COMPUTER ENGINEERING, B.SC.

Degree Requirements

Computer Engineering Departmental Program

Course	Title	Hours
Students must complete the Preliminary Engineering Program requirements for graduation.		37.5
ANTH 2430	Ecology, Technology and Society [1]	3
COMP 1020	Introductory Computer Science 2	3
COMP 2140	Data Structures: Analysis and Implementation	3
Choose one of: [2]		3-4
COMP 3010	Distributed Computing	
COMP 3430	Operating Systems	
ECE 3630	Real-time Embedded Systems	
ECE 4530	Parallel Processing	
ENG 2030	Engineering Communication: Strategies for the Profession	3
or ENG 2040	Engineering Communication: Strategies, Practice and Design	
ENG 3000	Engineering Economics	3
MATH 2130	Engineering Mathematical Analysis 1	3
MATH 2132	Engineering Mathematical Analysis 2	3
MATH 2136	Mathematics for Computer Engineering	3
PHYS 2152	Modern Physics for Engineers	3
STAT 2220	Contemporary Statistics for Engineers	3
ECE 2160	Electronics 2E	5
ECE 2220	Digital Logic Systems	5
ECE 2262	Electric Circuits	4
ECE 2400	Engineering Algorithms 1	4
ECE 3400	Engineering Algorithms 2	4
ECE 3610	Microprocessing Systems	4
ECE 3700	Telecommunication Network Engineering	4
ECE 3740	Systems Engineering Principles 1	4
ECE 3760	Digital Systems Design 1	4
ECE 3780	Signal Processing 1	4
ECE 4150	Control Systems	4
or ECE 4260	Communications Systems	
ECE 4240	Microprocessor Interfacing	4
ECE 4830	Signal Processing 2	4
ECE 4600	Group Design Project [3]	6
One Complementary Studies Elective [4]		3
Two Natural Science Electives from the approved list		6
Five Technical Electives from the approved list		15-20
Total Hours		**154.5-160.5**

1 ANTH 2430 is an Indigenous Knowledge course.
2 The course selected to meet this requirement may not also be counted as a Technical Elective.
3 Course continues through both terms with credit given upon completion.
4 The complementary studies elective can be any course at the 1000 level or above from either the faculties of Arts or Management. However, ARTS 1110 may not be used for credit in the Price Faculty of Engineering.

Computer Engineering Technical Electives [1]

Students may select their five technical electives from the following approved list of courses from Computer Engineering, Electrical Engineering, or Computer Science, with the only limitations that no more than two may come from the list of Approved Electrical Engineering Electives.

Computer Engineering Electives

Course	Title	Hours
ECE 3750	Systems Engineering Principles 2	4
ECE 3770	Digital Systems Design 2	4
ECE 4180	Introduction to Robotics	4
ECE 4250	Digital Communications	4
ECE 4420	Digital Control	4
ECE 4440	Computer Vision	4
ECE 4450	Applied Computational Intelligence	4
ECE 4520	Simulation and Modelling	4
ECE 4530	Parallel Processing	4
ECE 4560	Modern Computing Systems	4
ECE 4540	Wireless Networks	4
ECE 4740	Digital Systems Implementation	4
ECE 4850	Topics in Electrical and Computer Engineering 1 [2]	4
ECE 4860	Topics in Electrical and Computer Engineering 2 [2]	4
ECE 4870	Topics in Electrical and Computer Engineering 3 [2]	3
ECE 4880	Topics in Electrical and Computer Engineering 4 [2]	3

1 The Department of Electrical and Computer Engineering does not guarantee that all elective courses will be offered every session or that it will be possible to fit courses into all of the many possible timetable combinations of students taking the programs. The term in which an elective course is offered is specified each year in Aurora and on the Department website. There may be a maximum limit on the number of students allowed to take an elective in a particular session. Similarly, there may be a minimum limit and if registration is below the minimum, the elective will be cancelled for the session, and those registered will be required to transfer to another elective before registration revision deadline.
2 Requires permission of the Department.

Approved Electrical Engineering Electives (maximum of 2) [1]

Course	Title	Hours
ECE 3540	Advanced Circuit Analysis and Design	4
ECE 3600	Physical Electronics	4
ECE 3670	Electronics 3E	4
ECE 3720	Electric Power and Machines	4
ECE 4100	Introduction to Microelectronic Fabrication	4
ECE 4150	Control Systems	4
ECE 4160	Control Engineering	4
ECE 4260	Communications Systems	4
ECE 4390	Engineering Computations 4E	4
ECE 4610	Biomedical Instrumentation and Signal Processing	4

[1] The Department of Electrical and Computer Engineering does not guarantee that all elective courses will be offered every session or that it will be possible to fit courses into all of the many possible timetable combinations of students taking the programs. The term in which an elective course is offered is specified each year in Aurora and on the Department website. There may be a maximum limit on the number of students allowed to take an elective in a particular session. Similarly, there may be a minimum limit and if registration is below the minimum, the elective will be cancelled for the session, and those registered will be required to transfer to another elective before the registration revision deadline.

Approved Computer Science Electives

Course	Title	Hours
COMP 2150	Object Orientation	3
COMP 2160	Programming Practices	3
COMP 2400	Programming Paradigms	3
COMP 2450	Software Development 1	3
COMP 2452	Software Development 2	3
COMP 3010	Distributed Computing	3
COMP 3020	Human-Computer Interaction 1	3
COMP 3190	Introduction to Artificial Intelligence	3
COMP 3290	Introduction to Compiler Construction	3
COMP 3350	Software Engineering 1	3
COMP 3430	Operating Systems	3
COMP 3380	Databases Concepts and Usage	3
COMP 3490	Computer Graphics 1	3
COMP 4020	Human-Computer Interaction 2	3
COMP 4190	Artificial Intelligence	3
COMP 4350	Software Engineering 2	3
COMP 4360	Machine Learning	3
COMP 4380	Database Implementation	3
COMP 4430	Operating Systems 2	3
COMP 4490	Computer Graphics 2	3
COMP 4580	Computer Security	3
COMP 4710	Introduction to Data Mining	3

Natural Science Electives for Computer Engineering

The Computer Engineering program requires students to complete two (2) Natural Science Electives as part of their program selected from a Department approved list. These courses may be taken anytime during the student's program.

Course	Title	Hours
ASTR 1810	Introduction to Astronomy: The Magnificent Universe	3
ASTR 3180	Stars	3
BIOL 1020	Biology 1: Principles and Themes	3
BIOL 1300	Economic Plants	3
BIOL 1410	Anatomy of the Human Body	3
CHEM 1110	Introductory Chemistry 2: Interaction, Reactivity, and Chemical Properties	3
CHEM 1130	Introduction to Organic Chemistry	3
ENTM 2050	Introductory Entomology	3
GEOL 1340	The Dynamic Earth	3
MBIO 1220	Essentials of Microbiology	3
PHYS 2260	Optics	3
PHYS 2386	Introduction to Quantum Mechanics and Special Relativity	3
PHYS 2600	Electromagnetic Field Theory	3
PHYS 2650	Classical Mechanics 1	3
PHYS 3220	Medical Physics and Physiological Measurement	3
PHYS 3630	Electro - and Magnetostatic Theory	3

Note:

- Students are urged to discuss their program of courses with members of the instructional staff before the end of their third year to obtain advice concerning the best choice of electives for their needs.

Concentrations

Computer Engineering Focus Areas

Students wishing to pursue more focused studies in a Computer Engineering subject/research area have the choice of doing so through a recognized Focus Area. Courses taken towards a Focus Area take the place of some of the Technical Electives required in the Computer Engineering program.

Computer Networks and Communications Focus Area

Course	Title	Hours
ECE 4260	Communications Systems	4
Three CNC Electives		9-12
Two Technical Electives		6-8
Total Hours		**19-24**

Computer Networks and Communications (CNC) Electives

Course	Title	Hours
ECE 4250	Digital Communications	4
ECE 4520	Simulation and Modelling	4
ECE 4540	Wireless Networks	4
ECE 4870	Topics in Electrical and Computer Engineering 3 [1]	3
COMP 3010	Distributed Computing	3
COMP 4580	Computer Security	3

[1] Topic Title: ECE 4870 Computer Communication Networks

Embedded Systems Focus Area

Course	Title	Hours
ECE 4150	Control Systems	4
Three ES Electives		9-12
Two Technical Electives		6-8
Total Hours		**19-24**

Embedded Systems (ES) Electives List

Course	Title	Hours
ECE 3630	Real-time Embedded Systems [1]	4
ECE 3770	Digital Systems Design 2	4
ECE 4180	Introduction to Robotics	4
ECE 4440	Computer Vision	4
ECE 4560	Modern Computing Systems	4
ECE 4610	Biomedical Instrumentation and Signal Processing	4

ECE 4740	Digital Systems Implementation	4
COMP 3020	Human-Computer Interaction 1	3
COMP 4580	Computer Security	3

[1] If selected as a focus area elective, this course may not be used to satisfy other program requirements.

Software Engineering Focus Area

Course	Title	Hours
ECE 4260	Communications Systems	4
or ECE 4150	Control Systems	
COMP 3350	Software Engineering 1	3
Three SE Electives		9-12
One Technical Elective		3-4
Total Hours		**19-23**

Software Engineering (SE) Electives

Course	Title	Hours
ECE 3750	Systems Engineering Principles 2	4
ECE 4530	Parallel Processing	4
COMP 3010	Distributed Computing	3
COMP 3020	Human-Computer Interaction 1	3
COMP 3380	Databases Concepts and Usage	3
COMP 4350	Software Engineering 2	3
COMP 4580	Computer Security	3
COMP 4710	Introduction to Data Mining	3

Biomedical Focus Area

Course	Title	Hours
ECE 4610	Biomedical Instrumentation and Signal Processing	4
BIOL 1410	Anatomy of the Human Body [1]	3
PHYS 2600	Electromagnetic Field Theory [1]	3
One Biomedical Group A Elective Course		3-4
One Biomedical Group A or Group B Elective Course		3-4
Two Technical Electives		6-8
Total Hours		**22-26**

[1] These courses satisfy the Natural Science Elective Requirement.

Biomedical Group A Elective Courses

Course	Title	Hours
ECE 4860	Topics in Electrical and Computer Engineering 2 [1]	4
PHYS 3220	Medical Physics and Physiological Measurement	3
PHYS 4300	Topics in Physics	3

[1] Topic Title: ECE 4860 Biomedical Optics

Biomedical Group B Elective Courses

Course	Title	Hours
BIOL 1412	Physiology of the Human Body	3
MBIO 1220	Essentials of Microbiology	3
BIOE 3320	Engineering Properties of Biological Materials	4
BIOE 4610		4

mECHATRONICS FOCUS AREA (cOMP e)

Course	Title	Hours
ECE 4150	Control Systems	4
ECE 4180	Introduction to Robotics	4
MECH 4900	Mechatronics System Design	4
Two ME Electives		8
One Technical Elective		3-4
Total Hours		**23-24**

Mechatronics (ME) Electives List

Course	Title	Hours
ECE 3720	Electric Power and Machines [1]	4
ECE 4160	Control Engineering [1]	4
ECE 4370	Power Electronics [1]	4
ECE 4440	Computer Vision	4
ENG 4110	Operational Excellence	4

[1] Computer Engineering students are limited to a maximum of two (2) Electrical Engineering elective courses in their program.

Entrepreneurship Focus Area

Course	Title	Hours
MECH 3170	Project Management	4
ENTR 2020	Starting a New Business [1]	3
Two EN Electives		6-7
Two Technical Electives		6-8
Total Hours		**19-22**

[1] In addition to satisfying focus area requirements, ENTR 2020 also meets the general program requirement for one complementary studies elective.

Entrepreneurship (EN) Electives List

Course	Title	Hours
ENG 4110	Operational Excellence	4
ENTR 3060	Creativity and Entrepreneurial Thinking	3
ENTR 3070	Innovation Management	3
ENTR 3102	Technological Entrepreneurship	3
ENTR 4100	New Venture Analysis	3

Preliminary Engineering Program

Campus Address/General Office: E2-262 EITC
Telephone: (204) 474 9167
Email Address: eng.info@umanitoba.ca (eng_info@umanitoba.ca)
Website: umanitoba.ca/engineering (https://umanitoba.ca/engineering/)

The Preliminary Engineering Program is common to all programs in engineering. Students must complete a minimum of eight (**excluding CHEM 1122**) to be eligible to apply to one of the five degree granting engineering programs. A student must complete the following list of 13 courses as part of their engineering program in order to graduate with a BSc degree in engineering.

Course	Title	Hours
CHEM 1100	Introductory Chemistry 1: Atomic and Molecular Structure and Energetics [1]	3
CHEM 1122	Introduction to Chemistry Techniques for Engineering 1 [1]	1.5
COMP 1012	Computer Programming for Scientists and Engineers	3
ENG 1430	Design in Engineering	3
ENG 1440	Introduction to Statics	3
ENG 1450	Introduction to Electrical and Computer Engineering	3
ENG 1460	Introduction to Thermal Sciences	3
MATH 1210	Techniques of Classical and Linear Algebra [2]	3
MATH 1510	Applied Calculus 1 [3]	3
MATH 1710	Applied Calculus 2 [3]	3
PHIL 1290	Critical Thinking [4]	3
PHYS 1050	Physics 1: Mechanics	3
Written English Course [5,6]		3
Total Hours		**37.5**

1. The former CHEM 1300 may be used in lieu of the combination of CHEM 1100 and CHEM 1122.
2. MATH 1300 is not an acceptable equivalent to MATH 1210.
3. Students intending to obtain a degree in Engineering are strongly advised to complete MATH 1510 and MATH 1710. However, MATH 1500 or MATH 1230 may be taken in lieu of MATH 1510; MATH 1700 or MATH 1232 may be taken in lieu of MATH 1710. MATH 1524 is not an acceptable equivalent to MATH 1510.
4. PHIL 1290 is the recommended complementary studies elective. Students may; however, select any course from the Faculties of Arts or Management (Asper School of Business) at the 1000 level or above, except for ARTS 1110.
5. Course selected from the list of approved Written English Courses for Engineering students.
6. Three credit hours are required to satisfy the Written English course requirement. Should a student complete a six credit hour course, the additional three credit hours may be used to satisfy general complementary studies requirements within a student's program.
7. Equivalent courses offered through Université de Saint-Boniface may be used to satisfy program requirements.

Co-operative Education and Industrial Internship Programs

Contact and Program Information

Director: Carolyn Geddert, P.Eng., Engineer-in-Residence
Tel. 204 474 8948
Email: carolyn.geddert@umanitoba.ca
Cooperative Education Administrator: Megan Johnson
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The Price Faculty of Engineering offers a Co-operative education and Industrial Internship Program (Co-op/IIP) designed to complement and enrich the academic program with work experience. The work terms provide students with practical experience, assistance in financing their education, and guidance for future career specialization.

Applications are accepted for Co-op/IIP every fall. Co-op/IIP supports the application and participation of all students who meet the requirements and wish to apply. Application to Co-op/IIP is a process. The Co-op/IIP Office will work with you. Please connect with our staff via email: engineeringcoop@umanitoba.ca and refer to the web site (https://umanitoba.ca/engineering/co-operative-education/) for the benefits of Co-op/IIP.

Successful applicants to Co-op/IIP have:

- Attended an information session.
- Been accepted as an undergraduate student into an Engineering Department.
- Completed all 13 Preliminary Engineering Program courses before their first work term.
- Completed 42 credit hours towards your degree by the end of the Fall term. Students must return for at least one academic term following the completion of their final work term placement. (Application early in a student's degree program will support the completion of 3 work terms.)
- Been assessed as in Good Academic standing (GPA above 2.0). I.E. not on Probation or Academic Warning.
- Agree to follow all rules and regulations of the program as detailed in the Rules and Regulations

Work placements must be confirmed to be appropriate by the Co-op/IIP office in order be credited as a Co-op/IIP work term.

Upon securing a job placement, Engineering students enroll in the course ENG 4800 and subsequently the specific work term of employment ENG 4810, ENG 4820, ENG 4830, ENG 4840.

Students who are unable to maintain the standards of the Co-op/IIP will be transferred back into the regular program.

The course and grade requirements for completion of the Co-op/IIP are the same as those required for the regular program. However, in order to satisfy course prerequisite requirements, timetables may differ from the regular program. Co-op/IIP students are evaluated in the same manner as regular students and all rules and regulations of the Price Faculty of Engineering apply.

Students who are placed on Academic Probation may either be removed from Co-op/IIP or have their acceptance deferred until they have completed two consecutive terms with an Academic Standing of "Satisfactory".

Students who are Required to Withdraw will immediately become ineligible for Co-op/IIP and will remain ineligible after re-instatement to the Price Faculty of Engineering.

Written reports must be completed at the end of each four-month work term. Each successfully completed four-month work term and its corresponding report receives a Pass/Fail grade and is rated at one credit hour. Graduates who successfully complete at least three work terms and the required work term reports will have the Co-operative Education Option acknowledged on their B.Sc. graduation parchment.

For more information regarding the Co-op/IIP rules, benefits, regulations and requirements, please refer to the web site (https://umanitoba.ca/engineering/co-operative-education/).