BENG 380  
Introduction to Circuits and Electronics  
Fall 2015

Class Time:  Tuesday and Thursday at 10:30 am - 11:45 am  
Recitation:  Tuesdays at 12:30 pm -1:20 pm  
Location:  Nguyen Engineering Building 2608, Fairfax Campus  
Instructor:  Nayef Abu-Ageel, PhD  
Office location:  3800 Engineering Bldg  
E-mail: nabuagee@gmu.edu  
Office Hours:  Wednesday 1:30 pm – 2:30 pm, and by appointment.  
TA:  Alex Kaiser  
Office location:  3800 Engineering Bldg  
E-mail: akaiser4@masonlive.gmu.edu

Course Description:  This course is designed to introduce students to the properties of fundamental electronic devices and how to perform circuit analysis. The course covers linear circuit elements (resistors, capacitors, and inductors), operational amplifiers, semiconductor devices (diodes, transistors), and digital logic elements. Relevance to biological signal acquisition and biomedical instrumentation will be emphasized as examples. Prerequisite: PHYS 261 or permission of instructor; Co-requisite: BENG 381.

Course Objectives:  After successfully completing this course, a student will be able to:

- Use Kirchoff’s Current and Voltage Laws, mesh and nodal techniques to solve linear circuits.
- Apply phasor analysis to derive linear circuit outputs for AC inputs.
- Formulate and solve first-order and second-order differential equations derived from linear circuits to derive transient response.
- Analyze and design circuits based on operational amplifiers including active filters.
- Analyze circuits containing non-linear devices such as diodes and transistors.
- Analyze and design digital circuits containing logic gates and combinatorial logic modules.

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
c) 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

e) 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

Homework:

Problem sets will be assigned every week and will be collected at the beginning of the class meeting on the following week. Late homework submissions will NOT be accepted. Copying from other students, the internet, or other sources is NOT allowed. You are encouraged to discuss the assignments with classmates but you must hand in your own individual work.

Recitation Session:

The purpose of the recitation session is to allow additional time for students to answer questions, review homework problem solutions, conduct review and practice for exam preparation, review exam performance, and work on projects. It is recommended that you attend the recitation session and utilize it to maintain continuous progress in relation to course material and your project.

Exams:

There will be two mid-term exams and a final exam in the course. Students should expect that all exams will be closed book and closed notes. Use of calculators is permitted, but all formulas, notes, etc. stored in the calculator memory must be cleared prior to the exam. Use of cell-phones or smart phones as calculators for the exams is not permitted.

Project

The projects will be performed in small teams consisting of 3-5 students. The size and scope of the project is expected to be proportional to the team size. All students are expected to contribute equally to the team effort. In community-related projects, the team is expected to: (i) design and build a hands-on module related to class material, and (ii) design and conduct a 40-minute hands-on mini-workshop that demonstrates a concept relevant to the course material to a class of K-12 students at a local school utilizing the developed hands-on module of (i). In industry-related projects, the team is expected to solve an engineering problem in the context of a business opportunity and each project includes designing and building a prototype.
**Schedule:**

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<th>Topic</th>
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<td>1-Sep</td>
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<td>Course Organization</td>
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<td>3-Sep</td>
<td>2.1-2.2</td>
<td>Fundamentals of Electric Circuits</td>
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<td>8-Sep</td>
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<td>10-Sep</td>
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<td>Fundamentals of Electric Circuits</td>
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<tr>
<td>15-Sep</td>
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<td>Resistive Network Analysis</td>
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<td>22-Sep</td>
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<td>Capacitors and Inductors</td>
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<td>Phasors</td>
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<td>1-Oct</td>
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<td>6-Oct</td>
<td>4.3</td>
<td>Mid-term 1 review (recitation), phasors continued</td>
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<td>8-Oct</td>
<td>5.1-5.2</td>
<td>Transient response and Laplace Transforms</td>
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<td>13-Oct</td>
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<td>15-Oct</td>
<td>5.2-5.4</td>
<td>Transient response – initial and final conditions</td>
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<td>20-Oct</td>
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<td>Transient response of 2(^{rd}) order circuits</td>
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<td>22-Oct</td>
<td>6.1-6.2</td>
<td>Frequency response</td>
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<td>Frequency response and filters</td>
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<td>Operational Amplifiers</td>
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<td>Active Filters</td>
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<td>Semiconductors</td>
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<td>Mid-term 2</td>
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<td>10-Nov</td>
<td>9.4-9.5</td>
<td>Diodes and rectification</td>
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<td>10.1-10.2</td>
<td>Mid-term 2 review (recitation); Bipolar junction transistors</td>
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<td>17-Nov</td>
<td>10.3-10.4</td>
<td>Bipolar junction transistor operating modes</td>
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<td>19-Nov</td>
<td>12.1-12.3</td>
<td>Digital logic &amp; Boolean algebra</td>
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<td>24-Nov</td>
<td>12.3-12.4</td>
<td>Boolean algebra</td>
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<td>26-Nov</td>
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<td>Thanksgiving Break (25-29(^{th}))</td>
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<td>1-Dec</td>
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<td>Combinatorial logic</td>
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<td>3-Dec</td>
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<td>Project presentations</td>
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<td>10-Dec</td>
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<td>Project presentations/Review</td>
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<td>Final exam: 10:30 am - 1:15 pm</td>
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**Textbook:** This course and lectures will largely follow the textbook entitled:

*Fundamentals of Electrical Engineering [Paperback]*

Author: Giorgio Rizzoni  
Publisher: McGraw Hill Higher Education (May 1, 2008)

**Grading Policy:**
Midterm 1 exam: 15%
Midterm 2 exam: 15%
Homework: 10%
Project: 20%
Final exam: 40%

**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.

**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)

**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/](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-Emergency: (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