1. Course Information

Medical Biophysics 4455B:
Biological Control Systems
Winter Term 2020

An introduction to linear systems and control theory as applied to organ system regulation and adaptation. Emphasis is placed on biophysical models of the cardiovascular, respiratory, and neuromuscular systems and interactions of those systems with medical devices.

Antirequisite: Electrical & Computer Engineering 4455B.

Prerequisite(s): Medical Biophysics 3501F and Medical Biophysics 3505F, or permission of the department.

Extra Information: 3 lecture hours, 0.5 course.

Lectures:
Mondays 9:30 – 10:30 am  Amit Chakma Engineering Building, Room 1415
Wednesdays 9:30 – 10:30 am  Amit Chakma Engineering Building, Room 1415
Fridays 12:30 – 1:30 pm  Amit Chakma Engineering Building, Room 1415

Senate regulation regarding the student’s responsibility regarding requisites:

Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

2. Instructor Information

<table>
<thead>
<tr>
<th>Instructor</th>
<th>Email</th>
<th>Office</th>
<th>Phone</th>
<th>Office Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. James Lacefield</td>
<td><a href="mailto:jlacefie@uwo.ca">jlacefie@uwo.ca</a></td>
<td>ACEB 2405D</td>
<td>84303</td>
<td>To be announced</td>
</tr>
<tr>
<td>(Course Coordinator)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Luke Helpard</td>
<td><a href="mailto:lhelpard@uwo.ca">lhelpard@uwo.ca</a></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Teaching Assistant)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The instructor will also be available for additional consultation by appointment or via e-mail.

3. Course Materials

No required textbook. Recommended references will be placed on reserve at Taylor Library or distributed electronically via OWL.

Course web site: [https://owl.uwo.ca/portal](https://owl.uwo.ca/portal) (OWL).
To obtain a passing grade in the course, an average mark of 50% or more must be achieved on the homework as well as a mark of 50% or more on the final examination. A homework average or final examination mark < 50% will result in a final course grade of 48% or less.

**Homework Assignments:** The course will include four case-based homework assignments that will require students to critique assigned readings from biomedical engineering or physiology journals and investigate the behaviour of relevant systems models implemented in MATLAB. The readings and MATLAB models will be distributed via OWL. Homework assignments must be submitted electronically to the course OWL site.

Each homework assignment consists of two parts: short-answer questions about background knowledge relevant to the case study and a computational investigation of issues raised by the case using the MATLAB systems models. The MATLAB investigation components of the assignments will each include one or two lecture sessions devoted to use and discussion of the MATLAB systems models. Students should bring a laptop, tablet, or other device with MATLAB installed to these class sessions. **Students must be present for and participate in these in-class discussions to receive credit for the MATLAB investigation component of a homework assignment.** A schedule of the in-class MATLAB investigations will be posted on OWL at the beginning of the term.

The first part of each homework assignment (short-answer questions) will be due 15 minutes before the start of the corresponding MATLAB investigation classroom session. Late submissions of short-answer responses will not be accepted because the purpose of those questions is to prepare students to participate in the classroom portion of the MATLAB investigation.

The second part of each homework assignment (results of the MATLAB investigation) will be accepted without penalty until the end of a grace period lasting 24 hours after the posted due date. MATLAB investigations submitted more than 24 hours late will receive no credit unless alternate arrangements are agreed to in advance by the instructor.

**Minute Papers:** Two lecture sessions will be devoted to class discussions of ethical issues related to selected case studies. At the end of those discussions, students will complete “minute papers”, which are brief written responses to the class discussions. **Students must be present for these in-class discussions to have an opportunity to submit minute papers.** Late submissions of minute papers will not be accepted. A schedule of in-class ethics discussions will be posted on OWL at the beginning of the term.

**Final Exam:** A three-hour limited-open-book final exam will be scheduled during the regular Winter term examination period in April. The exam will focus on an assigned biomedical engineering or physiology journal article to be distributed via OWL no later than March 20. Calculator usage, including the use of programmable calculators, is permitted during the exam. A copy of the assigned article will be provided with the exam. Students may also bring one single-sided 8½ inch by 11 inch sheet of handwritten notes to refer to during the exam. No other written or electronic aids are permitted.
5. Course Syllabus

LEARNING OBJECTIVES – Students will be able to:

(i) Explain the physiological and biophysical basis of biomedical systems models and analyze those models using concepts from systems analysis and control theory.

(ii) Demonstrate the use of biomedical systems models to inform the design of medical devices.

(iii) Employ software tools to investigate the dynamic behaviour of biomedical systems models.

(iv) Independently investigate and critique hypotheses, modeling approaches, and conclusions presented in primary-source biomedical engineering and physiology literature.

(v) Identify ethical issues arising from development of medical technology and use of biomedical models to make decisions about public health or safety concerns.

TOPICS:

1. Cardiac electrophysiology and implantable cardioverter defibrillators
2. Cardiovascular mechanics and left ventricular assist devices
3. Respiratory mechanics and mechanical ventilators
4. Respiratory regulation and diagnosis of unstable periodic breathing
5. Neuromuscular control and upper-limb neural prosthetics

6. Additional Information/Statements

Use of Electronic Devices
Students may use laptops or tablets only to access the course OWL site or other information relevant to the course material during lectures or to run MATLAB during in-class computational investigations. Calculator use is permitted during examinations; students using programmable calculators must clear the device’s memory at the beginning of exams. No other electronic devices (e.g., cell phones, MP3 players) may be used during lectures or examinations.

Academic Offences
Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, in the relevant section of the Academic Calendar: www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_20

Students must write their essays and assignments in their own words. Whenever students take an idea, or a passage from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. All required papers may be subject to submission for textual similarity review to the commercial plagiarism detection software under license to the University for the detection of plagiarism. All papers submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between The University of Western Ontario and Turnitin.com http://www.turnitin.com
Absence from course commitments
Students must familiarize themselves with the policy concerning academic accommodations for absences; see the relevant section of the Academic Calendar:
www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_12

For more information concerning accommodations for religious holidays, see the relevant section of the Academic Calendar:
http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_16

Statement from the Dean’s Office
If you are unable to meet a course requirement due to illness or other serious circumstances, you must provide valid medical or other supporting documentation to the Dean’s office as soon as possible and contact your instructor immediately. It is the student’s responsibility to make alternative arrangements with their instructor once the accommodation has been approved and the instructor has been informed.

A student requiring academic accommodation due to illness should use the Student Medical Certificate when visiting an off-campus medical facility or request a Record's Release Form (located in the Dean’s Office) for visits to Student Health Services. For further information, please see:
https://www.uwo.ca/health/shs/notes.html

For medical illness affecting work worth less than 10% of the total course grade, evaluation may be re-weighted.

Special Examinations
A Special Examination is any examination other than the regular examination, and it may be offered only with the permission of the Dean of the Faculty in which the student is registered, in consultation with the instructor and Department Chair. Permission to write a Special Examination may be given on the basis of compassionate or medical grounds with appropriate supporting documents.

In the event of a missed final exam, a “Recommendation of Special Examination” form must be obtained from the Dean's Office immediately. For further information please see:
http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=5&SelectedCalendar=Live&ArchiveID=#SubHeading_70

Support Services:
Registrarial Services: http://www.registrar.uwo.ca/
Academic Counselling (Science and Basic Medical Sciences): http://www.uwo.ca/sci/counselling/index.html
Student Development Centre: http://www.sdc.uwo.ca/
Student Health Services: https://www.uwo.ca/health/shs/index.html

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 Student Accessibility Services at 519-661-2147 or ssd@uwo.ca for any specific question regarding an accommodation.

Students that are in emotional/mental distress should refer to Mental Wellbeing @ Western, https://www.uwo.ca/health/mental_wellbeing/, for a complete list of options about how to obtain help.