

Western University  
*School of Biomedical Engineering*

**BME 9502A – Biomedical Systems Analysis**

COURSE OUTLINE 2021-2022

---

**DESCRIPTION**

An introduction to biomedical engineering organized around applications of linear and control systems analysis to the dynamics of physiological systems and their responses to diagnostic and therapeutic interventions. Emphasis is placed on cardiovascular and respiratory physiology and interactions of those systems with medical devices. Assignments make use of numerical models implemented in MATLAB.

**PREREQUISITES**

Registration in an engineering or physical science graduate program. Familiarity with engineering applications of Fourier and Laplace analysis is recommended.

**TOPICS**

<b>Topic #</b>	<b>Description</b>	<b>Learning Activities</b>	<b>Tentative timeline</b>
1	Introduction to Biomedical Modeling	<ul style="list-style-type: none"><li>• 2 didactic lectures</li></ul>	Sept. 8-10
2	Cardiac Electrophysiology and Implantable Cardioverter Defibrillators	<ul style="list-style-type: none"><li>• 6 didactic lectures</li><li>• 3 discussion sessions</li><li>• Case study documents</li><li>• Journal article</li></ul>	Sept. 13 – Oct. 1
3	Cardiovascular Mechanics and Left Ventricular Assist Devices	<ul style="list-style-type: none"><li>• 6 didactic lectures</li><li>• 2 discussion sessions</li><li>• Case study document</li><li>• Journal article</li></ul>	Oct. 4-22
4	Respiratory Mechanics and Mechanical Ventilation	<ul style="list-style-type: none"><li>• 5 didactic lectures</li><li>• 3 discussion sessions</li><li>• Case study documents</li><li>• Journal article</li></ul>	Oct. 25 – Nov. 17
5	Respiratory Regulation and Treatment of Unstable Periodic Breathing	<ul style="list-style-type: none"><li>• 6 didactic lectures</li><li>• 2 discussion sessions</li><li>• Case study document</li><li>• Journal article</li></ul>	Nov. 19 – Dec. 8

## SPECIFIC LEARNING OUTCOMES

Graduate Degree Level Expectation	Weight	Assessment Tools	Outcomes
Depth and breadth of knowledge	30%	<ul style="list-style-type: none"> <li>Quizzes</li> <li>Assignments</li> <li>Project</li> </ul>	<ul style="list-style-type: none"> <li>Explain the physiological and biophysical foundations of cardiovascular and respiratory system models.</li> <li>Analyze biomedical system models using concepts from linear systems and control theory that are common to most engineering disciplines.</li> </ul>
Research & scholarship	25%	<ul style="list-style-type: none"> <li>Assignments</li> <li>Project</li> </ul>	<ul style="list-style-type: none"> <li>Critique hypotheses and conclusions presented in primary-source biomedical engineering literature.</li> </ul>
Application of knowledge	30%	<ul style="list-style-type: none"> <li>Assignments</li> <li>Project</li> </ul>	<ul style="list-style-type: none"> <li>Demonstrate the use of biomedical systems models to inform the design of medical devices.</li> <li>Employ engineering software tools to investigate the dynamic behaviour of biomedical systems models.</li> </ul>
Professional capacity / autonomy	5%	<ul style="list-style-type: none"> <li>Minute Papers</li> </ul>	<ul style="list-style-type: none"> <li>Identify and analyze ethical issues arising from allocation of scarce medical resources and use of biomedical models to make decisions about public health or safety concerns.</li> </ul>
Communication skills	10%	<ul style="list-style-type: none"> <li>Project</li> </ul>	<ul style="list-style-type: none"> <li>Compose an effective written report of an independent project that meets the scholarly standards of the biomedical engineering discipline.</li> </ul>
Awareness of limits of knowledge			<ul style="list-style-type: none"> <li>This GDLE is not assessed.</li> </ul>

## ASSESSMENTS

Assessment Type	Material Covered	Tentative Due Date	Weight
Homework Assignments (3)	Topics 2, 3, and 4	Oct. 4, Oct. 29, Nov. 22	30%
Quizzes (4)	Topics 2, 3, 4, and 5	Sept. 27, Oct. 22, Nov. 15, Dec. 3	20%
Minute Papers (2)	Topics 2 and 4	Oct. 1, Nov. 17	5%
Project Proposal	Topic selected by student	Nov. 8	5%
Project Report	Topic selected by student	Dec. 16	40%

### Activities in which collaboration is permitted:

- Homework assignments: students may work in groups of two or three to perform MATLAB simulations and prepare responses to homework questions.

### Activities in which students must work alone (collaboration is not permitted):

- Quizzes, minute papers, project proposal and report.

### **Late Submission Policies:**

All assessments will be due at 11:55 pm Eastern (London, Ontario) time on the due date unless otherwise specified.

Homework assignments and the course project will be accepted without penalty until the end of a grace period lasting 24 hours after the posted due date. Homework assignments or projects submitted more than 24 hours late will receive no credit unless alternate arrangements are agreed to *in advance* by the instructor.

The OWL quiz tool will not permit late submission of quizzes.

Minute papers will be completed during class sessions and must be submitted at the end of that class period. **Students must be present for these discussions to have an opportunity to submit minute papers.** Late submissions of minute papers will not be accepted.

### **CONTACT INFORMATION**

Course instructor: James Lacefield

E-mail address: [jlacefie@uwo.ca](mailto:jlacefie@uwo.ca)

Contact policy:

- Students may contact the instructor via e-mail at the address shown above.
- Weekly drop-in office hours will be held remotely via Zoom.
- Remote office hours will be Thursdays, 3:00-4:00 pm beginning September 16.

### **REQUIRED TEXTBOOK**

There is no textbook for this class. Required readings, which will include case study documents and journal articles, will be posted on the course OWL site.

### **OPTIONAL COURSE READINGS**

Optional readings and third-party videos will be posted on the course OWL site.

### **CHEATING, PLAGIARISM/ACADEMIC OFFENCES**

Academic integrity is an essential component of learning activities. Students must have a clear understanding of the course activities in which they are expected to work alone (and what working alone implies) and the activities in which they can collaborate or seek help; see information above under “Assessments” and ask instructor for clarification if needed. Any unauthorized forms of help-seeking or collaboration will be considered an academic offense. University policy states that cheating is an academic offence. If you are caught cheating, there will be no second warning. Students must write their essays and assignments in their own words. Whenever students take an idea or a passage of text from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. Plagiarism is a major academic offence. Academic offences are taken seriously and attended by academic penalties which may include expulsion from the program. Students are directed to read the appropriate policy, specifically, the definition of what constitutes a scholastic offence (see [Western's scholastic discipline regulations for graduate students](#)).

### **CONDUCT**

Students are expected to follow proper etiquette during classroom activities to maintain an appropriate and respectful academic environment. Any student who, in the opinion of the instructor, is not appropriately participating in the classroom learning activities will be reported to the Associate Dean (Graduate) after due warning has been given. On the recommendation of the Department

concerned, and with the permission of the Associate Dean (Graduate), the student could be debarred from completing the assessment activities in the course as appropriate.

### **HEALTH/WELLNESS**

As part of a successful graduate student experience at Western, we encourage students to make their health and wellness a priority. Western provides several health and wellness related services (remotely accessible) to help you achieve optimum health and engage in healthy living while pursuing your graduate degree. Information regarding health- and wellness-related services available to students may be found at <http://www.health.uwo.ca/>.

Students seeking help regarding mental health concerns are advised to speak to someone they feel comfortable confiding in, such as their faculty supervisor, their program director (graduate chair), or other relevant administrators in their unit. Campus mental health resources may be found at [http://www.health.uwo.ca/mental\\_health/resources.html](http://www.health.uwo.ca/mental_health/resources.html)  
<https://www.uwo.ca/health/psych/index.html>

### **SICKNESS**

Students should immediately consult with the Instructor (for a particular course) or Associate Chair (Graduate) (for a range of courses) if they have problems that could affect their performance. The student should seek advice from the Instructor or Associate Chair (Graduate) regarding how best to deal with the problem. Failure to notify the Instructor or the Associate Chair (Graduate) immediately (or as soon as possible thereafter) will have a negative effect on any appeal. Obtaining appropriate documentation (e.g., a note from the doctor) is valuable when asking for accommodation due to illness.

### **ACCESSIBILITY**

Please contact the course instructor if you require material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Accessible Education at 519-661-2111 ext. 82147 or [http://academicsupport.uwo.ca/accessible\\_education/index.html](http://academicsupport.uwo.ca/accessible_education/index.html) for any specific question regarding an accommodation.

*In the event of a COVID-19 resurgence during the course that necessitates the course delivery moving away from face-to-face interaction, all remaining course content will be delivered entirely online, either synchronously (i.e., at the times indicated in the timetable) or asynchronously (e.g., posted on OWL for students to view at their convenience). The grading scheme will not change. Any remaining assessments will also be conducted online at the discretion of the course instructor.*