The University of Manitoba
Department of Biosystems Engineering

Course Number BIOE 4640 **Course Title** Bioengineering Applications in Medicine
Academic Session Fall 2020 (CRN 20072) **Credit Hours** 4

Prerequisites and how they apply to this course:

BIOL 1410 – Anatomy of the Human Body and BIOL 1412 – 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 N/A, Online via UMLearn
Meeting Days and Class Hours MWF 9:30-10:20 am

Tutorial Location N/A, Online via UMLearn
Tutorial Hours M 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 Sara Parashin, MSc, (Sessional Instructor)
Office Location N/A
Email Address Sara.Parashin@umanitoba.ca
Office Hours F 10:30-11:30am; or whenever available

Teaching Assistant(s) Tasneem Vahora
Email Address Vahorat4@myumanitoba.ca
TA Office Hours and Location Available during tutorial time, or whenever available

Course Philosophy

Students' Learning Responsibilities
You are expected to learn the material covered in lectures and assignments. Online attendance for lectures and tutorial is not strictly enforced but it is expected. Submission of assignments is to be done prior to 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. As this is a remote course for Fall 2020, discussions will be carried out on the discussion forums

through UMLearn during lecture periods, tutorial time, and is also welcome anytime in between. While it is the instructor's responsibility to inform you of changes in due dates, assignment material, examinations, etc., it is your responsibility to read your university email regularly and visit the course website on UMLearn at least once a week. 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 remote learning through a combination of live online lectures with presentation slides (WebEx), lecture slides with pre-recorded audio, short videos/clips, textbook readings, and online class discussions.

A group design project will be assigned that requires three deliverables and material on design process/methodology presented online in the tutorial time that is not used for project development. Deliverables may be for 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. The tutorial period will be dedicated for project work. It is your responsibility to schedule additional online meetings with classmates as needed to complete the work required for the project assignments.

It is understood that the learning environment will be different than usual (online versus in a classroom), so there may be challenges along the way. Comments and suggestions throughout the semester are welcome to make this a successful and enjoyable experience for everyone.

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, RSA, 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 **

Learning Outcome	Attribute*											
	A1	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**	**A8**	**A9**	**A10**	**A11**	**A12**
1	2											
2		4										
3					3							
4				5,6								
5							5					
6												3

****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)	Mon. Sept. 21, 2:30 pm
Assignment I (Part B)	Wed. Oct. 7, 9:30 am
Assignment II	Fri. Nov. 20, 9:30 am
Assignment III	Mon. Dec. 7, 2:30 pm
Peer Assessment	Wed. Dec 9, 2:30 pm

Important Dates (e.g., voluntary withdrawal date)

Midterm Examination	Wed. Nov. 4, 9:30-10:20 am
Voluntary withdrawal date	Mon. Nov. 23, 2020
Fall Break	Nov 9-13, 2020
Final Examination	(to be Scheduled)

Description of Assignments

Students must form groups of two to three in order to do the assignments. Written notification of each group's members must be given to the Instructor no later than the beginning of the tutorial period on Mon. Sept 21 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.

Assignment Submissions

Assignments must be submitted online through the "Assignment" tab in UMLearn. Here you will also find links to assignment documents and scheduled due dates.

Description of Examinations

There is one final exam in this course (three hours) and one midterm examination scheduled in the lecture period (see Important Dates above).

Texts, Readings, Materials

Textbook(s) – Authors, Titles, Edition

Enderle J, Blanchard S, Bronzino J. ed. Introduction to Biomedical Engineering 3rd ed. Academic Press, 2012.

Supplementary Reading

Anon. Ed.. *Encyclopedia of Biomaterials and Biomedical Engineering*. Marcel Dekker, 2006

Bronzino, J. D. Ed.. *Tissue Engineering and Artificial Organs*, CRC Press, 2006.

David, Y., W. W. von Maltzahn, M. R. Neuman, and J. D. Bronzino, Eds.. *Clinical Engineering*, CRC Press, 2003.

Mudry, K. M., R. Plonsey, and J. D. Bronzino, Eds.. Biomedical Imaging, CRC Press, 2003.

Additional Materials

Supplied by instructor.

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 ofan 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 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, RSA, CT and MRI imaging modalities