

MIE331: Physiological Control Systems, Winter 2017

Course Syllabus

Course Instructor: Prof. José Zariffa

Introduction and Course Objectives

The human body relies on a multitude of complex processes to regulate its function. The purpose of this course is to provide undergraduate engineering students with an introduction to the physiological concepts and mathematical tools that they will need to understand and analyze these physiological control systems. Due to the scope and complexity of this field, this course will not cover all physiological control systems but rather a selected few such as the endocrine, cardiovascular, and neuromuscular control systems. This course will also provide an introduction to the structures and mechanisms responsible for the proper functioning of these systems. This course will combine physiology, linear control theory, and neuroscience with the objective of explaining how these complex systems operate in a healthy human body. The specific goals of the course are to:

- Introduce you to the study of physiology, and give you the tools that you will need to learn more.
- Provide you with an understanding of the key strategies that the body uses to regulate its function.
- Teach you to use linear control theory to model and analyze biological systems.

Course Times and Locations

<i>Lectures</i>
Tuesdays 1pm-3pm, GB221
Thursdays 1pm-2pm, MB128
<i>Tutorials</i>
Wednesdays 1pm-2pm, BA2145
Fridays 11am-12pm, BA2145
<i>Labs</i>
Section 1: Mondays 6pm-9pm, MB78
Section 2: Wednesdays 6pm-9pm, MB78
Section 3: Tuesdays 6pm-9pm, MB78

	<i>Lab Schedule</i>		
	Monday Section	Tuesday Section	Wednesday Section
Lab 1	January 30 th	January 31 st	February 1 st
Lab 2	February 27 th	February 28 th	March 1 st
Lab 3	March 20 th & March	March 21 st & March	March 22 nd & March

	27 th	28 th	29 th
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Important note: The lab dates and locations are different from what is in the ROSI timetable.

Design Studio

The labs will be held in the ~~Teaching Lab~~ of the Institute of Biomaterials and Biomedical Engineering (IBBME). IBBME policy states that all students must complete an overview of safety-related issues and workspace orientation, and pass a safety test in order to participate in required course-related laboratory activities. This will take place at the beginning of Lab 1.

Contact info, office hours, and contact policies

- Office hours will be held in my office, located in MB321, at the following times:
Tuesdays 3:10pm-4pm
Thursdays 2:10pm-3pm
- I can be reached at the following email address: jose.zariffa@utoronto.ca. You are welcome to meet with me outside of the regular office hours, but please make an appointment via email first.
- Although you are welcome to send me questions via email, I cannot guarantee a response time, particularly not just before exams or deliverables. For that reason I encourage you to make good use of the lectures and office hours for any questions about the course material.
- For email messages, please include “MIE331” in the subject line.
- The Teaching Assistants for this course are:
 - Jirapat Likitlersuang (tutorials). He can be reached at jirapat.likitlersuang@mail.utoronto.ca.
 - Sara Mahallati (labs). She can be reached at sara.mahallati@mail.utoronto.ca.

Textbooks:

Required textbook:

- L. Sherwood and C. Ward, *Human Physiology: from cells to systems*, Third Canadian Edition, Nelson

Note 1: in previous years this course used the 2nd edition of the same textbook, rather than the 3rd edition. If you are buying a used textbook, the 2nd edition is still suitable. A document is posted on Portal showing the readings for both editions.

Note 2: It is possible to purchase an electronic copy of the textbook, which is less expensive than the hardcopy version. The e-book can be purchased at <http://www.nelsonbrain.com>.

Recommended textbooks:

- M.C.K. Khoo, *Physiological Control Systems: Analysis, Simulation, and Estimation*, IEEE Engineering in Medicine and Biology Society, Wiley & Sons, ISBN 0-7803-3408-6. [**Note:** this book is available in electronic format through the U of T library.]
- R.C. Dorf and R.H. Bishop, *Modern Control Systems*, 12th Edition, Prentice Hall.

Marking scheme

Quizzes (3 x 1 hour)	45% (15% each)
Labs	15% (5% each)
Final Exam	40%

The quizzes will be held in class, at the usual lecture time. The lowest quiz mark will be replaced by the final exam mark, if the latter is higher.

Note: the problem sets will not be marked, but will be discussed in the tutorials according to the schedule below. The problem sets will be your only opportunity to practice some of the types of questions that will appear in the quizzes and exams, so you are expected to work through them on your own before attending the tutorial.

Course outline and important dates

The following is the approximate schedule for the course. Exact dates and order in which the material will be covered are subject to change.

Week	Dates	Topic	Problem sets	Labs	Readings from Sherwood (3 rd ed.)
W1	Jan 9 – Jan 13	Physiology: Introduction to physiology (homeostasis, cell biology)			Chapters 1 and 2 (sections 2.1 to 2.9)
W2	Jan 16 – Jan 20	Control: Modeling physical systems, the Laplace transform			
W3	Jan 23 – Jan 27	Control: Transfer functions and block diagram analysis Physiology: Endocrine system	Problem set 1		Chapters 5 and 16
W4	Jan 30 – Feb 3	Physiology: Endocrine system cont'd	Problem set 2	Lab 1	
W5	Feb 6 – Feb 10	Control: System response in the time and frequency domains;	Problem set 3		

		Physiology: Cardiovascular system			
	Feb 9	Quiz 1			
W6	Feb 13 – Feb 17	Physiology: Cardiovascular system ctn'd	Problem set 4		Chapters 7 and 8
W7	Reading Week				
W8	Feb 27 – Mar 3	Physiology: Cardiovascular system ctn'd	Problem set 5	Lab 2	
W9	Mar 6– Mar 10	Physiology: Cardiovascular system ctn'd Control: Stability analysis	Extra problems		
	Mar 9	Quiz 2			
W10	Mar 13 – Mar 17	Control: Design of PID controllers. Physiology: Nervous system	Problem set 6		
W11	Mar 20 – Mar 24	Physiology: Nervous system cnt'd	Problem set 7	Lab 3 Part 1	Chapters 2 (sections 2.10 to 2.14), 3 and 6
W12	Mar 27 –Mar 31	Physiology: Nervous system cnt'd	Problem set 8	Lab 3 Part 2	
W13	Apr 3 – Apr 7	Physiology: Nervous system cnt'd	Extra problems		
	Apr 6	Quiz 3			
W14	Apr 10 – Apr 14	Physiology: Nervous system cnt'd + Review	Final Review		

Policies

- Some of the material in this class will be delivered via Powerpoint presentations. The slides will be posted on Portal before the lectures. Other material, particularly in the control systems section of the course, will be delivered on the blackboard in class. YOU ARE RESPONSIBLE FOR ALL OF THE MATERIAL COVERED IN CLASS, WHETHER OR NOT IT WAS POSTED ONLINE.
- We reserve the right not to accept late deliverables, or to impose a penalty. In most cases late deliverables will simply not be accepted. If your deliverables are late because of circumstances outside of your control, supporting documentation will be required (e.g. doctor's note in case of illness), and it is expected that the deliverables will be submitted at the earliest possible time after the deadline.
- We ask that you use common sense and courtesy to ensure that you do not cause disruptions or distractions for those around you in class (e.g. keep cellphones on silent or vibrate, use laptops only for taking notes, etc).