THE PENNSYLVANIA STATE UNIVERSITY
MONT ALTO CAMPUS
Spring 2020

EE 210 - Circuits and Devices

Instructor: Dr. Khaled Amleh, Associate Professor of Electrical Engineering
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Office location: 314 Sci/Tech. Building
Office Hours: MWF 1:00 - 2:30
Course title: EE 210 “Circuits and Devices”
Prerequisite: PHYS 212, Concurrent: MATH 250
Section: 001
Credits: 4
Class Meeting: MWF 4:40PM - 5:30PM and 6:00PM - 7:15PM

Text and Material:

• TEXTBOOK:

• CLASS NOTES:
  Class notes are available on Canvas (https://canvas.psu.edu). You will need your user id and password to access the notes.

• LAB NOTEBOOK:
  Each group member MUST have a bound Lab Notebook (No loose leaves). You are expected to make regular entries related to each lab experiment and what each group member did. Entries into this notebook will also aid in preparing your final reports.

• COMPUTER SOFTWARE:
  We will be using Multisim circuit design to simulate electric circuits behavior. This program is available on all computers in the Physics Lab, Science/Technology Bldg.

Course Overview:

Circuits and Devices Introduces electrical circuit analysis, electronic devices, operational amplifier, capacitors and inductors, RL/RC/RLC circuits, time-domain transient analysis, sinusoidal steady state analysis and ac power circuit analysis.
**Course Objectives:**

This course provides the fundamental education in electrical and electronic circuits analysis to all electrical and computer engineering and engineering science majors. Students should be able to do the following upon completion of this course:

- Analyze basic DC resistive circuits using ohm’s law, Kirchhoff’s current and voltage laws.
- Analyze DC/AC circuits containing independent and dependent sources using Node-Voltage, Mesh-Current, Thevenin and Norton theorems, Superposition, and Source transformation techniques.
- Analyze basic Diode and Op – Amp circuits using circuit analysis techniques.
- Analyze the Natural and Step (Transient) responses of RL, RC circuits and RLC circuits with AC source.
- Become master in circuit simulations using computer software (e.g., Multisim).
- Learning technical - writing skills by writing laboratory reports
- Become a team player working on group projects by developing teamwork skills.

**Laboratory Projects**

Laboratory activities consist of a 3-hour hands-on experiment per week and one Final Project. The experiments are designed to help students understand concepts and implementation of theories covered in lectures. The students are required to submit a formal laboratory report for each experiment, that include:

- **Cover Page**
  - Should have your name and your lab partners names
  - The name and number of the lab
  - The date

- **Introduction/Objectives**
  - What is the purpose of this lab?
  - What are the various sections attempting to teach?

- **Summarized Procedure**
  - Briefly describe the setup for the various activities and measurements

- **Results**
  - State the results and perform any necessary analysis breaking it down according to the activity
• Conclusion/Discussion

  – Draw conclusions from your experiments and discuss any unexpected or interesting results

Class Policies

The following are ground rules to help us maintain a steady progress through the semester:

• Attendance

  – Attendance will not be taken on regular basis, however, students are expected to attend all classes.
  
  – Lab attendance is mandatory. If you miss a lab, you will receive a zero for that lab experiment.

• Assignments and Reports

  – Assignments are project based with computer simulations. Exams are a mix of writing, analyzing and evaluating electric circuits.

  – Assignments will be posted on Canvas (https://canvas.psu.edu) on weekly basis.

  – Assignments are due at the start of the class before the lecture begins. Late assignments will not be accepted.

  – In some cases, you will be asked to perform some pre-lab exercises (Multisim simulations, etc.) These pre-lab exercises are to be completed individually, rather than as a team pre-lab. All pre-lab reports are due at the start of the corresponding laboratory.

  – Lab experiments will be completed during one lab session and the lab report will be due the following week at the beginning of the lab period.

  – Make up exams/homework are only permitted for extreme cases and must be supported by written documentation, such as a doctor’s note.

  – It is the student’s responsibility to get any missing notes or assignments. If you miss a class, make sure to contact me or some one else in class to get important information that you might have missed.

  – Assignment papers must be clean, easy to follow and stapled. Do not fold or rip from a spiral notebook.

  – Students are encouraged to work in groups to study. However, you have to submit your own original work.
**General Conduct**

- Upon completion of your laboratory assignment, you will be expected to clean up your lab bench, put cables and other materials away, and turn off the instruments.
- The computers provided in the laboratory are for use with the assignment and/or to access copies of the laboratory assignments. These computers are not to be used to “surf the net” or for any other purposes.
- Food and drink are not allowed in the laboratory. Spills can lead to serious electrical shock and damage to equipment.
- All phones and any other electronic devices must be turned off during the class session.
- Courteous and mature behavior is expected. Inappropriate behavior towards other students or inappropriate comments will not be tolerated.

**Contacts**

- I will keep in touch with you over the course of the semester through e-mail. Please check your e-mail, frequently.
- When sending me an email, make sure to use your PSU email account. I do not respond to emails from unidentified sources.
- Feel free to send me any comment or thought about the course. I will be glad to hear from you.

**Grading System**

- Grades will be distributed as follows:
  - 3 exams 45% (15% each)
  - Final exam 15%
  - Homeworks 15%
  - Lab reports 25%

- Final letter grade will be assigned as follow:
  
  94 – 100 A
  90 – 93 A-
  87 – 89 B+
  83 – 86 B
  80 – 82 B-
  75 – 79 C+
  70 – 74 C
  60 – 69 D
  below 60 F
Academic Integrity

Academic integrity is a basic guiding principle for all academic activity at The Pennsylvania State University, and you are expected to act in accordance with this principle. Academic integrity is the pursuit of scholarly activity in an open, honest and responsible manner. Academic integrity includes a commitment not to engage in or tolerate acts of falsification, misrepresentation or deception. Such acts of dishonesty violate the fundamental ethical principles of the University community and compromise the worth of work completed by others. The list of academic integrity violations includes cheating, copying on a test, plagiarism, acts of aiding or abetting, submitting previous work, tampering with work, ghosting, altering exams and computer theft of programs/ materials. An explicit list of examples of academic integrity violations is found at: http://www.engr.psu.edu/Forms/AcademicIntegrity/precedent_students.pdf. This class will be expected to follow the academic integrity guidelines. Violations will be addressed using the steps outlined at http://www.engr.psu.edu/Forms/AcademicIntegrity/policies.pdf

Services for Students with Disabilities:

In order to receive consideration for reasonable accommodations, you must contact the Disability Coordinator, Kendra Wolgast, located on the first floor of the General Studies Building in the Student Success Center. She can be reached at 749-6045 or kmw24@psu.edu, Students must participate in an intake interview and provide documentation: http://equity.psu.edu/sdr/guidelines. If the documentation supports your request for reasonable accommodations, the disability services office will provide you with an accommodation letter. Please share this letter with your instructors and discuss the accommodations with them as early in your courses as possible. You must follow this process for every semester that you request accommodations.

Counseling and Psychological Services:

Many students at Penn State face personal challenges or have psychological needs that may interfere with their academic progress, social development, or emotional well-being. The university offers a variety of confidential services to help you through difficult times, including individual and group counseling, crisis intervention, consultations, and mental health screenings. These services are provided by staff that welcome all students and embrace a philosophy respectful of clients, cultural and religious backgrounds, and sensitive to differences in race, ability, gender identity and sexual orientation. Counseling Services at Mont Alto in 104 Conklin Hall Phone: 717-749-6125 or drp16@psu.edu (Darlene Pasi) Penn State Crisis Line (24 hours/7 days/week): 877-229-6400 Crisis Text Line (24 hours/7 days/week): Text LIONS to 741741
Educational Equity and Report Bias:

Consistent with University Policy AD29, students who believe they have experienced or observed a hate crime, an act of intolerance, discrimination, or harassment that occurs at Penn State are urged to report these incidents as outlined on the University’s Report Bias webpage: http://equity.psu.edu/reportbias.

Inclement Weather Policy:

In bad weather, please call 749-6090 or visit campus website http://montalto.psu.edu for campus status.

Schedule:

The following topics will be covered:

• Basic Components and Basic Circuits (2 classes)
  – Charge, Current, Voltage, and Power.
  – Voltage and Current Sources.
  – Ohm’s Law.

• Voltage and Current Laws (2 classes)
  – Kirchhoff’s Voltage and Current Laws
  – Series and Parallel Connected Independent Sources
  – Resistors in Series and Parallel
  – Voltage and Current Division

• Basic Circuit Analysis (2 classes)
  – Nodal Analysis and The Supernode
  – Mesh Analysis and The Supermesh

• More Analysis Techniques (4 classes)
  – Linearity and Superposition
  – Practical Sources and Source Transformations
  – Thevenin Equivalent Circuits.
  – Norton Equivalent Circuits.
  – Maximum Power Transfer
  – Delta-Wye Conversion

• EXAM 1
• Operational Amplifier (2 classes)
  – The Open-Loop Op Amp
  – The Idealized Op Amp
  – Op Amp Circuits and Cascaded Stages.
  – Practical Considerations and Saturation

• Capacitors and inductors (2 classes)
  – Calculating the Energy Stored in Inductors and Capacitors.
  – Reducing Series/Parallel Combinations for both Capacitors and Inductors.
  – Op Amp Circuits Containing Capacitors

• Basic RL and RC Circuits (4 classes)
  – Basic Concepts and Transient Response
  – Solution of 1st-order Differential Equations
  – Exponential Decay Properties
  – Source-free RC and RL Circuits
  – Driven RC and RL Circuits

• The RLC Circuit (4 classes)
  – Lossless LC Circuits
  – Series and Parallel RLC Circuits
  – Solution to 2nd-order Differential Equations
  – Solution to source-free RLC Circuits
  – Solution to driven RLC Circuits

• EXAM 2

• Sinusoidal Steady State Analysis (4 classes)
  – Complex Number Review
  – Sinusoidal Function Review.
  – Sinusoidal Steady State Analysis
  – Impedance and Admittance.
  – The Phasor Notation.
  – Circuit Analysis Techniques Using Phasors.
  – Frequency Response and Bode Plots
• AC Power Circuit Analysis (3 classes)
  – Power Dissipation in AC Circuits
  – Average, Effective, and Root-Mean-Square (RMS) Value
  – Average Power for Circuits with Time-varying Inputs
  – Maximum Power Transfer (revisited)
  – Complex Power
  – Power Factor
• EXAM 3

Laboratory Schedule
• Lab 1: Instrumentations - Part I
  – Introduction to the basic functionality of a Digital Multi-Meter (DMM), a prototyping board, a power supply and the relationship between a physical resistor and its mathematical model.
• Lab 2: Instrumentations - Part II
  – During this laboratory, the emphasis is on learning how to use the instrumentation in the lab, which consists of an oscilloscope and a function generator.
• Lab 3: Introduction to Voltage and Current Division
  – In this lab you will familiarize yourself with the potentiometer and apply Ohm’s law and Kirchhoff’s relationships to derive voltage and current division rules.
• Lab 4: Multsim Tutorial
  – Introduction to Multisim, a circuit simulation software package by National Instruments, that allows you to graphically build AC/DC circuit schematics, simulate, measure and analyze the circuit’s response using virtual lab instruments.
• Lab 5: Analysis of Networks - Part I
  – Introduction to nodal voltage and mesh current methods for solving circuits.
• Lab 6: Analysis of Networks - Part II
  – This lab verifies the Thévenin equivalent of a circuit, the maximum power transfer theorem, and the source superposition.
• Lab 7: Operational Amplifiers (Op-Amps) - Part I
  – In this lab you will verify the open-loop gain of the op-amp, and construct a closed loop inverting amplifier.

• Lab 8: Operational Amplifiers (Op-Amps) - Part II
  – In this lab, you will continue your study of op-amps by considering the characteristics of a closed-loop, non-inverting amplifier, a unity gain amplifier, and a summing amplifier.

• Lab 9: First Order RL and RC Circuits
  – The objective of this experiment is to observe the response of the first order RC and RL circuits.

• Lab 10: Second Order RLC Circuits
  – This experiment demonstrates the response of a series and a parallel RLC circuit. The over-damped, critically damped and under-damped responses are derived for each circuit.

• Lab 11: Sinusoidal Steady State
  – This experiment demonstrates the properties of ac networks, the concept of impedance and Phasors.