The University of Manitoba  
Department of Biosystems Engineering

Course Number  BIOE 4640  Course Title  Bioengineering Applications in Medicine
Academic Session  Fall 2018 (201890)  Credit Hours  4

Prerequisites and how they apply to this course

ZOOL 1320 – Anatomy of the Human Body and ZOOL 1330 – Physiology of the Human Body provides students with an understanding of the components and complexities of the human body sufficient to comprehend what is measured, modified or maintained during medical measurement or intervention. This provides a basis of biological knowledge that allows the technical medical topics pertaining to this course to be discussed quickly and be understood thereby enabling exploration of the technical engineering topics of this course.

BIOE 3320 – Engineering Properties of Biological Materials is required to provide a basis of understanding in tissue and material mechanics specific to biological materials. This enables this course to engage in a discussion of the mechanics and wear of prosthetic implants.

Classroom Location  E2-310 EITC Bldg
Meeting Days and Class Hours  MWF  9:30-10:20 am

Tutorial Location  E2-164 EITC Bldg
Tutorial Hours  W  2:30-5:15 pm

Department Office location  E2-376 EITC
Department Phone Number  204-474-6033

Course Web Page (if applicable)  See UMLearn

Instructor Information

Name & Title  Dr. Jason Morrison, P.Eng. (Assistant Professor)
Office Location  E1-356 EITC
Office Phone Number  204-474-8496
Email Address  Jason.Morrison@umanitoba.ca
Office Hours  W 10:30-11:30am; or whenever available

Teaching Assistant(s) (if applicable)  Not Applicable

TA Office Hours and Location  Not Applicable

Course Philosophy

Students’ Learning Responsibilities
You are expected to learn the material covered in lectures and assignments. Attendance for lectures and labs is not strictly enforced but it is expected. Submission of assignments is to be done at the beginning of lab or class time on the date mentioned in the assignment. To benefit the most from this class, you must be willing to participate in discussions about the material, preferably during class or tutorial. While it is the instructor’s responsibility to inform you of changes in due dates, assignment material, location of examinations, etc… it is your responsibility to read your university email regularly and visit the course website on Angel at least weekly. Finally, please respect your fellow students turning off all electronic devices not used to take notes during class. Lastly as this is a course with group work you are expected to work with group members and learn all aspects of your group’s project.
Why this course is useful?
This course provides the fundamental knowledge and skills required by a bioengineer to begin working in a medical related field and be capable of the necessary day-to-day collaborations with professionals in medicine and engineering.

Who should take this course?
This course is for students in 3rd or 4th year of Biosystems Engineering program who are interested in the field of engineering in medicine.

How this course fits into the curriculum
This course is a design elective that provides students with knowledge specific to the medical industry that is relevant to engineers who work in device development, clinical engineering or research of a biomedical engineering nature. As a design elective 50% of the course is targeted at learning knowledge and skills relevant to design. As a 4th year Biosystems Engineering course it targets a specialized area of engineering

Course Description/Objectives

Undergraduate Calendar Description
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.

Instructional Methods
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 therefore learning). In this course, dissemination of information will occur using the traditional lecture format, a group design project that requires three deliverables and material on design process/methodology presented in the lab time that is not used for project development. Deliverables may have be the group’s responsibility while others are for the individual. Therefore, you will be expected to prepare for class by reading the course text and suggested readings, working on your own and with your group to complete the assignments and questioning the professor whenever possible.

Learning Outcomes
At the conclusion of this course, the student should be able to:
1. Explain the fundamental knowledge required by a bioengineer to work in a medically related field.
2. Analyze x-ray, CT and MRI technology to determine constraints of working with these modalities.
3. Learn regulatory mechanisms relevant to designing new medical devices.
4. Design and evaluate biomedical equipment.
5. Summarize the results of the design process in a formal report.
6. Apply what was learned in the classroom to the novel situations of equipment design.

Expected Competency Level **

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<th>Learning Outcome</th>
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**Attributes:**
A1 A knowledge base for engineering  
A2 Problem analysis  
A3 Investigation  
A4 Design  
A5 Use of engineering tools  
A6 Individual and team work  
A7 Communication skills  
A8 Professionalism  
A9 Impact of engineering on society/environment  
A10 Ethics and equity  
A11 Economics and project management  
A12 Life-long learning

**Competency Levels:**
1 - Knowledge (Able to recall information)  
2 - Comprehension (Able to rephrase information)  
3 - Application (Able to apply knowledge in a new situation)  
4 - Analysis (Able to break problem into its components and establish relationships)  
5 - Synthesis (Able to combine separate elements into whole)  
6 - Evaluation (Able to judge of the worth of something)

**Grade Evaluation**
The grade for this course will be based on assignments, peer assessments, a midterm examination and a final examination. The specific distribution is shown below:

- 35% Final Examination (3hrs)  
- 15% Midterm  
- 15% Assignment I  
- 15% Assignment II  
- 20% Assignment III  
  Peer Assessment (applies to Assignment Grades)

**Assignment Due Dates**
- Assignment I part a: Wed. Sept. 19 2:30  
- Assignment I part b: Fri. Oct. 5 2:30  
- Assignment II: Wed. Nov. 21 2:30  
- Assignment III: Wed. Dec. 5 2:30  
- Peer Assessment: Fri. Dec. 7 4:00

**Important Dates (e.g., voluntary withdrawal date)**
- Midterm Examination: Fri. Nov. 2 9:30-10:20  
- Voluntary withdrawal date: Thurs. Nov. 19, 2018  
- Final Examination: (to be Scheduled)

**Description of Assignments**
Students must form groups of three or four in order to do the assignments. Written notification of each group's members must be given to the Instructor no later than the end of class on Mon. Jan. 20 as specified in Assignment #1. Since the three assignments are closely related, i.e., (1) design requirements, (2) initial design, and (3) final design report & presentation, the groups (once chosen) are expected to remain the same for the entire course.

**Description of Examinations**
There is one final exam in this course (three hours) and one midterm examinations scheduled in the lab (see Important Dates above).

**Texts, Readings, Materials**

**Required – Authors, Titles, Edition**

**Supplementary Reading**
Anon. Ed.. *Encyclopedia of Biomaterials and Biomedical Engineering*. Marcel Dekker, 2006
Course Policies

Late Assignments
Will not be accepted and will receive a zero grade.

Missed Assignments
Will receive a zero grade.

Missed Exams
If the midterm examination is missed and the student has a valid medical certificate or compassionate reason (e.g. death of an immediate family member), the grade will be transferred to the final. Students who miss the midterm examination without a valid reason will receive a grade of zero for the midterm examination.

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.

Use of Third Party Detection and Submission Tools
Electronic detection tools may be used to screen assignments in cases of suspected plagiarism.

Group Work Policies:
All assignments are to be done in a group or as an individual as specified in the assignment and the University’s policy on plagiarism does apply to assignments (see Academic Integrity above).

Additional Policies:
See remainder of document.

Course Content

1. Introduction to engineering in medicine, clinical engineering and basic regulations for medical devices;
2. Design, principles, and properties of biomedical sensors and biosensors
3. Biocompatibility, mechanics, wear and biological effects of biomaterials;
4. Principles of and design in radiology, x-ray, CT and MRI imaging modalities