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PHYS 242 Electric Circuits Analysis

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Instructor: Dr. Haider Khaleel  
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Office Hours: Tuesdays and Thursdays 9:45 AM-11:00 AM or by appointment  
Meeting Time: The class meets on Tuesdays and Thursdays 8:30-9:45 PM  
Co-requisite: PHYS 243  

Grading Policy:  
Homework 20% (6-8 assignments)  
Performance and Attendance 5%  
Quizzes 10% (5 pop quizzes)  
Midterm 20%  
Project 15%  
Final 30%  

Course Description and Goals:  
This course covers the fundamental concepts and laws of electric AC and DC circuits. Students will learn about Kirchhoff's laws, passive linear components including resistor, capacitor, inductor, and circuit design. Analysis techniques such as: Nodal, mesh, superposition theorem, Thevenin's and Norton's theorems will be covered. Moreover, transient analysis of linear circuits, power and power transfer, impedances, ideal transformers, operational amplifiers, and filters will be covered as well. A final project based on the covered material is required. The goal of the course is to allow students to gain a conceptual understanding of the course material in a manner that fosters critical thinking and problem solving skills.  

Course Objectives:  
A- Obtain a comprehensive understanding of the fundamental concepts and laws of electric circuits.  
B- Obtain analytical skills for solving problems in Electricity.  
C- Obtain a complete knowledge of the analysis and design of AC and DC circuits in addition to filters.
<table>
<thead>
<tr>
<th>ABET Student Outcomes</th>
<th>Course Learning Objectives</th>
<th>Level of Support</th>
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<tbody>
<tr>
<td>(a) an ability to apply knowledge of mathematics, science, and engineering</td>
<td>A,B,C</td>
<td>4</td>
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<td>(b) an ability to design and conduct experiments, as well as to analyze and interpret data</td>
<td>A,B,C</td>
<td>5</td>
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<td>(c) an ability to design a system, component, or process to meet desired needs</td>
<td>A,B,C</td>
<td>5</td>
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<td>(d) an ability to function on multi-disciplinary teams</td>
<td>B,C</td>
<td>5</td>
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<td>(e) an ability to identify, formulate, and solve engineering problems</td>
<td>A,B,C</td>
<td>5</td>
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<td>(f) an understanding of professional and ethical responsibility</td>
<td>A,B,C</td>
<td>5</td>
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<td>(g) an ability to communicate effectively</td>
<td>B</td>
<td>3</td>
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<td>(h) the broad education necessary to understand the impact of engineering solutions in a global and societal context</td>
<td>A,B,C</td>
<td>4</td>
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<tr>
<td>(i) a recognition of the need for, and an ability to engage in lifelong learning</td>
<td>B</td>
<td>3</td>
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<td>(j) a knowledge of contemporary issues</td>
<td>A,B</td>
<td>3</td>
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<td>(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice</td>
<td>A,B,C</td>
<td>5</td>
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<td>(l) one or more technical specialties that meet the engineering-related needs of companies in Cincinnati metro area</td>
<td>A,B,C</td>
<td>5</td>
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Tentative Outline of Course:

1 Fundamental Concepts of DC Circuits:
   1.1 Introduction and systems of units
   1.2 Charge and current
   1.3 Voltage
   1.4 Power and energy
   1.5 Circuit elements
   1.6 Applications

2 Basic Laws:
   2.1 Ohm’s law
   2.2 Nodes, branches, and loops
   2.3 Kirchhoff’s laws
   2.4 Series resistors and voltage division
   2.5 Parallel resistors and current division

3 Methods of Analysis:
   3.1 Nodal Analysis
   3.2 Nodal Analysis with Voltage Sources
   3.3 Mesh Analysis
   3.4 Mesh Analysis with Current Sources
   3.5 Nodal and Mesh with Dependent Sources

4 Circuit Theorems:
   4.1 Linearity Property
   4.2 Superposition
   4.3 Source Transformation
   4.4 Thevenin’s Theorem
   4.5 Norton’s Theorem
   4.6 Maximum Power Transfer
   4.7 Applications

5 Capacitors, Inductors, and Transformers:
   5.1 Capacitors
   5.2 Series and Parallel Capacitors
   5.3 Inductors
   5.4 Series and Parallel Inductors
   5.5 Transformers

6 Operational Amplifiers
   6.1 Ideal Op Amps
   6.2 Inverting Op Amps
   6.3 Non-inverting Op Amps
   6.4 Summing Amplifier
   6.5 Difference Amplifiers
   6.6 Applications

7 First Order Circuits
7.1 RC Circuits
7.2 RL Circuits
7.3 Response of RC and RL Circuits
7.4 Transient Analysis
7.5 Applications

8 AC Circuits, Sinusoids and Phasors:
8.1 Sinusoids
8.2 Phasors
8.3 Phasor Relationships for Circuit Elements
8.4 Impedance and Admittance
8.5 Kirchoff’s Laws in the Frequency Domain
8.6 Impedance Combinations

9 Sinusoidal Steady State Analysis:
9.1 Nodal Analysis
9.2 Mesh Analysis
9.3 Superposition Theorem
9.4 Source Transformation
9.5 Thevenin and Norton Equivalent Circuits
9.6 Operational Amplifier
9.7 RLC and Resonant Circuits

10 Filters
10.1 Introduction to Analog Filters

POLICIES:

CLASSROOM CONDUCTS: In order to create an appropriate environment for teaching and learning, students must show respect for their instructor and fellow students. Listed below are a few guidelines for classroom behavior. Students are expected to follow these rules to ensure that the learning environment is not compromised.

- **Class Participation**: You are expected to be in class the entire class time. Please do not enter late or leave early. Some exceptions may be made, particularly in emergency situations. Your participation in the class is crucial for assessment and material flow.
- **Absences**: Inform the instructor in advance, if you know you are going to miss a class. Also, take responsibility for getting missed assignments from other students. Your instructor is not responsible for re-teaching the material you missed due to an absence or being late.
- **Internet browsing/texting**: The use of handheld devices is prohibited during class. Please turn off your cell phone/laptop and listen to lectures. Check your emails before coming to class.

ASSIGNMENTS
Homework assignments must be submitted in class. Late submissions will receive 15 points deduction for each late day, including weekends.

EXAMS: Exams will consist of problems designed to test your understanding of the concepts covered in class. Anyone missing an exam will receive a zero grade for that exam. Make-up exams will only be given with a doctor's slip stating that you were too ill on the day of the exam to attend, or documented extraordinary circumstances.