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Course Outline for ENGR 44

INTRODUCTION TO CIRCUIT ANALYSIS

Effective: Fall 2018

I. CATALOG DESCRIPTION:
ENGR 44 — INTRODUCTION TO CIRCUIT ANALYSIS — 4.00 units

Introduction to analysis methods for electrical circuits. Topics include general techniques for circuit analysis, simple resistive circuits, inductors, capacitors, mutual coupling, operational amplifier circuits, transient and steady-state analysis of first-order and second-order circuits. Lab topics include introduction to the use of electronic test equipment, designing, assembling, testing and simulating various resistive, LC, RC and operational amplifier circuits. Simulations are done with available circuit simulations codes such as PSpice.

3.00 Units Lecture 1.00 Units Lab

Prerequisite
PHYS 1A - General Physics I
with a minimum grade of C

Grading Methods:
Letter Grade

Discipline:
- Engineering

	MIN
Lecture Hours:	54.00
Expected Outside of Class Hours:	108.00
Lab Hours:	54.00
Total Hours:	216.00

II. NUMBER OF TIMES COURSE MAY BE TAKEN FOR CREDIT: 1

III. PREREQUISITE AND/OR ADVISORY SKILLS:

Before entering the course a student should be able to:

A. PHYS1A
1. Use algebra, trigonometry, geometry, and calculus to model physical phenomena and calculate relevant physical parameters.
2. Design, perform, analyze, and assess the effectiveness of simple experiments to demonstrate physical phenomena.
3. Operate standard laboratory equipment and analysis tools, including digital data acquisition systems, spreadsheet programs, and plotting programs.
4. Analyze real-world experimental data, including appropriate use of error propagation, units and significant figures.
5. Relate the results of experimental data to the physical concepts discussed in the lecture portion of the class.
6. Write comprehensive laboratory reports that describe the scientific basis of the experiment, clearly explain the experimental procedure, present a complete mathematical analysis of data and uncertainties, and evaluate the effectiveness of the experiment based on calculated uncertainties.

IV. MEASURABLE OBJECTIVES:

Upon completion of this course, the student should be able to:

A. Analyze circuits using mesh current and node voltage simultaneous equations
B. Apply circuit theorems to simplify analysis of dc and ac circuits with independent and dependent sources
C. Determine the natural response of first and second order circuits
D. Determine the forced response of first and second order circuits
E. Analyze circuits with the appropriate diagnostic instruments, e.g. oscilloscope, DVM, etc.
F. Determine equivalent lumped magnitudes for r, l, c, y and z circuit combinations
G. Assemble physical circuits and measure voltages and currents using oscilloscopes, digital voltmeters etc.
H. Determine the steady-state response of R, RL, RC and RLC circuits
I. Utilize common circuit simulation programs, such has PSpice to analyze circuits and predict performance

V. CONTENT:
A. Charge and current

B. Voltage and power
C. Circuits, nodes and branches
D. Kirchhoff's voltage law
E. Kirchhoff's current law
F. Independent current and voltage sources
G. Dependent current adn voltage sources
H. Resistance
I. Capacitance
J. Inductance
K. Mutual coupling
L. Circuit analysis techniques
    1. Series circuit elements
    2. Parallel circuit elements
    3. Voltage dividers
    4. Current dividers
    5. Mesh-current method
    6. Node-voltage method
    7. Source transformations
    8. Superposition
    9. Thevenin equivalents
    10. Norton equivalents
M. Resistive circuit analysis
N. Power and energy relationships
O. Transient circuit analysis
P. Steady-state circuit analysis
Q. First-order circuits
R. Second order circuits
S. Energy storage and its system implications
T. Power dissipation and its system implications

VI. METHODS OF INSTRUCTION:

A. **Discussion** - Review and discussion of lecture topics
B. Group problem solving
C. **Projects** - Design, assemble and demonstrate projects in project teams
D. **Lab** - Assemble electrical circuits and measure electrical parameters
E. **Lecture** -

VII. TYPICAL ASSIGNMENTS:

A. Reading:
    1. Read and study chapter 8, "Natural and Step Responses of RLC Circuits" Nilsson and Riedel. Be prepared to participate in class discussion on finding the natural responses of various second order circuits.
B. Problem solving:
    1. Solve problems 7.1 7.5, 7.46 in "Electric Circuits" by Nilsson and Riedel. Show all work required to get to answers.
C. Laboratory performance:
    1. Introduce students to RLC electronic components and explain how they function.
        a. Build up circuit on breadboard.
        b. Calculate the answer to the circuit problem, and verify with an ohm-meter, voltmeter, etc., the calculations performed for the circuit analysis.
        c. Simulate circuits to predict performance using PSpice and validate predictions with electricalmeasurements.

VIII. EVALUATION:

A. **Methods**

1. Exams/Tests
2. Quizzes
3. Projects
4. Home Work
5. Lab Activities
6. Final Performance

B. **Frequency**

1. Weekly home work assignments
2. Quizzes as needed
3. Examinations at appropriate intervals throughout the semester
4. Lab project coordinated with lab activities at appropriate time in semester
5. Weekly lab activities
6. Final examination

IX. TYPICAL TEXTS:

1. Reed, Michael and Ron Rohrer *Applied Introductory Circuit Analysis for Electrical and Computer Engineers.*, Macmillan Publishing, 1999.
2. Schwarz, Steven, and William Oldham. *Electrical Engineering: An Introduction.*, Oxford University Press, 1993.
3. Boylestad, Robert. *Introductory Circuit Analysis.* Thirteenth ed., Pearson, 2015.
4. Nilsson, James, and Susan Riedel. *Electric Circuits.* 10th ed., Pearson, 2015.

X. OTHER MATERIALS REQUIRED OF STUDENTS:

A. Scientific calculator capable of coordinate conversions
B. Laptop computer with Word, Excel and Powerpoint and a version of PSpice