EE 210 – Circuits and Devices

Designation: Required course for electrical engineering, computer engineering and engineering science majors.

University Bulletin Description: EE 210: (4) Introduction to electrical circuit analysis, electronic devices, amplifier, and time-domain transient analysis.
Prerequisite**:** PHYS 212; Prerequisite or Concurrent: MATH 250.

Prerequisites by Topics:
1. Understanding of and ability to use basic and intermediate algebra, calculus & trigonometry, complex number and differential equations in solving linear circuits.
2. Understanding the physical properties of basic circuit elements (e.g., resistors, capacitors, and inductors)

Textbook/Required Materials:
Basic Engineering Circuit Analysis, 8ed., Irwin, D. and Nelms, M., Wiley, 2006

Learning Outcomes:
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:
1. Analyze DC resistive circuits containing independent and dependent sources through the use of ohm's law, Kirchhoff's current and voltage laws, and nodal/mesh analysis.
2. Simplify the analysis of DC circuits through the use of Thevenin and Norton theorems, superposition, and source transformation.
3. Analyze basic diode and operational amplifier circuits using circuit analysis techniques.
4. Understand the basic properties of capacitors and inductors.
5. Analyze the transient responses of RL, RC circuits and RLC circuits.
6. Analyze AC circuits using the phasor concepts
7. Simulate circuits using computer software (e.g., Multisim).
8. Use laboratory test equipment such as oscilloscopes, function generators, and digital multimeters.
9. Design, build and test laboratory prototypes of basic circuits.
10. Keep laboratory notebooks and write technical lab reports.
12. Work effectively in a group on the completion of a small-scale technical project.

Topics:
1. Electric charges and coulomb's law (1 class)
2. Definition of voltage, current, and power (1class)
3. Voltage and current sources and Ohm's law (2 class)
4. Kirchhoff's voltage and current laws (1 class)
5. Resistors in Series & Parallel and Voltage and Current Divider Rules (2 classes)
6. Node – Voltage and Mesh – Current Analysis Techniques (4 classes)
7. Ideal Op – Amp Circuits Analysis (4 classes)
8. Linearity and the Superposition Principle (1 class)
9. Thevenin and Norton Equivalent Circuits (5 classes)
10. Ideal Diode Circuits (3 classes)
11. Capacitors and Inductors (2 classes)
12. 1^{st} Order RC and RL circuits (4 classes)
13. 2^{nd} Order LC and RLC circuits (4 classes)
14. Phasors and Impedance/Admittance (2 classes)
15. Sinusoidal Steady State analysis (3 classes)

16. Frequency Response – Bode Plots, Decibel (1 class)
17. Average, Reactive, and Complex Powers (3 classes)
18. Power Factor and Power Factor Correction (1 class)

Class/laboratory Schedule:
Three 50-minute lectures and one 3-hour laboratory per week.

Computer usage:
Multisim is used to simulate and analyze electrical and electronic circuits.

Laboratory projects and /or assignments:
Laboratory activities consist of eight weekly 3-hour hands-on experiments and one multi-week Final Project.

1. The eight weekly experiments are designed to help students understand difficult concepts through active learning. In addition, the experiments expose students to effective laboratory practice and the use of electronic laboratory equipment. Specific lab experiments include:
   a. Introduction to basic test equipment: digital multimeter, digital oscilloscope, function generator, and power supply (2 weeks)
   b. Voltage and current division and the use of potentiometers (1 week)
   c. Modeling circuits in Multisim (1 week)
   d. The operational amplifier (1 week)
   e. Operational amplifier canonical circuits (1 week)
   f. Operation amplifier circuit design (1 week)
   g. Basic diode circuits (1 week)
   h. Capacitors, inductors and frequency response (1 week)

2. The Final Project is designed to incorporate elements from all eight weekly experiments into an audio mixer/tone-control circuit with an LED volume display. Students design the individual sub-circuits that make up this project, integrate them into a single circuit, layout the circuit using software CAD tools, and finally build/test the circuit. Students write a formal lab report once the project is completed.

Contribution to Meeting the Requirements of Criterion 5. Curriculum:
This course contributes to both the engineering topics and design components.

Relationship to Program Outcomes:
O.1.1. Graduates will possess mathematics skills necessary for electrical engineering.
O.1.3. Graduates will have attained computer proficiency.
O.2.1. Graduates will understand how to analyze and design simple electrical/electronic circuits.
O.2.2. Graduates will understand electronic devices.
O.5.1. Graduates will have good teamwork skills.
O.5.2. Graduates will possess good oral and written communication skills.

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