BME-706: Biomedical Engineering Core Course II

COURSE DESCRIPTION

This course introduces a wide variety of biomedical engineering topics which are closely related to human health and disease. The biological and chemical concepts involved in the design and operation of medical devices and processes will be discussed. In particular, the following themes will be emphasized which encompasses diverse topics in the field. Lectures on each topic will be delivered by expert professors. The following are selected examples. Cell and biological responses to biomaterials; biomaterials for cancer immunotherapy; tissue engineering; biomechanics of musculoskeletal injury; pharmacodynamics and pharmacokinetics; drug receptors and cellular signalling, biotechnology; engineered membranes for renal disease

SCHEDULE

Lectures: Thursdays 2:00pm-5:00pm
Room: ZOOM Platform .

INSTRUCTORS

Dr. Ram Mishra
(Course Coordinator)
mishrar@mcmaster.ca

Dr. Heather Sheardown
hdsheardown@gmail.com

Dr. Todd Hoare
hoaretr@mcmaster.ca

Dr. Peter Margetts
margetts@mcmaster.ca

Dr. Ryan Wylie
wylier@mcmaster.ca

TA: **Sandy Zakaria**
zakarias@mcmaster.ca

COURSE WEBSITE/ALTERNATE METHODS OF COMMUNICATION

Emails or http://avenue.mcmaster.ca/

ASSUMED KNOWLEDGE

This course is designed for students coming from engineering, physics, and non-biology backgrounds to introduce them to fundamental mechanisms/processes involved in biological systems and how biomedical engineering can be applied to human health and disease. This course is also cross listed as

Chem.Eng.781 and also open to other graduate students. There are no pre-requisites for taking this course; however, some knowledge of cellular mechanisms involved in human health would help, but not necessary.

COURSE MATERIALS

Relevant papers for each lecture topic will be distributed. For individual presentations, students will have complete freedom for the topic; they can choose from their own research projects or a topic related to various lectures given in the class.

COURSE OVERVIEW

Date/Week	TOPIC
Week 1 & 2 Dr. Sheardown	Biological Responses to biomaterials
Week 3 & 4 Dr. Wylie	Biomaterials for cancer immunotherapy
Week 5 & 6 Dr. Mishra	Pharmacodynamics, cellular signaling, biotechnological approaches for drug discovery
Week 7 & 8 Dr. Margetts	Application of biomedical engineering to end stage renal disease, dialysis membranes
Week 9 & 10 Dr. Hoare	Tissue engineering
Week 11,213 & 14 Students	Individual Presentations

Contingencies:
The instructor and university reserve the right to modify elements of the course during the term. The university may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary, reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes. It is the responsibility of the student to check their McMaster email and course websites weekly during the term and to note any changes.

ASSESSMENT

Course Evaluation
Group presentation: **60%**
Individual class Presentations: **40%**

Students will be divided into various groups (3-4 students/group) and each group will be given a relevant publication for each lecture. One presentation per instructor will be assigned in the first week of each section. Each student in a group is expected to contribute on an equal basis as the marks are assigned to a group. The presentation will be marked by both peers and the respective professor.

The individual presentation will be marked by peers as well as professors. Each student will prepare a 10-12 minute presentation on a topic either based on class lecture(s) or their research project.

STUDENT PRESENTATIONS (PREVIOUS YEAR)

1. Calcification progression in aortic valves
2. Lower extremity mechanics during running
3. High-resolution electron imaging of bone and bone-implant interfaces
4. Genetic engineering of bacteriophage
5. Biomimetic nano drug delivery systems for the brain
6. Fabrication of cell-laden bone models, effects on bone biomarkers and bone strength
7. An in-situ infection detection sensor
8. Amniotic epithelial cells to treat diabetes
9. Nanofibrous nerve conduits for peripheral nerve regeneration
10. Knee arthroplasty based on gait analysis before and post surgery
11. Biomechanical change following Total Knee Replacement
12. Biodegradable Polymer Drug-eluting Stent in the Treatment of Coronary Artery Disease
13. Principal Component Analysis for Gait Analysis
14. Scaffold properties as a function of time
15. The solid-state optical sensor for the biomedical imaging application (PET/MRI)

LEARNING OUTCOMES

The Ontario Universities Council on Quality Assurance lists a set of graduate degree level expectations, 6 each for both Master's and PhD programs (https://oucqa.ca/framework/appendix-1/). The alignment of graduate courses, within the School of Biomedical Engineering, with the program level learning outcomes of the Ontario Graduate Degree Level Expectations (GDLEs) that are assessed in BME-706 are summarized below.

Ontario Graduate Degree Level Expectation (GDLE)	**How Success in Obtaining the Attribute is Demonstrated**	**How is the GDLE is Assessed in BME-706**
1. Depth and breadth of knowledge	A systematic understanding of knowledge, including, where appropriate, relevant knowledge outside the field and/or discipline, and a critical awareness of current problems and/or new insights, much of which are at, or informed by, the	Preparation of class presentation in a group setting. Team working efforts evaluated by peers and

	forefront of their academic discipline, field of study, or area of professional practice.	professors.
2a. Research and Scholarship	A conceptual understanding and methodological competence that enables a working comprehension of how established techniques of research and inquiry are used to create and interpret knowledge in the discipline;	Major Assignments and presentations
2b. Research and Scholarship	A conceptual understanding and methodological competence that enables a critical evaluation of current research and advanced research and scholarship in the discipline or area of professional competence.	Major Assignments covering relevant topics in biomedical engineering relevant to health and diseases
3. Level of application of knowledge	Competence in the research process by applying an existing body of knowledge in the critical analysis of a new question or of a specific problem or issue in a new setting.	Major Assignment and group presentations
5. Level of communications skills	The ability to communicate ideas, issues and conclusions clearly.	Group and individual presentations

ACADEMIC INTEGRITY

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity. Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g. a grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university.

It is your responsibility to understand what constitutes academic dishonesty. For information on the various types of academic dishonesty please refer to the Academic Integrity Policy, located at http://www.mcmaster.ca/academicintegrity

The following illustrates only three forms of academic dishonesty:

1. Plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.
2. Improper collaboration in group work.
3. Copying or using unauthorized aids in tests and examinations.

ACADEMIC ACCOMMODATIONS

Students who require academic accommodation must contact Student accessibility Services (SAS) to make arrangements with a Program Coordinator. Academic accommodations must be arranged for each term of study. Student Accessibility Services can be contact by phone at 905.525.9140 ext. 28652 or e-mail at sas@mcmaster.ca. For further information, consult McMaster University's Policy: Academic Accommodation of Students with Disabilities.

Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the RISO policy. Students requiring a RISO accommodation should submit their request to the Engineering Student Services office normally within 10 working days

of the beginning of term in which they anticipate a need for accommodation or to the Registrar's Office prior to their examinations.

Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests.

STUDENT ABSENCE AND SUBMISSION OF REQUEST FOR RELIEF FOR MISSED ACADEMIC WORK

In the event of an absence for medical or other reasons, students should review and follow the Academic Regulation in the Undergraduate Calendar "Requests for Relief for Missed Academic Term Work".

EXTREME CIRCUMSTANCES

The University reserves the right to change the dates and deadlines for any or all courses in extreme circumstances (e.g., severe weather, labour disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, A2L and/or McMaster email.

AUTHENTICITY / PLAGIARISM DETECTION

In this course we will be using a web-based service (Turnitin.com) to reveal authenticity and ownership of student submitted work.

Students will be expected to submit their work electronically via Avenue to Learn (A2L) plagiarism detection (a service supported by Turnitin.com) so it can be checked for academic dishonesty. Students who do not wish to submit their work through A2L must still submit an electronic and/or hardcopy to the instructor. No penalty will be assigned to a student who does not submit work toor A2L. All submitted work is subject to normal verification that standards of academic integrity have been upheld (e.g., on-line search, other software, etc.). To see the Turnitin.com Policy, please go to www.mcmaster.ca/academicintegrity .

ONLINE ACCESS OR WORK

In this course we will be using various electronic means of learning. Students should be aware that, when they access the electronic components of this course, private information such as first and last names, user names for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in this course will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure please discuss this with the course instructor.

REFERENCE TO RESEARCH ETHICS

The two principles underlying integrity in research in a university setting are these: a researcher must be honest in proposing, seeking support for, conducting, and reporting research; a researcher must respect the rights of others in these activities. Any departure from these principles will diminish the integrity of the research enterprise. This policy applies to all those conducting research at or under the aegis of McMaster University. It is incumbent upon all members of the university community to practice and to promote ethical behaviour. To see the Policy on Research Ethics at McMaster University, please go to http://www.mcmaster.ca/policy/faculty/Conduct/ResearchEthicsPolicy.pdf.