BIOE HANDBOOK

2016-17

University of Manitoba
Engineering Society

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Biosystems Engineering

Department Contacts

Department Head: Danny Mann (danny_mann@umanitoba.ca)
Associate Head: Nazim Cicek (cicekn@umanitoba.ca

Department Description

Biosystems Engineering combines aspects of engineering with science and biology. Possible areas of study include plant and animal growth facilities, biomedical devices, new biological production systems in pharmaceutical industries and agricultural machines, among others. Biosystems Engineering also addresses concepts including the ecological impact of biological waste, new methods of food preservation, storage systems, land irrigation design, and drainage systems.

In addition to the standard Biosystems Engineering program, the department offers an Environmental, Bioresource and Biomedical specialization. Finally, the department also offers a program for students intending to enter the Faculty of Medicine. Students interested in any of these programs should consult with the Biosystems Department Office to select an appropriate set of elective courses.

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Tips for Incoming Biosystems Students

These tips are from current students in Biosystems and other departments.

1. If they are available, old midterms and finals are one of the best ways to prepare for your exams. Pay attention to the style of questions your professor has given in the past and to the concepts that were emphasized in previous years' exams.
2. Make friends, you will have several group projects for which you get to choose your partners.
3. Don't leave all of your tech electives for your last year as many of them are only offered every second year. It is important to plan them out to avoid conflicts and ensure you get into the courses you want.
4. Consider taking your complimentary electives in the evenings during the summer. They are less demanding and you can can lighten your course load during the school year.
5. Many of your courses will have weekly quizzes or assignments. Even though they aren't worth a large percentage of your grade, put in as much effort as you can. Your marks in these sections of the course can help boost your overall grade.
6. Take advantage of the professors' office hours, they can provide assistance on assignments and with studying for tests and exams.
7. Get your card encoded at the earliest opportunity, there are usually a few days it is done every fall term; it will be needed to access rooms such as the CAD lab.

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Conferences and Competitions

WESST Executive Meeting (WESST EM) - http://em.wesst.ca

Participation Available To: *UMES Executives only*
2015/2016 Conference Dates: *May 7th – 10th, 2015*
2015/2016 Conference Location: *Edmonton, AB*

WESST EM brings together student representatives from 10 engineering schools in Western Canada. The conference includes a number of sessions, presentations, meetings and discussions centered around the development of student leadership skills.

WESST Retreat - http://wesst.ca/retreat/

Participation Available To: *All Engineering students*
2015/2016 Retreat Dates: *Early October*
2015/2016 Retreat Location: *Regina, SK*

This retreat offers students from the 10 WESST schools an opportunity to interact in a camp setting. In addition to WESST's AGM, retreat activities include sessions on building leadership skills and a number of social and team-building activities.

Conference on Diversity in Engineering (CDE) - http://2015.cde.cfes.ca/index.html

Participation Available To: *All Engineering students*
2015/2016 Conference Dates: *November 13th – 15th, 2015*
2015/2016 Conference Location: *Waterloo, ON*

This conference focuses on the importance of diversity in Engineering, specifically examining the role of students in achieving the industry's related goals. CDE attracts approximately 150 engineering students from across Canada.

University of Manitoba Engineering Competition (UMEC) - http://umes.mb.ca/node/56

Participation Available To: *All Engineering students*
2015/2016 Competition Dates: *End of November*
2015/2016 Competition Location: *U of M Engineering*

This competition is run annually by UMES and is held here at the U of M. All students are encouraged to participate, and those who qualify will be sponsored by UMES to subsequently attend WEC (see below).

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CFES Congress - http://congress.cfes.ca

Participation Available To: *All Engineering students*
2015/2016 Conference Dates: *January 3rd – 9th, 2016*
2015/2016 Conference Location: *Calgary, AB*

Congress is an annual, student-run conference hosted by a different CFES school each year. The conference serves not only as CFES' Annual General Meeting (AGM), but also as a platform for students to interact with both engineering students and professionals from across the country. Each year CFES Congress attracts 150 to 200 student delegates from over 40 Canadian engineering schools.

Western Engineering Competition (WEC) - http://wec2015.ca

Participation Available To: *Winners of UMEC*
2015/2016 Competition Dates: *January 22nd – 26th, 2016*
2015/2016 Competition Location: *Kelowna, BC*

Run annually by WESST, this competition provides students from 10 Western Canadian engineering schools the opportunity to engage in competition. The competition also includes a series of industry tours and networking activities. Those who place first or second in their category qualify for CEC.

Canadian Engineering Competition (CEC) - http://cec2016.com

Participation Available To: *Winners of WEC*
2015/2016 Competition Dates: *March 3rd – 6th, 2016*
2015/2016 Competition Location: *Montreal, QC*

This competition is run annually by CFES and brings together 150 of the most innovative and creative Canadian engineering undergraduate students. In addition to gaining competition experience, participants will have the opportunity to engage with engineering students and professionals from across the country.

International Engineering Competition (IEC) - http://cfes.ca/events-and-services/iec/

Participation Available To: *Winners of CEC*
2015/2016 Competition Dates: *TBA*
2015/2016 Competition Location: *TBA*

Also organized annually by CFES, the International Engineering Competition engages students from across Canada, the United States and Europe in consulting and design engineering challenges. Much like CEC, participants are also provided the opportunity to interact with a diverse group of engineering students and professionals.

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Summer Session and Minors

Summer Sessions

Extended Education

188 Continued Education Complex
summer@umanitoba.ca
474-8008
http://umanitoba.ca/summer/

Taking summer session courses is a good way to reduce your workload during the year. However, do not rely on taking a given course during the summer as the course offerings at this time are very irregular. Those courses offered during the summer are targeted primarily at students who couldn't fit a course into their regular session or who failed/dropped a course during the regular session. If interested, you may petition a faculty to make a course available during the summer. Contact the Vice Stick Academic for help with putting a petition together.

Some courses which *are* typically offered in the summer include the engineering math courses (Calc I & II, Linear Algebra, Math 1 & 2), some preliminary year engineering courses (such as Intro. to Thermal Sciences and Statics), CHEM 1300 and many Arts and Management courses suitable for your complementary electives. Note that the Summer Session calendar is released in March. The term is generally divided into Spring and Summer "terms" of 2 months each, with some courses spanning both terms.

Minors

Engineering Student Affairs Office

EITC E1-284
Judy.Schroen-Galinaitis@umanitoba.ca
474-9808

Minors in Business, Arts, Music, Math, and Computer Science are offered to Engineering students. These programs help to broaden your education and increase your prospects for future employment. In order to obtain a minor you must complete 18 credit hours of courses from the given faculty.

Requirements for pursuing a minor include the completion of at least 30 credit hours toward your engineering degree, as well as a CGPA of at least 3.00. There are a limited number of spaces available in the minor programs therefore preference is given to students who are closest to completing their degree.

Visit the Engineering Undergraduate Student Affairs Office for more details on pursuing a minor. Applications for minors must be submitted to this office before the end of May.

*With the approval of the Faculty of Engineering, courses taken to complete minors may also be used to fulfill engineering course requirements.

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Summer Research Opportunities

The following is a list of research topics shared in the Fall 2016 term for potential summer research student positions. For more information about specific opportunities we have provided the contact information for the professors.

- **S. Cenkowski (204-474-6293) -** Stefan.Cenkowski@umanitoba.ca E1-352 EITC
    - Processing of biomass, drying and evaluating food using innovative systems; superheated steam processing.

- **Y. Chen (204-474-6292) -** Ying.Chen@umanitoba.ca
    - Soil-tool-material interactions associated with tillage & seeding machines; processing of agricultural fibres.

- **N. Cicek (204-474-6208) -** Nazim.Cicek@umanitoba.ca E2-376 EITC
    - Treatment of livestock waste, municipal wastewater, and industrial wastewater.

- **K. Dick (204-474-6457) -** Kristopher.Dick@umanitoba.ca E1-344 EITC
    - Alternative energy technologies and building envelope systems.

- **F. Jian (204-474-7965) -** Fuji.Jian@umanitoba.ca E1-532 EITC
    - Studies of insect biology; detection and control of insects & moulds; grain physical properties, grain drying, mathematical modeling of the stored-grain ecosystem.

- **D. Levin (204-474-7429) -** David.Levin@umanitoba.ca E1-354 EITC
    - Biological production of biofuels and bioproducts.

- **S. Liu (204-474-9616)** - Song.Liu@umanitoba.ca W581 Duff Roblin Bldg
    - Surface engineering of polymeric materials for medical and biomedical applications (surgical drapes, catheters, vascular grafts, ligament & tendon prostheses) to enhance biological interactions.

- **D. Mann (204-474-7149) -** Danny.Mann@umanitoba.ca E2-376 EITC
    - Ergonomics of agricultural guidance systems; remote supervision of autonomous agricultural machines; safety issues associated with agricultural machines.

- **J. Morrison (204-474-8496) -** Jason.Morrison@umanitoba.ca E1-356 EITC

  - Biofibre collection, separation, and grading of all stages using imaging, spectroscopy and mechanical assessment. Material properties assessment of biologically sourced and/or bio-compatible materials.

- **J. Paliwal (204-474-8429) -** J.Paliwal@umanitoba.ca E1-342 EITC
  - Infrared spectroscopy and electromagnetic imaging (visible, near-infrared hyperspectral, radio frequency, and X-ray) for quality assessment of raw and processed food products.

- **Rahman, M. (204-474-8509) -** Mashiur.Rahman@umanitoba.ca W583 Duff Roblin Bldg
  - Development of natural textile fibres; sustainable textile processing.

- **R. Sri Ranjan (204-474-9344) -** Sri.Ranjan@umanitoba.ca E1-346 EITC
  - Irrigation; drainage; remediation of contaminated soils & groundwater; instrumentation for soil & water monitoring.

- **Q. Zhang (204-474-9819) -** Qiang.Zhang@umanitoba.ca E1-399 EITC
  - Airborne disease transmission; air quality in animal facilities; airflow flow through porous media.

- **W. Zhong (204-474-9913) -** Wen.Zhong@umanitoba.ca W579 Duff Roblin Bldg
  - Functional electrospun nanofibers for biomedical applications including wound care and tissue engineering.

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What are Specializations?

In the Biosystems department students have to option to attain a designation on their transcript of a Biomedical, Bioresource or Environmental specialization. This requires the student to select their fourth year design electives so that all three of them fit into one of the three specialization categories. Along with the specific design electives the students will also choose their science courses, complimentary and free electives to enhance their knowledge in the specific area. For more information on the courses required for each of the specializations go to Faculty of Engineering - Biosystems Department - Student Advising Assistance on the University of Manitoba website.

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Course List

Second Year Courses
Solid Mechanics 1 (CIVL 2800) 4CR
Biosystems Engineering Design 1 (BIOE 2900) 4CR
Engineering Mathematical Analysis 2 (MATH 2132) 3CR
Biology for Engineers (BIOE 2590) 3CR
Transport Phenomena (BIOE 2110) 3CR
Chemistry (CHEM 1310) 3CR
Engineering CAD Tech for Biosystems (ENG 2022) 3CR
Fluid Mechanics (CIVL 2790) 4CR
Engineering Mathematical Analysis 1 (MATH 2130) 3CR
Numerical Methods (CIVL 3590) 4CR
Statistical Analysis for Engineers (STAT 2220) 3CR
Essentials of Microbiology (MBIO 1220) 3CR
Impacts of Engineering on the Environment (BIOE 2480) 3CR

Third Year Courses
Mechanics of Biological Materials (BIOE 3590) 4CR
Kinematics and Dynamics (MECH 3482) 4CR
Instrumentation and Measurement for Biosystems (BIOE 3270) 4CR
Biosystems Engineering Design 2 (BIOE 3900) 4CR
Engineering Properties fo Biological Materials (BIOE 3320) 4CR

Fourth Year Courses
Design 3 (BIOE 4900) 4CR
Design 4 (BIOE 4950) 4CR
Engineering Economics (CIVL 4050) 3CR
Technology, Society and the Future (CIVL 4460) 3CR (or ANTH 2430)
Graduation Project (BIOE 4240) 3CR

Design Electives
Design of Light-Frame Building Systems (BIOE 4412) 4CR
Unit Operations 1 (BIOE 4390) 4CR
Crop Preservation (BIOE 4420) 4CR
Bioprocessing for Biorefining (BIOE 4440) 4CR
Management of By-Products from Animal Production (BIOE 4590) 4CR
Design of Water Management Systems (BIOE 4600) 4CR
Air Pollution Assessment and Management (BIOE 4460) 4CR

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Remediation Engineering (BIOE 4620) 4CR
Alternative Building Design (BIOE 4700) 4CR
Imaging and Spectroscopy for Biosystems (BIOE 4414) 4CR
Design of Assistive Technology Devices (BIOE 4610) 4CR
Bioengineering Applications in Medicine (BIOE 4640) 4CR

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Course Descriptions

SECOND YEAR CORE COURSES

Solid Mechanics I (CIVL 2800) 4CR
Analysis of deformable bodies; stress and strain in three dimensions; equilibrium equations and strain-displacement relations; constitutive relations and mechanical behaviour of materials; radially symmetric and plane problems in elasticity; relevant experimental demonstrations.

Difficulty: 3 **Workload:** 3

Biosystems Engineering Design 1 (BIOE 2900) 4CR
Biosystems Engineering and its place in the professions of engineering and agrology. Design concepts, with an emphasis on team building and technical communication skills. Philosophy of project planning. Preparation of a conceptual design by teams in response to design assignment submitted by industry. Written report presented orally.

Difficulty: 3 **Workload:** 3.5
Tips: Make sure to start on the written assignments early and not leave them to the last minute, taking the time to review and edit your reports for grammar and formatting makes a big difference.

Engineering Mathematical Analysis 2 (MATH 2132) 3CR
(Lab required) Infinite series, Taylor and Maclaurin Series; ordinary differential equations including Laplace transforms. For Engineering and Geophysics students only. MATH 1210 and MATH 1710 are prerequisites.

Difficulty: 4 **Workload:** 3
Tips: The best way to prepare for your midterms and final is to do lots of practice problems in the textbook. The tutorials are taught by the professor, so they are a great opportunity to go through additional practice problems and ask your questions.

Biology for Engineers (BIOE 2590) 3CR
Provide theories and principles of Biology to engineering students and present applications of biological principles to engineering problems. Fundamental theories involved in cell structure and function, metabolism, genetics and heredity, bacteria and virus structure and function, plant and animal structure and function are covered. An introduction to animal and plant physiology is also provided. Laboratory sessions and term assignments focus on the engineering applications of these basic theories and principles to provide a good understanding of the role of Biology in Engineering.

Difficulty: 2 **Workload:** 2
Tips: When Dr. Levin teaches this course he has graduate students come out to the tutorials to tell you about their research projects. This can be a great opportunity to learn more about the wide range of topics that Biosystems Engineering covers.

Transport Phenomena (BIOE 2110) 3CR
Principles of heat transfer, solar radiation, psychometrics, molecular diffusion, mass transfer and refrigeration and their application to biosystems.

Difficulty: 3 **Workload:** 3.5
Tips: Make sure to take the time to do all of the tutorial questions and review them before the exams.

Chemistry (CHEM 1310) 3CR
Thermochemistry, chemical thermodynamics, and chemical kinetics. CHEM 1300 is a prerequisite.

Difficulty: 3.5 **Workload:** 3
Tips: Start your lab write ups early so that you have time to ask questions if needed and also to consult with other peers.

Engineering CAD Tech for Biosystems (ENG 2022) 3CR
Instruction in the use of current CAD technology for conveying design through the use of graphics. Students will gain knowledge in technical drawing, 3D modelling techniques, production technology, and visual communication. Registration restricted to students in Engineering.

Difficulty: 2 **Workload:** 3 (depending on how much effort you put in)
Tips: Pay attention during the step by step demonstrations during the in lab instruction and take notes if you feel that you are going to get behind as it can be difficult to try to catch up and remember what all of the steps are.

Fluid Mechanics (CIVL 2790) 4CR
Definition of fluid; fluid properties; variation of pressure in a fluid; hydrostatic forces; buoyancy; kinematics of flow; control volumes; continuity; Bernoulli's equation; momentum equation; energy equation; flow in closed conduits; open channel flow.

Difficulty: 3 **Workload:** 3

Engineering Mathematical Analysis 1 (MATH 2130) 3CR
Multivariable differential and integral calculus up to and including multiple integrals in cylindrical and spherical coordinates. For Engineering and Geophysics students only.Prerequisites: MATH 1210 or MATH 1211 and MATH 1710

Difficulty: 3 **Workload:** 3

Tips: Make sure to review your notes from Calculus 2 before starting this class. The textbook has lots of practice problems, which are a great way to prepare for the tests. Make an effort to attend the tutorials, as the professors will go through practice problems.

Numerical Methods (CIVL 3590) 4CR
Numerical methods applied to problems in engineering; roots of nonlinear equations and systems of linear equations, numerical differentiation and integration, initial-value problems.

*Note: This course is currently being changed to an engineering taught course instead of math, check your department's requirements before registration.

Statistical Analysis for Engineers (STAT 2220) 3CR
Descriptive statistics, basic probability concepts, special statistical distributions, statistical inference-estimation and hypothesis testing, regression, reliability, statistical process control.

Difficulty: 2 **Workload:** 2
Tips: Make sure you keep up with the practice problems. Although the material is relatively straightforward, it can get a little overwhelming if you fall behind.

Essentials of Microbiology (MBIO 1220) 3CR
An introduction to the essential principles of microbiology including immunity, with emphasis on microbial disease.

Difficulty: 3 **Workload:** 2
Tip: There are no assignments or labs for this course.

Impacts of Engineering on the Environment (BIOE 2480) 3CR
Students will gain an understanding of overall sustainability of industrial activities, life-cycle and risk assessment techniques for sustainability, and design improvements to enhance environmental performance of engineered systems. This course will introduce basic methodologies for conducting environmental impact assessments, including physical, chemical, ecological, social and economic impacts.

Difficulty: 2.5 **Workload:** 3

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THIRD YEAR CORE COURSES

Mechanics of Biological Materials (BIOE 3590) 4CR
In this course students will be exposed to both the theory and physical behaviour of materials when subjected to loads. The course will be delivered using a combination of lectures and hands-on labs. The materials presented include a wide range of design biosystems engineers may be involved with, including plastics, bone, wood, concrete, steel, other biological materials and composites.

Difficulty: 3.5 **Workload:** 3

Kinematics and Dynamics (MECH 3482) 4CR
Fundamentals of 2D and 3D rigid body motions (kinematics) and the forces/moments (kinetics) needed to produce such motions. Applications will emphasize elements of machine design.

Difficulty: ∞ **Workload:** 4

Instrumentation and Measurement for Biosystems (BIOE 3270) 4CR
Basic instrumentation for measuring electrical and non-electrical quantities associated with biosystems engineering and industry; transducers for automatic control.

Difficulty: 3.5 **Workload:** 3.5

Biosystems Engineering Design 2 (BIOE 3900) 4CR
An introduction to the use of reverse engineering to deduce design features from previously-designed products or systems. Considerations such as design for sustainability and design for disassembly will be discussed. Students will have opportunity to use reverse engineering principles i) to understand how components fit together to form functional systems, ii) to identify flaws and iii) to propose design improvements. Students will learn appropriate techniques for documenting the reverse engineering process. Theory of project management will also be taught and discussed. Prerequisites: BIOE 2900.

Engineering Properties of Biological Materials (BIOE 3320) 4CR
Engineering properties of biological and interacting materials within the system. Relationship between composition, structure, and properties of plant, animal, and human tissues. Definition and measurement of mechanical, thermal, electromagnetic, chemical and biological properties and their variability. Use of these properties in engineering calculations.

Difficulty: 3.5 **Workload:** 5

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FOURTH YEAR CORE COURSES

Design 3 (BIOE 4900) 4CR
An opportunity for the Biosystems Engineering student to practice fundamental engineering competencies (project management, technical communication) in the preparation of a preliminary design for the client. Students will be expected to demonstrate professionalism as a part of a design team. May not be held with BIOE 3580. Prerequisite: BIOE 3900.

Design 4 (BIOE 4950) 4CR
An opportunity for the Biosystems Engineering student to validate a conceptual solution to an engineering problem through fabrication and testing of a prototype. Students will be expected to employ project management skills to ensure completion of both prototype and an engineering report for a client by the end of the semester. May not be held with BIOE 4580. Prerequisite: BIOE 4900.

Engineering Economics (CIVL 4050) 3CR
Introduction to engineering economics. Time value of money and discounted cash flow calculations. Comparing alternatives. Replacement analysis and life-cycle costing. Public sector engineering economy studies. Private sector engineering economy studies. Before and after-tax analysis. Applications in cost-estimating. Applications in asset management systems. Basic accounting. Accommodating capital limitations. Dealing with inflation. Dealing with risk and uncertainty. Prerequisite: STAT 2220 or (STAT 1000 and STAT 2000).

Technology, Society and the Future (CIVL 4460) 3CR (or ANTH 2430)
Impact of technology and technological change on society - past, present, future; specific technologies, e.g. construction, machine power, computers, communications, medical, military: the process of technological change; invisible effects of technology; technology and resource use; sustainable development, limits to growth and the role of technology. Prerequisite: A grade of “C” or better in one of the courses from the list of Written English for Engineering Students, or the former ENGL 1310, or the former ENGL 1320.

Difficulty: 2 **Workload:** 3 (assuming you do the readings)

Graduation Project (BIOE 4240) 3CR
Either an independent or a directed study including at least one of: a comprehensive literature review, an experimental research project, or an engineering design problem. The project is to be concluded by a formal report or thesis. Prerequisites: BIOE 3270 or approval of department.

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DESIGN ELECTIVE DESCRIPTIONS

Design of Light-Frame Building Systems (BIOE 4412) 4CR
Light-frame buildings as a structural and environmental system; structural loads in building systems; energy (heat), moisture and air contaminants in building systems; built-environment for building occupants. Hands-on labs of constructing small-scale structures for students to gain an understanding of building construction techniques. Prerequisites: BIOE 2110 and BIOE 3590

Unit Operations 1 (BIOE 4390) 4CR
Equipment and systems used in handling, mixing, size reduction, separation and size enlargement of value-added food products. Prerequisites: CIVL 2790 or MECH 2262. Corequisites: BIOE 3320, BIOE 3270.

Crop Preservation (BIOE 4420) 4CR
Biological and physical deterioration during storage. Methods of preserving and storing cereals, oilseeds, and other agricultural crops. Prerequisite: BIOE 2110

Bioprocessing for Biorefining (BIOE 4440) 4CR
This course will provide students with an understanding of the principles involved in the design of proper conditions for processing of biomaterials for production of high-quality biofuels and bioproducts. The content of this course is built on the principles of physics, transport phenomena, thermodynamics, reaction, kinetics, fermentation, and industrial unit operations. Prerequiste:BIOE 2110. Pre-or corequiste: BIOE 3320.

Management of By-Products from Animal Production (BIOE 4590) 4CR
Topics covered include solid and liquid manure, manure characteristics, manure collection, storage, land application and utilization, biological treatment, design of equipment and facilities for manure handling. Environment issues, such as odour and water pollution associated with manure management will also be discussed. Prerequisites: CIVL 2790 or MECH 2262 (or MECH 2260)

Design of Water Management Systems (BIOE 4600) 4CR
To introduce the basic theoretical principles in the design of irrigation and drainage systems. Topics covered include the determination of irrigation depth and interval, evapotranspiration, measurement and analysis of precipitation, design of sprinkler and drip irrigation systems, selection of pumps, surface and subsurface drainage design, water quality issues, salinity management, and the environmental impact of water management practices. Corequisite: SOIL 4060 or CIVL 3730 or consent of instructor.

Air Pollution Assessment and Management (BIOE 4460) 4CR
Air pollutant sources and characteristics, their impact on the environment, their behaviour in the atmosphere. Methods of sampling and measurement and the basic technological alternatives available for separation/removal and control. Particular problems of regional interest are discussed. Corequisites: CIVL 2790 or MECH 2262 (or MECH 2260)

Remediation Engineering (BIOE 4620) 4CR
The theoretical basis for the engineering design of different remediation technologies to treat contaminated soil and groundwater will be introduced. Methods for site characterization, monitoring of progress in remediation, and modeling of the remediation process will be presented. Different methods such as soil washing, air sparging, bioremediation, phytoremediation, constructed wetlands, electrokinetic remediation, reactive barriers will be discussed. Prerequisite: CIVL 2790 or MECH 2262 (or MECH 2260).

Alternative Building Design (BIOE 4700) 4CR
This course will provide students with experience in the design of structures that utilize natural and green building materials and techniques. Students will get hands-on lab experience with various natural building materials such as straw, straw light clay, cob and stackwall. Prerequisites: BIOE 3590 or CIVL 3770.

Imaging and Spectroscopy for Biosystems (BIOE 4414) 4CR
The purpose of this course is to familiarize senior Biosystems Engineering students with the fundamentals of imaging and spectroscopy for biosystems. Techniques of image acquisition, storage, processing, and pattern recognition will be taught. Various spectroscopy techniques and their applicability to biological materials will be discussed. Analysis of data using statistical, artificial neural networks and chemometric methods will be covered. Offered in alternate years. Prerequisite: BIOE 3270

Design of Assistive Technology Devices (BIOE 4610) 4CR
Application and design of technology for individuals with disabilities; emphasizing the development of the requisite knowledge, skills, and attitudes to evaluate, design, and implement client-centred assistive technology. A multi-disciplinary approach to learning and applying knowledge will be emphasized with engineering and medical rehabilitation students collaborating on a design project. Prerequisite: BIOL 1412 (or ZOOL 1330).

Bioengineering Applications in Medicine (BIOE 4640) 4CR
This course surveys bioengineering applications and medicine from a clinical engineering perspective. Topics include: clinical engineering practice; device development legislation; biomedical sensors; biosensors; biomaterials and biocompatibility; as well as the principles of and design for medical imaging equipment. Prerequisites: BIOL 1410 (or ZOOL 1320) and BIOL 1412 (or ZOOL 1330) and BIOE 3320.

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Glossary

These are a few terms that may be helpful to know throughout your studies in our faculty.

- **APEGM:** The Association of Professional Engineers and Geoscientists of Manitoba. This organization governs the work of all Professional Engineers and Geoscientists in Manitoba.
- **CFES:** The Canadian Federation of Engineering Students (which includes U of M). This national organization provides a diverse range of services as they work to support a number of Canadian Engineering schools.
- **Co-Requisite:** Refers to a course which must be taken concurrently with another course.
- **EngO:** The U of M's Engineering Orientation, also known as the two funnest days of the year. Be sure to attend on September 8th and 9th!
- **Frosh:** Refers to a first-year student.
- **HIRED:** Helping Industry Reach Engineers Directly. These sessions are held every Monday evening and provide students the opportunity to interact with industry (there's free pizza!).
- **Lab:** Refers to the portion of a course involving hands-on experiments. Most labs also require the submission of an individual or group report.
- **Midterm:** Most courses include one or two midterm exams which cover a selected portion of the course content. Although they come up quickly, midterms serve as an effective tool to keep updated with course material.
- **Prerequisite:** Refers to a course which must be completed prior to registration for another course.
- **TA:** Teaching Assistant. TAs will usually be available to students during labs/tutorials and can be very helpful in answering questions.
- **Technical Societies:** Also called "Tech Socs", this term refers to the many engineering student groups associated with UMES. Tech Soc lounges are located on the fifth floor of E1.
- **The Window:** Opens onto the Engineering Atrium and is a great resource for all engineering students. Stop by The Window to purchase snacks, UMES merchandise and event tickets or to simply ask questions.
- **Tutorial:** Refers to the portion of a course involving practice problems. Some tutorials require these questions be submitted while others do not.
- **UMES:** The University of Manitoba Engineering Society. Refers to the faculty student council which coordinates many important events and services.
- **WESST:** The Western Engineering Students' Societies Team (which includes U of M). WESST provides a diverse range of services to its 10 Western Canadian member schools.