

Math 4600 (Spring 2018)

Math in Medicine

Lectures: TH 12:25-01:45 pm, LCB 215

Required Lab: F 12:55-01:45 pm, LCB 115

Course Information

- Instructor: Gregory Handy
 - Office: LCB (LeRoy Cowles building) 326
 - Email Address: handy@math.utah.edu
 - Office Hours: TBD and by appointment
 - Prerequisites: Math 2250 or Math 2270-2280 sequence.
 - Credit hours: 4 (3 lecture hours + a required computer lab a week)
 - Class website: **Canvas** will be used regularly (posting homework, grades, etc.)
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Course Goals and Overview

- The goals of this class are (i) to introduce students to a range of modern mathematical tools (from dynamical systems, stochastic processes and partial differential equations); (ii) to teach students the skill of building tractable mathematical models of biological processes; (iii) to show how to combine the mathematical knowledge, numerical simulations (in MATLAB) and biological intuition to derive new insights into the functioning of living systems.
 - Mathematical topics will include introduction to linear algebra, complex numbers, geometric dynamical systems, and partial differential equations
 - Biological topics will include modeling the heart and circulation, brain rhythms, HIV, insulin-secreting cells, antibiotic resistance in bacteria, regulation of gene expression, and biological pattern formation
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Referenced Texts (you are **not** required to purchase any of the following)

- Beuter et al., eds. **Nonlinear Dynamics in Physiology and Medicine: Interdisciplinary Applied Mathematics; v.25.** - on reserve at Marriott library
- G. de Vries, T. Hillen, M. Lewis, J.Muller, and B. Schoenfisch, **A Course in Mathematical Biology: Quantitative Modelling with Mathematical and Computational Methods**, SIAM, 2006 - on reserve at Marriott library
- Hoppensteadt, Peskin. **Modeling and simulation in medicine and the life sciences**, Springer, 2nd edition - on reserve at Marriott library
- J.Keener and J. Sneyd. **Mathematical Physiology I : Cellular Physiology**, Vol. 1. Springer-Verlag New York, 2008 - available online through Marriott library
- J.Keener and J. Sneyd. **Mathematical Physiology II : Systems Physiology**, Vol. 2. Springer-Verlag New York, 2008 - available online through Marriott library

Grading Policy:

- Homework (40%):
 - Homework will be posted on Canvas, and due at the beginning of lab sessions. You will have one week to complete each assignment.
 - These assignments will require a good amount of MATLAB coding.
 - Prior MATLAB experience is not required, since the necessary techniques will be introduced in the lab sessions each week.
 - **See the lab syllabus for additional information.**
- Two Exams ($2 \times 30 = 60\%$ total):
 - We will have an in-class midterm, and a take-home final.
 - The date of the in-class midterm is **Thursday, March 1**. A make-up midterm will not be offered unless the student notifies me before the day of the exam that he/she will be unable to attend and provides documented proof of significant illness, etc.
 - The final exam will be a take-home exam, and will be posted on the last day of lecture (Tuesday, April 24) and will be due one week later on **Tuesday, May 1 at 12:30pm**. Can be submitted either in person or dropped off in my mailbox (found JWB 228).
- Grading Scale

A	A-	B+	B	B-	C+	C	C-
> 93%	(93-90)%	(90-87)%	(87-83)%	(83-80)%	(80-77)%	(77-73)%	(73-70)%
D+	D	D-	E				
(70-67)%	(67-63)%	(63-60)%	< 60%				

- This scale may be adjusted to benefit all students of the class.
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Topics/Tentative Schedule:

1. Introduction to mathematical models, review of ideas from calculus and ODEs
 - Heart and circulation. Dynamics of the pulse. ~ 1 week.
2. Dynamical systems: geometric analysis, phase planes. Introduction to bifurcation theory. Phase oscillators, phase response curves. ~ 5 weeks.
 - Law of mass action, Hill's function
 - Gene activation model. Bistability and biological switches.
 - Hodgkin-Huxley equations
 - Pancreatic beta-cells
 - Epidemics
 - HIV modeling
3. Probability, random variables, Markov chains. ~ 4 weeks.
 - Natural selection
 - Plasmids (antibiotic resistance in bacteria)
 - Regulation of gene expression
4. Introduction to partial differential equations ~ 2 weeks.
 - Models for cancer-immune system interaction and for cancer-growth inhibitor interaction

Responsibilities: All students are expected to maintain adult and professional behavior in the classroom. Please respect your classmates by not engaging in idle chatter, using your cell phone, or otherwise creating distractions. More importantly, students are prohibited by the **Student Code** from cheating, as well as committing acts of fraud, vandalism, or theft.

Part of my responsibilities is maintaining a classroom conducive to learning and enforcing responsible classroom behavior. This instructor will take disciplinary actions, beginning with verbal warnings and ultimately progressing to dismissal from this class and a failing grade. Students have the right to appeal such action to the Student Behavior Committee.

ADA Statement: The University of Utah seeks to provide equal access to its programs, services and activities for people with disabilities. If you will need accommodations in the class, reasonable prior notice needs to be given to the Center for Disability & Access, 162 Olpin Union Building, 801-581-5020. CDA will work with you and the instructor to make arrangements for accommodations. All written information in this course can be made available in alternative format with prior notification to the Center for Disability & Access.

Important Dates:

Classes begin	Monday, January 8
Last day to add without a permission code	Friday, January 12
Last day to drop (delete) classes	Friday, January 19
Last day to add, elect CR/NC, or audit classes	Friday, January 19
Last day to withdraw from classes	Friday, March 9
Last day to reverse CR/NC option	Friday, April 20
Classes end	Tuesday, April 24
Final Exam Due Date	Tuesday, May 1

Disclaimer: This syllabus has been created as a preview to the course and I have tried to make it as accurate as possible. However, I reserve the right to make reasonable changes to the above policies.