ILLINOIS

THE GRAINGER COLLEGE OF ENGINEERING

Department of Bioengineering
1102 Everitt Laboratory, MC-278
1406 W. Green St.
Urbana, IL 61801

BIOE 504: Analytical Methods for Bioengineering Fall 2020

Instructor: Michael Insana Offices: 2108 EL & 4247 BI, mfi@illinois.edu

Time and place: MWF 9:00 am – 9:50 am, Room 3217 Everitt Lab if we meet in person. Otherwise, we will connect via Zoom at the same times.
Discussion and office hours are scheduled for after class MW and by appointment otherwise
Prerequisites: MATH 286; experience with scientific programming or graduate standing
Required Books: Course notes for BIOE 504 (purchased from the bookstore at https://bookstore.illinois.edu/ 809 S. Wright Street, C. ≤ $32.75

This is a required core course for all bioengineering graduate students but is open to students from other engineering and science programs with graduate standing or undergraduates with permission from the instructor. The objective is to introduce and review a broad range of mathematical and computational modeling methods related to data representation and systems that are common to the design and evaluation of measurement instruments and biological modeling. Assignments involve combinations of mathematical, statistical, and numerical modeling in Matlab.

Course grades are based on student performance on graded homework assignments (67%) and one take-home exam (33%).

Grades: A (85-100%), A- (80-84%), B+ (75-79%), B (70-74%), B- (65-69%), C (<65%)

Semester Schedule:

Classes begin	Monday August 24
Labor Day Holiday	Monday Sept. 7
Last day of any in-person meetings	Nov 20
Thanksgiving Holiday	Nov. 21 – Nov. 29
Last Day of Class	Wednesday Dec. 7
Take home exam due	Monday Dec. 14 at noon

- Introductory materials are found on Compass2G under BIOE 504.
- Homework problems are distributed through GradeScope under BIOE 504. You will also submit homework and receive comments and grades through this site.
- Invitations to attend Zoom class meetings have been sent through email. If you use Outlook, these will appear on your calendar. Recorded lectures will be posted on MediaSpace and most likely be available on Compass2G. Further details about recordings will be announced during class times.

August 11, 2020

Dates	Lectures and Discussions
Week 1 (Aug. 24)	• Review of linear algebra (Appen A, assignment on GradeScope) • Introduction and review of Matlab (assignment on Compass2G)
Week 2 (Aug. 31)	• The measurement equation (Ch. 4.1 – 4.3) • Matrix & comput. forms (Ch. 4.5 – 4.7) (Lin Alg assign Sep. 2)
Week 3 (Sep. 7)	• Labor day (Sep. 7) • Intro to basis decomp, PCA (Ch. 5.1 – 5.3) (Matlab assign Sep. 9)
Week 4 (Sep. 14)	• Fourier analysis (Ch. 5.4 – 5.6) • Fourier analysis (Ch. 5.7 – 5.9)
Week 5 (Sep. 21)	• Problem discussion and Ch. 4 homework review • Power spectral analysis (Ch. 5.11 – 5.13)
Week 6 (Sep. 28)	• Matrix-based Fourier analysis and eigenanalysis (Ch. 6.1 – 6.3) • Problems discussion and Ch. 5 homework review
Week 7 (Oct. 5)	• Singular value decomposition (Ch. 6.5 – 6.7) • Intro to systems biology models (Ch. 6.9)
Week 8 (Oct. 12)	• Problem discussion and Ch. 6 homework review • Experimental design and hypothesis testing (Ch. 8.1 – 8.2)
Week 9 (Oct. 19)	• Power analysis and ROC analysis (Ch. 8.2 – 8.3) • Problem discussion and Ch. 8 homework review
Week 10 (Oct. 26)	• Statistical pattern recognition in flow cytometry (Ch. 9.1 – 9.2) • Discriminant analysis and clustering (Ch. 9.3 – 9.4)
Week 11 (Nov. 2)	• Problem discussion and Ch. 9 homework review • First-order linear systems of equations (Ch. 10.1-10.2)
Week 12 (Nov. 9)	• Modeling cell growth (Ch. 10.3 – 10.4) • Nonlinear and linearized models: predator-prey (Ch. 10.5 -10.7)
Week 13 (Nov. 16)	• Modeling infectious disease in a population (Ch. 10.8 – 10.9) • Problem discussion and Ch. 10 homework review
Week 14 (Nov. 23)	Fall break
Week 15 (Nov. 30)	• Second-order systems: sensors (Ch. 11.1 – 11.2) • Laplace transforms for solving ODEs (Ch. 11.3 – 11.5)
Week 16 (Dec. 7)	• Take home exam assignment due Monday Dec 14 at noon.

Important dates. Topics covered if there is time.

You can access the VPN needed to connect to Matlab at the webstore via (it's free):
https://webstore.illinois.edu/Shop/product.aspx?zpid=2600

You can also obtain a VPN through the AppStore for iPads and other Apple products.

The following websites offer hardware and software resources that might be useful to you.
https://it.engineering.illinois.edu/keeplearning

https://it.engineering.illinois.edu/services-support-students/essential-technology-students

https://answers.uillinois.edu/illinois.engineering/104402

A nice college website with advice on remote learning:
https://students.grainger.illinois.edu/GFX/remote-learning/

You may use Engineering IT's Citrix Workspace to access Matlab at this site:
https://it.engineering.illinois.edu/services/instructional-services/remote-connections-citrix/remote-connections-citrix-sld

At the bottom of the page, you will find this link for connecting to Citrix:
https://it.engineering.illinois.edu/ews/lab-information/remote-connections/connecting-citrix

You need to connect to the campus VPN to use this service. Try it and let me know if you have difficulties.

Academic Integrity

This course is designed to encourage students to cooperate with each other and collaborate in problem solving assignments. Effective collaboration is a trait of successful researchers and educators in the 21st century. Students are strongly encouraged to participate in "classroom" discussions, offer perspectives, and ask questions that foster a vital part of the learning process.

Specifically in the pandemic year of 2020, every student has a responsibility to behave safely concerning social distancing, face coverings, and adhering to campus policies related to participation in educational activities, either in-person or remote. If there is a reason you cannot attend a scheduled class meeting (in-person or remote), it is your responsibility to notify the instructor of the planned absence.

Homework assignments: You may use textbooks and electronic resources to solve HW problems, but you must give credit to those sources. This is the same requirement that must be followed when publishing in the peer-reviewed literature. Ethical practice demands that you acknowledge the contributions of others.

Take-home final exam: I ask that you NOT collaborate but work alone to solve these problems. You may use textbooks and electronic resources of your choice.

In both forms of assessment, you will need to code in Matlab. Unless you have spent considerable time coding, the computational aspects of problem solving and modeling can be time consuming. Cooperation and code sharing is acceptable and encouraged if the sharing is equitable and acknowledged in writing within each assignment.