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: 300 Human Ecology Building
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. Danny Mann, P.Eng. (Professor & Department Head)
Office Location: E2-376F EITC
Office Hours or Availability: By appointment
Office Phone No. 204-474-7149
Email: Danny.Mann@umanitoba.ca

Instructor(s) Name: Dr. Jillian Seniuk Cicek
Office Location: E1-330 EITC
Office Hours or Availability: By appointment
Office Phone No. 204-474-9698
Email: Jillian.SeniukCicek@umanitoba.ca

Teaching Assistant: Mr. Uduak Edet
Office Location: A115 Agricultural Engineering Building
Office Phone No. 204-474-7446
Email: edetu@myumanitoba.ca

Textbook, Readings, Materials

Required textbook – The following book is available from the University of Manitoba Bookstore. Students are responsible for reading the stories in the textbook in preparation for in-class discussions throughout the semester and a written assignment.


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 written and oral communication skills, and with opportunities 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. Write a professional design report and deliver an effective oral presentation in a team setting.
**Expected Level of Development in Course **

<table>
<thead>
<tr>
<th>Learning Outcome</th>
<th>KB</th>
<th>PA</th>
<th>IN</th>
<th>DE</th>
<th>ET</th>
<th>IT</th>
<th>CS</th>
<th>PR</th>
<th>IE</th>
<th>EE</th>
<th>EP</th>
<th>LL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>D</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>D</td>
<td></td>
<td></td>
<td></td>
<td>D</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>D</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td>D</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>D</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>D</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*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

2. Engineering Communication Topics:
   a. Communication Principles (General Principles of Communication, Principles of Oral Communication, Preparing & Giving Effective Presentations, Writing Persuasively, Professional Correspondence)
   b. Teamwork (Collaborative Projects, Leadership Styles, Professional Behaviour: Managing effective meetings)
   c. Information Literacy (Information Literacy Practices, Writing Annotations, Reading 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
   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, although the majority of the grade will be based on individual work. **All assignments must be submitted in order to pass the course.**

Engineering Design Principles (75% of course grade)
- Term/Design Assignments: 10%
- Team Design Project: 30%
- Peer Evaluation: 5%
- Final Examination: 30%

Engineering Communication (25% of course grade)
- Biomimicry Assignment (Essay & Presentation): 4%
- Literature Review (Annotations & Slide): 8%
- Engineering Communication Midterm: 8%
- Oral Presentation (Team Design Project): 5%

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 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.

<table>
<thead>
<tr>
<th>Assessment Element</th>
<th>Value</th>
<th>Attributes Covered</th>
<th>Indicators being assessed</th>
<th>Level*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Assignments</td>
<td>10%</td>
<td>Design Communication Skills</td>
<td>DE.2 Uses design process, DE.3 Develops design solutions, CS.2 Produces appropriate engineering documents</td>
<td>D</td>
</tr>
<tr>
<td>Team Design Project</td>
<td>30%</td>
<td>Design Communication Skills</td>
<td>DE.1 Defines appropriate objectives &amp; constraints, DE.2 Uses design process, DE.3 Develops design solutions, CS.2 Produces appropriate engineering documents</td>
<td>D</td>
</tr>
<tr>
<td>Peer Evaluation</td>
<td>5%</td>
<td>Individual &amp; Teamwork Communication Skills Professionalism Ethics &amp; Equity Lifelong Learning</td>
<td>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.3 Learns from successes and mistakes</td>
<td>D</td>
</tr>
<tr>
<td>Final Examination</td>
<td>30%</td>
<td>Knowledge Base Design</td>
<td>KB.3 Fundamental engineering science, DE.2 Uses design process</td>
<td>D</td>
</tr>
<tr>
<td>Communication Assignments &amp; Midterm</td>
<td>20% Communication Skills Lifelong Learning</td>
<td>CS.1 Applies principles for effective engineering communication, CS.2 Produces appropriate engineering documents, CS.3 Delivers effective technical presentations, LL.4 Demonstrates research &amp; information literacy skills</td>
<td>I, D</td>
<td></td>
</tr>
<tr>
<td>Oral Presentation</td>
<td>5%</td>
<td>Communication Skills</td>
<td>CS.3 Delivers effective technical presentations</td>
<td>I</td>
</tr>
</tbody>
</table>

*Level of Development of Graduate Attributes (I = Introductory; D = Intermediate; A = Advanced)
Grading Scale
The grading scale used for this course is shown below.

<table>
<thead>
<tr>
<th>Letter Grade</th>
<th>Percentage out of 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>A+</td>
<td>92-100</td>
</tr>
<tr>
<td>A</td>
<td>85-91</td>
</tr>
<tr>
<td>B+</td>
<td>78-84</td>
</tr>
<tr>
<td>B</td>
<td>72-77</td>
</tr>
<tr>
<td>C+</td>
<td>66-71</td>
</tr>
<tr>
<td>C</td>
<td>60-65</td>
</tr>
<tr>
<td>D</td>
<td>50-59</td>
</tr>
<tr>
<td>F</td>
<td>Less than 50</td>
</tr>
</tbody>
</table>

Important Dates
October 8: No class – Thanksgiving Day
October 10: Engineering Communication Midterm
November 12: No class – Remembrance Day
November 13-17: No classes – Fall Break
November 19: Last date for Voluntary Withdrawal for fall term courses.
December 5: Team Design Project Oral Presentations & Written Reports Due

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.

Assignment Descriptions
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. Student work will be assessed in each of these areas.

Engineering Design Principles (75% of course grade)
Term/Design Assignments (10%): Students will be expected to complete several assignments that illustrate the principles of safety engineering, human factors engineering, and biomimicry during design. There will be other assignments associated with case studies where ethical issues relevant to the engineering profession will be explored. Specific instructions will be provided later in the term. Students will typically be given some lab time to work on these design assignments.

Team Design Project (30%): 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. The final report will be evaluated on the basis of both technical content and the ability to effectively communicate technical content (rubrics will be provided at a later date). The written report will be due on December 5, 2018.

Peer Evaluation (5%): Students will be required to assess their peers following completion of the team design project.
Final Examination (30%): Students will be evaluated on the application of principles of safety engineering and human factors engineering to design problems. The final examination will cover material from the entire course. The final examination will be scheduled during the examination period.

Engineering Communication (25% of course grade)

Writing Assignments (12%): Students will be expected to work individually to complete several short assignments which are intended to help students develop the skills needed to effectively communicate technical information both orally and in writing. Specific instructions will be provided later in the term.

Engineering Communication Midterm (8%): A written midterm examination will be used to assess student understanding of the principles associated with effective communication within an engineering context. The midterm examination is scheduled for the lab period on October 10, 2018.

Oral Presentation (5%): Design teams will be expected to give a formal oral presentation during the final lab session of the term (December 5, 2018). The oral presentations will be evaluated using a rubric to assess the student’s ability to effectively communicate technical information in an oral presentation.

Oral Presentations

A major focus of BIOE 2900 is to help you become better communicators. We recognize that giving an oral presentation causes anxiety for many of you. You will have several opportunities to speak in front of your peers over the next three months. The dates and topics of these oral presentations are given below.

September 12: 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 informally without the use of PowerPoint (cue cards are allowable if necessary). Your presentation should not exceed 2 minutes (target is 90 seconds).

September 26: Biomimicry Presentations
The first writing assignment requires you to prepare a short essay related to the topic of biomimicry. On September 26, you will be required to use a maximum of 2 slides to present your point of view to the class. Your presentation should not exceed 2 minutes (target is 90 seconds).

October 17: Evaluation of Bristleboard Guard Design
Back on the first day of the semester, you worked with a team of your classmates to design a safety guard for a specific mechanical hazard. After being exposed to principles of safety guard design, your team is required to critique its original design and suggest design modifications (if necessary). On October 17, each team will orally critique their original design and describe potential design modifications. Your team presentation should not exceed 5 min.

October 24: Sharing the findings of your review of the literature
During the first three weeks of October, each of you will have been researching your group design project. This is an opportunity to orally share the findings of your individual research with the other members of your design team. Prepare a brief formal presentation so that you can share your findings to your design team with the use of a laptop. Summarize your findings in 5-8 min. Each member of the design team will be expected to share their findings in the lecture period. A hard copy of the PowerPoint slides (6 slides per page) should be submitted to the instructor.

December 5: Group Oral Presentations
Prepare an oral presentation to describe the work done by your design team on the Team Design Project. Use of PowerPoint is required for this presentation. Your team presentation should not exceed 15 min.
**Reading Assignments/Class Discussion**

There is much that we can learn from the mistakes of others. In his book *The Atomic Chef*, Steven Casey retells historical events. In most cases, there is some type of design flaw that could have been avoided with the use of appropriate safety engineering or human factors engineering principles. We will be discussing a number of these stories over the term. Please be sure to read the chapters indicated prior to the dates listed. There will be specific assignments for each set of stories (to be distributed later).

- **October 22**  The Atomic Chef (page 13); Death on Call (page 63); Event Horizon (page 86); Caught on Tape (page 108)
- **October 24**  Under the Radar (page 152); Safer than Safe (page 176); The Perilous Plunge (page 224); Titanic’s Wake (page 236)
- **November 5**  The Embryo Imbroglio (page 27); Picture Window (page 78); Freeway Driver (page 97); 911, More or Less (page 136)
- **November 19**  Out of Synch (page 54); Rhymes and Reasons (page 196); A Kid in a Car (page 219); Negative Transfer (page 260)

---

**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, 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. Danny Mann or Dr. Jillian Seniuk Cicek. Course materials (both paper and digital) are for the participant’s private study and research.

**Course Technology**

As a courtesy to both the instructors and your classmates, use of cell phones is not permitted during class time. Please remember to switch your cell phone to vibrate mode to avoid interruptions. Laptops may be used during lectures only for the purpose of taking notes. Some course materials will be available through UM Learn.

**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_-_2014_06_05.pdf](http://umanitoba.ca/admin/governance/media/Electronic_Communication_with_Students_Policy_-_2014_06_05.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](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 or bringing unauthorized materials 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://crscalprod.ad.umanitoba.ca/Catalog/ViewCatalog.aspx?pageid=viewcatalog&catalogid=341&chapterid=4295&loaduseredits=False](http://crscalprod.ad.umanitoba.ca/Catalog/ViewCatalog.aspx?pageid=viewcatalog&catalogid=341&chapterid=4295&loaduseredits=False)).

**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 teacher and the student are engaged in the subject material. The role of the teacher, 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**

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/saa/accessibility/](http://umanitoba.ca/student/saa/accessibility/)
520 University Centre
204 474 7423
[Student_accessibility@umanitoba.ca](mailto: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*, 6) *Individual and Team Work*, 7) *Communication Skills*, 8) *Professionalism*, 10) *Ethics and Equity*, and 12) *Lifelong Learning*. 