the intent of the Accreditation Board with respect to complementary studies and are therefore not eligible.

### 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:

- ENG M 403
- ENG M 405
- HIST 115 - Technology and History
- HIST 391 - History of Technology
- HGP 250 - Natural Resources and Environmental Management
- INT D 361
- PHIL 265 - Philosophy of Science
- PHIL 366 - Computers and Culture
- PHIL 375
- STS 200 - Introduction to Studies in Science, Technology and Society
- SOC 366 - People in Industry
- SOC 363 - Sociology of Work and Industry

### English Electives

Engineering programs require ENGL 199.

## 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.

### 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.

### Nanoscale System Design Option in Computer Engineering

This option provides an introduction to the processes involved in the fabrication of nanoscale integrated circuits and to the computer aided design (CAD) tools necessary for the engineering of large scale systems on a chip. By selecting this option, students will learn about fault tolerance in nanoscale systems and gain an understanding of quantum phenomena in systems design.

The option retains most of the core elements of the traditional Computer Engineering Program and contains a number of new offerings in the form of program electives. Changes from the Traditional Computer Engineering Program occur only after second year.

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

- Computer
- Computer: Nanoscale System Design Option

## Computer (ENG) [Engineering]

### Year 2

#### Term 3

- CMPUT 274 - Introduction to Tangible Computing I
- ECE 202 - Electrical Circuits I
- ECE 210 - Introduction to Digital Logic Design
- MATH 201 - Differential Equations
- MATH 209 - Calculus III
- Complementary Studies Elective (3-0-0)

#### Term 4

- CMPUT 272 - Formal Systems and Logic in Computing Science
- CMPUT 275 - Introduction to Tangible Computing II
- ECE 203 - Electrical Circuits II
- ECE 212 - Introduction to Microprocessors
- ECE 240 - Continuous Time Signals and Systems
- PHYS 230 - Electricity and Magnetism

### Year 3

#### Term 5

- ECE 302 - Electronic Devices
- ECE 311 - Computer Organization and Architecture
- ECE 325 - Object-Oriented Software Design
- ECE 340 - Discrete Time Signals and Systems
- Group I Program Elective
  
- ENG M 310 - Engineering Economy **OR**
- ENG M 401 - Financial Management for Engineers

#### Term 6

- CMPUT 291 - Introduction to File and Database Management
- CMPUT 379 - Operating System Concepts
- ECE 315 - Computer Interfacing

- Complementary Studies Elective (3-0-0)
- Group II Program Elective
- ITS Elective (3-0-0)

## Year 4

### Term 7

- CMPUT 301 - Introduction to Software Engineering
- ECE 304 - Digital Electronics
- ECE 342 - Probability for Electrical and Computer Engineers
- ECE 410 - Advanced Digital Logic Design
- ENGG 404 - Engineering Safety and Risk Management-Leadership in Risk Management
- Group II Program Elective

### Term 8

- ECE 420 - Parallel and Distributed Programming
- ECE 487 - Data Communication Networks
- ECE 492 - Computer Engineering Design Project
- ENGG 400 - The Practice of the Engineering Profession
- Group I Program Elective
- Group II Program Elective

## Note:

See Program and Technical Electives for restrictions on the six program electives.

## Computer: Nanoscale System Design Option [Engineering]

## Year 2

### Term 3

- CMPUT 274 - Introduction to Tangible Computing I
- ECE 202 - Electrical Circuits I
- ECE 210 - Introduction to Digital Logic Design
- MATH 201 - Differential Equations
- MATH 209 - Calculus III
- Complementary Studies Elective (3-0-0)

## Term 4

- CMPUT 272 - Formal Systems and Logic in Computing Science
- CMPUT 275 - Introduction to Tangible Computing II
- ECE 203 - Electrical Circuits II
- ECE 212 - Introduction to Microprocessors
- ECE 240 - Continuous Time Signals and Systems
- PHYS 230 - Electricity and Magnetism

## Year 3

### Term 5

- ECE 302 - Electronic Devices
- ECE 311 - Computer Organization and Architecture
- ECE 325 - Object-Oriented Software Design
- ECE 342 - Probability for Electrical and Computer Engineers
- Complementary Studies Elective (3-0-0)
- Group I Program Elective

### Term 6

- CMPUT 291 - Introduction to File and Database Management
- ECE 315 - Computer Interfacing
- ECE 412 - Fault-Tolerant Computing
- ECE 450 - Nanoscale Phenomena in Electronic Devices
- ITS Elective (3-0-0)

## Year 4

### Term 7

- CMPUT 301 - Introduction to Software Engineering
- ECE 304 - Digital Electronics
- ECE 410 - Advanced Digital Logic Design
  
- ENG M 310 - Engineering Economy **OR**
- ENG M 401 - Financial Management for Engineers
  
- ENGG 404 - Engineering Safety and Risk Management-Leadership in Risk Management
- Group II Program Elective

## Term 8

- ECE 403 - Integrated Circuit Design
- ECE 457 - Microfabrication and Devices
- ECE 475 - Optoelectronic and Photovoltaic Devices
- ECE 492 - Computer Engineering Design Project
- ENGG 400 - The Practice of the Engineering Profession
- Group I Program Elective
- Group II Program Elective

### Note:

See Computer Engineering: Nanoscale System Design Option for restrictions on the program electives.

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

- Computer
- Computer: Nanoscale System Design Option
- Computer: Software Option

## Computer (Co-op) [Engineering]

### Year 2

#### Fall Term 3

- CMPUT 274 - Introduction to Tangible Computing I
- ECE 202 - Electrical Circuits I
- ECE 210 - Introduction to Digital Logic Design
- ENGG 299 - Orientation to Cooperative Education
- MATH 201 - Differential Equations
- MATH 209 - Calculus III

#### Winter Term 4

- CMPUT 272 - Formal Systems and Logic in Computing Science
- CMPUT 275 - Introduction to Tangible Computing II
- ECE 203 - Electrical Circuits II
- ECE 212 - Introduction to Microprocessors
- ECE 240 - Continuous Time Signals and Systems

- PHYS 230 - Electricity and Magnetism

### Summer

- WKEXP 901 - Engineering Work Experience I

## Year 3

### Fall Term 5

- CMPUT 291 - Introduction to File and Database Management
- ECE 302 - Electronic Devices
- ECE 311 - Computer Organization and Architecture
- ECE 325 - Object-Oriented Software Design
- ECE 340 - Discrete Time Signals and Systems
- Group I Program Elective

### Winter

- WKEXP 902 - Engineering Work Experience II

### Summer

- WKEXP 903 - Engineering Work Experience III

## Year 4

### Fall Term 6

- CMPUT 379 - Operating System Concepts
- ECE 304 - Digital Electronics
- ECE 342 - Probability for Electrical and Computer Engineers
- ECE 410 - Advanced Digital Logic Design
- Complementary Studies Elective (3-0-0)
- Group II Program Elective

### Winter Term 7

- CMPUT 301 - Introduction to Software Engineering
- ECE 315 - Computer Interfacing



- ECE 420 - Parallel and Distributed Programming
- Complementary Studies Elective (3-0-0)
- Group I Program Elective
- ITS Elective

### Summer

- WKEXP 904 - Engineering Work Experience IV

### Year 5

#### Fall

- WKEXP 905 - Engineering Work Experience V

#### Winter Term 8

- ECE 487 - Data Communication Networks
- ECE 492 - Computer Engineering Design Project
  
- ENG M 310 - Engineering Economy **OR**
- ENG M 401 - Financial Management for Engineers
  
- ENGG 400 - The Practice of the Engineering Profession
- ENGG 404 - Engineering Safety and Risk Management-Leadership in Risk Management
- Group II Program Elective
- Group II Program Elective

### Note:

See Program and Technical Electives for restrictions on the six program electives.

## Computer: Nanoscale System Design Option (Co-op) [Engineering]

### Year 2

#### Fall Term 3

- CMPUT 274 - Introduction to Tangible Computing I
- ECE 202 - Electrical Circuits I

- ECE 210 - Introduction to Digital Logic Design
- ENGG 299 - Orientation to Cooperative Education
- MATH 201 - Differential Equations
- MATH 209 - Calculus III

### Winter Term 4

- CMPUT 272 - Formal Systems and Logic in Computing Science
- CMPUT 275 - Introduction to Tangible Computing II
- ECE 203 - Electrical Circuits II
- ECE 212 - Introduction to Microprocessors
- ECE 240 - Continuous Time Signals and Systems
- PHYS 230 - Electricity and Magnetism

### Summer

- WKEXP 901 - Engineering Work Experience I

### Year 3

### Fall Term 5

- ECE 302 - Electronic Devices
- ECE 311 - Computer Organization and Architecture
- ECE 325 - Object-Oriented Software Design
- Complementary Studies Elective (3-0-0)
- Complementary Studies Elective (3-0-0)
- Group I Program Elective

### Winter

- WKEXP 902 - Engineering Work Experience II

### Summer

- WKEXP 903 - Engineering Work Experience III

## Year 4

### Fall Term 6

- CMPUT 291 - Introduction to File and Database Management
- ECE 304 - Digital Electronics
- ECE 342 - Probability for Electrical and Computer Engineers
- ECE 410 - Advanced Digital Logic Design
- ENGG 404 - Engineering Safety and Risk Management-Leadership in Risk Management
- ITS Elective (3-0-0)

### Winter Term 7

- CMPUT 301 - Introduction to Software Engineering
- ECE 315 - Computer Interfacing
- ECE 403 - Integrated Circuit Design
- ECE 450 - Nanoscale Phenomena in Electronic Devices
- ECE 475 - Optoelectronic and Photovoltaic Devices
  
- ENG M 310 - Engineering Economy **OR**
- ENG M 401 - Financial Management for Engineers

### Summer

- WKEXP 904 - Engineering Work Experience IV

## Year 5

### Fall Term 7

- WKEXP 905 - Engineering Work Experience V

### Winter Term 8

- ECE 412 - Fault-Tolerant Computing
- ECE 457 - Microfabrication and Devices
- ECE 492 - Computer Engineering Design Project
- ENGG 400 - The Practice of the Engineering Profession
- Group I Program Elective
- Group II Program Elective
- Group II Program Elective

### Note:

See Computer Engineering: Nanoscale System Design Option for restrictions on the program electives.

## Computer: Software Option (Co-op) [Engineering]

### Year 2

#### Fall Term 3

- CMPUT 274 - Introduction to Tangible Computing I
- ECE 202 - Electrical Circuits I
- ECE 210 - Introduction to Digital Logic Design
- ENGG 299 - Orientation to Cooperative Education
- MATH 201 - Differential Equations
- MATH 209 - Calculus III

#### Winter Term 4

- CMPUT 272 - Formal Systems and Logic in Computing Science
- CMPUT 275 - Introduction to Tangible Computing II
- ECE 212 - Introduction to Microprocessors
- ECE 240 - Continuous Time Signals and Systems
- PHYS 230 - Electricity and Magnetism
- Complementary Studies Elective (3-0-0)

#### Summer

- WKEXP 901 - Engineering Work Experience I

### Year 3

#### Fall Term 5

- ECE 311 - Computer Organization and Architecture
- ECE 321 - Software Requirements Engineering
- ECE 325 - Object-Oriented Software Design
- STAT 235 - Introductory Statistics for Engineering
- Group I Program Elective
- Complementary Studies Elective (3-0-0)

## Winter

- WKEXP 902 - Engineering Work Experience II

## Summer

- WKEXP 903 - Engineering Work Experience III

## Year 4

### Fall Term 6

- CMPUT 291 - Introduction to File and Database Management
- CMPUT 301 - Introduction to Software Engineering
- CMPUT 379 - Operating System Concepts
- ECE 322 - Software Testing and Maintenance Engineering
- Group I Program Elective
- ITS Elective (3-0-0)

### Winter Term 7

- ECE 315 - Computer Interfacing
- ECE 421 - Exploring Software Development Domains
- ECE 487 - Data Communication Networks
- ENGG 404 - Engineering Safety and Risk Management-Leadership in Risk Management
- Group II Program Elective
- Group II Program Elective

## Summer

- WKEXP 904 - Engineering Work Experience IV

## Year 5

### Fall

- WKEXP 905 - Engineering Work Experience V

## Winter Term 8

- ECE 420 - Parallel and Distributed Programming
- ECE 422 - Reliable and Secure Systems Design
- ECE 493 - Software Systems Design Project
  
- ENG M 310 - Engineering Economy **OR**
- ENG M 401 - Financial Management for Engineers
  
- ENGG 400 - The Practice of the Engineering Profession
- Group II Program Elective
- Group II Program Elective

## Notes

1. See Computer Engineering: Software Option for restrictions on the five program electives.
2. At the discretion of the Office of the Dean, students may be transferred to a traditional (non-coop) degree.

## Program and Technical Electives

- Computer
- Computer Engineering: Nanoscale System Design Option
- Computer Engineering: Software Option

## Computer (Program and Technical Electives) [Engineering]

### Group I (Interdisciplinary) Electives

Two from CH E 243, MAT E 201 and MEC E 250 must be selected.

### Group II Electives

The three program electives in this group must be selected from the following list:

- CMPUT 250 - Computers and Games
- CMPUT 304 - Algorithms II
- CMPUT 307 - 3D Modeling and Animation
- CMPUT 325 - Non-Procedural Programming Languages
- CMPUT 350 - Advanced Games Programming
- CMPUT 366 - Intelligent Systems

- CMPUT 391 - Database Management Systems
- CMPUT 411 - Introduction to Computer Graphics
- CMPUT 415 - Compiler Design
- CMPUT 466 - Machine Learning
- ECE 303 - Analog Electronics
- ECE 321 - Software Requirements Engineering
- ECE 322 - Software Testing and Maintenance Engineering
- ECE 360 - Control Systems I
- ECE 380 - Introduction to Communication Systems
- ECE 402 - RF Communication Circuits
- ECE 403 - Integrated Circuit Design
- ECE 405 - Biophysical Measurement and Instrumentation
- ECE 412 - Fault-Tolerant Computing
- ECE 421 - Exploring Software Development Domains
- ECE 422 - Reliable and Secure Systems Design
- ECE 440 - Digital Computer Processing of Images
- ECE 442 - Introduction to Multimedia Signal Processing
- ECE 449 - Intelligent Systems Engineering
- ECE 450 - Nanoscale Phenomena in Electronic Devices
- ECE 455 - Engineering of Nanobiotechnological Systems
- ECE 456 - Introduction to Nanoelectronics
- ECE 475 - Optoelectronic and Photovoltaic Devices

One of

- ECE 406 - Special Topics in Computer Engineering
- ECE 407 - Special Topics in Computer Engineering

Note

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

## Computer Engineering: Nanoscale System Design Option (Program and Technical Electives) [Engineering]

### Group I (Interdisciplinary) Electives

Two from CH E 243, MAT E 201 and MEC E 250 must be selected.

## Group II Electives

The two program electives in this group must be selected from the following list:

- CMPUT 313 - Computer Networks
- CMPUT 379 - Operating System Concepts
- ECE 340 - Discrete Time Signals and Systems
- ECE 370 - Engineering Electromagnetics I
- ECE 380 - Introduction to Communication Systems
- ECE 422 - Reliable and Secure Systems Design
- ECE 449 - Intelligent Systems Engineering
- ECE 452 - Computation for Nanoengineering
- ECE 455 - Engineering of Nanobiotechnological Systems
- ECE 456 - Introduction to Nanoelectronics
- ECE 475 - Optoelectronic and Photovoltaic Devices

One of

- ECE 406 - Special Topics in Computer Engineering
- ECE 407 - Special Topics in Computer Engineering

Note

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

## **Computer Engineering: Software Option (Program and Technical Electives)** **[Engineering]**

### Group I (Interdisciplinary) Electives

Two from CH E 243, MAT E 201 and MEC E 250 must be selected.

### Group II Electives

The four program electives in this group must be selected from the following list:

- CMPUT 250 - Computers and Games
- CMPUT 304 - Algorithms II
- CMPUT 307 - 3D Modeling and Animation
- CMPUT 325 - Non-Procedural Programming Languages
- CMPUT 350 - Advanced Games Programming



- CMPUT 366 - Intelligent Systems
- CMPUT 391 - Database Management Systems
- CMPUT 404 - Web Applications and Architecture
- CMPUT 411 - Introduction to Computer Graphics
- CMPUT 415 - Compiler Design
- CMPUT 466 - Machine Learning
- ECE 360 - Control Systems I
- ECE 370 - Engineering Electromagnetics I
- ECE 380 - Introduction to Communication Systems
- ECE 405 - Biophysical Measurement and Instrumentation
- ECE 440 - Digital Computer Processing of Images
- ECE 449 - Intelligent Systems Engineering
- ECE 455 - Engineering of Nanobiotechnological Systems

#### One of

- ECE 406 - Special Topics in Computer Engineering
- ECE 407 - Special Topics in Computer Engineering

#### Note

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

### Complementary Studies Electives

- Complementary Studies Electives

## Complementary Studies Electives

To better understand the role of Engineering within a broader social context, all programs require an element of complementary studies consisting of the humanities, social sciences, arts, management, engineering economics and communications. Aspects of these topics are covered in mandatory courses, but each program contains complementary studies electives so that students may explore areas of particular interest. Notwithstanding this, the Canadian Engineering Accreditation Board requires that programs include exposure to the central thought processes of the humanities and social sciences. Students must take the number of complementary studies electives as required by their program. Students can take a maximum of one list 1 complementary studies elective. Note that in some cases, a course may appear both on a complementary studies list and as a program required or program elective course. A single course cannot be used to satisfy multiple course requirements under Programs of Study.

Students interested in taking a minor should select their first complementary studies courses with this in mind. For the Business minor, student should take ECON 204; for an Arts minor, students should select a course in a possible area of concentration of interest, see minors for specific requirements for each minor.

### List 1

- ANTHR 101 - Introductory Anthropology
- ANTHR 110 - Gender, Age, and Culture
- ANTHR 150 - Race and Racism
- CLASS 102 - Greek and Roman Mythology
- CLASS 103 - Introduction to Ancient Greece
- CLASS 104 - Introduction to Ancient Rome
- CLASS 110 - The Ancient World
- ECON 101 - Introduction to Microeconomics
- ECON 102 - Introduction to Macroeconomics
- ENGL 125 - Aboriginal Writing \*
- HIST 110 - The Pre-Modern World
- HIST 111 - The Early Modern World
- HIST 112 - The Modern World
- HIST 114 - The History of the World in the Last 10 Years
- HIST 116 - The Emergence of the Atlantic World
- LING 101 - Introduction to Linguistic Analysis
- PHIL 120 - Symbolic Logic I
- PHIL 125 - Practical Logic
- POL S 101 - Introduction to Politics
- PSYCO 104 - Basic Psychological Processes
- SOC 100 - Introductory Sociology

### List 2

- ACCTG 300 - Introduction to Accounting
- ACCTG 311 - Introduction to Accounting for Financial Performance
- ANTHR 230 - Anthropology of Science, Technology, and Environment
- AREC 365 - Natural Resource Economics
- B LAW 301 - Legal Foundations of the Canadian Economy \*\*
- B LAW 422 - Law of Business Organizations
- B LAW 428 - Natural Resource and Environmental Law \*\*\*
- B LAW 432 - The Legal Regulation of Business
- CHRTC 350 - Science and Religion: Christian Perspectives
- CLASS 254 - Introduction to Greek Art and Archaeology
- CLASS 255 - Introduction to Roman Art and Archaeology
- CLASS 283 - Introductory Roman History II
- CLASS 294 - Ancient Science, Technology, and Medicine
- CLASS 376
- ECON 204 - Principles of Economics
- ECON 281 - Intermediate Microeconomic Theory I
- ECON 282 - Intermediate Macroeconomic Theory I

- ENGG 420 - Engineering Law
- ENG M 402 - Project Management and Entrepreneurship
- ENG M 406
- HECOL 211 - Human Sexuality
- HIST 260 - Pre-Confederation Canada
- HIST 261 - Post-Confederation Canada
- HIST 295 - 20th-Century Warfare
- HIST 397 - History of Science I
- HIST 398 - History of Science II
- INT D 303 - Economics of World Food and Agriculture
- LA ST 210 - South America
- LING 204 - English Syntax
- LING 205 - Phonetics
- MARK 301 - Introduction to Marketing
- OM 352 - Operations Management
- PHIL 205 - Philosophy of Mind
- PHIL 220 - Symbolic Logic II
- PHIL 250 - Contemporary Ethical Issues
- PHIL 325 - Risk, Choice, and Rationality
- PHIL 355 - Environmental Ethics
- POL S 223 - City Government and Politics
- PSYCO 258 - Cognitive Psychology
- PSYCO 275 - Brain and Behavior
- R SOC 355 - Rural Communities and Global Economies
- R SOC 365 - Sociology of Environment and Development
- SMO 200 - Introduction to Management for Non-Business Students
- SMO 301 - Behavior in Organizations
- SMO 330 - Introduction to Entrepreneurship
- SOC 212 - Classical Social Theory
- SOC 224 - Sociology of Deviance and Conformity
- SOC 225 - Criminology
- SOC 241 - Social Psychology
- SOC 242 - Biologically Coordinated Social Psychology
- SOC 251 - Population and Society
- SOC 301 - Sociology of Gender
- WGS 220 - Feminism and Popular Culture

## Notes:

\*\*Not available to Civil students

\*\*\*Not available to Civil (Environmental Engineering Option) students.

A second course from the ITS List may be taken as part of List 2. However, a single course cannot be used to satisfy both the ITS and Complementary Studies requirements. This list is updated annually. Courses that teach a language or the application of a particular skill (such as courses in physical education, music and art) do not meet the intent of the Accreditation Board with respect to complementary studies and are therefore not eligible.

## 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:

- ENG M 403
- ENG M 405
- HIST 115 - Technology and History
- HIST 391 - History of Technology
- HGP 250 - Natural Resources and Environmental Management
- INT D 361
- PHIL 265 - Philosophy of Science
- PHIL 366 - Computers and Culture
- PHIL 375
- STS 200 - Introduction to Studies in Science, Technology and Society
- SOC 366 - People in Industry
- SOC 363 - Sociology of Work and Industry

## English Electives

Engineering programs require ENGL 199.

## 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.

## Areas of Study

Students are required to choose 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 Biomedical Option in Electrical Engineering and Biomedical Engineering 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, papermaking 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.

## 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 program 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 Areas of Study, Biomedical Engineering and Doctor of Medicine (MD) for more information.

## Nanoengineering Option in Electrical Engineering

This option provides an introduction to the principles of electronics, electromagnetics and photonics as they apply at the nanoscale level. By selecting this option, students will learn about the processes involved in the fabrication of nanoscale structures and become familiar with the computer aided design (CAD) tools necessary for analyzing phenomena at these very high levels of miniaturization.

The Option retains most of the core elements of the traditional Electrical Engineering Program and contains a number of offerings in the form of program electives. Changes from the Traditional Electrical Engineering Program occur only after second year.

## Required Courses and Suggested Course Sequence for Traditional Programs

- Electrical
- Electrical: Biomedical Engineering Option
- Electrical: Nanoengineering Option

## Electrical [Engineering]

### Year 2

#### Term 3

- ECE 202 - Electrical Circuits I
- ECE 210 - Introduction to Digital Logic Design
- MATH 201 - Differential Equations
- MATH 209 - Calculus III
- Group I Program Elective
- Complementary Studies Elective (3-0-0)

#### Term 4

- ECE 203 - Electrical Circuits II
- ECE 212 - Introduction to Microprocessors
- ECE 220 - Programming for Electrical Engineering
- ECE 240 - Continuous Time Signals and Systems

- PHYS 230 - Electricity and Magnetism
- Complementary Studies Elective

### Year 3

#### Term 5

- ECE 302 - Electronic Devices
- ECE 312 - Embedded System Design
- ECE 330 - Introduction to Power Engineering
- ECE 340 - Discrete Time Signals and Systems
- ECE 370 - Engineering Electromagnetics I
- MATH 309 - Mathematical Methods for Electrical Engineers

#### Term 6

- ECE 303 - Analog Electronics
- ECE 332 - Electric Machines
- ECE 342 - Probability for Electrical and Computer Engineers
- ECE 360 - Control Systems I
- ECE 380 - Introduction to Communication Systems

### Year 4

#### Term 7

- ECE 490 - Electrical Engineering Design Project I
- ENGG 404 - Engineering Safety and Risk Management-Leadership in Risk Management
- Group I Program Elective
- Group II Program Elective
- Group II Program Elective
- Group II Program Elective

#### Term 8

- ECE 491 - Electrical Engineering Design Project II
- ENG M 310 - Engineering Economy **OR**
- ENG M 401 - Financial Management for Engineers
- ENGG 400 - The Practice of the Engineering Profession

- Group II Program Elective
- Group II Program Elective
- Group II Program Elective
- ITS Elective (3-0-0)

### Note:

See Program and Technical Electives for restrictions on the nine program electives.

## Electrical: Biomedical Engineering Option [Engineering]

### Year 2

#### Term 3

- ECE 202 - Electrical Circuits I
- ECE 210 - Introduction to Digital Logic Design
- MATH 201 - Differential Equations
- MATH 209 - Calculus III
- Group I Program Elective
- Complementary Studies Elective (3-0-0)

#### Term 4

- ECE 203 - Electrical Circuits II
- ECE 212 - Introduction to Microprocessors
- ECE 220 - Programming for Electrical Engineering
- ECE 240 - Continuous Time Signals and Systems
- PHYS 230 - Electricity and Magnetism
- Complementary Studies Elective (3-0-0)

### Year 3

#### Term 5

- BIOL 107 - Introduction to Cell Biology
- ECE 302 - Electronic Devices
- ECE 312 - Embedded System Design
- ECE 340 - Discrete Time Signals and Systems
- ECE 370 - Engineering Electromagnetics I



- MATH 309 - Mathematical Methods for Electrical Engineers

### Term 6

- ECE 303 - Analog Electronics
- ECE 342 - Probability for Electrical and Computer Engineers
- ECE 360 - Control Systems I
- ECE 380 - Introduction to Communication Systems
- Group I Program Elective
- ENGG 404 - Engineering Safety and Risk Management-Leadership in Risk Management

### Year 4

#### Term 7

- ECE 405 - Biophysical Measurement and Instrumentation
- ECE 440 - Digital Computer Processing of Images
- ECE 490 - Electrical Engineering Design Project I
- Group II Program Elective
- PHYSL 210 - Human Physiology A
- ITS Elective (3-0-0)

#### Term 8

- ECE 491 - Electrical Engineering Design Project II
- Group II Program Elective
- Group II Program Elective
  
- ENG M 310 - Engineering Economy **OR**
- ENG M 401 - Financial Management for Engineers
  
- ENGG 400 - The Practice of the Engineering Profession
- PHYSL 210 - Human Physiology B

### Note:

See Program and Technical Electives for restrictions on the program electives and information for students interested in applying for admission into the Faculty of Medicine and Dentistry MD program

## Electrical: Nanoengineering Option [Engineering]

### Year 2

#### Term 3

- ECE 202 - Electrical Circuits I
- ECE 210 - Introduction to Digital Logic Design
- MATH 201 - Differential Equations
- MATH 209 - Calculus III
- Group I Program Elective
- Complementary Studies Elective (3-0-0)

#### Term 4

- ECE 203 - Electrical Circuits II
- ECE 212 - Introduction to Microprocessors
- ECE 220 - Programming for Electrical Engineering
- ECE 240 - Continuous Time Signals and Systems
- PHYS 230 - Electricity and Magnetism
- Complementary Studies Elective (3-0-0)

### Year 3

#### Term 5

- ECE 302 - Electronic Devices
- ECE 312 - Embedded System Design
- ECE 340 - Discrete Time Signals and Systems
- ECE 370 - Engineering Electromagnetics I
- ECE 471 - Photonics I
- MATH 309 - Mathematical Methods for Electrical Engineers

#### Term 6

- ECE 303 - Analog Electronics
- ECE 341 - Analytical Methods in Electrical Engineering
- ECE 342 - Probability for Electrical and Computer Engineers
- ECE 456 - Introduction to Nanoelectronics
- ITS Elective (3-0-0)

## Year 4

### Term 7

- ECE 360 - Control Systems I
- ECE 457 - Microfabrication and Devices
- ECE 490 - Electrical Engineering Design Project I
- ENGG 404 - Engineering Safety and Risk Management-Leadership in Risk Management
- Group I Program Elective
- Group II Program Elective

### Term 8

- ECE 450 - Nanoscale Phenomena in Electronic Devices
- ECE 475 - Optoelectronic and Photovoltaic Devices
- ECE 491 - Electrical Engineering Design Project II
  
- ENG M 310 - Engineering Economy **OR**
- ENG M 401 - Financial Management for Engineers
  
- ENGG 400 - The Practice of the Engineering Profession
- Group II Program Elective
- Group II Program Elective

## Note:

See Program and Technical Electives for restrictions on the program electives

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

- Electrical
- Electrical: Nanoengineering Option

## Electrical (Co-op) [Engineering]

## Year 2

### Fall Term 3

- ECE 202 - Electrical Circuits I

- ECE 210 - Introduction to Digital Logic Design
- ENGG 299 - Orientation to Cooperative Education
- MATH 201 - Differential Equations
- MATH 209 - Calculus III
- Group I Program Elective

### Winter Term 4

- ECE 203 - Electrical Circuits II
- ECE 212 - Introduction to Microprocessors
- ECE 220 - Programming for Electrical Engineering
- ECE 240 - Continuous Time Signals and Systems
- PHYS 230 - Electricity and Magnetism
- Complementary Studies Elective (3-0-0)

### Summer

- WKEXP 901 - Engineering Work Experience I

## Year 3

### Fall Term 5

- ECE 302 - Electronic Devices
- ECE 312 - Embedded System Design
- ECE 330 - Introduction to Power Engineering
- ECE 340 - Discrete Time Signals and Systems
- ECE 370 - Engineering Electromagnetics I
- MATH 309 - Mathematical Methods for Electrical Engineers

### Winter

- WKEXP 902 - Engineering Work Experience II

### Summer

- WKEXP 903 - Engineering Work Experience III

## Year 4

### Fall Term 6

- ECE 303 - Analog Electronics
- ECE 332 - Electric Machines
- ECE 342 - Probability for Electrical and Computer Engineers
- ECE 360 - Control Systems I
- ECE 380 - Introduction to Communication Systems
- Complementary Studies Elective (3-0-0)

### Winter

- WKEXP 904 - Engineering Work Experience IV

### Summer

- WKEXP 905 - Engineering Work Experience V

## Year 5

### Fall Term 7

- ECE 490 - Electrical Engineering Design Project I
- ENGG 404 - Engineering Safety and Risk Management-Leadership in Risk Management
- Group I Program Elective
- Group II Program Elective
- Group II Program Elective
- Group II Program Elective

### Winter Term 8

- ECE 491 - Electrical Engineering Design Project II
- ENG M 310 - Engineering Economy **OR**
- ENG M 401 - Financial Management for Engineers
- ENGG 400 - The Practice of the Engineering Profession
- Group II Program Elective
- Group II Program Elective
- Group II Program Elective

- ITS Elective

### Note:

See Program and Technical Electives for restrictions on the nine program electives.

## Electrical: Nanoengineering Option (Co-op) [Engineering]

### Year 2

#### Fall Term 3

- ECE 202 - Electrical Circuits I
- ECE 210 - Introduction to Digital Logic Design
- ENGG 299 - Orientation to Cooperative Education
- MATH 201 - Differential Equations
- MATH 209 - Calculus III
- Group I Program Elective

#### Winter Term 4

- ECE 203 - Electrical Circuits II
- ECE 212 - Introduction to Microprocessors
- ECE 220 - Programming for Electrical Engineering
- ECE 240 - Continuous Time Signals and Systems
- PHYS 230 - Electricity and Magnetism
- Complementary Studies Elective (3-0-0)

#### Summer

- WKEXP 901 - Engineering Work Experience I

### Year 3

#### Fall Term 5

- ECE 302 - Electronic Devices
- ECE 312 - Embedded System Design
- ECE 340 - Discrete Time Signals and Systems
- ECE 370 - Engineering Electromagnetics I

- ECE 471 - Photonics I
- MATH 309 - Mathematical Methods for Electrical Engineers

### Winter

- WKEXP 902 - Engineering Work Experience II

### Summer

- WKEXP 903 - Engineering Work Experience III

### Year 4

#### Fall

- WKEXP 904 - Engineering Work Experience IV

#### Winter Term 6

- ECE 303 - Analog Electronics
- ECE 341 - Analytical Methods in Electrical Engineering
- ECE 342 - Probability for Electrical and Computer Engineers
- ECE 456 - Introduction to Nanoelectronics
- ITS Elective (3-0-0)
- Complementary Studies Elective (3-0-0)

#### Summer

- WKEXP 905 - Engineering Work Experience V

### Year 5

#### Fall Term 7

- ECE 360 - Control Systems I
- ECE 457 - Microfabrication and Devices
- ECE 490 - Electrical Engineering Design Project I
- ENGG 404 - Engineering Safety and Risk Management-Leadership in Risk Management
- Group I Program Elective
- Group II Program Elective

## Winter Term 8

- ECE 450 - Nanoscale Phenomena in Electronic Devices
- ECE 475 - Optoelectronic and Photovoltaic Devices
- ECE 491 - Electrical Engineering Design Project II
  
- ENG M 310 - Engineering Economy **OR**
- ENG M 401 - Financial Management for Engineers
  
- ENGG 400 - The Practice of the Engineering Profession
- Group II Program Elective
- Group II Program Elective

### Note:

See Program and Technical Electives for restrictions on the program electives.

## Program and Technical Electives - Electrical

- Electrical
- Electrical: Biomedical Option
- Electrical: Nanoengineering Option

## Electrical (Program and Technical Electives) [Engineering]

### Group I (Interdisciplinary) Electives

Two must be selected from

- CH E 243 - Engineering Thermodynamics
- MAT E 201 - Materials Science I
- MEC E 250 - Engineering Mechanics II

### Group II Electives

Of the six single-term program electives in this group, at least three must be from

- ECE 304 - Digital Electronics



- ECE 401 - Power Electronics
- ECE 402 - RF Communication Circuits
- ECE 403 - Integrated Circuit Design
- ECE 410 - Advanced Digital Logic Design
- ECE 432 - Variable Speed Drives
- ECE 433 - Power System Stability and Transients
- ECE 440 - Digital Computer Processing of Images
- ECE 442 - Introduction to Multimedia Signal Processing
- ECE 449 - Intelligent Systems Engineering
- ECE 450 - Nanoscale Phenomena in Electronic Devices
- ECE 457 - Microfabrication and Devices
- ECE 460 - Control Systems II
- ECE 464 - Medical Robotics and Computer-Integrated Intervention
- ECE 471 - Photonics I
- ECE 476 - Engineering Electromagnetics II
- ECE 478 - Microwave Circuits
- ECE 485 - Digital Communications

and at most two program electives may be chosen from the following list of courses:

- BME 513 - Imaging Methods in Medicine
- ECE 405 - Biophysical Measurement and Instrumentation
  
- ECE 408 - Special Topics in Electrical Engineering **OR**
- ECE 409 - Special Topics in Electrical Engineering
  
- ECE 412 - Fault-Tolerant Computing
- ECE 452 - Computation for Nanoengineering
- ECE 487 - Data Communication Networks

Any remaining program electives may be chosen from the following list of courses:

- ECE 341 - Analytical Methods in Electrical Engineering
- ECE 430 - Power System Analysis
- ECE 434 - Power System Protection and Grounding
- ECE 456 - Introduction to Nanoelectronics
- ECE 458 - Introduction to Microelectromechanical Systems
- ECE 472 - Photonics II
- ECE 474 - Introduction to Plasma Engineering
- ECE 475 - Optoelectronic and Photovoltaic Devices
- ECE 486 - Wireless Communications

## Notes

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

Total lab hours per week in the Group II Electives must be a minimum of 4.5 hours. The Lab hours in a graduate course may not count towards the minimum 4.5 hours/week.

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

## **Electrical: Biomedical Option (Program and Technical Electives) [Engineering]**

### Group I (Interdisciplinary) Electives

Two must be selected from

- CH E 243 - Engineering Thermodynamics
- MAT E 201 - Materials Science I
- MEC E 250 - Engineering Mechanics II

### Group II Electives

Of the three program electives in this group, at least two must be from

- ECE 304 - Digital Electronics
- ECE 401 - Power Electronics
- ECE 442 - Introduction to Multimedia Signal Processing
- ECE 450 - Nanoscale Phenomena in Electronic Devices
- ECE 457 - Microfabrication and Devices
- ECE 460 - Control Systems II
- ECE 471 - Photonics I
- ECE 476 - Engineering Electromagnetics II

Any remaining program electives may be chosen from the following list of courses:

- BIOCH 200 - Introductory Biochemistry
- BME 513 - Imaging Methods in Medicine
- BME 564 - Fundamentals of Magnetic Resonance Imaging, MRI
- CHEM 261 - Organic Chemistry I
- CHEM 263 - Organic Chemistry II
- ECE 330 - Introduction to Power Engineering
- ECE 332 - Electric Machines

- ECE 430 - Power System Analysis
- ECE 445
- ECE 452 - Computation for Nanoengineering
- ECE 456 - Introduction to Nanoelectronics
- ECE 458 - Introduction to Microelectromechanical Systems
- ECE 464 - Medical Robotics and Computer-Integrated Intervention
- ECE 475 - Optoelectronic and Photovoltaic Devices
- ECE 478 - Microwave Circuits

### Note

Admission requirements for the Doctor of Medicine (MD) degree program include a specific number of course units in various core subjects. This information can be found in Academic Requirements. Students in the Biomedical Option who plan to apply to the MD degree program must select their electives carefully to obtain the necessary credit for required subjects. It may also be necessary to take courses over and above those included in the Biomedical Option to meet the course unit requirements in all of the core subjects required for Medicine. Students in the Biomedical Option who plan to apply for admission to the MD degree program should contact their program advisor in the Fall term of second year for guidance on the selection of appropriate electives and any specific courses which would be in addition to those required for the engineering degree.

## Electrical: Nanoengineering Option (Program and Technical Electives) [Engineering]

### Group I (Interdisciplinary) Electives

Two must be selected from

- CH E 243 - Engineering Thermodynamics
- MAT E 201 - Materials Science I
- MEC E 250 - Engineering Mechanics II

### Group II Electives

The three single-term program electives in this group must be selected from the following list:

- BME 513 - Imaging Methods in Medicine
- BME 564 - Fundamentals of Magnetic Resonance Imaging, MRI
- ECE 304 - Digital Electronics
- ECE 330 - Introduction to Power Engineering
- ECE 332 - Electric Machines
- ECE 380 - Introduction to Communication Systems
- ECE 401 - Power Electronics
- ECE 402 - RF Communication Circuits
- ECE 403 - Integrated Circuit Design

- ECE 405 - Biophysical Measurement and Instrumentation
- ECE 408 - Special Topics in Electrical Engineering **OR**
- ECE 409 - Special Topics in Electrical Engineering
  
- ECE 410 - Advanced Digital Logic Design
- ECE 430 - Power System Analysis
- ECE 440 - Digital Computer Processing of Images
- ECE 449 - Intelligent Systems Engineering
- ECE 452 - Computation for Nanoengineering
- ECE 455 - Engineering of Nanobiotechnological Systems
- ECE 458 - Introduction to Microelectromechanical Systems
- ECE 460 - Control Systems II
- ECE 464 - Medical Robotics and Computer-Integrated Intervention
- ECE 472 - Photonics II
- ECE 474 - Introduction to Plasma Engineering
- ECE 476 - Engineering Electromagnetics II
- ECE 478 - Microwave Circuits

## Notes

Other courses, including 500-level graduate ECE courses, may be taken in lieu of those on the latter list with Departmental approval.

Total lab hours per week in the Group II Electives must be a minimum of 3.0 hours. The Lab hours in a graduate course may not count towards the minimum 3 hours/week.

## Complementary Studies Electives

- Complementary Studies Electives

## Complementary Studies Electives

To better understand the role of Engineering within a broader social context, all programs require an element of complementary studies consisting of the humanities, social sciences, arts, management, engineering economics and communications. Aspects of these topics are covered in mandatory courses, but each program contains complementary studies electives so that students may explore areas of particular interest. Notwithstanding this, the Canadian Engineering Accreditation Board requires that programs include exposure to the central thought processes of the humanities and social sciences. Students must take the number of complementary studies electives as required by their program. Students can take a maximum of one list 1 complementary studies elective. Note that in some cases, a course may appear both on a complementary studies list and as a program required or program elective course. A single course cannot be used to satisfy multiple course requirements under Programs of Study.

Students interested in taking a minor should select their first complementary studies courses with this in mind. For the Business minor, student should take ECON 204; for an Arts minor, students should select a course in a possible area of concentration of interest, see minors for specific requirements for each minor.

### List 1

- ANTHR 101 - Introductory Anthropology
- ANTHR 110 - Gender, Age, and Culture
- ANTHR 150 - Race and Racism
- CLASS 102 - Greek and Roman Mythology
- CLASS 103 - Introduction to Ancient Greece
- CLASS 104 - Introduction to Ancient Rome
- CLASS 110 - The Ancient World
- ECON 101 - Introduction to Microeconomics
- ECON 102 - Introduction to Macroeconomics
- ENGL 125 - Aboriginal Writing \*
- HIST 110 - The Pre-Modern World
- HIST 111 - The Early Modern World
- HIST 112 - The Modern World
- HIST 114 - The History of the World in the Last 10 Years
- HIST 116 - The Emergence of the Atlantic World
- LING 101 - Introduction to Linguistic Analysis
- PHIL 120 - Symbolic Logic I
- PHIL 125 - Practical Logic
- POL S 101 - Introduction to Politics
- PSYCO 104 - Basic Psychological Processes
- SOC 100 - Introductory Sociology

### List 2

- ACCTG 300 - Introduction to Accounting
- ACCTG 311 - Introduction to Accounting for Financial Performance
- ANTHR 230 - Anthropology of Science, Technology, and Environment
- AREC 365 - Natural Resource Economics
- B LAW 301 - Legal Foundations of the Canadian Economy \*\*
- B LAW 422 - Law of Business Organizations
- B LAW 428 - Natural Resource and Environmental Law \*\*\*
- B LAW 432 - The Legal Regulation of Business
- CHRTC 350 - Science and Religion: Christian Perspectives
- CLASS 254 - Introduction to Greek Art and Archaeology
- CLASS 255 - Introduction to Roman Art and Archaeology
- CLASS 283 - Introductory Roman History II
- CLASS 294 - Ancient Science, Technology, and Medicine
- CLASS 376
- ECON 204 - Principles of Economics
- ECON 281 - Intermediate Microeconomic Theory I
- ECON 282 - Intermediate Macroeconomic Theory I

- ENGG 420 - Engineering Law
- ENG M 402 - Project Management and Entrepreneurship
- ENG M 406
- HECOL 211 - Human Sexuality
- HIST 260 - Pre-Confederation Canada
- HIST 261 - Post-Confederation Canada
- HIST 295 - 20th-Century Warfare
- HIST 397 - History of Science I
- HIST 398 - History of Science II
- INT D 303 - Economics of World Food and Agriculture
- LA ST 210 - South America
- LING 204 - English Syntax
- LING 205 - Phonetics
- MARK 301 - Introduction to Marketing
- OM 352 - Operations Management
- PHIL 205 - Philosophy of Mind
- PHIL 220 - Symbolic Logic II
- PHIL 250 - Contemporary Ethical Issues
- PHIL 325 - Risk, Choice, and Rationality
- PHIL 355 - Environmental Ethics
- POL S 223 - City Government and Politics
- PSYCO 258 - Cognitive Psychology
- PSYCO 275 - Brain and Behavior
- R SOC 355 - Rural Communities and Global Economies
- R SOC 365 - Sociology of Environment and Development
- SMO 200 - Introduction to Management for Non-Business Students
- SMO 301 - Behavior in Organizations
- SMO 330 - Introduction to Entrepreneurship
- SOC 212 - Classical Social Theory
- SOC 224 - Sociology of Deviance and Conformity
- SOC 225 - Criminology
- SOC 241 - Social Psychology
- SOC 242 - Biologically Coordinated Social Psychology
- SOC 251 - Population and Society
- SOC 301 - Sociology of Gender
- WGS 220 - Feminism and Popular Culture

### Notes:

\*\*Not available to Civil students

\*\*\*Not available to Civil (Environmental Engineering Option) students.

A second course from the ITS List may be taken as part of List 2. However, a single course cannot be used to satisfy both the ITS and Complementary Studies requirements. This list is updated annually. Courses that teach a language or the application of a particular skill (such as courses in physical education, music and art) do not meet the intent of the Accreditation Board with respect to complementary studies and are therefore not eligible.

### 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:

- ENG M 403
- ENG M 405
- HIST 115 - Technology and History
- HIST 391 - History of Technology
- HGP 250 - Natural Resources and Environmental Management
- INT D 361
- PHIL 265 - Philosophy of Science
- PHIL 366 - Computers and Culture
- PHIL 375
- STS 200 - Introduction to Studies in Science, Technology and Society
- SOC 366 - People in Industry
- SOC 363 - Sociology of Work and Industry

### English Electives

Engineering programs require ENGL 199.

## 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.

### 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.

## Required Courses and Suggested Course Sequence for Traditional

- Engineering Physics
- Engineering Physics: Nanoengineering Option

## Engineering Physics [Engineering]

### Year 2

#### Term 3

- ECE 202 - Electrical Circuits I
- MAT E 201 - Materials Science I
- MATH 201 - Differential Equations
- MATH 209 - Calculus III
- PHYS 281 - Electricity and Magnetism
- PHYS 292 - Experimental Physics for Engineers
- Complementary Studies Elective (3-0-0)

#### Term 4

- CH E 243 - Engineering Thermodynamics
- ECE 203 - Electrical Circuits II
- ECE 240 - Continuous Time Signals and Systems
- PHYS 244 - Mechanics
- PHYS 271 - Introduction to Modern Physics
- PHYS 292 - Experimental Physics for Engineers
- Complementary Studies Elective (3-0-0)

### Year 3

#### Term 5

- ECE 210 - Introduction to Digital Logic Design
- ECE 302 - Electronic Devices
- ECE 340 - Discrete Time Signals and Systems
- ECE 471 - Photonics I



- MATH 311 - Theory of Functions of a Complex Variable
- PHYS 381 - Electromagnetic Theory I

### Term 6

- ECE 220 - Programming for Electrical Engineering
- ECE 303 - Analog Electronics
- ECE 341 - Analytical Methods in Electrical Engineering
- PHYS 311 - Statistical Physics
- PHYS 372 - Quantum Mechanics A
- Program Elective

### Year 4

#### Term 7

- ECE 494 - Engineering Physics Design Project I
- ENGG 404 - Engineering Safety and Risk Management-Leadership in Risk Management
- PHYS 415 - Introduction to Condensed Matter Physics I
- PHYS 481 - Electromagnetic Theory II
- Program Elective
- Program Elective

#### Term 8

- ECE 360 - Control Systems I
- ECE 495 - Engineering Physics Design Project II
  
- ENG M 310 - Engineering Economy **OR**
- ENG M 401 - Financial Management for Engineers
  
- ENGG 400 - The Practice of the Engineering Profession
- ITS Elective
- Program Elective
- Program Elective

### Notes

1. See Program and Technical Electives for restrictions on the five program electives.
2. Students may take an extra course per term if their GPA is at least 3.3.

## Engineering Physics: Nanoengineering Option [Engineering]

### Year 2

#### Term 3

- ECE 202 - Electrical Circuits I
- MAT E 201 - Materials Science I
- MATH 201 - Differential Equations
- MATH 209 - Calculus III
- PHYS 281 - Electricity and Magnetism
- PHYS 292 - Experimental Physics for Engineers
- Complementary Studies Elective (3-0-0)

#### Term 4

- CH E 243 - Engineering Thermodynamics
- ECE 203 - Electrical Circuits II
- ECE 240 - Continuous Time Signals and Systems
- PHYS 244 - Mechanics
- PHYS 271 - Introduction to Modern Physics
- PHYS 292 - Experimental Physics for Engineers
- Complementary Studies Elective (3-0-0)

### Year 3

#### Term 5

- ECE 210 - Introduction to Digital Logic Design
- ECE 302 - Electronic Devices
- ECE 457 - Microfabrication and Devices
- ECE 471 - Photonics I
- MATH 311 - Theory of Functions of a Complex Variable
- PHYS 381 - Electromagnetic Theory I

#### Term 6

- ECE 303 - Analog Electronics
- ECE 341 - Analytical Methods in Electrical Engineering
- ECE 360 - Control Systems I

- ECE 456 - Introduction to Nanoelectronics
- PHYS 311 - Statistical Physics
- PHYS 372 - Quantum Mechanics A

## Year 4

### Term 7

- CHEM 261 - Organic Chemistry I
- ECE 494 - Engineering Physics Design Project I
- ENGG 404 - Engineering Safety and Risk Management-Leadership in Risk Management
- PHYS 415 - Introduction to Condensed Matter Physics I
- PHYS 481 - Electromagnetic Theory II
- Program Elective

### Term 8

- BIOCH 200 - Introductory Biochemistry
- ECE 455 - Engineering of Nanobiotechnological Systems
- ECE 495 - Engineering Physics Design Project II
  
- ENG M 310 - Engineering Economy **OR**
- ENG M 401 - Financial Management for Engineers
  
- ENGG 400 - The Practice of the Engineering Profession
- ITS Elective
- Program Elective

## Notes

1. See Program and Technical Electives for restrictions on the five program electives.
2. Students may take an extra course per term if their GPA is at least 3.3.

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

- Engineering Physics
- Engineering Physics: Nanoengineering Option

## Engineering Physics: (Co-op) [Engineering]

### Year 2

#### Fall Term 3

- ECE 202 - Electrical Circuits I
- ENGG 299 - Orientation to Cooperative Education
- MAT E 201 - Materials Science I
- MATH 201 - Differential Equations
- MATH 209 - Calculus III
- PHYS 281 - Electricity and Magnetism
- PHYS 292 - Experimental Physics for Engineers

#### Winter Term 4

- CH E 243 - Engineering Thermodynamics
- ECE 203 - Electrical Circuits II
- ECE 220 - Programming for Electrical Engineering
- ECE 240 - Continuous Time Signals and Systems
- PHYS 271 - Introduction to Modern Physics
- PHYS 292 - Experimental Physics for Engineers
- Complementary Studies Elective (3-0-0)

#### Summer

- WKEXP 901 - Engineering Work Experience I

### Year 3

#### Fall Term 5

- ECE 210 - Introduction to Digital Logic Design
- ECE 302 - Electronic Devices
- ECE 340 - Discrete Time Signals and Systems
- ECE 471 - Photonics I
- MATH 311 - Theory of Functions of a Complex Variable
- PHYS 381 - Electromagnetic Theory I

## Winter

- WKEXP 902 - Engineering Work Experience II

## Summer

- WKEXP 903 - Engineering Work Experience III

## Year 4

### Fall

- WKEXP 904 - Engineering Work Experience IV

### Winter Term 6

- ECE 303 - Analog Electronics
- ECE 341 - Analytical Methods in Electrical Engineering
- PHYS 244 - Mechanics
- PHYS 311 - Statistical Physics
- PHYS 372 - Quantum Mechanics A
- Program Elective

### Summer

- WKEXP 905 - Engineering Work Experience V

## Year 5

### Fall Term 7

- ECE 494 - Engineering Physics Design Project I
- ENGG 404 - Engineering Safety and Risk Management-Leadership in Risk Management
- PHYS 415 - Introduction to Condensed Matter Physics I
- PHYS 481 - Electromagnetic Theory II
- Complementary Studies Elective (3-0-0)
- Program Elective
- Program Elective

## Winter Term 8

- ECE 360 - Control Systems I
- ECE 495 - Engineering Physics Design Project II
  
- ENG M 310 - Engineering Economy **OR**
- ENG M 401 - Financial Management for Engineers
  
- ENGG 400 - The Practice of the Engineering Profession
- ITS Elective
- Program Elective
- Program Elective

## Engineering Physics: Nanoengineering Option (Co-op) [Engineering]

### Year 2

#### Fall Term 3

- ECE 202 - Electrical Circuits I
- ENGG 299 - Orientation to Cooperative Education
- MAT E 201 - Materials Science I
- MATH 201 - Differential Equations
- MATH 209 - Calculus III
- PHYS 281 - Electricity and Magnetism
- PHYS 292 - Experimental Physics for Engineers

#### Winter Term 4

- CH E 243 - Engineering Thermodynamics
- ECE 203 - Electrical Circuits II
- ECE 240 - Continuous Time Signals and Systems
- PHYS 244 - Mechanics
- PHYS 271 - Introduction to Modern Physics
- PHYS 292 - Experimental Physics for Engineers
- Complementary Studies Elective (3-0-0)

#### Summer

- WKEXP 901 - Engineering Work Experience I

### Year 3

#### Fall Term 5

- ECE 210 - Introduction to Digital Logic Design
- ECE 302 - Electronic Devices
- ECE 457 - Microfabrication and Devices
- ECE 471 - Photonics I
- MATH 311 - Theory of Functions of a Complex Variable
- PHYS 381 - Electromagnetic Theory I

#### Winter

- WKEXP 902 - Engineering Work Experience II

#### Summer

- WKEXP 903 - Engineering Work Experience III

### Year 4

#### Fall

- WKEXP 904 - Engineering Work Experience IV

#### Winter Term 6

- ECE 303 - Analog Electronics
- ECE 341 - Analytical Methods in Electrical Engineering
- ECE 360 - Control Systems I
- ECE 456 - Introduction to Nanoelectronics
- PHYS 311 - Statistical Physics
- PHYS 372 - Quantum Mechanics A

#### Summer

- WKEXP 905 - Engineering Work Experience V

## Year 5

### Fall Term 7

- CHEM 261 - Organic Chemistry I
- ECE 494 - Engineering Physics Design Project I
- ENGG 404 - Engineering Safety and Risk Management-Leadership in Risk Management
- PHYS 415 - Introduction to Condensed Matter Physics I
- PHYS 481 - Electromagnetic Theory II
- Complementary Studies Elective (3-0-0)
- Program Elective

### Winter Term 8

- BIOCH 200 - Introductory Biochemistry
- ECE 455 - Engineering of Nanobiotechnological Systems
- ECE 495 - Engineering Physics Design Project II
  
- ENG M 310 - Engineering Economy **OR**
- ENG M 401 - Financial Management for Engineers
  
- ENGG 400 - The Practice of the Engineering Profession
- ITS Elective
- Program Elective

## Program and Technical Electives - Engineering Physics

- Engineering Physics
- Engineering Physics: Nanoengineering Option

## Engineering Physics (Program and Technical Electives) [Engineering]

### Of the five program electives at least two must be from

- ECE 212 - Introduction to Microprocessors
- ECE 380 - Introduction to Communication Systems
- ECE 450 - Nanoscale Phenomena in Electronic Devices
- ECE 452 - Computation for Nanoengineering
- ECE 456 - Introduction to Nanoelectronics
- ECE 457 - Microfabrication and Devices
- ECE 472 - Photonics II



- ECE 475 - Optoelectronic and Photovoltaic Devices
- ECE 476 - Engineering Electromagnetics II
- ECE 478 - Microwave Circuits

Any remaining program electives may be chosen from the following list of courses:

- BME 513 - Imaging Methods in Medicine
- BME 564 - Fundamentals of Magnetic Resonance Imaging, MRI
- ECE 304 - Digital Electronics
- ECE 330 - Introduction to Power Engineering
- ECE 332 - Electric Machines
- ECE 401 - Power Electronics
- ECE 402 - RF Communication Circuits
- ECE 403 - Integrated Circuit Design
- ECE 405 - Biophysical Measurement and Instrumentation
- ECE 410 - Advanced Digital Logic Design
- ECE 432 - Variable Speed Drives
- ECE 440 - Digital Computer Processing of Images
- ECE 442 - Introduction to Multimedia Signal Processing
- ECE 450 - Nanoscale Phenomena in Electronic Devices
- ECE 455 - Engineering of Nanobiotechnological Systems
- ECE 458 - Introduction to Microelectromechanical Systems
- ECE 460 - Control Systems II
- ECE 464 - Medical Robotics and Computer-Integrated Intervention
- ECE 474 - Introduction to Plasma Engineering
- ECE 485 - Digital Communications
- ECE 486 - Wireless Communications
- PHYS 397 - Projects in Experimental Physics

### Note

Other courses from Faculty of Engineering and Faculty of Science (at the graduate or undergraduate level) can be substituted with Department approval.

## **Engineering Physics: Nanoengineering Option (Program and Technical Electives) [Engineering]**

Of the two program electives at least one must be from:

- ECE 212 - Introduction to Microprocessors
- ECE 220 - Programming for Electrical Engineering
- ECE 380 - Introduction to Communication Systems

- ECE 450 - Nanoscale Phenomena in Electronic Devices
- ECE 452 - Computation for Nanoengineering
- ECE 472 - Photonics II
- ECE 475 - Optoelectronic and Photovoltaic Devices
- ECE 476 - Engineering Electromagnetics II
- ECE 478 - Microwave Circuits

Any remaining program electives may be chosen from the following list of courses:

- BME 513 - Imaging Methods in Medicine
- BME 564 - Fundamentals of Magnetic Resonance Imaging, MRI
- ECE 304 - Digital Electronics
- ECE 330 - Introduction to Power Engineering
- ECE 332 - Electric Machines
- ECE 401 - Power Electronics
- ECE 402 - RF Communication Circuits
- ECE 403 - Integrated Circuit Design
- ECE 405 - Biophysical Measurement and Instrumentation
- ECE 410 - Advanced Digital Logic Design
- ECE 432 - Variable Speed Drives
- ECE 440 - Digital Computer Processing of Images
- ECE 442 - Introduction to Multimedia Signal Processing
- ECE 449 - Intelligent Systems Engineering
- ECE 458 - Introduction to Microelectromechanical Systems
- ECE 460 - Control Systems II
- ECE 464 - Medical Robotics and Computer-Integrated Intervention
- ECE 474 - Introduction to Plasma Engineering
- ECE 485 - Digital Communications
- ECE 486 - Wireless Communications
- MAT E 494 - Nanostructured Materials
- MAT E 495 - Nanomaterials and Biomedical Applications

### Note

Other courses from Faculty of Engineering and Faculty of Science (at the graduate or undergraduate level) can be substituted with Department approval.

### Complementary Studies Electives

- Complementary Studies Electives

## Complementary Studies Electives

To better understand the role of Engineering within a broader social context, all programs require an element of complementary studies consisting of the humanities, social sciences, arts, management, engineering economics and communications. Aspects of these topics are covered in mandatory courses, but each program contains complementary studies electives so that students may explore areas of particular interest. Notwithstanding this, the Canadian Engineering Accreditation Board requires that programs include exposure to the central thought processes of the humanities and social sciences. Students must take the number of complementary studies electives as required by their program. Students can take a maximum of one list 1 complementary studies elective. Note that in some cases, a course may appear both on a complementary studies list and as a program required or program elective course. A single course cannot be used to satisfy multiple course requirements under Programs of Study.

Students interested in taking a minor should select their first complementary studies courses with this in mind. For the Business minor, student should take ECON 204; for an Arts minor, students should select a course in a possible area of concentration of interest, see minors for specific requirements for each minor.

### List 1

- ANTHR 101 - Introductory Anthropology
- ANTHR 110 - Gender, Age, and Culture
- ANTHR 150 - Race and Racism
- CLASS 102 - Greek and Roman Mythology
- CLASS 103 - Introduction to Ancient Greece
- CLASS 104 - Introduction to Ancient Rome
- CLASS 110 - The Ancient World
- ECON 101 - Introduction to Microeconomics
- ECON 102 - Introduction to Macroeconomics
- ENGL 125 - Aboriginal Writing \*
- HIST 110 - The Pre-Modern World
- HIST 111 - The Early Modern World
- HIST 112 - The Modern World
- HIST 114 - The History of the World in the Last 10 Years
- HIST 116 - The Emergence of the Atlantic World
- LING 101 - Introduction to Linguistic Analysis
- PHIL 120 - Symbolic Logic I
- PHIL 125 - Practical Logic
- POL S 101 - Introduction to Politics
- PSYCO 104 - Basic Psychological Processes
- SOC 100 - Introductory Sociology

### List 2

- ACCTG 300 - Introduction to Accounting
- ACCTG 311 - Introduction to Accounting for Financial Performance
- ANTHR 230 - Anthropology of Science, Technology, and Environment

- AREC 365 - Natural Resource Economics
- B LAW 301 - Legal Foundations of the Canadian Economy \*\*
- B LAW 422 - Law of Business Organizations
- B LAW 428 - Natural Resource and Environmental Law \*\*\*
- B LAW 432 - The Legal Regulation of Business
- CHRTC 350 - Science and Religion: Christian Perspectives
- CLASS 254 - Introduction to Greek Art and Archaeology
- CLASS 255 - Introduction to Roman Art and Archaeology
- CLASS 283 - Introductory Roman History II
- CLASS 294 - Ancient Science, Technology, and Medicine
- CLASS 376
- ECON 204 - Principles of Economics
- ECON 281 - Intermediate Microeconomic Theory I
- ECON 282 - Intermediate Macroeconomic Theory I
- ENGG 420 - Engineering Law
- ENG M 402 - Project Management and Entrepreneurship
- ENG M 406
- HECOL 211 - Human Sexuality
- HIST 260 - Pre-Confederation Canada
- HIST 261 - Post-Confederation Canada
- HIST 295 - 20th-Century Warfare
- HIST 397 - History of Science I
- HIST 398 - History of Science II
- INT D 303 - Economics of World Food and Agriculture
- LA ST 210 - South America
- LING 204 - English Syntax
- LING 205 - Phonetics
- MARK 301 - Introduction to Marketing
- OM 352 - Operations Management
- PHIL 205 - Philosophy of Mind
- PHIL 220 - Symbolic Logic II
- PHIL 250 - Contemporary Ethical Issues
- PHIL 325 - Risk, Choice, and Rationality
- PHIL 355 - Environmental Ethics
- POL S 223 - City Government and Politics
- PSYCO 258 - Cognitive Psychology
- PSYCO 275 - Brain and Behavior
- R SOC 355 - Rural Communities and Global Economies
- R SOC 365 - Sociology of Environment and Development
- SMO 200 - Introduction to Management for Non-Business Students
- SMO 301 - Behavior in Organizations
- SMO 330 - Introduction to Entrepreneurship
- SOC 212 - Classical Social Theory
- SOC 224 - Sociology of Deviance and Conformity

- SOC 225 - Criminology
- SOC 241 - Social Psychology
- SOC 242 - Biologically Coordinated Social Psychology
- SOC 251 - Population and Society
- SOC 301 - Sociology of Gender
- WGS 220 - Feminism and Popular Culture

### Notes:

\*\*Not available to Civil students

\*\*\*Not available to Civil (Environmental Engineering Option) students.

A second course from the ITS List may be taken as part of List 2. However, a single course cannot be used to satisfy both the ITS and Complementary Studies requirements. This list is updated annually. Courses that teach a language or the application of a particular skill (such as courses in physical education, music and art) do not meet the intent of the Accreditation Board with respect to complementary studies and are therefore not eligible.

### 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:

- ENG M 403
- ENG M 405
- HIST 115 - Technology and History
- HIST 391 - History of Technology
- HGP 250 - Natural Resources and Environmental Management
- INT D 361
- PHIL 265 - Philosophy of Science
- PHIL 366 - Computers and Culture
- PHIL 375
- STS 200 - Introduction to Studies in Science, Technology and Society
- SOC 366 - People in Industry
- SOC 363 - Sociology of Work and Industry

### English Electives

Engineering programs require ENGL 199.

## Materials Engineering

Materials Engineering involves engineering of materials themselves; materials are designed and selected for their function in society. Materials Engineering students will learn to think in the materials paradigm, which focuses on the interrelationships between structure, properties, processing, and performance. Materials Engineers also characterize the structure, properties, and performance of materials in order to determine interrelationships.

Students who want to take Materials Engineering will benefit by developing spatial reasoning skills, the ability to visualize technical information, and an interest in small length scales and how materials fail.

Materials Engineering involves selecting the length 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.

The discipline focuses on 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, 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 engineering aspects of manufacturing 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 also includes the recycling industries. In all sectors Materials Engineers are often involved with the selection of materials for use in designs, and are consulted for failure analysis.

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 program electives it is possible for the students to go into more depth in particular areas of interest, e.g., mineral processing and extractive metallurgy, polymer materials, structural materials, and functional materials.

## Elective Streams in Materials Engineering

1. **Mineral Processing and Extractive Metallurgy:** Metallic and nonmetallic 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.
2. **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.
3. **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, failure analysis, automotive and consulting.
4. **Functional Materials:** Functional materials are those which exhibit inherent properties and functions (e.g., piezoelectricity, magnetism, ferroelectricity, or energy storage). Functional materials can be in any class of material – ceramics, metals, polymers, semiconductors, or composites. Subject areas in this stream cover electronic, optical and magnetic materials, thin film materials, nanomaterials and their applications, nanostructured molecular sieves, nano 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.

## Required Courses and Suggested Course Sequence for Traditional

- Materials

## Materials [Engineering]

### Year 2

#### Term 3

- CH E 243 - Engineering Thermodynamics
- CHEM 261 - Organic Chemistry I
- CME 200 - Introduction to Chemical and Materials Engineering
- MAT E 202 - Materials Science II
- MATH 209 - Calculus III
- STAT 235 - Introductory Statistics for Engineering
- ITS Elective (3-0-0)

#### Term 4

- CH E 312 - Fluid Mechanics
- CIV E 270 - Mechanics of Deformable Bodies I
- CME 265 - Process Analysis
- MATH 201 - Differential Equations
- MAT E 204 - Materials Engineering Thermodynamics
- MAT E 211 - Characterization of Materials

### Year 3

#### Term 5

- CH E 314 - Heat Transfer
- CH E 374 - Computational Methods in Engineering
- Complementary Studies Elective (3-0-0)
- MAT E 335 - Phase Transformations I
- MAT E 341 - Applied Electrochemistry
- MAT E 361 - Materials Engineering Laboratory I

#### Term 6

- CH E 314 - Heat Transfer
- MAT E 336 - Phase Transformations II
- MAT E 345 - Corrosion, Oxidation, and Degradation
- MAT E 351 - Mechanical Properties

- MAT E 362 - Materials Engineering Laboratory II
- MAT E 473 - Processing of Materials

## Year 4

### Term 7

- CME 481 - Colloquium I
- ENG M 310 - Engineering Economy **OR**
- ENG M 401 - Financial Management for Engineers
- ENGG 404 - Engineering Safety and Risk Management-Leadership in Risk Management
- MAT E 464 - Materials Process Engineering Design
- Program Elective (3-0-0)
- Complementary Studies Elective (3-0-0)

### Term 8

- CME 483 - Colloquium II
- ENGG 400 - The Practice of the Engineering Profession
- MAT E 461 - Materials Engineering Laboratory III
- MAT E 465 - Materials Design Project
- MAT E 474 - Performance of Materials
- Program Elective (3-0-0)
- Program Elective (3-0-0)

## Notes

1. See Program and Technical Electives for restrictions on the three program electives.
2. Students who are interested in Structural Materials, Mineral Processing and Extractive Metallurgy, Functional Materials, or Polymer Materials Elective Streams should consult the Department for course schedules.

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

- Materials



## Materials (Co-op) [Engineering]

### Year 2

#### Fall Term 3

- CH E 243 - Engineering Thermodynamics
- CHEM 261 - Organic Chemistry I
- CME 200 - Introduction to Chemical and Materials Engineering
- ENGG 299 - Orientation to Cooperative Education
- MAT E 202 - Materials Science II
- MATH 209 - Calculus III
- STAT 235 - Introductory Statistics for Engineering

#### Winter Term 4

- CIV E 270 - Mechanics of Deformable Bodies I
- CH E 312 - Fluid Mechanics
- CME 265 - Process Analysis
- MATH 201 - Differential Equations
- MAT E 204 - Materials Engineering Thermodynamics
- MAT E 211 - Characterization of Materials

#### Summer

- WKEXP 901 - Engineering Work Experience I

### Year 3

#### Fall Term 5

- Complementary Studies Elective (3-0-0)
- CH E 314 - Heat Transfer
- CH E 374 - Computational Methods in Engineering
- MAT E 335 - Phase Transformations I
- MAT E 341 - Applied Electrochemistry
- MAT E 361 - Materials Engineering Laboratory I

## Winter

- WKEXP 902 - Engineering Work Experience II

## Summer

- WKEXP 903 - Engineering Work Experience III

## Year 4

### Fall Term 6

- ENG M 310 - Engineering Economy **OR**
- ENG M 401 - Financial Management for Engineers
  
- ENGG 404 - Engineering Safety and Risk Management-Leadership in Risk Management
- MAT E 464 - Materials Process Engineering Design
- ITS Elective (3-0-0)
- Program Elective (3-0-0)
- Complementary Studies Elective (3-0-0)

### Winter Term 7

- CME 481 - Colloquium I
- MAT E 345 - Corrosion, Oxidation, and Degradation
- MAT E 336 - Phase Transformations II
- MAT E 351 - Mechanical Properties
- MAT E 362 - Materials Engineering Laboratory II
- MAT E 473 - Processing of Materials
- Complementary Studies Elective (3-0-0)

## Summer

- WKEXP 904 - Engineering Work Experience IV

## Year 5

### Fall

- WKEXP 905 - Engineering Work Experience V

## Winter Term 8

- CME 483 - Colloquium II
- ENGG 400 - The Practice of the Engineering Profession
- MAT E 461 - Materials Engineering Laboratory III
- MAT E 465 - Materials Design Project
- MAT E 474 - Performance of Materials
- Program Elective (3-0-0)
- Program Elective (3-0-0)

## Notes

1. See Program and Technical Electives for restrictions on the three program electives.
2. Students who are in or are interested in Structural Materials, Mineral Processing and Extractive Metallurgy, Functional Materials, or Polymer Materials Elective Streams should consult the Department for course schedules.

## Program and Technical Electives

- Materials

## Materials (Program and Technical Electives) [Engineering]

### Program electives

Students in the Materials Engineering program are required to take three program electives from the following list of courses. At least one of the three must be a CME and/or MAT E course.

- BIOCH 200 - Introductory Biochemistry
- BIOL 107 - Introduction to Cell Biology
- BIOL 201 - Eukaryotic Cellular Biology
- BME 410
- BME 320 - Human Anatomy and Physiology: Cells and Tissue
- BME 321 - Human Anatomy and Physiology: Systems
- BME 541
- CELL 201 - Introduction to Molecular Cell Biology
- CME 421 - Mineral Processing
- CME 422
- CME 458 - Special Projects in Chemical and Materials Engineering I (see Note 1)
- CME 459 - Special Projects in Chemical and Materials Engineering II (see Note 1)
- CME 472 - Extractive Metallurgy
- CME 482 - Fundamentals of Polymers

- CME 484
- CME 485
- CME 494 - Special Topics in Chemical and Materials Engineering
- CH E 343 - Chemical Engineering Thermodynamics
- CH E 446 - Process Dynamics and Control
- CH E 482
- CH E 484 - Introduction to Biochemical Engineering
- CH E 485 - Fuel Cells and Their Applications
- CH E 582 - Introduction to Biomaterials
- CHEM 211 - Quantitative Analysis I
- CHEM 213 - Quantitative Analysis II
- CHEM 263 - Organic Chemistry II
- CHEM 303 - Environmental Chemistry I
- CHEM 333 - Inorganic Materials Chemistry
- CHEM 371 - Energetics of Chemical Reactions
- CHEM 373 - Physical Properties and Dynamics of Chemical Systems
- CIV E 221 - Environmental Engineering Fundamentals
- CIV E 321 - Principles of Environmental Modeling and Risk
- CIV E 372 - Structural Analysis I
- CIV E 374 - Structural Design I
- CIV E 421
- EAS 210 - Engineering Earth Science
- EAS 224 - Mineralogy I
- EAS 320 - Geochemistry I
- ECE 209 - Fundamentals of Electrical Engineering
- ECE 457 - Microfabrication and Devices
- ENGG 406 - Engineering Safety and Risk Management - Methodologies and Tools
- ENG M 514 - Reliability Engineering
- ENG M 530 - Engineering Project Management
- ENV E 251 - Properties of Environmental Engineering Materials
- GEOPH 223 - Environmental Geophysics
- MAT E 466 - Special Topics in Materials Engineering
- MAT E 470 - Process Dynamics
- MAT E 471 - Ceramics
- MAT E 476 - Microalloyed Steels
- MAT E 491 - Solid State Physics of Materials
- MAT E 494 - Nanostructured Materials
- MAT E 495 - Nanomaterials and Biomedical Applications
- MATH 300 - Advanced Boundary Value Problems I
- MEC E 250 - Engineering Mechanics II
- MEC E 260 - Mechanical Design I
- MEC E 360 - Mechanical Design II
- MEC E 380 - Advanced Strength of Materials I
- MGTSC 405 - Forecasting for Planners and Managers

- MIS 311 - Management Information Systems
- OM 352 - Operations Management
- OM 404
- OM 422 - Simulation and Computer Modelling Techniques in Management
- OM 426
- PHYS 230 - Electricity and Magnetism
- PHYS 271 - Introduction to Modern Physics
- STAT 265 - Statistics I
- STAT 335
- STAT 368 - Introduction to Design and Analysis of Experiments
- STAT 378 - Applied Regression Analysis

## Notes

1. CME 458 or CME 459 may only be taken with an appropriate project approved by the Department.
2. Other courses may be taken as program electives with written permission from the Department.

## Mineral Processing and Extractive Metallurgy Elective Stream

The three program electives should be CME 421, CME 422 , and CME 472.

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

## Polymer Materials Elective Stream

The three program electives should be CME 482, CME 484 , and CME 485 .

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

## Structural Materials Elective Stream

Two of the three program electives should be CME 472 and MAT E 476. The third program elective can be one of MAT E 466, MAT E 470, MAT E 471 or CME 482.

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

## Functional Materials Elective Stream

The two of the three program electives should be MAT E 491 and MAT E 494. The third program elective can be selected from list (1).

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

## Complementary Studies Electives

- Complementary Studies Electives

### Complementary Studies Electives

To better understand the role of Engineering within a broader social context, all programs require an element of complementary studies consisting of the humanities, social sciences, arts, management, engineering economics and communications. Aspects of these topics are covered in mandatory courses, but each program contains complementary studies electives so that students may explore areas of particular interest. Notwithstanding this, the Canadian Engineering Accreditation Board requires that programs include exposure to the central thought processes of the humanities and social sciences. Students must take the number of complementary studies electives as required by their program. Students can take a maximum of one list 1 complementary studies elective. Note that in some cases, a course may appear both on a complementary studies list and as a program required or program elective course. A single course cannot be used to satisfy multiple course requirements under Programs of Study.

Students interested in taking a minor should select their first complementary studies courses with this in mind. For the Business minor, student should take ECON 204; for an Arts minor, students should select a course in a possible area of concentration of interest, see minors for specific requirements for each minor.

#### List 1

- ANTHR 101 - Introductory Anthropology
- ANTHR 110 - Gender, Age, and Culture
- ANTHR 150 - Race and Racism
- CLASS 102 - Greek and Roman Mythology
- CLASS 103 - Introduction to Ancient Greece
- CLASS 104 - Introduction to Ancient Rome
- CLASS 110 - The Ancient World
- ECON 101 - Introduction to Microeconomics
- ECON 102 - Introduction to Macroeconomics
- ENGL 125 - Aboriginal Writing \*
- HIST 110 - The Pre-Modern World
- HIST 111 - The Early Modern World
- HIST 112 - The Modern World
- HIST 114 - The History of the World in the Last 10 Years
- HIST 116 - The Emergence of the Atlantic World
- LING 101 - Introduction to Linguistic Analysis
- PHIL 120 - Symbolic Logic I
- PHIL 125 - Practical Logic
- POL S 101 - Introduction to Politics
- PSYCO 104 - Basic Psychological Processes
- SOC 100 - Introductory Sociology

List 2

- ACCTG 300 - Introduction to Accounting
- ACCTG 311 - Introduction to Accounting for Financial Performance
- ANTHR 230 - Anthropology of Science, Technology, and Environment
- AREC 365 - Natural Resource Economics
- B LAW 301 - Legal Foundations of the Canadian Economy \*\*
- B LAW 422 - Law of Business Organizations
- B LAW 428 - Natural Resource and Environmental Law \*\*\*
- B LAW 432 - The Legal Regulation of Business
- CHRTC 350 - Science and Religion: Christian Perspectives
- CLASS 254 - Introduction to Greek Art and Archaeology
- CLASS 255 - Introduction to Roman Art and Archaeology
- CLASS 283 - Introductory Roman History II
- CLASS 294 - Ancient Science, Technology, and Medicine
- CLASS 376
- ECON 204 - Principles of Economics
- ECON 281 - Intermediate Microeconomic Theory I
- ECON 282 - Intermediate Macroeconomic Theory I
- ENGG 420 - Engineering Law
- ENG M 402 - Project Management and Entrepreneurship
- ENG M 406
- HECOL 211 - Human Sexuality
- HIST 260 - Pre-Confederation Canada
- HIST 261 - Post-Confederation Canada
- HIST 295 - 20th-Century Warfare
- HIST 397 - History of Science I
- HIST 398 - History of Science II
- INT D 303 - Economics of World Food and Agriculture
- LA ST 210 - South America
- LING 204 - English Syntax
- LING 205 - Phonetics
- MARK 301 - Introduction to Marketing
- OM 352 - Operations Management
- PHIL 205 - Philosophy of Mind
- PHIL 220 - Symbolic Logic II
- PHIL 250 - Contemporary Ethical Issues
- PHIL 325 - Risk, Choice, and Rationality
- PHIL 355 - Environmental Ethics
- POL S 223 - City Government and Politics
- PSYCO 258 - Cognitive Psychology
- PSYCO 275 - Brain and Behavior
- R SOC 355 - Rural Communities and Global Economies

- R SOC 365 - Sociology of Environment and Development
- SMO 200 - Introduction to Management for Non-Business Students
- SMO 301 - Behavior in Organizations
- SMO 330 - Introduction to Entrepreneurship
- SOC 212 - Classical Social Theory
- SOC 224 - Sociology of Deviance and Conformity
- SOC 225 - Criminology
- SOC 241 - Social Psychology
- SOC 242 - Biologically Coordinated Social Psychology
- SOC 251 - Population and Society
- SOC 301 - Sociology of Gender
- WGS 220 - Feminism and Popular Culture

### Notes:

\*\*Not available to Civil students

\*\*\*Not available to Civil (Environmental Engineering Option) students.

A second course from the ITS List may be taken as part of List 2. However, a single course cannot be used to satisfy both the ITS and Complementary Studies requirements. This list is updated annually. Courses that teach a language or the application of a particular skill (such as courses in physical education, music and art) do not meet the intent of the Accreditation Board with respect to complementary studies and are therefore not eligible.

### 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:

- ENG M 403
- ENG M 405
- HIST 115 - Technology and History
- HIST 391 - History of Technology
- HGP 250 - Natural Resources and Environmental Management
- INT D 361
- PHIL 265 - Philosophy of Science
- PHIL 366 - Computers and Culture
- PHIL 375
- STS 200 - Introduction to Studies in Science, Technology and Society
- SOC 366 - People in Industry
- SOC 363 - Sociology of Work and Industry

### English Electives

Engineering programs require ENGL 199.



## 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 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.

### 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.

## 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 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.

## Required Courses and Suggested Course Sequence for Traditional

- Mechanical
- Mechanical: Alternate Format

## Mechanical [Engineering]

### Year 2

#### Fall Term 3

- CIV E 270 - Mechanics of Deformable Bodies I
- MATH 209 - Calculus III
- STAT 235 - Introductory Statistics for Engineering

## Course Group 2A

- CH E 243 - Engineering Thermodynamics
- MEC E 200 - Introduction to Mechanical Engineering
- MEC E 250 - Engineering Mechanics II

OR

## Course Group 2B

- MEC E 230 - Introduction to Thermo-Fluid Sciences
- MEC E 260 - Mechanical Design I
- MEC E 265 - Engineering Graphics and CAD

## Winter Term 4

- ECE 209 - Fundamentals of Electrical Engineering
- MAT E 202 - Materials Science II
- MATH 201 - Differential Equations

## Course Group 2A

- CH E 243 - Engineering Thermodynamics
- MEC E 200 - Introduction to Mechanical Engineering
- MEC E 250 - Engineering Mechanics II

OR

## Course Group 2B

- MEC E 230 - Introduction to Thermo-Fluid Sciences
- MEC E 260 - Mechanical Design I
- MEC E 265 - Engineering Graphics and CAD

Year 3

## Fall Term 5

## Course Group 3A

- MATH 300 - Advanced Boundary Value Problems I
- MEC E 300 - Mechanical Measurements
- MEC E 301 - Mechanical Engineering Laboratory I
- MEC E 331 - Fluid Mechanics I
- MEC E 371 - Heat Transfer
- MEC E 380 - Advanced Strength of Materials I

OR

## Course Group 3B

- ENG M 310 - Engineering Economy **OR**
- ENG M 401 - Financial Management for Engineers
  
- Complementary Studies Elective (3-0-0)
- MEC E 340 - Applied Thermodynamics
- MEC E 360 - Mechanical Design II
- MEC E 362 - Mechanics of Machines
- MEC E 390 - Numerical Methods of Mechanical Engineers

## Winter Term 6

## Course Group 3A

- MATH 300 - Advanced Boundary Value Problems I
- MEC E 300 - Mechanical Measurements
- MEC E 301 - Mechanical Engineering Laboratory I
- MEC E 331 - Fluid Mechanics I
- MEC E 371 - Heat Transfer
- MEC E 380 - Advanced Strength of Materials I

OR

## Course Group 3B

- ENG M 310 - Engineering Economy **OR**
- ENG M 401 - Financial Management for Engineers
  
- Complementary Studies Elective (3-0-0)
- MEC E 340 - Applied Thermodynamics

- MEC E 360 - Mechanical Design II
- MEC E 362 - Mechanics of Machines
- MEC E 390 - Numerical Methods of Mechanical Engineers

## Year 4

### Fall Term 7

- Program Elective (3-0-0)
- Program Elective (3-0-0)

### Course Group 4A

- ENGG 404 - Engineering Safety and Risk Management-Leadership in Risk Management
- MEC E 430 - Fluid Mechanics II **OR**
- MEC E 480 - Advanced Strength of Materials II
- MEC E 463 - Thermo-Fluids Systems Design
- Program Elective (3-0-0)

OR

### Course Group 4B

- ITS Elective (3-0-0)
- MEC E 403 - Mechanical Engineering Laboratory II
- MEC E 451 - Vibrations and Sound
- MEC E 460 - Design Project

### Winter Term 8

- CH E 448 - Process Control for Mechanical Engineers **OR**
- MEC E 420 - Feedback Control Design of Dynamic Systems
- ENGG 400 - The Practice of the Engineering Profession
- Program Elective (3-0-0)

### Course Group 4A

- ENGG 404 - Engineering Safety and Risk Management-Leadership in Risk Management

- MEC E 430 - Fluid Mechanics II **OR**
- MEC E 480 - Advanced Strength of Materials II
  
- MEC E 463 - Thermo-Fluids Systems Design
- Program Elective (3-0-0)

OR

#### Course Group 4B

- ITS Elective (3-0-0)
- MEC E 403 - Mechanical Engineering Laboratory II
- MEC E 451 - Vibrations and Sound
- MEC E 460 - Design Project

#### Notes

1. See Program and Technical Electives for restrictions on the four program 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).

## Mechanical: Alternate Format [Engineering]

### Year 2

#### Fall Term 3

- ENG M 310 - Engineering Economy **OR**
- ENG M 401 - Financial Management for Engineers
  
- ENGG 404 - Engineering Safety and Risk Management-Leadership in Risk Management
- Complementary Studies Elective (3-0-0)
- ITS Elective (3-0-0)
- MATH 201 - Differential Equations
- MATH 209 - Calculus III

#### Winter Term 4

- CIV E 270 - Mechanics of Deformable Bodies I
- MEC E 230 - Introduction to Thermo-Fluid Sciences
- MEC E 260 - Mechanical Design I

- MEC E 265 - Engineering Graphics and CAD
- STAT 235 - Introductory Statistics for Engineering

### Summer Term 5

- CH E 243 - Engineering Thermodynamics
- ECE 209 - Fundamentals of Electrical Engineering
- MAT E 202 - Materials Science II
- MEC E 200 - Introduction to Mechanical Engineering
- MEC E 250 - Engineering Mechanics II

### Year 3

#### Fall Term 6

##### Course Group 3A-alt

- MATH 300 - Advanced Boundary Value Problems I
- MEC E 300 - Mechanical Measurements
- MEC E 301 - Mechanical Engineering Laboratory I
- MEC E 331 - Fluid Mechanics I
- MEC E 371 - Heat Transfer
- MEC E 380 - Advanced Strength of Materials I

OR

##### Course Group 3B-alt

- MEC E 340 - Applied Thermodynamics
- MEC E 360 - Mechanical Design II
- MEC E 362 - Mechanics of Machines
- MEC E 390 - Numerical Methods of Mechanical Engineers
- Program Elective (3-0-0)

#### Winter Term 7

##### Course Group 3A-alt

- MATH 300 - Advanced Boundary Value Problems I
- MEC E 300 - Mechanical Measurements
- MEC E 301 - Mechanical Engineering Laboratory I

- MEC E 331 - Fluid Mechanics I
- MEC E 371 - Heat Transfer
- MEC E 380 - Advanced Strength of Materials I

OR

#### Course Group 3B-alt

- MEC E 340 - Applied Thermodynamics
- MEC E 360 - Mechanical Design II
- MEC E 362 - Mechanics of Machines
- MEC E 390 - Numerical Methods of Mechanical Engineers
- Program Elective (3-0-0)

#### Summer Term 8

- Program Elective (3-0-0)
- Program Elective (3-0-0)

#### Course Group 4A-alt

- MEC E 430 - Fluid Mechanics II **OR**
- MEC E 480 - Advanced Strength of Materials II
  
- MEC E 463 - Thermo-Fluids Systems Design
- Program Elective (3-0-0)

OR

#### Course Group 4B-alt

- MEC E 403 - Mechanical Engineering Laboratory II
- MEC E 451 - Vibrations and Sound
- MEC E 460 - Design Project

### Year 4

#### Fall Term 9

- CH E 448 - Process Control for Mechanical Engineers **OR**
- MEC E 420 - Feedback Control Design of Dynamic Systems



- ENGG 400 - The Practice of the Engineering Profession

#### Course Group 4A-alt

- MEC E 430 - Fluid Mechanics II **OR**
- MEC E 480 - Advanced Strength of Materials II
  
- MEC E 463 - Thermo-Fluids Systems Design
- Program Elective (3-0-0)

OR

#### Course Group 4B-alt

- MEC E 403 - Mechanical Engineering Laboratory II
- MEC E 451 - Vibrations and Sound
- MEC E 460 - Design Project

#### Notes

1. See Mechanical (Program and Technical Electives) for restrictions on the four program electives.
2. Offered in consecutive terms, including Summer, from Term 3 to Term 9.
3. In each term of years 3 and 4, students take either Group A-alt then Group B-alt, or Group B-alt then Group A-alt.

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

- Mechanical Plan I
- Mechanical Plan II
- Mechanical Plan III : Biomedical Option
- Mechanical Plan IV

## Mechanical Plan I (Co-op) [Engineering]

### Year 2

### Fall Term 3

- CIV E 270 - Mechanics of Deformable Bodies I
- ENGG 299 - Orientation to Cooperative Education
- MATH 209 - Calculus III
- MEC E 230 - Introduction to Thermo-Fluid Sciences
- MEC E 260 - Mechanical Design I
- MEC E 265 - Engineering Graphics and CAD
- STAT 235 - Introductory Statistics for Engineering

### Winter Term 4

- CH E 243 - Engineering Thermodynamics
- ECE 209 - Fundamentals of Electrical Engineering
- MAT E 202 - Materials Science II
- MATH 201 - Differential Equations
- MEC E 200 - Introduction to Mechanical Engineering
- MEC E 250 - Engineering Mechanics II

### Summer

- WKEXP 901 - Engineering Work Experience I

### Year 3

#### Fall

- WKEXP 902 - Engineering Work Experience II

#### Winter Term 5

#### Course Group 3A

- MATH 300 - Advanced Boundary Value Problems I
- MEC E 300 - Mechanical Measurements
- MEC E 301 - Mechanical Engineering Laboratory I
- MEC E 331 - Fluid Mechanics I
- MEC E 371 - Heat Transfer
- MEC E 380 - Advanced Strength of Materials I

OR

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### Course Group 3B

- ENG M 310 - Engineering Economy **OR**
- ENG M 401 - Financial Management for Engineers
  
- Complementary Studies Elective (3-0-0)
- MEC E 340 - Applied Thermodynamics
- MEC E 360 - Mechanical Design II
- MEC E 362 - Mechanics of Machines
- MEC E 390 - Numerical Methods of Mechanical Engineers

### Summer

- WKEXP 903 - Engineering Work Experience III

### Year 4

#### Fall

- WKEXP 904 - Engineering Work Experience IV

#### Winter Term 6

### Course Group 3A

- MATH 300 - Advanced Boundary Value Problems I
- MEC E 300 - Mechanical Measurements
- MEC E 301 - Mechanical Engineering Laboratory I
- MEC E 331 - Fluid Mechanics I
- MEC E 371 - Heat Transfer
- MEC E 380 - Advanced Strength of Materials I

OR

### Course Group 3B

- ENG M 310 - Engineering Economy **OR**
- ENG M 401 - Financial Management for Engineers
  
- Complementary Studies Elective (3-0-0)
- MEC E 340 - Applied Thermodynamics

- MEC E 360 - Mechanical Design II
- MEC E 362 - Mechanics of Machines
- MEC E 390 - Numerical Methods of Mechanical Engineers

### Summer Term 7

- ENGG 404 - Engineering Safety and Risk Management-Leadership in Risk Management
- Program Elective (3-0-0)
- Program Elective (3-0-0)
  
- MEC E 430 - Fluid Mechanics II **OR**
- MEC E 480 - Advanced Strength of Materials II
  
- MEC E 463 - Thermo-Fluids Systems Design
- Program Elective (3-0-0)

### Year 5

#### Fall

- WKEXP 905 - Engineering Work Experience V

#### Winter Term 8

- CH E 448 - Process Control for Mechanical Engineers **OR**
- MEC E 420 - Feedback Control Design of Dynamic Systems
  
- ENGG 400 - The Practice of the Engineering Profession
- ITS Elective (3-0-0)
- MEC E 403 - Mechanical Engineering Laboratory II
- MEC E 451 - Vibrations and Sound
- MEC E 460 - Design Project
- Program Elective (3-0-0)

### Note:

See Program and Technical Electives for restrictions on the four program electives.

## Mechanical Plan II (Co-op) [Engineering]

### Year 2

#### Fall Term 3

- CH E 243 - Engineering Thermodynamics
- CIV E 270 - Mechanics of Deformable Bodies I
- ENGG 299 - Orientation to Cooperative Education
- MATH 209 - Calculus III
- MEC E 200 - Introduction to Mechanical Engineering
- MEC E 250 - Engineering Mechanics II
- STAT 235 - Introductory Statistics for Engineering

#### Winter

- WKEXP 901 - Engineering Work Experience I

#### Summer Term 4

- ECE 209 - Fundamentals of Electrical Engineering
- MAT E 202 - Materials Science II
- MATH 201 - Differential Equations
- MEC E 230 - Introduction to Thermo-Fluid Sciences
- MEC E 260 - Mechanical Design I
- MEC E 265 - Engineering Graphics and CAD

### Year 3

#### Fall Term 5

#### Course Group 3B

- ENG M 310 - Engineering Economy **OR**
- ENG M 401 - Financial Management for Engineers
  
- Complementary Studies Elective (3-0-0)
- MEC E 340 - Applied Thermodynamics
- MEC E 360 - Mechanical Design II
- MEC E 362 - Mechanics of Machines

- MEC E 390 - Numerical Methods of Mechanical Engineers

### Winter

- WKEXP 902 - Engineering Work Experience II

### Summer

- WKEXP 903 - Engineering Work Experience III

## Year 4

### Fall Term 6

#### Course Group 3A

- MATH 300 - Advanced Boundary Value Problems I
- MEC E 300 - Mechanical Measurements
- MEC E 301 - Mechanical Engineering Laboratory I
- MEC E 331 - Fluid Mechanics I
- MEC E 371 - Heat Transfer
- MEC E 380 - Advanced Strength of Materials I

### Winter

- WKEXP 904 - Engineering Work Experience IV

### Summer Term 7

- Program Elective (3-0-0)
- Program Elective (3-0-0)
- ITS Elective (3-0-0)
- MEC E 403 - Mechanical Engineering Laboratory II
- MEC E 451 - Vibrations and Sound
- MEC E 460 - Design Project

## Year 5

### Fall

- WKEXP 905 - Engineering Work Experience V

### Winter Term 8

- CH E 448 - Process Control for Mechanical Engineers **OR**
- MEC E 420 - Feedback Control Design of Dynamic Systems
  
- ENGG 400 - The Practice of the Engineering Profession
- ENGG 404 - Engineering Safety and Risk Management-Leadership in Risk Management
- Program Elective (3-0-0)
  
- MEC E 430 - Fluid Mechanics II **OR**
- MEC E 480 - Advanced Strength of Materials II
  
- MEC E 463 - Thermo-Fluids Systems Design
- Program Elective (3-0-0)

### Note:

See Program and Technical Electives for restrictions on the four program electives.

## Mechanical Plan III : Biomedical Option (Co-op) [Engineering]

## Year 2

### Fall Term 3

- CIV E 270 - Mechanics of Deformable Bodies I
- ENGG 299 - Orientation to Cooperative Education
- MATH 209 - Calculus III
- STAT 235 - Introductory Statistics for Engineering
- CH E 243 - Engineering Thermodynamics
- MEC E 200 - Introduction to Mechanical Engineering
- MEC E 250 - Engineering Mechanics II

### Winter Term 4

- ECE 209 - Fundamentals of Electrical Engineering
- MAT E 202 - Materials Science II
- MATH 201 - Differential Equations
- MEC E 230 - Introduction to Thermo-Fluid Sciences
- MEC E 260 - Mechanical Design I
- MEC E 265 - Engineering Graphics and CAD

### Summer

- WKEXP 902 - Engineering Work Experience II

### Year 3

### Fall Term 5

- BME 320 - Human Anatomy and Physiology: Cells and Tissue
- ENG M 310 - Engineering Economy **OR**
- ENG M 401 - Financial Management for Engineers
- MEC E 340 - Applied Thermodynamics
- MEC E 360 - Mechanical Design II
- MEC E 362 - Mechanics of Machines
- MEC E 390 - Numerical Methods of Mechanical Engineers

### Winter

- WKEXP 903 - Engineering Work Experience III

### Summer Term 6

- MATH 300 - Advanced Boundary Value Problems I
- MEC E 300 - Mechanical Measurements
- MEC E 301 - Mechanical Engineering Laboratory I
- MEC E 331 - Fluid Mechanics I
- MEC E 371 - Heat Transfer
- MEC E 380 - Advanced Strength of Materials I



## Year 4

### Fall Term 7

- BME 321 - Human Anatomy and Physiology: Systems
- ENGG 404 - Engineering Safety and Risk Management-Leadership in Risk Management
- Complementary Studies Elective (3-0-0)
- MEC E 563 - Finite Element Method for Mechanical Engineering
- Program Elective (3-0-0)
- STAT 337 - Biostatistics

### Winter

- WKEXP 906 - Engineering Work Experience VI

### Summer

- WKEXP 904 - Engineering Work Experience IV

## Year 5

### Fall Term 8

- ITS Elective (3-0-0)
- MEC E 430 - Fluid Mechanics II
- MEC E 463 - Thermo-Fluids Systems Design
- Program Elective (3-0-0)
- Program Elective (3-0-0)

### Winter Term 9

- CH E 448 - Process Control for Mechanical Engineers **OR**
- MEC E 420 - Feedback Control Design of Dynamic Systems
  
- ENGG 400 - The Practice of the Engineering Profession
- MEC E 485 - Biomechanical Modelling of Human Tissues and Systems
- MEC E 403 - Mechanical Engineering Laboratory II
- MEC E 451 - Vibrations and Sound
- MEC E 460 - Design Project
- PHIL 386 - Health Care Ethics

## Notes

1. See Mechanical (Biomedical Option) for restrictions on the program electives.
2. The order of WKEXP 904 and WKEXP 906 may be switched. See the program advisor.
3. Students wishing to apply for admission to the Faculty of Medicine and Dentistry MD program should see Mechanical (Biomedical Option).

## Mechanical Plan IV (Co-op) [Engineering]

### Year 2

#### Fall Term 3

- CIV E 270 - Mechanics of Deformable Bodies I
- ENGG 299 - Orientation to Cooperative Education
- MATH 209 - Calculus III
- STAT 235 - Introductory Statistics for Engineering
- MEC E 230 - Introduction to Thermo-Fluid Sciences
- MEC E 260 - Mechanical Design I
- MEC E 265 - Engineering Graphics and CAD

#### Winter Term 4

- ECE 209 - Fundamentals of Electrical Engineering
- MATH 201 - Differential Equations
- CH E 243 - Engineering Thermodynamics
- MAT E 202 - Materials Science II
- MEC E 200 - Introduction to Mechanical Engineering
- MEC E 250 - Engineering Mechanics II

### Summer Term 5

#### Course Group 3A

- MATH 300 - Advanced Boundary Value Problems I
- MEC E 300 - Mechanical Measurements
- MEC E 301 - Mechanical Engineering Laboratory I
- MEC E 331 - Fluid Mechanics I
- MEC E 371 - Heat Transfer
- MEC E 380 - Advanced Strength of Materials I

OR

### Course Group 3B

- ENG M 310 - Engineering Economy **OR**
- ENG M 401 - Financial Management for Engineers
  
- Complementary Studies Elective (3-0-0)
- MEC E 340 - Applied Thermodynamics
- MEC E 360 - Mechanical Design II
- MEC E 362 - Mechanics of Machines
- MEC E 390 - Numerical Methods of Mechanical Engineers

### Year 3

Fall

- WKEXP 901 - Engineering Work Experience I

Winter

- WKEXP 902 - Engineering Work Experience II

Summer Term 6

### Course Group 3A

- MATH 300 - Advanced Boundary Value Problems I
- MEC E 300 - Mechanical Measurements
- MEC E 301 - Mechanical Engineering Laboratory I
- MEC E 331 - Fluid Mechanics I
- MEC E 371 - Heat Transfer
- MEC E 380 - Advanced Strength of Materials I

OR

### Course Group 3B

- ENG M 310 - Engineering Economy **OR**
- ENG M 401 - Financial Management for Engineers
  
- Complementary Studies Elective (3-0-0)
- MEC E 340 - Applied Thermodynamics
- MEC E 360 - Mechanical Design II
- MEC E 362 - Mechanics of Machines
- MEC E 390 - Numerical Methods of Mechanical Engineers

### Year 4

#### Fall

- WKEXP 903 - Engineering Work Experience III

#### Winter

- WKEXP 904 - Engineering Work Experience IV

#### Summer

- WKEXP 905 - Engineering Work Experience V

### Year 5

#### Fall Term 7

- Program Elective (3-0-0)
- Program Elective (3-0-0)
- ENGG 404 - Engineering Safety and Risk Management-Leadership in Risk Management
  
- MEC E 430 - Fluid Mechanics II **OR**
- MEC E 480 - Advanced Strength of Materials II
  
- MEC E 463 - Thermo-Fluids Systems Design
- Program Elective (3-0-0)

## Winter Term 8

- CH E 448 - Process Control for Mechanical Engineers **OR**
- MEC E 420 - Feedback Control Design of Dynamic Systems
  
- ENGG 400 - The Practice of the Engineering Profession
- ITS Elective (3-0-0)
- MEC E 403 - Mechanical Engineering Laboratory II
- MEC E 451 - Vibrations and Sound
- MEC E 460 - Design Project
- Program Elective (3-0-0)

### Note:

See Mechanical (Program and Technical Electives) for restrictions on the four program electives.

## Program and Technical Electives

- Mechanical
- Mechanical (Biomedical Option)

## Mechanical (Program and Technical Electives) [Engineering]

### One program elective must be chosen from the following:

- MEC E 467 - Modelling and Simulation of Engineering Systems
- MEC E 468 - Numerical Simulation in Mechanical Engineering Design
- MEC E 539 - Applied Computational Fluid Dynamics
- MEC E 563 - Finite Element Method for Mechanical Engineering

### The remaining three program electives must be chosen from the following:

- ACCTG 300 - Introduction to Accounting
- ACCTG 311 - Introduction to Accounting for Financial Performance
- B LAW 301 - Legal Foundations of the Canadian Economy
- B LAW 422 - Law of Business Organizations
- B LAW 444 - International Business Transactions
- BIOCH 200 - Introductory Biochemistry
- BIOL 107 - Introduction to Cell Biology
- BIOL 108 - Introduction to Biological Diversity
- BIOL 207 - Molecular Genetics and Heredity

- BME 320 - Human Anatomy and Physiology: Cells and Tissue
- BME 321 - Human Anatomy and Physiology: Systems
- BME 410
- BME 513 - Imaging Methods in Medicine
- BME 553 - Rehabilitation Engineering: Assisted Movement After Injury
- BME 564 - Fundamentals of Magnetic Resonance Imaging, MRI
- CH E 582 - Introduction to Biomaterials
- CHEM 261 - Organic Chemistry I
- CHEM 263 - Organic Chemistry II
- ECE 405 - Biophysical Measurement and Instrumentation
- ECE 440 - Digital Computer Processing of Images
- ECE 449 - Intelligent Systems Engineering
- ENGG 406 - Engineering Safety and Risk Management - Methodologies and Tools
- ENGG 420 - Engineering Law
- ENG M 402 - Project Management and Entrepreneurship
- ENG M 406
- ENG M 408 - Manufacturing Systems and Engineering
- ENG M 501 - Production and Operations Management
- ENG M 508 - Energy Auditing and Management
- ENG M 510
- ENG M 514 - Reliability Engineering
- ENG M 516 - Maintenance Management
- ENG M 530 - Engineering Project Management
- ENG M 540 - Introduction to Optimization Models and Algorithms
- ENG M 558
- FIN 301 - Introduction to Finance
- MARK 301 - Introduction to Marketing
- MATH 225 - Linear Algebra II
- MATH 311 - Theory of Functions of a Complex Variable
- MAT E 345 - Corrosion, Oxidation, and Degradation
- MAT E 466 - Special Topics in Materials Engineering
- MAT E 495 - Nanomaterials and Biomedical Applications
- MEC E 364 - Manufacturing Processes
- MEC E 409 - Experimental Design Project I
- MEC E 415 - Busting Myths with Analysis
- MEC E 430 - Fluid Mechanics II
- MEC E 439
- MEC E 443 - Energy Conversion
- MEC E 453
- MEC E 464 - Design for Manufacture
- MEC E 466 - Building Systems Design
- MEC E 467 - Modelling and Simulation of Engineering Systems
- MEC E 468 - Numerical Simulation in Mechanical Engineering Design
- MEC E 469 - Experimental Design Project II

- MEC E 480 - Advanced Strength of Materials II
- MEC E 485 - Biomechanical Modelling of Human Tissues and Systems
  
- MEC E 494 - Introduction to Research **AND**
- MEC E 495 - Research Project
  
- MEC E 537 - Aerodynamics
- MEC E 539 - Applied Computational Fluid Dynamics
- MEC E 541 - Combustion Engines
- MEC E 551
- MEC E 563 - Finite Element Method for Mechanical Engineering
- MEC E 564
- OM 352 - Operations Management
- PET E 275 - Petroleum Reservoir Fluids
- PET E 364 - Drilling Engineering
- PET E 365 - Well Logging and Formation Evaluation
- PET E 366 - Petroleum Production Operations
- PET E 444 - Natural Gas Engineering
- PHYS 230 - Electricity and Magnetism
- SMO 301 - Behavior in Organizations
- SMO 321 - Introduction to Strategic Management and Organization Design

## Notes

Other courses, including graduate-level ENG M and MEC E courses, may be taken with Department approval. Program elective courses (including transfer courses) must be at 300-level or above unless cleared in advance by the Department or specified for particular streams.

Note that some courses have prerequisites that must be satisfied.

## Biomedical Engineering Elective Stream

Students wishing to specialize in the area of biomedical engineering should choose their three program electives from the following courses:

- BME 320 - Human Anatomy and Physiology: Cells and Tissue
- BME 321 - Human Anatomy and Physiology: Systems
- BME 513 - Imaging Methods in Medicine
- BME 553 - Rehabilitation Engineering: Assisted Movement After Injury
- BME 583
- ECE 405 - Biophysical Measurement and Instrumentation
- ECE 440 - Digital Computer Processing of Images
- MEC E 409 - Experimental Design Project I
- MEC E 469 - Experimental Design Project II
- MEC E 485 - Biomechanical Modelling of Human Tissues and Systems

### Note:

In particular, BME 320, BME 321, and MEC E 485 are especially recommended.

Some of these courses may not be offered every year. See department for details.

## Business and Management Elective Stream

Students wishing to obtain an introduction to business and management principles should take ENG M 401 instead of ENG M 310, ENG M 405 as their ITS elective, and ECON 204 as their complementary studies elective in Term 8. In addition, they can choose their program electives from the following:

### Within the Faculty of Engineering:

- ENGG 420 - Engineering Law
- ENG M 402 - Project Management and Entrepreneurship
- ENG M 501 - Production and Operations Management
- ENG M 508 - Energy Auditing and Management
- ENG M 516 - Maintenance Management
- ENG M 530 - Engineering Project Management
- ENG M 540 - Introduction to Optimization Models and Algorithms
- ENG M 558
- MEC E 467 - Modelling and Simulation of Engineering Systems

### Note:

Note that some of these courses may not be offered every year. See department for details.

### Within the Faculty of Business:

- ACCTG 300 - Introduction to Accounting
- B LAW 301 - Legal Foundations of the Canadian Economy
- FIN 301 - Introduction to Finance
- MARK 301 - Introduction to Marketing
- OM 352 - Operations Management
- SMO 301 - Behavior in Organizations
- SMO 321 - Introduction to Strategic Management and Organization Design

### Notes

Note that admission to FIN 301, MARK 301, SMO 301, SMO 321 is preferentially reserved for students within that Faculty, and is available to engineering students only on a spaceavailable basis.



Credit will only be given for one of E E 404 and ENG M 515, and for one of CIV E 592 and OM 352.

Specific selection of electives should reflect the student's specific interests and needs.

### Aerospace Engineering Elective Stream

Students wishing to specialize in the area of aerospace engineering should choose their three program electives from the following courses:

- ENG M 514 - Reliability Engineering
- MEC E 420 - Feedback Control Design of Dynamic Systems
- MEC E 537 - Aerodynamics
- MEC E 539 - Applied Computational Fluid Dynamics
- MEC E 541 - Combustion Engines
- MEC E 569 - Mechanics and Design of Composite Materials

## Mechanical (Biomedical Option) (Program and Technical Electives) [Engineering]

### Program electives

The three program electives may be chosen from the following in addition to courses listed in Mechanical (Program and Technical Electives) [Engineering]:

- BIOCH 200 - Introductory Biochemistry
- BIOL 107 - Introduction to Cell Biology
- BIOL 108 - Introduction to Biological Diversity
- BIOL 207 - Molecular Genetics and Heredity
- CHEM 261 - Organic Chemistry I
- CHEM 263 - Organic Chemistry II

### Note:

Admission requirements for the Doctor of Medicine (MD) degree program include a specific number of course units in various core subjects. This information can be found in Admission Requirements. Students in the Biomedical Option who plan to apply to the MD degree program must select their electives carefully to obtain the necessary credit for required subjects. It may also be necessary to take courses over and above those included in the Biomedical Option to meet the course unit requirements in all of the core subjects required for Medicine. Students in the Biomedical Option who plan to apply for admission to the MD degree program should contact their program advisor in the Fall term of second year for guidance on the selection of appropriate electives and any specific courses which would be in addition to those required for the engineering degree.

### Complementary Studies Electives

- Complementary Studies Electives

## Complementary Studies Electives

To better understand the role of Engineering within a broader social context, all programs require an element of complementary studies consisting of the humanities, social sciences, arts, management, engineering economics and communications. Aspects of these topics are covered in mandatory courses, but each program contains complementary studies electives so that students may explore areas of particular interest. Notwithstanding this, the Canadian Engineering Accreditation Board requires that programs include exposure to the central thought processes of the humanities and social sciences. Students must take the number of complementary studies electives as required by their program. Students can take a maximum of one list 1 complementary studies elective. Note that in some cases, a course may appear both on a complementary studies list and as a program required or program elective course. A single course cannot be used to satisfy multiple course requirements under Programs of Study.

Students interested in taking a minor should select their first complementary studies courses with this in mind. For the Business minor, student should take ECON 204; for an Arts minor, students should select a course in a possible area of concentration of interest, see minors for specific requirements for each minor.

### List 1

- ANTHR 101 - Introductory Anthropology
- ANTHR 110 - Gender, Age, and Culture
- ANTHR 150 - Race and Racism
- CLASS 102 - Greek and Roman Mythology
- CLASS 103 - Introduction to Ancient Greece
- CLASS 104 - Introduction to Ancient Rome
- CLASS 110 - The Ancient World
- ECON 101 - Introduction to Microeconomics
- ECON 102 - Introduction to Macroeconomics
- ENGL 125 - Aboriginal Writing \*
- HIST 110 - The Pre-Modern World
- HIST 111 - The Early Modern World
- HIST 112 - The Modern World
- HIST 114 - The History of the World in the Last 10 Years
- HIST 116 - The Emergence of the Atlantic World
- LING 101 - Introduction to Linguistic Analysis
- PHIL 120 - Symbolic Logic I
- PHIL 125 - Practical Logic
- POL S 101 - Introduction to Politics
- PSYCO 104 - Basic Psychological Processes
- SOC 100 - Introductory Sociology

### List 2

- ACCTG 300 - Introduction to Accounting
- ACCTG 311 - Introduction to Accounting for Financial Performance
- ANTHR 230 - Anthropology of Science, Technology, and Environment

- AREC 365 - Natural Resource Economics
- B LAW 301 - Legal Foundations of the Canadian Economy \*\*
- B LAW 422 - Law of Business Organizations
- B LAW 428 - Natural Resource and Environmental Law \*\*\*
- B LAW 432 - The Legal Regulation of Business
- CHRTC 350 - Science and Religion: Christian Perspectives
- CLASS 254 - Introduction to Greek Art and Archaeology
- CLASS 255 - Introduction to Roman Art and Archaeology
- CLASS 283 - Introductory Roman History II
- CLASS 294 - Ancient Science, Technology, and Medicine
- CLASS 376
- ECON 204 - Principles of Economics
- ECON 281 - Intermediate Microeconomic Theory I
- ECON 282 - Intermediate Macroeconomic Theory I
- ENGG 420 - Engineering Law
- ENG M 402 - Project Management and Entrepreneurship
- ENG M 406
- HECOL 211 - Human Sexuality
- HIST 260 - Pre-Confederation Canada
- HIST 261 - Post-Confederation Canada
- HIST 295 - 20th-Century Warfare
- HIST 397 - History of Science I
- HIST 398 - History of Science II
- INT D 303 - Economics of World Food and Agriculture
- LA ST 210 - South America
- LING 204 - English Syntax
- LING 205 - Phonetics
- MARK 301 - Introduction to Marketing
- OM 352 - Operations Management
- PHIL 205 - Philosophy of Mind
- PHIL 220 - Symbolic Logic II
- PHIL 250 - Contemporary Ethical Issues
- PHIL 325 - Risk, Choice, and Rationality
- PHIL 355 - Environmental Ethics
- POL S 223 - City Government and Politics
- PSYCO 258 - Cognitive Psychology
- PSYCO 275 - Brain and Behavior
- R SOC 355 - Rural Communities and Global Economies
- R SOC 365 - Sociology of Environment and Development
- SMO 200 - Introduction to Management for Non-Business Students
- SMO 301 - Behavior in Organizations
- SMO 330 - Introduction to Entrepreneurship
- SOC 212 - Classical Social Theory
- SOC 224 - Sociology of Deviance and Conformity

- SOC 225 - Criminology
- SOC 241 - Social Psychology
- SOC 242 - Biologically Coordinated Social Psychology
- SOC 251 - Population and Society
- SOC 301 - Sociology of Gender
- WGS 220 - Feminism and Popular Culture

### Notes:

\*\*Not available to Civil students

\*\*\*Not available to Civil (Environmental Engineering Option) students.

A second course from the ITS List may be taken as part of List 2. However, a single course cannot be used to satisfy both the ITS and Complementary Studies requirements. This list is updated annually. Courses that teach a language or the application of a particular skill (such as courses in physical education, music and art) do not meet the intent of the Accreditation Board with respect to complementary studies and are therefore not eligible.

### 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:

- ENG M 403
- ENG M 405
- HIST 115 - Technology and History
- HIST 391 - History of Technology
- HGP 250 - Natural Resources and Environmental Management
- INT D 361
- PHIL 265 - Philosophy of Science
- PHIL 366 - Computers and Culture
- PHIL 375
- STS 200 - Introduction to Studies in Science, Technology and Society
- SOC 366 - People in Industry
- SOC 363 - Sociology of Work and Industry

### English Electives

Engineering programs require ENGL 199.

## 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.

## Required Courses and Suggested Course Sequence for Traditional

- Mining

### Mining [Engineering]

#### Year 2

#### Term 3

- CIV E 265 - Engineering Drawing and Computer Graphics
- EAS 210 - Engineering Earth Science
- ECE 209 - Fundamentals of Electrical Engineering
- MATH 209 - Calculus III
- MIN E 295 - Introduction to Mining Engineering

#### Term 4

- CH E 243 - Engineering Thermodynamics
- CIV E 250 - Plane Surveying
- CIV E 270 - Mechanics of Deformable Bodies I
- MATH 201 - Differential Equations

- MIN E 310 - Ore Reserve Estimation

### Term 5 (Spring/Summer)

- CIV E 251 - Survey School
- CIV E 330 - Introduction to Fluid Mechanics **OR**
- CH E 312 - Fluid Mechanics
- CIV E 381 - Soil Mechanics
- MIN E 323 - Rock Mechanics
- MIN E 325 - Mine Planning and Design

### Year 3

#### Term 6

- CME 421 - Mineral Processing
- ENG M 310 - Engineering Economy **OR**
- ENG M 401 - Financial Management for Engineers
- ENGG 404 - Engineering Safety and Risk Management-Leadership in Risk Management
- Program Elective (3-0-0) (See Program and Technical Electives - Mining)
- STAT 235 - Introductory Statistics for Engineering

#### Term 7

- MIN E 324 - Drilling, Blasting, and Explosives
- MIN E 330 - Mine Transport and Plant Engineering
- MIN E 408 - Mining Enterprise Economics
- Complementary Studies Elective (3-0-0)
- Complementary Studies Elective (3-0-0) (See Complementary Studies Electives)

### Year 4

#### Term 8

- MIN E 402 - Mine Design Project I
- MIN E 413 - Surface Mining Methods and Operations Management
- MIN E 414 - Underground Mining Methods

- Program Elective (3-0-0) (See Program and Technical Electives - Mining)
- ITS Elective (3-0-0)

### Term 9

- ENGG 400 - The Practice of the Engineering Profession
- MIN E 403 - Mine Design Project II
- MIN E 407 - Principles of Mine Ventilation
- MIN E 420 - Mine Equipment Selection and Maintenance
- MIN E 422 - Environmental Impact of Mining Activities

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

- Mining Plan I
- Mining Plan II

## Mining Plan I (Co-op) [Engineering]

### Year 2

#### Fall Term 3

- CIV E 265 - Engineering Drawing and Computer Graphics
- EAS 210 - Engineering Earth Science
- ECE 209 - Fundamentals of Electrical Engineering
- ENGG 299 - Orientation to Cooperative Education
- MATH 209 - Calculus III
- MIN E 295 - Introduction to Mining Engineering
- STAT 235 - Introductory Statistics for Engineering

#### Winter Term 4

- CH E 243 - Engineering Thermodynamics
- CIV E 250 - Plane Surveying
- CIV E 251 - Survey School \*
- CIV E 270 - Mechanics of Deformable Bodies I
- MATH 201 - Differential Equations
- MIN E 310 - Ore Reserve Estimation
- ITS Elective (3-0-0)

## Summer

- WKEXP 901 - Engineering Work Experience I

## Note

\*Held in Spring/Summer (Spring Term)

## Year 3

### Fall

- WKEXP 902 - Engineering Work Experience II

### Winter Term 5

- CIV E 330 - Introduction to Fluid Mechanics **OR**
- CH E 312 - Fluid Mechanics
  
- MIN E 324 - Drilling, Blasting, and Explosives
- MIN E 330 - Mine Transport and Plant Engineering
- Complementary Studies Elective (3-0-0)
- Program Elective (3-0-0) (See Program and Technical Electives - Mining)

### Summer Term 6

- CIV E 381 - Soil Mechanics
- CME 421 - Mineral Processing
  
- ENG M 310 - Engineering Economy **OR**
- ENG M 401 - Financial Management for Engineers
  
- MIN E 323 - Rock Mechanics
- MIN E 325 - Mine Planning and Design

## Year 4

### Fall Term 6

- WKEXP 903 - Engineering Work Experience III



## Winter

- WKEXP 904 - Engineering Work Experience IV

## Summer

- WKEXP 905 - Engineering Work Experience V

## Year 5

### Fall Term 7

- ENGG 404 - Engineering Safety and Risk Management-Leadership in Risk Management
- MIN E 402 - Mine Design Project I
- MIN E 413 - Surface Mining Methods and Operations Management
- MIN E 414 - Underground Mining Methods
- Complementary Studies Elective (3-0-0)
- Program Elective (3-0-0) (See Program and Technical Electives - Mining)

### Winter Term 8

- ENGG 400 - The Practice of the Engineering Profession
- MIN E 403 - Mine Design Project II
- MIN E 407 - Principles of Mine Ventilation
- MIN E 408 - Mining Enterprise Economics
- MIN E 420 - Mine Equipment Selection and Maintenance
- MIN E 422 - Environmental Impact of Mining Activities

## Mining Plan II (Co-op) [Engineering]

## Year 2

### Fall Term 3

- CIV E 265 - Engineering Drawing and Computer Graphics
- EAS 210 - Engineering Earth Science
- ECE 209 - Fundamentals of Electrical Engineering
- ENGG 299 - Orientation to Cooperative Education
- MATH 209 - Calculus III
- MIN E 295 - Introduction to Mining Engineering

- STAT 235 - Introductory Statistics for Engineering

### Winter

- WKEXP 901 - Engineering Work Experience I

### Summer Term 4

- CH E 243 - Engineering Thermodynamics
- CIV E 250 - Plane Surveying
- CIV E 251 - Survey School \*
- CIV E 270 - Mechanics of Deformable Bodies I
- MATH 201 - Differential Equations
- MIN E 310 - Ore Reserve Estimation
- ITS Elective (3-0-0)

### Note

\*Held in Spring/Summer (Spring Term)

## Year 3

### Fall Term 5

- CIV E 330 - Introduction to Fluid Mechanics **OR**
- CH E 312 - Fluid Mechanics
  
- MIN E 324 - Drilling, Blasting, and Explosives
- MIN E 330 - Mine Transport and Plant Engineering
- Complementary Studies Elective (3-0-0)
- Program Elective (3-0-0) (See Program and Technical Electives - Mining)

### Winter

- WKEXP 902 - Engineering Work Experience II

### Summer

- WKEXP 903 - Engineering Work Experience III

## Year 4

### Fall Term 6

- CIV E 381 - Soil Mechanics
- CME 421 - Mineral Processing
  
- ENG M 310 - Engineering Economy **OR**
- ENG M 401 - Financial Management for Engineers
  
- MIN E 323 - Rock Mechanics
- MIN E 325 - Mine Planning and Design

### Winter

- WKEXP 904 - Engineering Work Experience IV

### Summer

- WKEXP 905 - Engineering Work Experience V

## Year 5

### Fall Term 7

- ENGG 404 - Engineering Safety and Risk Management-Leadership in Risk Management
- MIN E 402 - Mine Design Project I
- MIN E 413 - Surface Mining Methods and Operations Management
- MIN E 414 - Underground Mining Methods
- Complementary Studies Elective (3-0-0)
- Program Elective (3-0-0) (See Program and Technical Electives - Mining)

### Winter Term 8

- ENGG 400 - The Practice of the Engineering Profession
- MIN E 403 - Mine Design Project II
- MIN E 407 - Principles of Mine Ventilation
- MIN E 408 - Mining Enterprise Economics
- MIN E 420 - Mine Equipment Selection and Maintenance
- MIN E 422 - Environmental Impact of Mining Activities

## Program and Technical Electives - Mining

- Mining

### **Mining (Program and Technical Electives) [Engineering]**

The following courses are approved electives for the BSc program in Mining Engineering.

Courses not listed must be preapproved by the Mining Undergraduate Student Advisor. Preapproval forms can be obtained from the Department. Without a preapproval form in your file there is no guarantee you will be given credit for the course if it is not in this list.

- B LAW 301 - Legal Foundations of the Canadian Economy
- B LAW 428 - Natural Resource and Environmental Law
- CH E 374 - Computational Methods in Engineering
- CIV E 221 - Environmental Engineering Fundamentals
- CIV E 303 - Project Management
- CIV E 321 - Principles of Environmental Modeling and Risk
- CIV E 331 - Applied Hydraulics
- CIV E 391 - Civil Engineering Materials
- CIV E 431 - Water Resources Engineering
- CIV E 481 - Soil Engineering
- CME 422
- CME 472 - Extractive Metallurgy
- CMPUT 201 - Practical Programming Methodology
- CMPUT 204 - Algorithms I
- EAS 204 - Environment Alberta
- EAS 205 - Environment Earth
- EAS 208 - Introduction to Global Change
- EAS 209 - Geology of Western Canada and the National and Provincial Parks
- EAS 221 - Introduction to Geographical Information Systems and Remote Sensing
- EAS 224 - Mineralogy I
- EAS 233 - Geologic Structures
- EAS 323 - Introduction to Hydrogeology
- EAS 368 - Ore Deposits Geology
- EAS 421 - Structural Geology and Tectonics
- ECON 355
- ECON 366 - Energy Economics
- ENCS 352 - Natural Resource and Environmental Law
- ENGG 420 - Engineering Law
- ENG M 406
- ENG M 501 - Production and Operations Management
- ENG M 510

- ENG M 514 - Reliability Engineering
- ENG M 530 - Engineering Project Management
- ENV E 302 - Environmental Impact Assessment
- ENV E 320 - Environmental Hydrology
- ENV E 322 - Environmental Protection
- ENV E 423 - Principles of Air Quality Management and Control
- FIN 301 - Introduction to Finance
- FIN 413 - Risk Management
- FIN 422 - Capital Investment
- GEOPH 223 - Environmental Geophysics
- GEOPH 224 - Geophysical Exploration Techniques
- MIN E 555 - Special Topics in Mining Engineering
- OM 352 - Operations Management
- OM 422 - Simulation and Computer Modelling Techniques in Management
- OM 426
- PET E 364 - Drilling Engineering
- PHYS 230 - Electricity and Magnetism
- REN R 210 - Introduction to Soil Science
- REN R 250 - Water Resource Management
- REN R 260 - History and Fundamentals of Environmental Protection and Conservation
- REN R 307 - Environmental Assessment Principles and Methods
- REN R 350 - Physical Hydrology
- SMO 301 - Behavior in Organizations
- SMO 402 - Management Skills for Supervisors and Leaders
- STAT 361 - Sampling Techniques
- STAT 368 - Introduction to Design and Analysis of Experiments
- STAT 378 - Applied Regression Analysis
- STAT 432 - Survival Analysis
- STAT 441 - Applied Statistical Methods for Data Mining
- STAT 479 - Time Series Analysis

## Note

Credit will only be given for one of B LAW 301 and ENGG 420.

## Focus Electives

The following courses are recommended program electives focus groups for the BSc program in Mining Engineering.

### Mineral Processing:

- CME 472 - Extractive Metallurgy

### Geology:

- EAS 233 - Geologic Structures
- EAS 421 - Structural Geology and Tectonics

### Business:

- FIN 301 - Introduction to Finance
- FIN 413 - Risk Management
- FIN 422 - Capital Investment
- OM 352 - Operations Management
- OM 422 - Simulation and Computer Modelling Techniques in Management
- SMO 301 - Behavior in Organizations
- SMO 402 - Management Skills for Supervisors and Leaders

### Note:

Registration in more advanced business courses requires approval of the Faculty of Business.

## Complementary Studies Electives

- Complementary Studies Electives

## Complementary Studies Electives

To better understand the role of Engineering within a broader social context, all programs require an element of complementary studies consisting of the humanities, social sciences, arts, management, engineering economics and communications. Aspects of these topics are covered in mandatory courses, but each program contains complementary studies electives so that students may explore areas of particular interest. Notwithstanding this, the Canadian Engineering Accreditation Board requires that programs include exposure to the central thought processes of the humanities and social sciences. Students must take the number of complementary studies electives as required by their program. Students can take a maximum of one list 1 complementary studies elective. Note that in some cases, a course may appear both on a complementary studies list and as a program required or program elective course. A single course cannot be used to satisfy multiple course requirements under Programs of Study.

Students interested in taking a minor should select their first complementary studies courses with this in mind. For the Business minor, student should take ECON 204; for an Arts minor, students should select a course in a possible area of concentration of interest, see minors for specific requirements for each minor.

### List 1

- ANTHR 101 - Introductory Anthropology
- ANTHR 110 - Gender, Age, and Culture

- ANTHR 150 - Race and Racism
- CLASS 102 - Greek and Roman Mythology
- CLASS 103 - Introduction to Ancient Greece
- CLASS 104 - Introduction to Ancient Rome
- CLASS 110 - The Ancient World
- ECON 101 - Introduction to Microeconomics
- ECON 102 - Introduction to Macroeconomics
- ENGL 125 - Aboriginal Writing \*
- HIST 110 - The Pre-Modern World
- HIST 111 - The Early Modern World
- HIST 112 - The Modern World
- HIST 114 - The History of the World in the Last 10 Years
- HIST 116 - The Emergence of the Atlantic World
- LING 101 - Introduction to Linguistic Analysis
- PHIL 120 - Symbolic Logic I
- PHIL 125 - Practical Logic
- POL S 101 - Introduction to Politics
- PSYCO 104 - Basic Psychological Processes
- SOC 100 - Introductory Sociology

## List 2

- ACCTG 300 - Introduction to Accounting
- ACCTG 311 - Introduction to Accounting for Financial Performance
- ANTHR 230 - Anthropology of Science, Technology, and Environment
- AREC 365 - Natural Resource Economics
- B LAW 301 - Legal Foundations of the Canadian Economy \*\*
- B LAW 422 - Law of Business Organizations
- B LAW 428 - Natural Resource and Environmental Law \*\*\*
- B LAW 432 - The Legal Regulation of Business
- CHRTC 350 - Science and Religion: Christian Perspectives
- CLASS 254 - Introduction to Greek Art and Archaeology
- CLASS 255 - Introduction to Roman Art and Archaeology
- CLASS 283 - Introductory Roman History II
- CLASS 294 - Ancient Science, Technology, and Medicine
- CLASS 376
- ECON 204 - Principles of Economics
- ECON 281 - Intermediate Microeconomic Theory I
- ECON 282 - Intermediate Macroeconomic Theory I
- ENGG 420 - Engineering Law
- ENG M 402 - Project Management and Entrepreneurship
- ENG M 406
- HECOL 211 - Human Sexuality

- HIST 260 - Pre-Confederation Canada
- HIST 261 - Post-Confederation Canada
- HIST 295 - 20th-Century Warfare
- HIST 397 - History of Science I
- HIST 398 - History of Science II
- INT D 303 - Economics of World Food and Agriculture
- LA ST 210 - South America
- LING 204 - English Syntax
- LING 205 - Phonetics
- MARK 301 - Introduction to Marketing
- OM 352 - Operations Management
- PHIL 205 - Philosophy of Mind
- PHIL 220 - Symbolic Logic II
- PHIL 250 - Contemporary Ethical Issues
- PHIL 325 - Risk, Choice, and Rationality
- PHIL 355 - Environmental Ethics
- POL S 223 - City Government and Politics
- PSYCO 258 - Cognitive Psychology
- PSYCO 275 - Brain and Behavior
- R SOC 355 - Rural Communities and Global Economies
- R SOC 365 - Sociology of Environment and Development
- SMO 200 - Introduction to Management for Non-Business Students
- SMO 301 - Behavior in Organizations
- SMO 330 - Introduction to Entrepreneurship
- SOC 212 - Classical Social Theory
- SOC 224 - Sociology of Deviance and Conformity
- SOC 225 - Criminology
- SOC 241 - Social Psychology
- SOC 242 - Biologically Coordinated Social Psychology
- SOC 251 - Population and Society
- SOC 301 - Sociology of Gender
- WGS 220 - Feminism and Popular Culture

### Notes:

\*\*Not available to Civil students

\*\*\*Not available to Civil (Environmental Engineering Option) students.

A second course from the ITS List may be taken as part of List 2. However, a single course cannot be used to satisfy both the ITS and Complementary Studies requirements. This list is updated annually. Courses that teach a language or the application of a particular skill (such as courses in physical education, music and art) do not meet the intent of the Accreditation Board with respect to complementary studies and are therefore not eligible.

### 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:

- ENG M 403
- ENG M 405
- HIST 115 - Technology and History
- HIST 391 - History of Technology
- HGP 250 - Natural Resources and Environmental Management
- INT D 361
- PHIL 265 - Philosophy of Science
- PHIL 366 - Computers and Culture
- PHIL 375
- STS 200 - Introduction to Studies in Science, Technology and Society
- SOC 366 - People in Industry
- SOC 363 - Sociology of Work and Industry

### English Electives

Engineering programs require ENGL 199.

## 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.

### Required Courses and Suggested Course Sequence for Traditional

- Petroleum

## Petroleum [Engineering]

### Year 2

### Term 3

- CH E 243 - Engineering Thermodynamics

- EAS 210 - Engineering Earth Science
- ECE 209 - Fundamentals of Electrical Engineering
- MAT E 202 - Materials Science II
- MATH 209 - Calculus III
- Complementary Studies Elective (3-0-0)

#### Term 4

- CH E 312 - Fluid Mechanics
- CIV E 270 - Mechanics of Deformable Bodies I
- MATH 201 - Differential Equations
- PET E 275 - Petroleum Reservoir Fluids
- STAT 235 - Introductory Statistics for Engineering
- Complementary Studies (3-0-0)

#### Year 3

#### Term 5

- CHEM 371 - Energetics of Chemical Reactions
- ENG M 310 - Engineering Economy **OR**
- ENG M 401 - Financial Management for Engineers
- PET E 364 - Drilling Engineering
- PET E 373 - Fundamental Reservoir Engineering
- Program Elective (3-0-0) (See Program and Technical Electives)
- Complementary Studies (3-0-0)

#### Term 6

- CH E 374 - Computational Methods in Engineering
- EAS 222 - Stratigraphy and Sedimentation
- PET E 365 - Well Logging and Formation Evaluation
- PET E 366 - Petroleum Production Operations
- Program Elective (3-0-0) (See Program and Technical Electives)

#### Term 7

- CH E 314 - Heat Transfer
- ENGG 404 - Engineering Safety and Risk Management-Leadership in Risk Management
- PET E 444 - Natural Gas Engineering

- PET E 475 - Applied Reservoir Engineering
- PET E 476 - Well Completion and Stimulation
- PET E 484 - Oil and Gas Property Evaluation

### Term 8

- ENGG 400 - The Practice of the Engineering Profession
- PET E 471 - Enhanced Oil Recovery
- PET E 477 - Modelling in Petroleum Engineering
- PET E 478 - Thermal Methods in Heavy Oil Recovery
- PET E 496 - Petroleum Engineering Design Project
- ITS Elective (3-0-0)

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

- Petroleum

### Petroleum (Co-op) [Engineering]

#### Year 2

##### Fall Term 3

- CH E 243 - Engineering Thermodynamics
- EAS 210 - Engineering Earth Science
- ECE 209 - Fundamentals of Electrical Engineering
- ENGG 299 - Orientation to Cooperative Education
- MAT E 202 - Materials Science II
- MATH 209 - Calculus III
- Complementary Studies Elective (3-0-0)

##### Winter Term 4

- CH E 312 - Fluid Mechanics
- CIV E 270 - Mechanics of Deformable Bodies I
- MATH 201 - Differential Equations
- PET E 275 - Petroleum Reservoir Fluids
- STAT 235 - Introductory Statistics for Engineering
- Complementary Studies (3-0-0)

## Summer

- WKEXP 901 - Engineering Work Experience I

## Year 3

### Fall

- WKEXP 902 - Engineering Work Experience II

### Winter Term 5

- CH E 374 - Computational Methods in Engineering
- EAS 222 - Stratigraphy and Sedimentation
- PET E 366 - Petroleum Production Operations
- PET E 365 - Well Logging and Formation Evaluation
- Program Elective (3-0-0) (See Program and Technical Electives)

## Summer

- WKEXP 903 - Engineering Work Experience III

## Year 4

### Fall Term 6

- CHEM 371 - Energetics of Chemical Reactions
- ENG M 310 - Engineering Economy **OR**
- ENG M 401 - Financial Management for Engineers
  
- PET E 364 - Drilling Engineering
- PET E 373 - Fundamental Reservoir Engineering
- Program Elective (3-0-0) (See Program and Technical Electives)
- Complementary Studies (3-0-0)

## Winter

- WKEXP 904 - Engineering Work Experience IV

## Summer

- WKEXP 905 - Engineering Work Experience V

## Year 5

### Fall Term 7

- CH E 314 - Heat Transfer
- ENGG 404 - Engineering Safety and Risk Management-Leadership in Risk Management
- PET E 444 - Natural Gas Engineering
- PET E 475 - Applied Reservoir Engineering
- PET E 476 - Well Completion and Stimulation
- PET E 484 - Oil and Gas Property Evaluation

### Winter Term 8

- ENGG 400 - The Practice of the Engineering Profession
- PET E 471 - Enhanced Oil Recovery
- PET E 477 - Modelling in Petroleum Engineering
- PET E 478 - Thermal Methods in Heavy Oil Recovery
- PET E 496 - Petroleum Engineering Design Project
- ITS Elective (3-0-0)

## Program and Technical Electives

- Petroleum

## **Petroleum (Program and Technical Electives) [Engineering]**

The two program electives should be chosen from the following:

- ACCTG 300 - Introduction to Accounting
- B LAW 301 - Legal Foundations of the Canadian Economy
- B LAW 428 - Natural Resource and Environmental Law
- CH E 343 - Chemical Engineering Thermodynamics
- CH E 522 - Fundamentals of Oil Sands Upgrading
- CH E 534 - Fundamentals of Oilsands Extraction

- CIV E 265 - Engineering Drawing and Computer Graphics
- CME 265
- EAS 204 - Environment Alberta
- EAS 205 - Environment Earth
- EAS 209 - Geology of Western Canada and the National and Provincial Parks
- EAS 323 - Introduction to Hydrogeology
- ECON 355
- ECON 365 - Resource Economics
- ECON 366 - Energy Economics
- ECE 341 - Analytical Methods in Electrical Engineering
- ENGG 406 - Engineering Safety and Risk Management - Methodologies and Tools
- ENGG 420 - Engineering Law
- ENG M 530 - Engineering Project Management
- FIN 301 - Introduction to Finance
- FIN 422 - Capital Investment
- GEOPH 224 - Geophysical Exploration Techniques
- GEOPH 326 - Seismic Imaging
- MAT E 345 - Corrosion, Oxidation, and Degradation
- MATH 253 - Theory of Interest
- MATH 300 - Advanced Boundary Value Problems I
- MATH 311 - Theory of Functions of a Complex Variable
- MATH 337 - Introduction to Partial Differential Equations
- MATH 436 - Intermediate Partial Differential Equations I
- MATH 438
- MEC E 340 - Applied Thermodynamics
- OM 352 - Operations Management
- OM 422 - Simulation and Computer Modelling Techniques in Management
- OM 426
- PHYS 230 - Electricity and Magnetism
- SMO 301 - Behavior in Organizations
- SMO 321 - Introduction to Strategic Management and Organization Design
- SMO 402 - Management Skills for Supervisors and Leaders
- SMO 404 - Interpersonal Communication and Team Management
- SMO 412 - Effective Negotiations
- STAT 361 - Sampling Techniques
- STAT 368 - Introduction to Design and Analysis of Experiments

## Notes

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 can be used as either a program or complementary elective.

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

## Complementary Studies Electives

- Complementary Studies Electives

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To better understand the role of Engineering within a broader social context, all programs require an element of complementary studies consisting of the humanities, social sciences, arts, management, engineering economics and communications. Aspects of these topics are covered in mandatory courses, but each program contains complementary studies electives so that students may explore areas of particular interest. Notwithstanding this, the Canadian Engineering Accreditation Board requires that programs include exposure to the central thought processes of the humanities and social sciences. Students must take the number of complementary studies electives as required by their program. Students can take a maximum of one list 1 complementary studies elective. Note that in some cases, a course may appear both on a complementary studies list and as a program required or program elective course. A single course cannot be used to satisfy multiple course requirements under Programs of Study.

Students interested in taking a minor should select their first complementary studies courses with this in mind. For the Business minor, student should take ECON 204; for an Arts minor, students should select a course in a possible area of concentration of interest, see minors for specific requirements for each minor.

#### List 1

- ANTHR 101 - Introductory Anthropology
- ANTHR 110 - Gender, Age, and Culture
- ANTHR 150 - Race and Racism
- CLASS 102 - Greek and Roman Mythology
- CLASS 103 - Introduction to Ancient Greece
- CLASS 104 - Introduction to Ancient Rome
- CLASS 110 - The Ancient World
- ECON 101 - Introduction to Microeconomics
- ECON 102 - Introduction to Macroeconomics
- ENGL 125 - Aboriginal Writing \*
- HIST 110 - The Pre-Modern World
- HIST 111 - The Early Modern World
- HIST 112 - The Modern World
- HIST 114 - The History of the World in the Last 10 Years
- HIST 116 - The Emergence of the Atlantic World
- LING 101 - Introduction to Linguistic Analysis
- PHIL 120 - Symbolic Logic I
- PHIL 125 - Practical Logic
- POL S 101 - Introduction to Politics
- PSYCO 104 - Basic Psychological Processes
- SOC 100 - Introductory Sociology

List 2

- ACCTG 300 - Introduction to Accounting
- ACCTG 311 - Introduction to Accounting for Financial Performance
- ANTHR 230 - Anthropology of Science, Technology, and Environment
- AREC 365 - Natural Resource Economics
- B LAW 301 - Legal Foundations of the Canadian Economy \*\*
- B LAW 422 - Law of Business Organizations
- B LAW 428 - Natural Resource and Environmental Law \*\*\*
- B LAW 432 - The Legal Regulation of Business
- CHRTC 350 - Science and Religion: Christian Perspectives
- CLASS 254 - Introduction to Greek Art and Archaeology
- CLASS 255 - Introduction to Roman Art and Archaeology
- CLASS 283 - Introductory Roman History II
- CLASS 294 - Ancient Science, Technology, and Medicine
- CLASS 376
- ECON 204 - Principles of Economics
- ECON 281 - Intermediate Microeconomic Theory I
- ECON 282 - Intermediate Macroeconomic Theory I
- ENGG 420 - Engineering Law
- ENG M 402 - Project Management and Entrepreneurship
- ENG M 406
- HECOL 211 - Human Sexuality
- HIST 260 - Pre-Confederation Canada
- HIST 261 - Post-Confederation Canada
- HIST 295 - 20th-Century Warfare
- HIST 397 - History of Science I
- HIST 398 - History of Science II
- INT D 303 - Economics of World Food and Agriculture
- LA ST 210 - South America
- LING 204 - English Syntax
- LING 205 - Phonetics
- MARK 301 - Introduction to Marketing
- OM 352 - Operations Management
- PHIL 205 - Philosophy of Mind
- PHIL 220 - Symbolic Logic II
- PHIL 250 - Contemporary Ethical Issues
- PHIL 325 - Risk, Choice, and Rationality
- PHIL 355 - Environmental Ethics
- POL S 223 - City Government and Politics
- PSYCO 258 - Cognitive Psychology
- PSYCO 275 - Brain and Behavior
- R SOC 355 - Rural Communities and Global Economies



- R SOC 365 - Sociology of Environment and Development
- SMO 200 - Introduction to Management for Non-Business Students
- SMO 301 - Behavior in Organizations
- SMO 330 - Introduction to Entrepreneurship
- SOC 212 - Classical Social Theory
- SOC 224 - Sociology of Deviance and Conformity
- SOC 225 - Criminology
- SOC 241 - Social Psychology
- SOC 242 - Biologically Coordinated Social Psychology
- SOC 251 - Population and Society
- SOC 301 - Sociology of Gender
- WGS 220 - Feminism and Popular Culture

### Notes:

\*\*Not available to Civil students

\*\*\*Not available to Civil (Environmental Engineering Option) students.

A second course from the ITS List may be taken as part of List 2. However, a single course cannot be used to satisfy both the ITS and Complementary Studies requirements. This list is updated annually. Courses that teach a language or the application of a particular skill (such as courses in physical education, music and art) do not meet the intent of the Accreditation Board with respect to complementary studies and are therefore not eligible.

### 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:

- ENG M 403
- ENG M 405
- HIST 115 - Technology and History
- HIST 391 - History of Technology
- HGP 250 - Natural Resources and Environmental Management
- INT D 361
- PHIL 265 - Philosophy of Science
- PHIL 366 - Computers and Culture
- PHIL 375
- STS 200 - Introduction to Studies in Science, Technology and Society
- SOC 366 - People in Industry
- SOC 363 - Sociology of Work and Industry

### English Electives

Engineering programs require ENGL 199.