BME 241: Introductory Biomedical Engineering Laboratory

Instructors:
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IA’s:
Allison Grant (Sec 2)
allgrant@umich.edu
Khushi Vakharia (Sec 3)
khushibv@umich.edu
Kevin Hsieh (Sec 4)
hsiehke@umich.edu

Lecture:  Mon & Wed, 12:30pm – 1:30pm, G906 Cooley

Lab:
Sec 2:  Mon, 3:30 – 7:30pm, 1105/1220 LBME (Allison)
Sec 3:  Tue, 3:30 – 7:30pm, 1105/1220 LBME (Khushi)
Sec 4:  Wed, 3:30 – 7:30pm, 1105/1220 LBME (Kevin)

Office hours:
Claflin:  Wed 1:30 – 2:30pm  (2232 LBME)
Arnold:  Mon 1:30 – 2:30pm  (2220 LBME)
Allison:  Mon 2:30 – 3:30pm  (1105/1220 LBME)
Khushi:  Tue 2:30 – 3:30pm  (1105/1220 LBME)
Kevin:  Wed 2:30 – 3:30pm  (1105/1220 LBME)

Course Materials

Required:
• LabArchives account (https://mynotebook.labarchives.com)
• Lab handouts (instructions), equipment manuals, etc. (Canvas, “Pages”)

Suggested:
• Statistics text – Miller & Freund's Probability and Statistics for Engineers (8th 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
Canvas

Refer to the Canvas course website for all course information including assignments, lab handouts, lecture slides, grades, etc. All course-wide communication will be via Canvas “Announcements”.

The BME 241 Canvas calendar (accessed via a link in the far-left column of the Canvas user interface) provides a comprehensive view of lecture times, lab times & topics, and all assignment due-dates. Calendar entries are Section-specific – you will only see events and due-dates that apply to your Section. Our goal is to have all date- & time-critical information available in one place for your convenience.

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, 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). All notebook entries are made using “LabArchives”, an electronic laboratory notebook (ELN) platform (used for first time in W-2019!). Notebook entries are submitted weekly for grading by exporting a PDF of the relevant pages from LabArchives, then uploading the PDF to Canvas. Please consult lecture notes, the lab notebook grading rubric (available on Canvas), your IA & grader for guidance on lab notebook content.

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 IA in advance and then arrange to make up the session at a time convenient to the IA. 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 IA as soon as possible if an emergency arises.

Honor Code Policy

Much of the learning in this course will be from interactions with other students and the instructional team. These interactions are strongly encouraged. However, for the first two lab modules (Circuits, EMG), each student will be required to submit an independent lab report based upon one set of results collected by their group. 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. Lab reports for the third and fourth lab modules (Materials, Cells) and the Research Project poster are group efforts and all group members are expect to contribute equally. In all cases, information taken from journal articles, books and websites must be adequately referenced. Finally, all homework assignments and quizzes are intended to be completed individually.
<table>
<thead>
<tr>
<th>Week</th>
<th>Lab</th>
<th>Monday</th>
<th>Wednesday</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>No Lab</td>
<td>Mon 1-07, Tue 1-08, Wed 1-09</td>
<td>07-Jan No Lecture</td>
</tr>
<tr>
<td>2</td>
<td>Lab 1: Introductory Circuits</td>
<td>Mon 1-14, Tue 1-15, Wed 1-16</td>
<td>14-Jan Lab Notebooks, Lab Reports, Breadboards</td>
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<tr>
<td>3</td>
<td>Lab 2 - LabVIEW “take home”</td>
<td>21-Jan No Lecture (MLK Holiday)</td>
<td>23-Jan R-C Filters, Operational Amplifiers</td>
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<td>4</td>
<td>Lab 3: Op-Amps</td>
<td>Mon 1-28, Tue 1-29, Wed 1-30</td>
<td>28-Jan Op-Amps, Active Filters, Instrumentation Amplifiers</td>
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<td>5</td>
<td>Lab 4: EMG</td>
<td>Mon 2-04, Tue 2-05, Wed 2-06</td>
<td>04-Feb Definitions, Descriptive Statistics</td>
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<td>6</td>
<td>Lab 5: Tensile Testing</td>
<td>Mon 2-11, Tue 2-12, Wed 2-13</td>
<td>11-Feb Probability, Discrete Random Variables and Distributions</td>
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<td>8</td>
<td>Lab 7: Compression Testing</td>
<td>Mon 2-25, Tue 2-26, Wed 2-27</td>
<td>25-Feb Hypothesis Testing I</td>
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<tr>
<td>9</td>
<td>No Lab (Spring Break)</td>
<td>Mon 3-04, Tue 3-05, Wed 3-06</td>
<td>04-Mar Spring Break</td>
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<td>10</td>
<td>Lab 8: Flexure Testing</td>
<td>Mon 3-11, Tue 3-12, Wed 3-13</td>
<td>11-Mar Cell Culture, Research Project</td>
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<td>12</td>
<td>Lab 10: Cell Viability</td>
<td>Mon 3-25, Tue 3-26, Wed 3-27</td>
<td>25-Mar Point Estimation, Confidence Intervals</td>
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<td>13</td>
<td>Lab 11: Research Project (1 of 3)</td>
<td>Mon 4-01, Tue 4-02, Wed 4-03</td>
<td>01-Apr Linear Regression</td>
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<td>14</td>
<td>Lab 11: Research Project (2 of 3)</td>
<td>Mon 4-08, Tue 4-09, Wed 4-10</td>
<td>08-Apr ANOVA</td>
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<tr>
<td>15</td>
<td>Lab 11: Research Project (3 of 3)</td>
<td>Mon 4-15, Tue 4-16, Wed 4-17</td>
<td>15-Apr Summary</td>
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<tr>
<td>16</td>
<td>No Lab (and no Lecture)</td>
<td>Mon 4-22, Tue 4-23, Wed 4-24</td>
<td>Research Project Poster Presentations: Monday, April 29, 1:30PM - 3:30PM [Due 4-28, 11:59PM: Poster &amp; Project Notebook PDF uploads to Canvas] [Due 4-29, 1:30PM: Poster hard-copy]</td>
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<tr>
<td>Week</td>
<td>Lab</td>
<td>What's Due?</td>
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<tr>
<td>1</td>
<td>No Lab Mon 1-07, Tue 1-08, Wed 1-09</td>
<td>Pre-lab: Intro Circuits (Lab 1)</td>
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<td>2</td>
<td>Lab 1: Introductory Circuits Mon 1-14, Tue 1-15, Wed 1-16</td>
<td>Pre-lab: Intro Circuits (Lab 1)</td>
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<td>3</td>
<td>Lab 2: LabVIEW &quot;take home&quot; LabVIEW (Lab 2) (upload 6 VI's by 5PM Fri, 1-25)</td>
<td>Pre-lab: Intro Circuits (Lab 1)</td>
<td>Lab 1 (turn in by 5PM Fri, 1-25)</td>
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<td>4</td>
<td>Lab 3: Op-Amps Mon 1-28, Tue 1-29, Wed 1-30</td>
<td>Pre-lab: Op-Amps (Lab 3)</td>
<td>Lab 2</td>
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<td>5</td>
<td>Lab 4: EMG Mon 2-04, Tue 2-05, Wed 2-06</td>
<td>Pre-lab: EMG (Lab 4)</td>
<td>Pre-lab: Op-Amps (Lab 3) (5-page limit, individual)</td>
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<td>Pre-lab: Tensile Testing (Lab 5)</td>
<td>Lab 4</td>
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<td>7</td>
<td>Lab 6: Tensile Testing - Biological Mon 2-18, Tue 2-19, Wed 2-20</td>
<td>Pre-lab: EMG (5-page limit, individual)</td>
<td>Lab 5</td>
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<td>8</td>
<td>Lab 7: Compression Testing Mon 2-25, Tue 2-26, Wed 2-27</td>
<td>Pre-lab: Compression Testing (Lab 7)</td>
<td>Lab 6</td>
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<td>10</td>
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<td>Pre-lab: Flexure Testing (Lab 8)</td>
<td>Lab 7</td>
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<td>11</td>
<td>Lab 9: Cell Adhesion Mon 3-18, Tue 3-19, Wed 3-20</td>
<td>Pre-lab: Tensile &amp; Compression (10-page limit, group)</td>
<td>Project Proposal (due Wed, 3-20, 11:59PM)</td>
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<td>12</td>
<td>Lab 10: Cell Viability Mon 3-25, Tue 3-26, Wed 3-27</td>
<td>Pre-lab: Flexure Testing (Lab 8)</td>
<td>Lab 8 &amp; Lab 9</td>
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