

# BIOSYSTEMS ENGINEERING (BIOE)

## **BIOE 0222 Precision Agriculture- Technological Tools for Decision Making 4 cr**

(Lab required) Precision agriculture is a philosophy of agricultural management that has been enabled by modern technology. This course will examine both the technology and the techniques that can be used to improve the efficiency of agricultural operations by decreasing costs, increasing profits, and decreasing hazards to the environment. Students will be introduced to current and emerging technologies for crop, livestock and business management. Students will have the opportunity to apply data generated from these technologies to support decision making required by farm managers.

## **BIOE 0600 Farm Machinery 4 cr**

Operating principles of basic farm implements with emphasis on seed cleaning, seeding, tillage, haying, and harvest machines including their selection, adjustment, efficiency, and cost of operation with respect to test data.

## **BIOE 0700 Agricultural Buildings and Environments 4 cr**

Factors that impact the practicality of farm buildings. Components of buildings, including materials and construction techniques. Techniques of maintaining building environments to facilitate production and/or storage.

## **BIOE 0710 Materials Handling and Electrical Controls 3 cr**

Fundamental concepts and systems approach to storing, conditioning, moving, processing, and metering of agricultural produce. Principles and practices of fans, grain drying, dust control, and electrical supply. Students may not hold credit for BIOE 0710.

## **BIOE 2480 Impact of Engineering on the Environment 3 cr**

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. May not be held with the former BIOE 4480. Registration restricted to Biosystems Engineering students.

**Mutually Exclusive:** BIOE 4480

## **BIOE 2590 Biology for Engineers 3 cr**

(Lab required) the course introduces biological principles, including cell structure and function, metabolism, photosynthesis, and structure and function of systems in plants, micro-organisms, and animals, to provide Biosystems engineering students with the necessary knowledge to solve problems involving biologically – centered systems. Students focus on various topics to demonstrate how a fundamental understanding of biology contributes to better engineering solutions. May not be held with BIOL 1020 or BIOL 1030.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: CHEM 1100 or the former CHEM 1300.

**Mutually Exclusive:** BIOL 1020, BIOL 1021, BIOL 1030, BIOL 1031

## **BIOE 2600 Plant and Animal Physiology for Engineers 4 cr**

(Lab required) Plant and animal physiology as affected by environment for use in the design of agricultural machines, structures, and food processes for biological products; models of simulation of plant and animal growth. May not be held with the former AGRI 2200.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: BIOE 2590.

**Mutually Exclusive:** AGRI 2200

## **BIOE 2790 Fluid Mechanics 4 cr**

(Lab required) this course introduces the fundamental principles of fluid flow in closed conduit and open channels. Case studies will demonstrate the importance of understanding fluid mechanics in designing water distribution systems for food production, processing, and water control within the environment. May not be held with CIVL 2790.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisites: ENG 1440 (or ENG 1441) and (MATH 1710 or MATH 1701).

**Mutually Exclusive:** CIVL 2790

## **BIOE 2800 Solid Mechanics 4 cr**

(Lab required) Introduction to the analysis of deformable bodies, namely the fundamental principles governing the response of solid materials to external loads. The concept of stress, strain and displacement are explained from theoretical models and appropriate engineering laboratory work. May not be held with CIVIL 2800.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisites: ENG 1440 (or ENG1441) and (MATH 1710 or MATH 1700 or MATH 1701).

**Mutually Exclusive:** CIVL 2800

## **BIOE 2900 Biosystems Engineering Design 1 4 cr**

(Lab required) An introduction to the professional discipline of Biosystems Engineering and the philosophy of systems thinking that is used by the Biosystems engineer. Students will be introduced to several principles (i.e., safety engineering, human factors engineering and biomimicry) that should be considered during the design process, and will be given opportunity to apply these principles to design problems. The course will provide opportunity for students to develop technical communication, project management and teamwork skills. May not be held with BIOE 2580.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: ENG 1430.

**Equiv To:** BIOE 2580

## **BIOE 3100 Agricultural Engineering Fundamentals for Agronomists 3 cr**

(Lab required) The course will provide fundamental technical competencies from the discipline of agricultural engineering for the study of agronomy. Students will be introduced to i) concepts from "smart" farming, ii) functions of machinery for production agriculture, iii) water management for production agriculture, and iv) safe storage and handling of grains and oilseeds.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: PLNT 2500 (D).

## **BIOE 3270 Instrumentation and Measurement for Biosystems 4 cr**

(Lab required) Engineers must frequently take measurements to inform their engineering decisions. This course introduces the basic theory and instrumentation involved in measuring physical quantities (temperature, humidity, pressure, strain, and flow) and imaging fundamentals (image acquisition, storage, and image processing).

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: ENG 1450 and MATH 2132.

**BIOE 3320 Engineering Properties of Biological Materials 4 cr**

(Lab required) this course emphasizes the importance of understanding the properties of biological materials and the design of engineered systems. The discussion focuses on the definition and the measurement of mechanical, optical, water-retaining, rheological and thermal properties of biological materials.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisites: MATH 2130 and [BIOE 2800 or CIVL 2800 or MECH 2222 (or the former MECH 2220)].

**BIOE 3400 Design of Structural Components in Machines 4 cr**

(Lab required) Design of structural components in machines; designing for axial tension and compression, connections for axial loadings, pinned trusses, bending, torsion, and combined loads; designing for welded connections; use of fluid power to enable movement of structural components. Students will use the computer as a design tool. May not be held with the former BIOE 4530.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: BIOE 2800 or CIVL 2800 or MECH 2222.

**Equiv To:** BIOE 4530

**BIOE 3530 Engineering Fundamentals 3 cr**

(Lab required) Principles of heat transfer, steam, psychometrics, fluid mechanics, material balances, electricity and refrigeration. Cannot be held for credit in the Price Faculty of Engineering.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: [MATH 1300 or equivalent] and [MATH 1500 or equivalent] or the former MATH 1680.

**BIOE 3590 Mechanics of Materials in Biosystems 4 cr**

(Lab required) 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 materials biosystems engineers may be involved with, including plastics, bone, wood, concrete, steel, other biological materials and composites.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: BIOE 2800 or CIVL 2800, or MECH 2222.

**BIOE 3900 Biosystems Engineering Design 2 4 cr**

(Lab required) 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.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisites: [BIOE 2900 or the former BIOE 2580] and ENG 2022 or the former ENG 2020].

**BIOE 4240 Graduation Project 3 cr**

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.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisites: BIOE 3270 or approval of department.

**BIOE 4390 Unit Operations 1 4 cr**

(Lab required) Equipment and systems used in handling, mixing, size reduction, separation and size enlargement of value-added food products.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisites: BIOE 2790 or CIVL 2790 or MECH 2262. Pre- or Corequisites: BIOE 3320 and BIOE 3270.

**BIOE 4412 Design of Light-Frame Building Systems 4 cr**

(Lab required) 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. Lab activities provide students with an opportunity to construct small-scale structures. Students will be introduced to alternative building systems. May not be held with CIVL 4024.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisites: (BIOE 3110 or the former BIOE 2110) and BIOE 3590.

**Mutually Exclusive:** CIVL 4024

**BIOE 4414 Imaging and Spectroscopy for Biosystems 4 cr**

(Lab required) 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.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: BIOE 3270.

**BIOE 4416 Topics in Biosystems Engineering 3 cr**

(Lab required) This course will cover contemporary topics in Biosystems Engineering. The specific topics and a detailed outline will be available at the time of registration.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: Permission of the department.

**BIOE 4420 Crop Preservation 4 cr**

(Lab required) Biological and physical deterioration during storage. Methods of preserving and storing cereals, oilseeds, and other agricultural crops.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: BIOE 3110 or the former BIOE 2110.

**BIOE 4440 Bioprocessing for Biorefining 4 cr**

(Lab required) 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.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: BIOE 3110 or the former BIOE 2110. Pre-#or corequisite: BIOE 3320.

**BIOE 4460 Air Pollution Assessment and Management 4 cr**

(Lab required) 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.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Pre- or co-requisites: BIOE 2790 or CIVL 2790 or MECH 2262 or the former MECH 2260.

**BIOE 4560 Structural Design in Wood 4 cr**

(Lab required) Design using wood as a structural material in light-frame buildings. Consideration of design constraints associated with sawn lumber as well as based composite materials. Emphasis on use of computer based design aids.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisites: CIVL 3770 or BIOE 3590.

**BIOE 4590 Management of By-Products from Animal Production 4 cr**

(Lab required) 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.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisites: BIOE 2790 or CIVL 2790 or MECH 2262 or the former MECH 2260.

**BIOE 4600 Design of Water Management Systems 4 cr**

(Lab required) 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.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Co-requisite: SOIL 4060 or CIVL 3730 or consent of instructor.

**BIOE 4610 Design of Assistive Technology Devices 4 cr**

(Lab required) 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.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: BIOL 1412.

**BIOE 4620 Remediation Engineering 4 cr**

(Lab required) 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.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: BIOE 2790 or CIVL 2790 or MECH 2262 or the former MECH 2260.

**BIOE 4640 Bioengineering Applications in Medicine 4 cr**

(Lab required) 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.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisites: BIOL 1410 and BIOL 1412 and BIOE 3320.

**BIOE 4650 Textiles in Healthcare and Medical Applications 4 cr**

This course provides students with an introduction to medical textiles and healthcare products used in current practices, as well as fundamentals for designing textile products and devices that improve the health and quality of life of human beings. The course includes both basic topics related to healthcare and medical textiles (i.e., materials and structures, nanofibers for medical uses, comfort and health problems with textiles, biocompatibility and biostability issues) and applications of textile products for healthcare and medical end uses (i.e., protective and hygiene textiles, external devices, tissue engineering and intelligent/smart textiles).

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: BIOE 2590. Pre- or Co-requisite: BIOE 3320.

**Equiv To:** TXSC 3500, TXSC 4500

**BIOE 4900 Biosystems Engineering Design 3 4 cr**

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.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: BIOE 3900.

**Equiv To:** BIOE 3580

**BIOE 4950 Biosystems Engineering Design 4 4 cr**

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.

**PR/CR: A minimum grade of C is required unless otherwise indicated.**

Prerequisite: BIOE 4900.

**Equiv To:** BIOE 4580