

# BME 241: Introductory Biomedical Engineering Laboratory

Instructors:	GSI <sup>s</sup> :	IA <sup>s</sup> :
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**Lecture:** Mon & Wed, 12:30pm – 1:30pm, G906 Cooley

**Lab:** Sec 2: Mon, 3:30 – 7:30pm, 1105/1220 LBME (Amos, Nusayba)  
Sec 3: Tue, 3:30 – 7:30pm, 1105/1220 LBME (Amos, Tess)  
Sec 4: Wed, 3:30 – 7:30pm, 1105/1220 LBME (Hengky, Phillip)

## Office hours:

Claflin:	Wed,	1:30 – 2:30pm	(2232 LBME)
Lempka:	Mon,	1:30 – 2:30pm	(2189 LBME)
Amos:	Tue,	1:30 – 3:30pm	(1105/1220 LBME)
Hengky:	Wed,	2:30 – 3:30pm	(1105/1220 LBME)

## Course Materials

Required:

- Laboratory notebook (purchase scientific lab notebook – 192-page version)
- Lab instructions, equipment manuals, etc. ([Canvas](#), “Pages”)

Suggested:

- Statistics text – Miller & Freund's Probability and Statistics for Engineers (8<sup>th</sup> Edition) by Richard Johnson, Irwin Miller, John Freund

## Grading

Lab Notebook	15%
Pre-lab Homework	10%
Post-lab Reports	30%
Research Project	10%
Statistics Homework	15%
Statistics Quizzes	20%

## Lab Modules

*Circuits, Op-Amps*.....Introduction to lab instrumentation, simple circuits, op-amp circuits  
*EMG (+LabVIEW)*.....Instrumentation amps, acquire and analyze electromyograms (EMG)  
*Material Properties* ....Investigate and compare mechanical properties of biological materials  
*Cell Culture* .....Attachment rates and live-dead assays using cultured cells  
*Research Project*.....Develop hypothesis, then design and conduct experiments.  
Project deliverables: proposal, lab notebook, poster presentation

## **Lab Safety**

All students are expected to work safely in the lab. Safety glasses must be worn at all times in the Wet Lab. Students must wear long pants, shirts with sleeves (or a lab coat, buttoned up), and close-toed shoes. No eating or drinking is allowed in the lab.

Biohazardous material, glass material, solvents, raw chicken, etc. must be disposed of properly. Details for proper disposal will be discussed in lab. Please do not touch any materials or equipment not relevant to your lab. Take care when using fast-moving, sharp, or other dangerous parts of lab equipment and be familiar with safety features of the devices.

## **Lab Notebook Maintenance**

Student performance is evaluated in part on the maintenance of a lab notebook (15% of course grade). Please consult lecture notes and lab notebook grading rubric (available on Canvas) for detailed instructions on how to maintain your lab notebook.

## **Attendance Policy**

Students are expected to attend *all* sessions of the laboratory. A student choosing to miss a lab session to attend another commitment (*e.g.* job interviews, graduate school interviews) must inform their GSI in advance and then make up the session at a time convenient to the GSI and possibly her/his lab partners – subject to availability of equipment. If a convenient time cannot be established or the student chooses to not make up the session, no points will be given for the assignments related to that session. Illness and family emergencies will be handled on an individual basis. Contact your GSI as soon as possible if an emergency arises.

## **Honor Code Policy**

Much of the learning in this lab will be from interaction with other students and the instructional team. It is important that a collegial environment is maintained. For most experiments, you and your partners will collect only one set of data. You may discuss strategies for data preparation and interpretation with your partners and other students, but you must do all data calculations, graphing, tabulating, etc. yourself. All homework assignments and quizzes are also to be completed individually. Finally, you must do all of the writing yourself, unless specified otherwise (exceptions being the final 2 lab reports, which are group efforts). You may consult the lab protocols, course notes, other textbooks, review articles, and published research papers. Information taken from journals, books and websites must be adequately referenced.

# BME 241 Lab and Lecture Schedule, W-2017

Week	Lab	Lecture			
		Monday		Wednesday	
		Date (2017)	Topic	Date (2017)	Topic
1	<b>No Lab</b> Mon 1-02, Tue 1-03, Wed 1-04	02-Jan	No Lecture	04-Jan	Intro, Circuits
2	<b>Lab 1: Introductory Circuits</b> Mon 1-09, Tue 1-10, Wed 1-11	09-Jan	Lab Notebooks, Lab Reports, Breadboards	11-Jan	Bode Plots, Fourier Analysis, LabVIEW
3	<b>Lab 2 - LabVIEW "take home"</b> To complete Part 4: Lab open Wednesday and Friday (1/18 & 1/20) from 9AM to 5PM	16-Jan	No Lecture (MLK Holiday)	18-Jan	R-C Filters, Operational Amplifiers
4	<b>Lab 3: Op-Amps</b> Mon 1-23, Tue 1-24, Wed 1-25	23-Jan	Op-Amps, Active Filters, Instrumentation Amplifiers	25-Jan	Electromyogram (EMG), Origin & Acquisition
5	<b>Lab 4: EMG</b> Mon 1-30, Tue 1-31, Wed 2-01	30-Jan	Definitions, Descriptive Statistics	01-Feb	Materials Testing: Stress, Strain, Young's Modulus, Tensile Testing, Viscoelasticity
6	<b>Lab 5: Tensile Testing</b> Mon 2-06, Tue 2-07, Wed 2-08	06-Feb	Probability, Discrete Random Variables and Distributions	08-Feb	Continuous Random Variables and Distributions
7	<b>Lab 6: Tensile Testing - Biological</b> Mon 2-13, Tue 2-14, Wed 2-15	13-Feb	Materials Testing: Compression, Beam Theory, Flexure Tests, Research Project introduction	15-Feb	Sampling Distributions, t-distribution
8	<b>Lab 7: Compression Testing</b> Mon 2-20, Tue 2-21, Wed 2-22	20-Feb	Hypothesis Testing I	22-Feb	<b>Quiz 1 (G906 Cooley)</b>
9	<b>No Lab (Spring Break)</b> Mon 2-27, Tue 2-28, Wed 3-01	27-Feb	Spring Break	01-Mar	Spring Break
10	<b>Lab 8: Flexure Testing</b> Mon 3-06, Tue 3-07, Wed 3-08	06-Mar	Cell Culture, Research Project	08-Mar	Hypothesis Testing II
11	<b>Lab 9: Cell Adhesion</b> Mon 3-13, Tue 3-14, Wed 3-15	13-Mar	Hypothesis Testing III, Power	15-Mar	<b>Project Micro-Pitches (Research Project proposal due)</b>
12	<b>Lab 10: Cell Viability</b> Mon 3-20, Tue 3-21, Wed 3-22	20-Mar	Point Estimation, Confidence Intervals	22-Mar	<b>Quiz 2 (G906 Cooley)</b>
13	<b>Lab 11: Research Project (1 of 3)</b> Mon 3-27, Tue 3-28, Wed 3-29	27-Mar	Linear Regression	29-Mar	Multiple Regression
14	<b>Lab 11: Research Project (2 of 3)</b> Mon 4-03, Tue 4-04, Wed 4-05	03-Apr	ANOVA	05-Apr	Two-Way ANOVA
15	<b>Lab 11: Research Project (3 of 3)</b> Mon 4-10, Tue 4-11, Wed 4-12	10-Apr	Summary	12-Apr	<b>Quiz 3 (G906 Cooley)</b>
16	<b>No Lab (and no Lecture)</b> Mon 4-17, Tue 4-18, Wed 4-19	<b>Research Project Poster Presentations: Thursday, April 20, 1:30PM - 3:30PM</b> [Due 4-19, 11:59PM: Poster in PDF format - upload via Canvas "Submit Assignment" button] [Due 4-20, 1:30PM: Poster hard-copy, Lab Notebooks]			

# BME 241 Assignment Due Dates, W-2017

Week	Lab	What's Due?			
		Pre-lab (collected at start of lab)	Lab Report (Hardcopy + PDF upload)	Lab Notebook (collected at end of lab)	Other (Stats HW, Project Proposal) (PDF uploads)
1	<b>No Lab</b> Mon 1-02, Tue 1-03, Wed 1-04				
2	<b>Lab 1: Introductory Circuits</b> Mon 1-09, Tue 1-10, Wed 1-11	Intro Circuits (Lab 1)			
3	<b>Lab 2: LabVIEW "take home"</b>	LabVIEW (Lab 2) (upload 6 vi <sup>s</sup> by 5PM Fri, 1-20)		yes (Lab 1) (turn in by 5PM Fri, 1-20)	
4	<b>Lab 3: Op-Amps</b> Mon 1-23, Tue 1-24, Wed 1-25	Op-Amps (Lab 3)			
5	<b>Lab 4: EMG</b> Mon 1-30, Tue 1-31, Wed 2-01	EMG (Lab 4)	Op-Amps (5-page limit, individual)	yes (Labs 2 & 3)	
6	<b>Lab 5: Tensile Testing</b> Mon 2-06, Tue 2-07, Wed 2-08	Tensile Testing (Lab 5)			Stats HW 1 (due Fri, 2-10, 11PM)
7	<b>Lab 6: Tensile Testing - Biological</b> Mon 2-13, Tue 2-14, Wed 2-15		EMG (5-page limit, individual)	yes (Labs 4 & 5)	Stats HW 2 (due Fri, 2-17, 11PM)
8	<b>Lab 7: Compression Testing</b> Mon 2-20, Tue 2-21, Wed 2-22	Compression Testing (Lab 7)			
9	<b>No Lab (Spring Break)</b> Mon 2-27, Tue 2-28, Wed 3-01				
10	<b>Lab 8: Flexure Testing</b> Mon 3-06, Tue 3-07, Wed 3-08	Flexure Testing (Lab 8)			Stats HW 3 (due Fri, 3-10, 11PM)
11	<b>Lab 9: Cell Adhesion</b> Mon 3-13, Tue 3-14, Wed 3-15		Tensile & Compression (10-page limit, group)	yes (Labs 6 & 7)	Project Proposal (due Wed, 3-15, 11:59AM)
12	<b>Lab 10: Cell Viability</b> Mon 3-20, Tue 3-21, Wed 3-22				Stats HW 4 (due Mon, 3-20, 11PM)
13	<b>Lab 11: Research Project (1 of 3)</b> Mon 3-27, Tue 3-28, Wed 3-29		Cell Adhesion (5-page limit, group)	yes (Labs 8 & 9)	
14	<b>Lab 11: Research Project (2 of 3)</b> Mon 4-03, Tue 4-04, Wed 4-05				Stats HW 5 (due Wed, 4-05, 11PM)
15	<b>Lab 11: Research Project (3 of 3)</b> Mon 4-10, Tue 4-11, Wed 4-12			yes (Lab 10)	
16	<b>No Lab (and no Lecture)</b> Mon 4-17, Tue 4-18, Wed 4-19	<b>Research Project Poster Presentations: Thursday, April 20, 1:30PM - 3:30PM</b> [Due 4-19, 11:59PM: Poster in PDF format - upload via Canvas "Submit Assignment" button] [Due 4-20, 1:30PM: Poster hard-copy, Lab Notebooks]			