

BioE 103: Systems Physiology and Design
Spring 2014 Syllabus

Description: Physiology of intact human tissues, organs, and organ systems in health and disease, and bioengineering tools used (or needed) to probe and model these physiological systems. Topics: Clinical physiology, network physiology and system design/plasticity, diseases and interventions (major syndromes, simulation, and treatment, instrumentation for intervention, stimulation, diagnosis, and prevention), and new technologies including tissue engineering and optogenetics. Discussions of pathology of these systems in a clinical-case based format, with a view towards identifying unmet clinical needs. Learning computational skills that not only enable simulation of these systems but also apply more broadly to biomedical data analysis.

Prerequisites: CME 102; PHY 41; BIO 41, 42; or instructor approval.

Time/Location: Lecture: Tu/Th 11:00 AM-12:15 PM, LKSC 306.

Recitation: Friday 10-10:50 AM, LKSC 208, except 4/18 (205/6) and 5/30 (304/5)

Course Websites: Coursework and OpenEdX for problem sets, case-study assignments, online discussion forums, and video recordings of lectures.

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Grading: The class will have three homework problem sets, each worth 10% of the total grade (30% total), medical case studies worth 10% of the grade, a midterm exam worth 20%, and a final exam worth 35%. Additionally, 5% of the total grade will depend on in-class participation and attendance.

Assignments:

The homework problem sets will reinforce the quantitative analysis performed in lecture or recitation (e.g., “derive a set of equations that describe the spread of HIV”). The assignments will generally require Matlab or similar software. Although group work is encouraged, each student should submit their own assignment and perform any necessary calculations on their own. The homework will be tied to lecture and recitation topics.

The medical case studies will be introduced at the end of most lectures and are structured like medical rounds for medical school students. We will cover four complex multi-part case studies throughout the quarter. Students will be given a patient scenario and asked to answer specific questions about patient diagnosis and/or treatment through the course of a few lectures. Students will be organized into randomized groups for each case study and are encouraged to discuss the case with each other and look up any information online as necessary, and should submit their answers as part of a group much like a consensus diagnosis. However, they will be given a limited amount of time (usually until 12PM the next day) to answer the questions posed to reflect the time-limited nature of medical diagnosis. Answers are limited to 1 page, 400 words maximum.

Exams:

Each exam will be similar in layout to the homework assignments and medical case study questions, and will be based on material from the lectures. Importantly, anything that is on the slides, in the homework, or *spoken as part of the lecture* is “fair game”. However, supplemental reading or other material will not be required for the exams. For the midterm, one side of an 8.5”x11” piece of paper is allowed for notes; for the final, both sides of an 8.5”x11” piece of paper are allowed.

Class Schedule:

Date	Instructor	Topic	HW (due)	Suggested Reading
4/1	Shih	Introduction		
4/3	Deisseroth	Central Nervous System		GH12: Ch 45, 57
4/4	Recitation	MATLAB basics		TBD
4/8	Deisseroth	Peripheral Nervous System		GH12: Ch 46, 54
4/10	Deisseroth	Musculoskeletal System		GH12: Ch 84
4/11	Recitation	Linear Parameter Estimation	HW1 (4/29)	TBD
4/15	Deisseroth	Endocrine System		GH12: Ch 74-79
4/17	Deisseroth	Gastrointestinal System		GH12: Ch 62, 65
4/18	Recitation	Non-linear Parameter Estimation		TBD
4/22	Shih	Human Microbiome		Costello et al., 2009
4/24	Shih	Obesity		Yu and Kim, 2012
4/25	Recitation	Convolutions		TBD
4/29	Deisseroth	Renal System	<i>*HW1 due*</i>	GH12: Ch 25-28
5/1	Deisseroth	Cardiovascular System		GH12: Ch 9-11, 14, 15, 19, 20, 22
5/2	Recitation	Simulink	HW2 (5/20)	TBD
5/6	Deisseroth	Respiratory System		GH12: Ch 37, 39, 40
5/8	TA's	Review		

5/9	Recitation	Partial Differential Equations		
5/13	MIDTERM	Covers through 5/6		
5/15	Deisseroth	Reproductive System		GH12: Ch 80-81
5/16	Recitation	GUI design	HW3 (6/3)	TBD
5/20	Shih	Aging	<i>*HW2 due*</i>	
5/22	Deisseroth	Stem Cells		GH12: Ch 33, 34
5/23	Recitation	Image Processing I		TBD
5/27	Shih	Cancer		Hanahan and Weinberg, 2011
5/29	Shih	Blood and Immunology		
5/30	Recitation	Image Processing II		TBD
6/3	Deisseroth	Tissue Engineering	<i>*HW3 due*</i>	
6/5	TA's	Review (optional)		Time & Location: TBD
6/6	FINAL EXAM	Comprehensive		Time: 3:30-630PM Location: Alway M206

Suggested Texts:

GH12: *Textbook of Medical Physiology*, Guyton and Hall. The 12th edition is available at the bookstore; two copies are on reserve at the Biology (Falconer) library, and used for suggested reading. We strongly recommend this textbook in order to review basic human physiology; we will be building off of prior knowledge gained in previous classes such as PHYS 41 and BIO 42, so if you are not familiar with a particular topic, the suggested reading will get you up to speed.