September 4, 2019

University of Manitoba
Department of Biosystems Engineering

Course Details

Course Title & Number:	BIOE 2900 Biosystems Engineering Design 1
Class Times & Days of Week:	Lectures: MWF 1:30-2:20
	Labs: W 2:30-5:15
Location for classes/labs/tutorials:	Virtual (Webex/MS-Teams/Zoom)
Pre-Requisites:	ENG 1430 Design in Engineering

Course Description:

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.

Instructor Information

Instructor(s) Name:	Dr. Jillian Seniuk Cicek
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Teaching Assistant:	Bezalel Ovie Orogun
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Textbook, Readings, Materials

Required textbook – The following book is available from the University of Manitoba Bookstore.

> Dunwoody, A.B., T.N. Teslenko, J. Reilly, S.E. Nesbit, P.J. Cramond and C.S. Paterson. 2018. Fundamental Competencies for the 21st-Century Engineer, Second Edition. Don Mills, ON: Oxford University Press.

Supplementary readings – A set of course notes has been prepared. They will be made available through the UM Learn site for this course. Students are responsible for the content covered in these course notes for the final examination.

General Course Information

Design is one of the core graduate attributes identified by the Canadian Engineering Accreditation Board. Although engineers must have sufficient skills to analyze complex problems, they must also be able to communicate effectively and work in teams or individually to solve challenging, open-ended problems within real time constraints. This course specifically introduces the engineering student to design principles such as safety engineering and human factors engineering that must be considered during the design process to ensure the safety of the public and the usability of the design. Furthermore, the course will introduce students to the discipline of Biosystems Engineering, the "systems" approach to problem solving, and biomimicry (i.e., design lessons that can be learned from nature). The course will facilitate the engineering student to develop the CEAB graduate attributes needed for a career as a professional engineer: engineering communication skills, working in a team to manage a project, professionalism, and lifelong learning.

How does this course fit into the curriculum?

This is a required course in the Biosystems Engineering program; the prerequisite for BIOE 2900 is ENG 1430. The Biosystems Engineering program has four design courses that build upon basics that were introduced in ENG 1430 (i.e., introduction to the engineering design process and the dynamics of working as a team to solve an engineering problem). BIOE 2900 is the first of these four courses and is to be taken during the 2nd year of the program.

Course Goals

The intent of this course is:

- To introduce students to the professional discipline of Biosystems Engineering and the philosophy of systems thinking that is essential to the Biosystems engineer.
- To introduce fundamental concepts of safety engineering, human factors engineering, and biomimicry; and to demonstrate how these design principles can be considered during the design process.
- To provide students with an opportunity to use the engineering design process to solve problems.
- To provide students with an opportunity to collaborate equitably with group members in a team setting to manage an engineering design project.
- To provide students with instruction in the basics of professional communication skills and information literacy, and with opportunities to practice using these skills to effectively communicate a design solution.

Intended Learning Outcomes

At the conclusion of the course, the student should be able to:

1. Describe careers available to Biosystems engineers, the philosophy of systems thinking that is essential to a Biosystems engineer, and the means by which the professional Biosystems engineer can practice lifelong learning.
2. Explain principles of safety engineering, human factors engineering, and biomimicry as they relate to the design process.
3. Critique case studies of engineering design failures to i) identify principles of safety engineering or human factors engineering that were violated, and ii) assign responsibility for the errors.
4. Apply principles of safety engineering, human factors engineering, and biomimicry to design problems.
5. Demonstrate effective written, oral, and graphic communicative competence in conducting engineering tasks.

Expected Level of Development in Course **

Learning Outcome	Attribute*											
	KB	**PA**	**IN**	**DE**	**ET**	**IT**	**CS**	**PR**	**IE**	**EE**	**EP**	**LL**
1	D							D				D
2	D			D								
3								D		D		D
4	D			D								
5				D		D	D	D		D		D

***Attributes*:**
KB A knowledge base for engineering
PA Problem analysis
IN Investigation
DE Design
ET Use of engineering tools
IT Individual and team work
CS Communication skills
PR Professionalism
IE Impact of engineering on society/ environment
EE Ethics and equity
EP Economics and project management
LL Life-long learning

**Expected Level of Development:
I – Introductory
D – Intermediate
A – Advanced

Lecture Topics

1. Introduction to Discipline of Biosystems Engineering
    a. History of Biosystems Engineering, Philosophy of Systems Thinking, Lifelong Learning for the Biosystems Engineering Professional, Ethics & Professionalism in Engineering
    b. Career Development: Embracing a Career Mindset; Career Planning & Goal Setting; Occupational research

2. Engineering Communication Topics:
    a. Principles of Effective Communication & Technical Communication: Written, Verbal, Graphical; Progress and Engineering Reports; Keeping a Journal; Preparing & Giving Effective Presentations; Writing Informatively, Reflexively, and Persuasively)
    b. Teamwork (Brainstorming; Collaborative Projects and Presentations; Leadership Styles; Professional and Ethical Behaviour; Peer Evaluations)
    c. Information Literacy (Research Practices; CSBE Referencing Style; Writing Annotations; Reading & Writing Critically)

3. Engineering Design Principles
    a. Engineering Design Process, Engineering tools for decision-making
    b. Safety Engineering: Safety Engineering Hierarchy, Design of guards, Design of warning labels
    c. Human Factors Engineering: Anthropometrics, Human-Machine Interface, Task Analysis, Issues with Automation
    d. Biomimicry

Course Evaluation Methods

The course introduces several principles (i.e., safety engineering, human factors engineering, biomimicry) that should be considered during the design process. In addition, the course will provide opportunity for students to develop engineering communication skills. A portion of the grade will be based on a team design project. **All assignments must be submitted in order to pass the course.**

Communication and Design Assignments 25%

Unranked paired comparison assignment (September 23) (each student to complete) (3%)
Idea generation & analysis assignment (September 25) (each student to complete) (3%)
Annotated bibliography (September 30) (each student to complete) (5%)
Safety engineering considerations report (November 4) (one report per design team) (3%)
Human factors engineering considerations report (November 18) (one report per design team) (3%)
Critique of conceptual designs report (December 2) (one report per design team) (3%)
Reflections on articles distributed for class discussions (various dates) (each student to complete) (5%)

Team Design Project 40%

Team Progress Report (2%)
Team Presentation (10%)
Team Presentation Slides (3%)
Draft Written Report (15%) (one report per design team)
Final Written Report (10%) (one report per design team)

Professional Skills 15%

Reflective Letter #1 (each student to complete) (1.5%)
Individual Presentation (2%)
Informational interview, reflection/Ted Talk (each student to complete) (5%)
Reflective Letter #2 (each student to complete) (1.5%)
Self & Peer evaluation (each student to complete) (5%)

Exam 20%

Assignment Descriptions

Communication & Design Assignments (25%): There will be a number of communication and design assignments due throughout the semester. Some will be completed individually, but many will be completed by the design teams. These assignments are intended to ensure that design teams are making continual progress on their projects.

Team Design Project (40%): The scheduled laboratory time will be used to enable students to complete a team design project on a topic relevant to the discipline of Biosystems Engineering. Students will be expected to research the assigned topic to learn about the relevant issues, to conduct a brainstorming session to identify potential solutions, to employ a formal decision-making process to select an appropriate conceptual solution, and to fully describe the conceptual solution in a formal engineering report. Teams are required to submit a draft report which will be evaluated by Professor Seniuk Cicek and feedback will be provided prior to the due date for the final report. Team presentations will occur on November 20th. A final written report is required from each design team (these reports will be evaluated by Mr. Edet).

Professional Skills (15%):
There are several assignments that will be completed throughout the semester which will contribute to the development of your professional skills, including critical reflection and presentation skills.

Exam (20%): Students will be evaluated on the application of principles of safety engineering and human factors engineering to design problems, and principles of communication. The examination will cover material from the entire course and will be scheduled during the final lab period of the semester.

Assignment Extension and Late Submission Policy

Deadlines are a reality in the world of engineering; we expect assignments to be completed on time. Assignments submitted after the due date will be docked 10% per day. **All assignments must be submitted to pass the course.**

Development of Presentation Skills

A major focus of BIOE 2900 is to help you become better communicators. We recognize that giving a presentation causes anxiety for many of you. You will have several opportunities to speak in front of your peers over the next three months as practicing will improve your skills and thereby alleviate some of the anxiety that is natural when giving presentations. The dates and topics of these presentations are as follows:

September 16: **Sharing about the profession of Biosystems Engineering**

Many interesting ideas that have been developed by Biosystems engineers are highlighted in *Resource* magazine (a publication of the American Society of Agricultural and Biological Engineers – ASABE). Summarize one project that appears in a recent issue of *Resource* magazine. You are expected to speak formally with the use of one PowerPoint slide. Your presentation should be maximum 2 minutes.

October 21: Informal progress update

Design teams will be required to provide a brief, progress update to the course instructors. Each member of the team is expected to briefly describe what they have learned / achieved with respect to the design project (approximately 2 minutes per person).

November 25: Team presentations

Design teams will have approximately 3 minutes per team member to describe the details of the concept they are proposing in response to the stated design problem. Each member of the team is expected to equitably participate in the presentation. There will be a brief question period to follow.

December 2: **Sharing the findings of your occupational research**

During the term, students are required to conduct an informational interview with a professional. Students will share what they learned about the professional's career and how it relates to the Biosystems engineering profession.

Grading Scale

The grading scale used for this course is shown below.

Letter Grade	Percentage out of 100
A+	92-100
A	85-91
B+	78-84
B	72-77
C+	66-71

C	60-65
D	50-59
F	Less than 50

Important Dates

October 12:	No class – Thanksgiving Day
November 11:	No class – Remembrance Day
November 9-13	No classes – Fall Break
November 20:	Drafts of Team Design Project Reports due
November 23:	Last date for Voluntary Withdrawal for fall term courses.
November 25:	Team Design Project Presentations
December 4:	Final Team Design Project Reports due
December 9:	Final Examination (written during the final lab period)
December 11:	Peer Evaluations due; Course Recognition Awards

UNIVERSITY & COURSE POLICIES

Using Copyrighted Material

Please respect copyright. We will use copyrighted content in this course. The content used is appropriately acknowledged and is copied in accordance with copyright laws and University guidelines. Copyrighted works, including those created by us, are made available for private study and research and must not be distributed in any format without permission.

Recording Class Lectures

Dr. Danny Mann, Dr. Jillian Seniuk Cicek, Mr. Uduak Edet, and the University of Manitoba hold copyright over the course materials, presentations and lectures that form part of this course. No audio or video recording of lectures or presentations is allowed in any format, openly or surreptitiously, in whole or in part without permission from Dr. Jillian Seniuk Cicek or Mr. Edet. Course materials (both paper and digital) are for the participant's private study and research.

Course Technology

The course will be delivered using Webex/MS-Teams/Zoom. Students will be asked to use their computer cameras and microphones as well as the Chat and other features this program offers to engage in classes, listen to recordings and view videos. Students will also present live using both audio and video and may need to record PowerPoint presentations. Students who have constraints with technology should speak with the instructors. Students who have technical difficulties should consult IST. UM Learn will be central for content, assignments and communication.
As a courtesy to both the instructors and your classmates, distractions are to be avoided during class time. Please remember to have your mic on mute unless you are speaking to avoid disruptions.

Class Communication

The University requires all students to activate an official University email account. For full details of the Electronic Communication with Students please visit:
http://umanitoba.ca/admin/governance/media/Electronic_Communication_with_Students_Policy_-_2013_09_01_RF.pdf

Please note that all communication between you as a student and your instructors/TAs must comply with the electronic communication with student policy (http://umanitoba.ca/admin/governance/governing_documents/community/electronic_communication_with_students_policy.html). You are required to obtain and use your U of M email account for all communication between yourself and the university.

Academic Integrity

Plagiarism or any other form of cheating in examinations, term tests or academic work is subject to serious academic penalty. Cheating in examinations or tests may take the form of copying from another student, getting help from someone with individual assignments/exam or bringing unauthorized materials or person into the exam room. Exam cheating can also include exam impersonation. A student found guilty of contributing to cheating in examinations or term assignments is also subject to serious academic penalty. Students should acquaint themselves with the University's policy on plagiarism, cheating, exam impersonation and duplicate submission. Electronic detection tools may be used to screen assignments in cases of suspected plagiarism. Please refer to the "Academic Integrity" section of the University of Manitoba Undergraduate Academic Calendar.
(http://umanitoba.ca/student-supports/academic-supports/academic-integrity).

Referencing Style

Students are expected to follow the citation style that is used by the Canadian Biosystems Engineering journal when citing references in course assignments. A document describing the citation style is available through UM Learn. Please refer to this guide to ensure that you follow the correct referencing style.

Expectations: You Can Expect Us To

Learning is most effective when both the instructor and the student are engaged in the subject material. The role of the instructor, therefore, is to create an environment that facilitates student engagement and learning. In this course, some dissemination of information will occur using the traditional lecture format. However, a substantial portion of the content will be distributed as reading materials, which will be covered using classroom discussion or other learning activities. You can expect us to endeavour to create an active learning environment.

Expectations: We Expect You To

We expect you to be in attendance, and on time, for all scheduled lectures and labs. If you must be absent, please show us the courtesy of sending an e-mail notifying us of your absence.

To benefit the most from this class, you must be willing to participate in class discussions. Therefore, you will be expected to prepare for class by reading the assigned materials.

Student Accessibility Services

Student Accessibility Services
If you are a student with a disability, please contact SAS for academic accommodation supports and services such as note-taking, interpreting, assistive technology and exam accommodations. Students who have, or think they may have, a disability (e.g. mental illness, learning, medical, hearing, injury-related, visual) are invited to contact SAS to arrange a confidential consultation.

Student Accessibility Services http://umanitoba.ca/student-supports/accessibility

520 University Centre
204 474 7423
Student_accessibility@umanitoba.ca

Supplemental Course Information for BIOE 2900

All courses in the Biosystems Engineering program are expected to contribute, in some way, to the development of one or more of the 12 graduate attributes that have been identified by the Canadian Engineering Accreditation Board. The 12 graduate attributes have been defined below for your information.

Graduate Attributes

1. **A Knowledge Base for Engineering:** Demonstrated competence in university level mathematics, natural sciences, engineering fundamentals, and specialized engineering knowledge appropriate to the program.
2. **Problem Analysis:** An ability to use appropriate knowledge and skills to identify, formulate, analyze, and solve complex engineering problems in order to reach substantiated conclusions.
3. **Investigation:** An ability to conduct investigations of complex problems by methods that include appropriate experiments, analysis and interpretation of data, and synthesis of information in order to reach valid conclusions.
4. **Design:** An ability to design solutions for complex, open-ended engineering problems and to design systems, components or processes that meet specified needs with appropriate attention to health and safety risks, applicable standards, and economic, environmental, cultural and societal considerations.
5. **Use of Engineering Tools:** An ability to create, select, apply, adapt, and extend appropriate techniques, resources, and modern engineering tools to a range of engineering activities, from simple to complex, with an understanding of the associated limitations.
6. **Individual and Team Work:** An ability to work effectively as a member and leader in teams, preferably in a multi-disciplinary setting.
7. **Communication Skills:** An ability to communicate complex engineering concepts within the profession and with society at large. Such ability includes reading, writing, speaking and listening, and the ability to comprehend and write effective reports and design documentation, and to give and effectively respond to clear instructions.
8. **Professionalism:** An understanding of the roles and responsibilities of the professional engineer in society, especially the primary role of protection of the public and the public interest.
9. **Impact of Engineering on Society and the Environment:** An ability to analyze social and environmental aspects of engineering activities. Such ability includes an understanding of the interactions that engineering has with the economic, social, health, safety, legal, and cultural aspects of society, the uncertainties in the prediction of such interactions; and the concepts of sustainable design and development and environmental stewardship.
10. **Ethics and Equity:** An ability to apply professional ethics, accountability, and equity.
11. **Economics and Project Management:** An ability to appropriately incorporate economics and business practices including project, risk, and change management into the practice of engineering and to understand their limitations.
12. **Life-long Learning:** An ability to identify and address their own educational needs in a changing world in ways sufficient to maintain their competence and to allow them to contribute to the advancement of knowledge.

While there are likely some aspects of many of these attributes that can be found in this course, the graduate attributes being emphasized in this course are: 1) *A Knowledge Base for Engineering, 4) Design, 5) Use of Engineering Tools, 6) Individual and Team Work, 7) Communication Skills, 8) Professionalism, 10) Ethics and Equity, and 12) Lifelong Learning.*

The table below shows the graduate attributes covered in BIOE 2900 in relation to the assessment element that contributes to your overall grade in the course. The final column indicates the approximate level of development in graduate attributes that is anticipated in this course.

Assessment Element	Value	Attributes Covered	Indicators being assessed	Level*
Communication and Design Assignments	25%	Design Engineering Tools Communication Skills Professionalism Ethics & Equity Lifelong Learning	DE.2 Uses design process DE.3 Develops design solutions DE.4 Evaluates (critiques) design solution ET.1 Uses tools to complete engineering activities CS.2 Produces appropriate engineering documents PR.1 Understands safety & human factors aspects of engineering designs EE.2 Articulates ethical dilemmas LL.1 Applies knowledge to new situations LL.2 – Engages in activities to advance knowledge and understands the role of ongoing professional development LL.3 Learns from successes and mistakes LL.4 Demonstrates research & information literacy skills	D
Team Design Project	40%	Design Communication Skills	DE.1 Defines appropriate objectives & constraints DE.2 Uses design process DE.3 Develops design solutions CS.2 Produces appropriate engineering documents CS.3 Delivers effective technical presentations	D I I
Professional Skills (Written reflections, peer assessment)	15%	Individual & Teamwork Communication Skills Professionalism Ethics & Equity Lifelong Learning	IT.1 Participates in group activities IT.2 Contributes equitably to group work IT.3 Exhibits appropriate interpersonal skills IT.4 Develops or demonstrates leadership skills CS.1 Applies principles for effective engineering communication PR.3 Exhibits appropriate professional behaviour EE.3 Demonstrates individual accountability LL.1 Applies knowledge to new situations LL.2 – Engages in activities to advance knowledge and understands the role of ongoing professional development LL.3 Learns from successes and mistakes	D
Final Examination	20%	Knowledge Base Design	KB.3 Fundamental engineering science DE.2 Uses design process CS.1 Applies principles for effective engineering communication	D

*Level of Development of Graduate Attributes (I = Introductory; D = Intermediate; A = Advanced)