ENGR 017 INTRODUCTORY CIRCUIT ANALYSIS

**Required Course**

**2002 – 2004 Catalog Data:** ENGR 17. Introductory Circuit Analysis. Writing of mesh and node equations. DC and transient circuit analysis by linear differential equation techniques. Applications of laws and theorems of Kirchoff, Ohm, Thevenin, Norton and maximum power transfer. Sinusoidal analysis using phasors, average power. Prerequisite: PHYS 011C and MATH 045; either the math or physics may be taken concurrently, but not both. 3 units.

**Text:** Electric Circuits, Sixth Edition, by James W. Nilsson & Susan A. Riedel and Intro to Circuit Analysis by J-P. R. Bayard, are required. The student exercise manual is highly recommended.

**Support Tool:** A calculator able to perform complex matrix operations is recommended.

**Course Objectives:** This course presents the fundamentals of circuit analysis. Beginning with traditional subjects such as defining voltage, current, sources and Ohm's law, it proceeds to develop general and powerful procedures (nodal and mesh analyses) used in analyzing electric circuits; these methods are applied first to resistive circuits and later to circuits with more complex elements such as capacitor, inductors and operational amplifiers. Circuits with DC sources as well as with sinusoidal sources are analyzed.

**Prerequisites by Topic:**

1. Fundamentals of electric charge.
2. Potential rises and drops in resistive circuits.
3. Basic circuit elements.
4. Integral calculus.

**Topics Covered/Class Schedule/Evaluation:**

1. Voltage and current divisions.
2. Nodal and mesh analyses for DC circuits.
4. Source transformations.
5. Maximum power transfer.
6. Thevenin and Norton models for DC circuits.
10. Sinusoidal analysis – Phasor / frequency-domain analysis.
11. Nodal, mesh analyses, Norton and Thevenin models for sinusoidal circuits.
12. Sinusoidal power.

**Course Outline**

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<th>Week</th>
<th>Topic</th>
<th>Quizzes (Indiv)</th>
<th>Quizzes (Group)</th>
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<tr>
<td>Exam</td>
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<tr>
<td>½</td>
<td>Basic circuit concepts.</td>
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<td>System of units.</td>
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<td>Charge and current concepts.</td>
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<td>Various types of source and the concept of power.</td>
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<td>½ - 3/2</td>
<td>Basic laws of circuit theory.</td>
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<td>Ohm's law.</td>
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Kirchoff's laws.
Analysis of simple (one node pair or one loop) circuits.
Voltage and current division.  QI
1.5-5  Circuit analysis.
Nodal analysis.  QI
Mesh analysis.
The principle of superposition.
Thevenin and Norton theorems.  QG  E
6  Operational Amplifiers.
7  More complex circuit elements.
Introduction to inductors and Capacitors.
Current-voltage relationship for these elements.
8  RL and RC circuits with zero input.  QI
9  Introduction to the step function and its application to circuits.
10-11  The RLC circuit.
Natural response.
Various types of damped response.
The complete response.  QG  E
12-14  Circuits with sinusoidal input.
Introduction to the phasor concept.
Phasor relationship for various circuit elements (R, L, C).
Sinusoidal steady-state response.  QG
15  Complex, average, RMS and maximum power concepts.
16  Exam Week - Final Exam  E

**Evaluation**

Homework assignments are the best way to prepare for the exams and quizzes. They are assigned weekly, but are not graded. Instead seven 20-25-minute quizzes are administered in class (4 individually and 3 in groups of two students). These quizzes are targeted evaluation instruments seeking to measure student performance in one specific topic of the course. For example, the second quiz will ask learners to calculate the node voltages for a given DC circuit. Quizzes (weight of 2.86% each) allow learners time to make adjustments in their knowledge base before an exam. The use of group quiz is typically reserved for more complicated types of problems, such as the calculation of a Thevenin’s model for a circuit with a dependent source. In the group setting, both participants benefit regardless of their level of expertise. Group quizzes help form a community of learner, and improve class attendance.

Using the course website ([http://gaia.ecs.csus.edu/~bayardj/engr17/inde2.html](http://gaia.ecs.csus.edu/~bayardj/engr17/inde2.html)), students can assess their learning any time, privately (online quizzes), and use the appropriate tutorial module in the multimedia section to reinforce circuit concepts and skills.

Homework (0%), computer-based exercises (0%), 7 quizzes (20%), 2 exams (25% each), and a final exam (30%). All Exams and quizzes are closed notes – closed book. The final exam will emphasize the later topics covered after the second, however using concepts learned throughout the course.

**Contribution of Course to the Professional Education Component:**

- Homework assignments and exams provide students analytical and critical-thinking skills.
- Group activity introduces students early in the curriculum to the need and benefits of team work.
- Science and Design Content Distribution: Science – 3 units or 100%

**Relationship of Course to Program Outcomes:**
• #1. Knowledge of mathematics: Considering the transient responses of RLC circuits, first and second-order differential equations are developed and used to trace the flow of energy as DC sources are switched on or off.
• #2. Knowledge of basic engineering science: Fundamental concepts and laws pertaining to current flow and potential/voltage learned in physics are the basis for nodal and mesh analysis used throughout the course.
• #3. Problem solving: This course applies complex arithmetic, matrix algebra, and differential equations to the solution of circuit problems.
• #4. Knowledge of core EEE topics: Circuit analysis is one of the fundamental topics of an electrical and electronic engineering curriculum. This course provides the basis for the whole curriculum.

Course Coordinator: Jean-Pierre R Bayard, EEE

Date: May 15, 2003