BIOE HANDBOOK

2016-17

University of Manitoba
Engineering Society

@uines_eng /uines.eng @uines_eng

204-474-6362 • EITC E2-292 • 75A Chancellors Circle • Winnipeg, MB R32 5V6

TABLE OF CONTENTS

DEPARTMENT INFORMATION

Biosystems Engineering
Biosystems Department Office

EITC E2-376
headbio@cc.umanitoba.ca
474-6033
http://umanitoba.ca/faculties/engineering/departments/biosystems/

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

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 Option for students interested in this field. Similarly, the department also offers areas of specialization including Bioprocessing, Agricultural and Biomedical Engineering. 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.

University of Manitoba
Engineering Society
204-474-6362 • EITC E2-292 • 75A Chancellors Circle • Winnipeg, MB R32 5V6

GLOSSARY

These terms will help guide you through the Department Handbook and through your years in engineering!

- **CAD Lab:** This refers to one of the three computer labs that have the software you will need in your courses such as Solidworks.
- **Core Courses:** All of these courses must be taken and passed.
- **Co-Requisite:** Refers to a course which must be taken concurrently with another course.
- **Prerequisite:** Refers to a course that must be completed with a letter grade of D or higher before beginning a subsequent course.

University of Manitoba
Engineering Society
204-474-6362 • EITC E2-292 • 75A Chancellors Circle • Winnipeg, MB R32 5V6

DESIGN ELECTIVES FOR SPECIALIZATIONS

Environmental Specialization (choose 3)

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

BIOE 4700 Alternative Building Design

Bioresources Specialization (choose 3)

BIOE 4390 Unit Operations 1

BIOE 4412 Design of Light-Frame Building Systems

BIOE 4420 Crop Preservation

BIOE 4440 Bioprocessing for Biorefining

BIOE 4590 Management of By-Products from Animal Production

BIOE 4600 Design of Water Management Systems

Biomedical Specialization (choose 3)

BIOE 4414 Imaging and Spectroscopy for Biosystems

BIOE 4610 Design of Assistive Technology Devices

BIOE 4640 Bioengineering Applications in Medicine

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

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

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

Chemistry (CHEM 1310) 3CR
Thermochemistry, chemical thermodynamics, and chemical kinetics.

Difficulty: 3.5 **Workload:** 3

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)

Fluid Mechanics (CIVL2790) 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.

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 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

University of Manitoba
Engineering Society
204-474-6362 • EITC E2-292 • 75A Chancellors Circle • Winnipeg, MB R32 5V6

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:**

University of Manitoba
Engineering Society
204-474-6362 • EITC E2-292 • 75A Chancellors Circle • Winnipeg, MB R32 5V6

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 ANTH2430)
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

204-474-6362 • EITC E2-292 • 75A Chancellors Circle • Winnipeg, MB R32 5V6

project is to be concluded by a formal report or thesis. Prerequisites: BIOE 3270 or approval of department.

University of Manitoba
Engineering Society
204-474-6362 • EITC E2-292 • 75A Chancellors Circle • Winnipeg, MB R32 5V6

DESIGN ELECTIVES

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).

University of Manitoba
Engineering Society
204-474-6362 • EITC E2-292 • 75A Chancellors Circle • Winnipeg, MB R32 5V6

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.