

MIE331: Physiological Control Systems, Winter 2015

Course Syllabus

Course Instructor: Prof. José Zariffa

Introduction and Course Objectives

The human body relies on a multitude of complex process 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, GB220	
Fridays 1pm-3pm, GB220	
<i>Tutorials</i>	
Wednesdays 3pm-4pm, BA2195	
Fridays 11am-12pm, BA2145	
<i>Labs</i>	
Section 1: Mondays 6pm-9pm, MB325	
Section 2: Wednesdays 6pm-9pm, MB325	

<i>Lab Schedule</i>		
	Section 1	Section 2
Lab 1	January 26	January 28
Lab 2	February 23	February 25
Lab 3	March 23	March 25

Important note: *The lab dates are different from what is in the ROSI timetable.*

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
Fridays 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 Assistant for this course is Ms. Martha Garcia. She can be reached at martha.garcia@mail.utoronto.ca.

Textbooks:

Required textbook:

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

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.]

Marking scheme

Midterm	25%
Quizzes (4 x 15 min)	20% (5% each)
Labs	15% (5% each)
Final Exam	40%

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, Kell and Ward
W1	Jan 5 – Jan 9	Physiology: Introduction to physiology (homeostasis, cell biology)			Chapters 1 and 2
W2	Jan 12 – Jan 16	Control: Modeling physical systems, the Laplace transform			
W3	Jan 19 – Jan 22	Control: Transfer functions and block diagram analysis Physiology: Endocrine system	Problem set 1		Chapters 5 and 16
	Jan 20	Quiz 1			
W4	Jan 26 – Jan 30	Physiology: Endocrine system cont'd; Cardiovascular system	Problem set 2	Lab 1	
W5	Feb 2 – Feb 6	Physiology: Cardiovascular system ctn'd	Problem set 3		Chapters 7 and 8
	Feb 3	Quiz 2			
W6	Feb 9 – Feb 13	Physiology: Cardiovascular system ctn'd	Problem set 4		
W7	Reading Week				
W8	Feb 23 – Feb 27	Control: System response in the time and frequency domains	Midterm review	Lab 2	
W9	Mar 2 – Mar 6	Control: Stability analysis Physiology: Nervous system			Chapters 3 and 6
	Mar 3	Midterm			
W10	Mar 9 – Mar 13	Physiology: Nervous system cnt'd	Problem set 5		
W11	Mar 16 – Mar 20	Physiology: Nervous system cnt'd	Problem set 6		
	Mar 17	Quiz 3			
W12	Mar 23 – Mar 27	Control: Design of PID controllers; controllability and observability	Problem set 7	Lab 3	
W13	Mar 30 – Apr 3	System identification	Problem set 8		
	Mar 31	Quiz 4			
W14	Apr 6 – Apr 9	System identification cnt'd and Review			

Policies

- Some of the material in this class will be delivered via Powerpoint presentations. The slides will be posted on Blackboard before the lectures. Other material, particularly in the control systems section of the course, will be delivered on the blackboard in class (that's blackboard with a small "b"). 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 (e.g. keep cellphones on silent or vibrate, use laptops only for taking notes, etc).