

ELECTRICAL ENGINEERING, B.SC.

Degree Requirements

Electrical 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
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 3132	Engineering Mathematical Analysis 3	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 2240	Numerical Methods for Electrical Engineers	4
ECE 2262	Electric Circuits	4
ECE 3540	Advanced Circuit Analysis and Design	4
ECE 3580	Foundations of Electromagnetics	4
ECE 3590	Electromagnetic Theory	4
ECE 3600	Physical Electronics	4
ECE 3610	Microprocessing Systems	4
ECE 3670	Electronics 3E	4
ECE 3720	Electric Power and Machines	4
ECE 3730	Principles of Embedded System Design	4
ECE 3780	Signal Processing 1	4
ECE 4150	Control Systems	4
ECE 4260	Communications Systems	4
ECE 4600	Group Design Project ²	6
One Complementary Studies Elective ³		3
One Natural Science Elective from the approved list		3
Seven Technical Electives from the approved list		24-29
Total Hours		159.5-164.5

¹ ANTH 2430 is an Indigenous Knowledge course.

² Course continues through both terms with credit given upon completion.

³ The complementary studies electives 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.

Electrical Engineering Technical Electives ^{1,2}

Group A Qualified Engineering Design Elective Courses

Course	Title	Hours
ECE 4160	Control Engineering	4
ECE 4250	Digital Communications	4
ECE 4290	Microwave Engineering	4
ECE 4370	Power Electronics	4
ECE 4830	Signal Processing 2	4

Group B Technical Elective Courses

Course	Title	Hours
ECE 3650	Electric Machines	5
ECE 3700	Telecommunication Network Engineering	4
ECE 3770	Digital Systems Design 2	4
ECE 4100	Introduction to Microelectronic Fabrication	4
ECE 4180	Introduction to Robotics	4
ECE 4240	Microprocessor Interfacing	4
ECE 4270	Antennas	4
ECE 4280	Engineering Electromagnetics	4
ECE 4300	Electrical Energy Systems 1	4
ECE 4310	Electrical Energy Systems 2	4
ECE 4360	High Voltage Engineering	4
ECE 4390	Engineering Computations 4E	4
ECE 4420	Digital Control	4
ECE 4430	Design of RF Devices and Wireless Systems	4
ECE 4440	Computer Vision	4
ECE 4450	Applied Computational Intelligence	4
ECE 4520	Simulation and Modelling	4
ECE 4530	Parallel Processing	4
ECE 4540	Wireless Networks	4
ECE 4560	Modern Computing Systems	4
ECE 4580	Optoelectronics	4
ECE 4610	Biomedical Instrumentation and Signal Processing	4
ECE 4740	Digital Systems Implementation	4
ECE 4850	Topics in Electrical and Computer Engineering 1	4
ECE 4860	Topics in Electrical and Computer Engineering 2	4
ECE 4870	Topics in Electrical and Computer Engineering 3	3
ECE 4880	Topics in Electrical and Computer Engineering 4	3
COMP 1020	Introductory Computer Science 2	3
COMP 2140	Data Structures: Analysis and Implementation	3
MATH 3460	Partial Differential Equations	3
PHYS 2260	Optics	3
PHYS 3220	Medical Physics and Physiological Measurement	3
PHYS 4590	Advanced Optics	3
PHYS 4646	Electro - and Magnetodynamics and Special Relativity	3

¹ A minimum of 3 electives are required from Group A; the other 4 electives may be taken from either Group A or B unless the student completes a Focus Area.

² 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 the online

timetables on the Department website. There may be a maximum limit set on the number of students allowed to take a particular elective in a session. Similarly, there may be a minimum limit and if registration is below the minimum, the elective will be cancelled and those registered will be required to transfer to another elective before the registration revision deadline.

Natural Science Electives for Electrical Engineering

The Electrical Engineering program requires students to complete an elective course in natural science selected from the following Department approved list.

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 2650	Classical Mechanics 1	3
PHYS 3220	Medical Physics and Physiological Measurement	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

Electrical Engineering Focus Areas

Students wishing to pursue more focused studies in an Electrical 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 or all of the Technical Electives required in the Electrical Engineering program. Please refer to the Faculty website (http://umanitoba.ca/ece/curr_students/undergrad/ee-focus-areas.html) for a detailed description of each area and the courses required.

Power and Energy Systems Focus Area

To complete the Power and Energy Systems Focus the four prescribed courses must be taken. One of the three Power and Energy Systems Technical Elective courses must also be taken. To complete the program requirements two additional courses must be selected from the elective courses listed in the Electrical Engineering Standard Program. (p. 1)

Prescribed Power and Energy Systems Courses

Course	Title	Hours
ECE 3650	Electric Machines	5
ECE 4300	Electrical Energy Systems 1	4

ECE 4370	Power Electronics	4
One additional course from the list of Group A Qualified Design Elective Courses found in the Electrical Engineering Standard Program		4
Electives		
One Power and Energy Systems Technical Elective		4
Two additional courses from the Elective Courses found in the Electrical Engineering Standard Program		6-9
Total Hours		27-30

Power and Energy Systems Technical Electives

Course	Title	Hours
ECE 4310	Electrical Energy Systems 2	4
ECE 4360	High Voltage Engineering	4

Communication Devices Focus Area

To complete the Communication Devices Focus the three prescribed courses must be taken. Two of the five Communication Devices Technical Elective courses must also be taken. To complete the program requirements two additional courses must be selected from the elective courses listed in the Electrical Engineering Standard Program. (p. 1)

Prescribed Communication Devices Courses

Course	Title	Hours
ECE 4270	Antennas	4
ECE 4290	Microwave Engineering	4
ECE 4250	Digital Communications	4
or ECE 4830	Signal Processing 2	
Electives		
Two Communication Devices Technical Electives		8
Two additional courses from the Elective Courses found in the Electrical Engineering Standard Program		6-9
Total Hours		26-29

Communication Devices Technical Electives

Course	Title	Hours
ECE 4250	Digital Communications	4
ECE 4280	Engineering Electromagnetics	4
ECE 4430	Design of RF Devices and Wireless Systems	4
ECE 4580	Optoelectronics	4
ECE 4830	Signal Processing 2	4
Total Hours		20

Biomedical Focus Area

To complete the focus area, students are required to take a total of six (6) courses as indicated below. Of these, five (5) replace general technical electives and one (1) is in place of the Natural Science Elective in the Electrical Engineering program. To complete the program requirements two (2) additional courses must be selected from the technical electives listed in the Electrical Engineering Standard Program. (p. 1)

Biomedical Courses

Course	Title	Hours
ECE 4610	Biomedical Instrumentation and Signal Processing	4
ECE 4830	Signal Processing 2	4
BIOL 1410	Anatomy of the Human Body	3
Electives		
One Biomedical Group A Elective Course		3-4

One Biomedical Group A or Group B Elective Course	3-4
One additional course from the list of Group A Qualified Design Elective Courses found in the Electrical Engineering Standard Program	4
Two additional courses from the list of Technical Elective Courses found in the Electrical Engineering Standard Program	6-9
Total Hours	27-32

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

Engineering Physics Focus Area

In the standard Electrical Engineering program, seven Technical Elective Courses and one Natural Science Elective are required. To complete the Engineering Physics focus area, students are required to take a total of seven courses as indicated below, including the four prescribed Engineering Physics courses. Three further courses must be taken from the list of Engineering Physics Elective courses. To complete the program requirements a course must be selected from the technical electives listed in the Electrical Engineering Standard Program (p. 1).

Prescribed Engineering Physics Courses

Course	Title	Hours
ECE 4270	Antennas	4
ECE 4580	Optoelectronics	4
PHYS 2386	Introduction to Quantum Mechanics and Special Relativity	3
PHYS 2650	Classical Mechanics 1	3

Electives

Three Engineering Physics Technical Elective Courses	9-13
One additional course from the list of Technical Elective Courses found in the Electrical Engineering Standard Program	3-5
Total Hours	26-32

Engineering Physics Technical Elective Courses

Course	Title	Hours
ECE 4860	Topics in Electrical and Computer Engineering 2 ¹	4
PHYS 2260	Optics	3
PHYS 3220	Medical Physics and Physiological Measurement	3
PHYS 3386	Quantum Mechanics 2	3
PHYS 3430	Honours Physics Laboratory	6
PHYS 3570	Physics of Materials 1	3
PHYS 4646	Electro - and Magnetodynamics and Special Relativity	3
PHYS 3650	Classical Mechanics 2	3

PHYS 3670	Classical Thermodynamics	3
PHYS 4680	Statistical Mechanics	3
PHYS 4520	Introduction to Solid State Physics	3
PHYS 4590	Advanced Optics	3

1 Topic Title: ECE 4860 Materials Characterization

Mechatronics FOCUS Area

To complete the Mechatronics Focus the two (2) prescribed courses must be taken. Two (2) of the five Mechatronics Technical Elective courses must also be taken. To complete program requirements, students must select three (3) additional electives from the Qualified Engineering Design Electives and/or Technical Electives in the Electrical Engineering standard program.

Course	Title	Hours
ECE 4180	Introduction to Robotics	4
MECH 4900	Mechatronics System Design	4
Two Mechatronics Electives ¹		8
Three additional courses from the Elective Courses found in the Electrical Engineering Standard Program ¹		10-13

Total Hours **26-29**

Mechatronics Electives List

Course	Title	Hours
ECE 4160	Control Engineering ¹	4
ECE 4240	Microprocessor Interfacing	4
ECE 4370	Power Electronics ¹	4
ECE 4440	Computer Vision	4
ENG 4110	Operational Excellence	4

¹ Of the five (5) elective courses taken, three (3) MUST be selected from the Qualified Engineering Design Electives list found in the Electrical Engineering Standard Program.

Entrepreneurship Focus Area

To complete the Entrepreneurship Focus the two (2) prescribed courses and two (2) of the five Entrepreneurship Elective courses must be taken. To complete program requirements, students must select three (3) additional electives from the list of Qualified Engineering Design Electives and one (1) further Technical Elective from the Electrical Engineering standard program.

Course	Title	Hours
MECH 3170	Project Management	4
ENTR 2020	Starting a New Business ¹	3
Two Entrepreneurship Electives		6-7
Three courses from the list of Group A Qualified Design Elective Courses found in the Electrical Engineering Standard Program		12
One additional course from the Elective Courses found in the Electrical Engineering Standard Program		3-5
Total Hours		28-31

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

Entrepreneurship Electives List

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

Preliminary Engineering Program

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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

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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 to 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/>).