

1. Course Information

**Medical Biophysics 4455B:
Biological Control Systems
Winter Term 2019**

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 Three C+ Engineering Building, Room 1415
Wednesdays 9:30 – 10:30 am Three C+ Engineering Building, Room 1415
Fridays 2:30 – 3:30 pm Three C+ 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

Instructor	Email	Office	Phone	Office Hours
Dr. James Lacefield (Course Coordinator)	jlacefie@uwo.ca	Three C+ 2405D	84303	To be announced
To be determined (Teaching Assistant)				

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> (OWL).

4. Evaluation:

Component	% of Final Mark
Homework assignments (4 assignments)	45%
Minute papers	5%
Final exam (Date TBA, limited open book, 3 hours)	50%

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 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.

Marks for homework assignments submitted up to 24 hours late will be reduced by 10% of the total marks available. Assignments 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.** 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 22. 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 noninvasive mechanical ventilation
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, at the following Web site:

https://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf

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. Plagiarism is a major academic offence (see Scholastic Offence Policy in the Western Academic Calendar).

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

A. Absence for medical illness:

Students must familiarize themselves with the Policy on Accommodation for Medical Illness: https://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_illness.pdf

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. 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:

https://www.uwo.ca/sci/counselling/procedures/special_examination.html

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. The form can be found at:

https://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform_15JUN.pdf

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

B. Absence for non-medical reasons:

Non-medical absences from in-class MATLAB investigations, in-class ethics discussions, or the final exam must be documented to receive accommodation. Documentation must be submitted by the student directly to the appropriate Faculty Dean's Office and not to the instructor. The Dean's Office will determine if accommodation is warranted.

C. 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.

A Special Examination must be written at the University or an Affiliated University College no later than 30 days after the end of the examination period involved. To accommodate unusual circumstances, a date later than this may be arranged at the time permission is first given by the Dean of the Faculty. The Dean will consult with the instructor and Department Chair and, if a later date is arranged, will communicate this to Registrarial Services. If a student fails to write a scheduled Special Examination, permission to write another Special Examination will be granted only with the permission of the Dean in exceptional circumstances and with appropriate supporting documents. In such a case, the date of this Special Examination normally will be the scheduled date for the final exam the next time the course is offered.

Support Services:

Registrarial Services: <http://www.registrar.uwo.ca/index.cfm>

Academic Counselling (Science and Basic Medical Sciences):

<http://www.uwo.ca/sci/counselling/index.html>

Student Development Services: <http://www.sdc.uwo.ca>

Student Health Services: <http://www.shs.uwo.ca/>

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 Services for Students with Disabilities (SSD) at 519-661-2111 ext. 82147 for any specific question regarding an accommodation.

Students that are in emotional/mental distress should refer to Mental Health @ Western, <http://www.uwo.ca/uwocom/mentalhealth/>, for a complete list of options about how to obtain help.