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: By appointment.
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.

• 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

Penn State welcomes students with disabilities into the University’s educa
tional programs. If you have a disability-related need for reasonable academic adjust-
ments in this course, contact the Disability Coordinator, Kendra Sites, 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. For further information re-
garding the Penn State Student Disability Resources, please visit their web site at
www.equity.psu.edu/ods/. Instructors should be notified as early in the semester
as possible regarding the need for reasonable academic adjustments.
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

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 (3 classes)
  - The Open-Loop Op Amp
  - The Idealized Op Amp
  - Op Amp Circuits and Cascaded Stages.
  - Practical Considerations and Saturation

• Capacitors and inductors (3 classes)
  - Voltage-Current relationship of ideal Capacitors/Inductors.
  - 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
    * over damped
    * under damped
    * critically damped
  - Solution to source-free RLC Circuits
  - Solution to driven RLC Circuits

• EXAM 2

• Sinusoidal Steady State Analysis (5 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.
  – During this laboratory, the emphasis is on learning how to use the instrumentation in the lab, which consists of an oscilloscope, function generator, multimeter, and power supply.

• Lab 2: Elementary Measurements.
  – Ohm’s Law
  – Kirchhoff’s Relationships.
  – AC Waveforms

• Lab 3: Thevenin’s Circuit.
  – This laboratory highlights Thevenin equivalent circuits using simple voltage and resistance measurements.

• Lab 4: Exponential waveforms
  – This project will illustrate the exponential waveforms produced when a square wave is applied to either an RC or an RL circuit.

• Lab 5: Digital-to-Analog Converter

• Lab 6: Oscilloscope Display of Electrical Conduction Characteristics

• Lab 7: Operational Amplifiers (Op-Amps) - Part 1

• Lab 8: Operational Amplifiers (Op-Amps) - Part 2