Course Description: This is a one credit course designed to provide practical laboratory-based experience in constructing and measuring basic electronic circuits. In addition to linear circuits, transistor and digital logic circuits will be introduced. Students build circuits and measure circuit functions and relate these results to those obtained from theoretical calculations and computer based simulations. Wherever possible, relevance to biological signal acquisition and analysis will be emphasized. Prerequisite: PHYS 261 or permission of instructor; Co-requisite: BENG 380

Course Objectives: After successfully completing this course, a student will be able to:
- Collect and analyze measurements from electronics circuits
- Compare measured results with theoretical predictions
- Understand limitations of conventional electronics laboratory measurement equipment and electronics components.
- Prepare a laboratory report.

Relationship to Bioengineering Program Outcomes: It is expected that this course will help students achieve the following outcomes:

a) An ability to apply knowledge of mathematics (including differential equations and statistics), science (including biology and physiology), and engineering to solve problems at the interface of engineering and the life sciences
- students will have acquired necessary knowledge, such as differential equations, statistics, physics, computational techniques, cellular biology and integrative physiology, that would allow them to address problems at the interface of engineering and the life sciences
- students can apply an appropriate combination of mathematical, scientific and engineering techniques to solve a problem at the interface of engineering and the life sciences
- students apply engineering judgment to evaluate answers
b) An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, health and safety, manufacturability, and sustainability

- students understand design requirements and consider relevant constraints
- students use appropriate engineering and computational tools in their design
- students evaluate their design objectively

c) An ability to identify, formulate, and solve engineering problems, addressing issues associated with the interface of engineering and the life sciences.

- students can identify and formulate engineering problems that are at the interface of living and non-living systems
- students can use engineering approaches to solve problems in the life sciences

Course Organization: Students will work individually or in groups of two to undertake each of the laboratory exercises. Laboratory topics are coordinated with the lecture course BENG 380.

Schedule:

<table>
<thead>
<tr>
<th>Section 1 (Tues)</th>
<th>Lab #</th>
<th>Topic</th>
</tr>
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<tbody>
<tr>
<td>August 29</td>
<td></td>
<td>Course Organization, Lab Safety and equipment orientation &amp; Policies</td>
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<tr>
<td>September 5</td>
<td>1</td>
<td>Continuous Orientation for lab equipment</td>
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<tr>
<td>September 12</td>
<td>2</td>
<td>Ohm’s Law and Loading</td>
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<tr>
<td>September 19</td>
<td>3</td>
<td>Network Analysis</td>
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<td>September 26</td>
<td>4</td>
<td>Forced Sinusoidal</td>
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<tr>
<td>October 3</td>
<td>5</td>
<td>Transient Response 1st Order Circuits</td>
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<tr>
<td>October 10</td>
<td>6</td>
<td>Transient Response 2nd Order Circuits</td>
</tr>
<tr>
<td>October 17</td>
<td>7</td>
<td>Operational Amplifier</td>
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<tr>
<td>October 24</td>
<td>8</td>
<td>Electrocardiography I</td>
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<tr>
<td>October 31</td>
<td>9</td>
<td>Electrocardiography II</td>
</tr>
<tr>
<td>November 7</td>
<td>10</td>
<td>Bipolar Junction</td>
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<td>November 14</td>
<td>11</td>
<td>Logic Gate</td>
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<tr>
<td>November 21</td>
<td>12</td>
<td>NO Lab Thanksgiving Holiday</td>
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<tr>
<td>November 28</td>
<td>13</td>
<td>LAB Review</td>
</tr>
<tr>
<td>December 5</td>
<td>Open Lab</td>
<td>Students are allowed to practice before the final exam. This may be used for lab make up because of weather condition</td>
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<tr>
<td>December 12</td>
<td></td>
<td>*Reading Day – option Section and practice. This may be used for lab make up because of weather condition</td>
</tr>
<tr>
<td>December 19</td>
<td></td>
<td>Regularly Scheduled Final Exam Lab Practical: 7:00 Pm to 10:30 PM</td>
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</tbody>
</table>

*Final Exams- Because the Final Exam is a laboratory practical, we will need to schedule an open 3 hours window for a subset of students. This will likely be scheduled between December 6 and December 20 as the availability of the laboratory room.
Laboratory Reports: No more than 2 people in a lab group, unless previously approved. A single laboratory report will be submitted and graded for each group. All group members are expected to contribute to the report. The laboratory reports should include the following:

- Course number (BENG 381), title of the laboratory exercise
- Your name, date laboratory performed, date of laboratory report submission
- Laboratory objectives (2-3 lines)
- Theory: predictions of circuit behavior based on theoretical considerations, as appropriate.
- Results: table and/or graph of results - label table columns or axes of each curve with units, oscilloscope display (sketch by hand is adequate, or digital image capture), and discuss briefly in a few sentences what was observed
- Discussion: answer any questions posed in the laboratory exercise, interpret the results, compare theoretical and experimental results, as appropriate, and explain sources of error or variations (resolution of measurement devices). Percent deviation = (observed-actual)/actual *100%
- Contributions: brief paragraph on who wrote/prepared which sections of the report

Laboratory reports should be submitted in hardcopy or electronically format no later than 1 week after the laboratory exercise.

Textbook: No textbook is required for this course. Laboratory exercises and manuals will be available as PDFs on MyMason (Blackboard) or made available in the classroom. Students are expected to read the laboratory material in preparation for conducting the laboratory exercise.

Hardware: Each student is expected to purchase a lab kit from the Bioengineering “store”. Please see Ms. McGowan in the Bioengineering office during regular office hours. The lab kit must be purchased before the date of the first lab. Each student should purchase his / her own kit.

Grading Policy: The primary metric for this course is laboratory reports and in each session. Students can help one another during data collection but each student must demonstrate he/she is capable of collection and interpretation of the data on his/her own. Each student will be evaluated each session for experimental knowledge and experiment results interpretation. Copying of data or laboratory report text from another lab group is not permitted. A hands-on final exam will test each individual student’s ability to work with the prototyping board, introduce signals, measure outputs, and present data. While the laboratory session runs for nearly 3 hours, it is important that each student arrive on time. There will often be introductory information provided at the beginning of class and it will not be repeated. Grades will be determined according to the following distribution:

Laboratory Reports (Group) 30%
Pre-Lab (Individual): 20
Final Exam: 40%
Timely Class Attendance and Participation: 10
This evaluation will be done in every session for each student. It is not a group evaluation.

**THERE WILL BE NO MAKE UP FOR MISSING LABORATORY DAY. ANY MISSING LAB WILL HAVE A GREAT IMPACT ON THE FINAL GRADE**

**Mason Email Accounts:** Students must use their MasonLIVE email account to receive important University information, including messages related to this class. See [http://masonlive.gmu.edu](http://masonlive.gmu.edu) for more information.

**Classroom Etiquette:** No food or drinks should be consumed during the laboratory. Cell/smart phones must be put into silent mode and no texting is permitted in the laboratory during the exercise or especially during any lectures. If you have an emergency need to answer a call please quietly leave the room BEFORE answering the call.

**Office of Disability Services:** If you are a student with a disability and you need academic accommodations, please see me and contact the Office of Disability Services (ODS) at 993-2474. All academic accommodations must be arranged through the ODS. [http://ods.gmu.edu](http://ods.gmu.edu)
GMU Policies and Resources for Students:

- Students must adhere to the guidelines of the George Mason University Honor Code [See http://academicintegrity.gmu.edu/honorcode/].
- Students must follow the university policy for Responsible Use of Computing [See http://universitypolicy.gmu.edu/all-policies/].
- Students are responsible for the content of university communications sent to their George Mason University email account and are required to activate their account and check it regularly. All communication from the university, college, school, and program will be sent to students solely through their Mason email account.
- The George Mason University Counseling and Psychological Services (CAPS) staff consists of professional counseling and clinical psychologists, social workers, and counselors who offer a wide range of services (e.g., individual and group counseling, workshops and outreach programs) to enhance students’ personal experience and academic performance [See http://caps.gmu.edu/].
- Students with disabilities who seek accommodations in a course must be registered with the George Mason University Office of Disability Services (ODS) and inform their instructor, in writing, at the beginning of the semester [See http://ods.gmu.edu/].
- Students must follow the university policy stating that all sound emitting devices shall be turned off during class unless otherwise authorized by the instructor. The George Mason University Writing Center staff provides a variety of resources and services (e.g., tutoring, workshops, writing guides, handbooks) intended to support students as they work to construct and share knowledge through writing [See http://writingcenter.gmu.edu/].

Professional Dispositions:

- Students are expected to exhibit professional behaviors and dispositions at all times.

Core Values Commitment:

- The College of Education & Human Development is committed to collaboration, ethical leadership, innovation, research–based practice, and social justice. Students are expected to adhere to these principles. [See http://cehd.gmu.edu/values/].

WAVES: Wellness, Alcohol and Violence Education and Services:
WAVES promotes wellness within the Mason community through health education, alcohol/drug assessment and education, and violence awareness, prevention and sexual assault response. We help students make healthy, safe choices and encourage lifelong, thoughtful healthy decision-making through individualized support, creative programming, and evidence-based education and outreach.

**WAVES office 703-993-9999**  
SUB I, Suite 3200

**24-Hour Sexual and Intimate Partner Violence Crisis Line 703-380-1434**

waves.gmu.edu

- 703-360-7273 (Fairfax County Office for Women and Domestic and Sexual Violence Services 25 hotline)
- 703-228-4848 (Arlington County Domestic Violence Services Hotline)
- 703-368-4141 (Prince William County Sexual Assault Victims Advocacy Services (SAVAS) hotline)
- 1-800-838-8238 (Virginia Family Violence and Sexual Assault Hotline)
- 1-800-656-HOPE (Rape, Abuse and Incest National Network) https://ohl.rainn.org/online/

**CAPS: Counseling and Psychological Services:**

Counseling and Psychological Services (CAPS) provides a wide range of free confidential services to students, faculty, and staff. Services are provided by a staff of professional clinical psychologists, social workers, counselors, learning specialists, and psychiatric providers. CAPS individual and group counseling, workshops, and outreach programs are designed to enhance students’ personal experience and academic performance.

Visit us at caps.gmu.edu for additional resources.

- For consultation or emergency assistance during office hours call 703-993-2380.
- For assistance during non-office hours, call University Police at 703-993-4357.
- 703-527-4077 (CrisisLink)
- 1-800-273-8255 (National Suicide Prevention Lifeline)
- 1-877-838-2838 (Veterans’ Crisis Hotline)

**Student Health Services (SHS)** — provides confidential health care to enrolled students in emergency and non-emergency circumstances on the Fairfax, Arlington and Prince William campuses. If there is a medical emergency and Student Health Services (SHS) is closed, please contact the free after-hours nurse ((703) 993-2831), a hospital emergency room, an urgent care facility, or call 911.

**SUB 1, Suite 2300**

703-993-2831
University Police:

Emergency: 911      Non-emergencies: (703) 993-2810

Reporting a Crime (Crime Solvers Anonymous Tip Hot-Line): (703) 993-4111

Mason Police Website: http://police.gmu.edu/

Eric Heath, Chief of Police    Phone: (703) 993-3840    E-mail: eheath2@gmu.edu