

BIOSYSTEMS ENGINEERING, B.SC.

Degree Requirements

Program Core Courses

Note: Students are encouraged to consult the department for eight- and ten-term program models. Students are strongly encouraged to follow the model programs when possible, as timetabling and course offerings are based on these program models.

Course	Title	Hours
Students must complete the Preliminary Engineering Program requirements for graduation. 37.5		
BIOE 2480	Impact of Engineering on the Environment	3
BIOE 2590	Biology for Engineers ¹	3
BIOE 2790	Fluid Mechanics	4
BIOE 2800	Solid Mechanics	4
BIOE 2900	Biosystems Engineering Design 1	4
BIOE 3110	Heat Transfer in Biological Systems	4
BIOE 3270	Instrumentation and Measurement for Biosystems	4
BIOE 3320	Engineering Properties of Biological Materials	4
BIOE 3400	Design of Structural Components in Machines	4
BIOE 3590	Mechanics of Materials in Biosystems	4
BIOE 3900	Biosystems Engineering Design 2	4
BIOE 4240	Graduation Project	3
BIOE 4900	Biosystems Engineering Design 3	4
BIOE 4950	Biosystems Engineering Design 4	4
CHEM 1110	Introductory Chemistry 2: Interaction, Reactivity, and Chemical Properties ²	3
CHEM 1126	Introduction to Chemistry Techniques for Engineering ²	1.5
ENG 2022	Engineering CAD Technology for Biosystems	3
ENG 3000	Engineering Economics	3
MATH 2130	Engineering Mathematical Analysis 1	3
MATH 2132	Engineering Mathematical Analysis 2	3
MBIO 1220 or MBIO 1010	Essentials of Microbiology Microbiology I	3
MECH 2150	Mechanical Engineering Modelling and Numerical Methods	4
MECH 3482	Kinematics and Dynamics	4
STAT 2220	Contemporary Statistics for Engineers	3
One course in Technology and Society (ENG 3020 or ANTH 2430) 3		
One course from the List of Indigenous Knowledge Courses ³ 3		
Two Science Electives (see list below) 6		
Three Biosystems Engineering Design Electives 12		
One Complementary Studies Electives 3		
Two Free Electives 6-8		
Total Hours		154-156

¹ Please note the combination of BIOL 1020 Biology 1: Principles and Themes and BIOL 1030 Biology 2: Biological Diversity, Function and Interactions can be used in place of BIOE 2590 Biology for Engineers.

² The former CHEM 1310 may be used in place of the combination of CHEM 1110 and CHEM 1126.

³ Students are required to take at least one of the courses from the list of Indigenous Knowledge courses.

Science Electives

Course	Title	Hours
AGEC 2370	Principles of Ecology (or the equivalent BIOL 2300)	3
ANSC 3530	The Animal and Its Environment	3
BIOL 1410	Anatomy of the Human Body	3
BIOL 1412	Physiology of the Human Body	3
PLNT 2510	Fundamentals of Horticulture	3
SOIL 4060	Physical Properties of Soils	3

Students planning to complete a specialization, should take note that there are specific courses to be used as science electives.

Biosystems Engineering Design Electives

Course	Title	Hours
BIOE 4390	Unit Operations 1	4
BIOE 4412	Design of Light-Frame Building Systems	4
BIOE 4414	Imaging and Spectroscopy for Biosystems	4
BIOE 4420	Crop Preservation	4
BIOE 4440	Bioprocessing for Biorefining	4
BIOE 4460	Air Pollution Assessment and Management	4
BIOE 4560	Structural Design in Wood	4
BIOE 4590	Management of By-Products from Animal Production	4
BIOE 4600	Design of Water Management Systems	4
BIOE 4610	Design of Assistive Technology Devices	4
BIOE 4620	Remediation Engineering	4
BIOE 4640	Bioengineering Applications in Medicine	4
BIOE 4650	Textiles in Healthcare and Medical Applications	4

Design elective courses offered vary from year to year. Courses offered in the current year are listed on the online timetables on the department website. Students planning to complete a specialization should take note that there are specific courses to be used as design electives.

Indigenous Knowledge Courses

Course	Title	Hours
INDG 1200	Indigenous Peoples in Canada	6
INDG 1220	Indigenous Peoples in Canada, Part 1	3
INDG 1240	Indigenous Peoples in Canada, Part 2	3
INDG 2012 or HIST 2010	Indigenous History in Canada Indigenous History in Canada (C)	6
INDG 2020 or HIST 2020	The Métis in Canada The Métis in Canada (C)	3
POLS 2802	Introduction to Indigenous Politics	3
ENG 4100	Contemporary Topics in Engineering Practice ¹	4

¹ ENG 4100 may be used to meet this requirement when the course content satisfies the requirements of an Indigenous course.

Complementary Studies Electives

Complementary studies electives are required to give the engineering student exposure to topics outside the fields of science and engineering. Many university courses fulfill the complementary studies requirement:

- Any course at the 1000-level or above from the Faculties of Arts or Management;
- Any course at the 1000-level or above from the Department of Agribusiness and Agricultural Economics;
- Any course listed in Group C of our three specializations

ARTS 1110 may not be used for credit in the Price Faculty of Engineering. Other university courses, which do not cover topics of science or engineering, may also be acceptable. Please consult with the department head (or his/her designate) for approval of such courses. Students planning to complete a specialization, should take note that there are specific courses to be used as complementary studies electives.

Free Electives

Any university course at the 1000-level or above can be used as a free elective. However, ARTS 1110 may not be used for credit in the Price Faculty of Engineering. Students are permitted to take additional design electives or engineering courses from other departments to fulfill free elective requirements. Students planning to complete a specialization, should take note that there are specific courses to be used as free electives.

Concentrations

Specializations in Biosystems Engineering

Students wishing to pursue more focused studies in a Biosystems Engineering subject area have the choice of completing one of three specializations:

1. Biomedical,
2. Bioresource, or
3. Environmental.

To complete a specialization, you will be required to complete two science electives (identified as Group A), three Biosystems Engineering design electives (identified as Group B), one complementary studies elective (identified as Group C), one Indigenous knowledge course, and two free electives (selected from Groups B, C or D). The similarly-themed courses that have been identified for each specialization take the place of two science electives, three Biosystems Engineering design electives, two complementary studies electives, and two free electives in the general Biosystems Engineering program (i.e., completing a specialization does not require any additional coursework).

Biomedical Specialization

The biomedical specialization provides engineers with knowledge of human anatomy and physiology to enhance the understanding of the role to be played by engineers in specific areas within biomedical engineering such as rehabilitation engineering, clinical engineering, medical imaging, and orthopedics.

Students who obtain a grade of "C" or better in the courses listed below will receive a notation of "Biomedical Specialization" on their transcript at the time of graduation.

Course	Title	Hours
Group A: Science Electives		
BIOL 1410	Anatomy of the Human Body	3

BIOL 1412	Physiology of the Human Body	3
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Group B: Biosystems Engineering Design Electives

Three of the following: 12

BIOE 4414	Imaging and Spectroscopy for Biosystems
BIOE 4610	Design of Assistive Technology Devices
BIOE 4640	Bioengineering Applications in Medicine
BIOE 4650	Textiles in Healthcare and Medical Applications

Group C: Complementary Studies Electives

One of the following:¹ 3

ENG 1900	Occupational Health and Safety Awareness
ENVR 3400	Introduction to Environment and Health
HIST 4660	History of Health and Disease (G) (counts as two)
HIST 4680	Social History of Health and Disease in Modern Canada (C) (counts as two)
HNSC 1210	Nutrition for Health and Changing Lifestyles
INDG 3240	Indigenous Medicine and Health
KPER 1200	Physical Activity, Health and Wellness
PHIL 2740	Ethics and Biomedicine
	or PHIL 2741 Éthique et biomédecine

Group D: Free Electives

Two of the following:^{1,2} 6-8

BIOL 2410	Human Physiology 1
BIOL 2420	Human Physiology 2
BIOL 4470	Physiology of Excitable Cells
CHEM 2100	Organic Chemistry 1: Foundations of Organic Chemistry
CHEM 2700	Biochemistry 1: Biomolecules and an Introduction to Metabolic Energy
CHEM 2710	Biochemistry 2: Catabolism, Synthesis, and Information Pathways
ECE 4610	Biomedical Instrumentation and Signal Processing
KPER 2330	Biomechanics
KIN 4330	Advanced Biomechanics
MECH 4360	Topics in Engineering Materials 2
MECH 4832	Biomaterials in Biomedical Engineering
PHYS 3220	Medical Physics and Physiological Measurement
PHYS 4400	Linear Systems for Imaging

Total Hours 27-29

- ¹ Special permission may be granted by the Head of Department for courses not appearing on the list of Group C or Group D.
- ² Additional courses from Group B and C can be used to fulfill Group D electives.

Bioresource Specialization

Challenges remain in the production of food and renewable resources for a world of ever-increasing population. The Bioresource Specialization provides the educational background to enable engineers to devise strategies and technologies for producing food, fibre, bio-based products, and renewable energy efficiently and sustainably.

Students who obtain a grade of "C" or better in the courses listed below will receive a notation of "Bioresource Specialization" on their transcript at the time of graduation.

Course	Title	Hours
Group A: Science Electives		
SOIL 4060	Physical Properties of Soils	3
And one of the following:		3
ANSC 3530	The Animal and Its Environment	
PLNT 2510	Fundamentals of Horticulture	
Group B: Biosystems Engineering Design Electives		
Three of the following:		12
BIOE 4390	Unit Operations 1	
BIOE 4412	Design of Light-Frame Building Systems	
BIOE 4420	Crop Preservation	
BIOE 4440	Bioprocessing for Biorefining	
BIOE 4560	Structural Design in Wood	
BIOE 4590	Management of By-Products from Animal Production	
BIOE 4600	Design of Water Management Systems	
Group C: Complementary Studies Electives		
One of the following:		3
ABIZ 1000	Introduction to Agribusiness Management	
ABIZ 1010	Economics of World Food Issues and Policies	
ABIZ 3530	Farm Management	
FOOD 1000	Food Safety Today and Tomorrow	
GEOG 2520	Geography of Natural Resources (HS)	
Group D: Free Electives^{1,2}		
Two of the following:		6-8
AGRI 1600	Introduction to Agrifood Systems	
ENTM 3170	Crop Protection Entomology	
FOOD 3010	Food Process 1	
FOOD 4260	Water Management in Food Processing	
PLNT 2500	Crop Production	
PLNT 2510	Fundamentals of Horticulture ³	
PLNT 3560	Organic Crop Production on the Prairies	
SOIL 3520	Pesticides: Environment, Economics and Ethics	
Total Hours		27-29

- ¹ Special permission may be granted by the Head of Department for courses not appearing on the list of Group C or Group D.
- ² Additional Courses from Group B or C can be used to fulfill Group D electives
- ³ PLNT 2510 can be counted as a Free Elective if ANSC 3530 is taken.

Environmental Specialization

There are numerous environmental issues faced by society. The environmental specialization provides engineers with the knowledge to predict environmental impacts due to human developments and to solve problems associated with the environment (soil contamination, pollution of rivers and lakes, air pollution, wastewater treatment).

Students who obtain a grade of "C" or better in the courses listed below will receive a notation of "Environmental Specialization" on their transcript at the time of graduation.⁴

Course	Title	Hours
Group A: Science Electives		
SOIL 4060	Physical Properties of Soils	3

And one of the following:		3
AGEC 2370	Principles of Ecology	
BIOL 2300	Principles of Ecology	

Group B: Biosystems Engineering Design Electives		
Three of the following:		12
BIOE 4412	Design of Light-Frame Building Systems	
BIOE 4460	Air Pollution Assessment and Management	
BIOE 4590	Management of By-Products from Animal Production	
BIOE 4600	Design of Water Management Systems	
BIOE 4620	Remediation Engineering	

Group C: Complementary Studies Electives		
One of the following:		3
ABIZ 2390	Introduction to Environmental Economics	
ENVR 1000	Environmental Science 1 - Concepts	
ENVR 2000	Environmental Science 2 - Issues	
ENVR 2810	Environmental Critical Thinking and Scientific Research	
ENVR 3160	Environmental Responsibilities and the Law	
ENVR 3400	Introduction to Environment and Health	
ENVR 3750	Green Building and Planning	
ENVR 3850	Sustainable Manitoba (A)	
ENVR 4050	Ecosystem Management	
ENVR 4400	Advanced Issues in Environment and Health	
GEOG 2520	Geography of Natural Resources (HS)	
PHIL 2750	Ethics and the Environment	

Group D: Free Electives^{1,2}		
Two of the following:		6-8
CIVL 3690	Environmental Engineering Analysis	
CIVL 3700	Environmental Engineering Design	
CIVL 4350	Hazardous Waste Treatment	
ENVR 2550	Environmental Chemistry	
ENVR 3110	Environmental Conservation and Restoration	
GEOG 3730	Geographic Information Systems (TS)	
Total Hours		27-29

- ¹ Special permission may be granted by the Head of Department for courses not appearing on the list for Group C or Group D.
- ² Additional courses from Group B or C can be used to fulfill Group D electives.

Preliminary Engineering Program

Campus Address/General Office: E2-262 EITC

Telephone: (204) 474 9807

Email Address: 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

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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 first year Engineering courses before their first work term.
- Completed 42 but not more than 90 credit hours towards your degree by the end of the Fall term. (This 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

In addition to students following regular departmental programs, Internationally Educated Engineers Qualification (<http://umanitoba.ca/engineering/ieeq/>) (IEEQ) Program participants may also be approved for participation in Co-op/IIP upon written approval of the IEEQ Director.

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 Warning or 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/>).