Lecture Contact Hours: 48-54; Homework Hours: 96-108; Total Student Learning Hours: 144-162
Laboratory Contact Hours: 48-54; Homework Hours: 0; Total Student Learning Hours: 48-54

CUYAMACA COLLEGE
COURSE OUTLINE OF RECORD

ENGINEERING 210 – ELECTRIC CIRCUITS

3 hours lecture, 3 hours laboratory, 4 units

Catalog Description
Fundamentals of electrical circuits for engineers. Includes both DC and AC analysis. Concepts include Kirchhoff's laws, nodal and mesh analysis, linearity and superposition, Thevenin's theorem, ideal and real operational amplifiers, step response of first and second order RLC circuits, complex impedance, steady-state sinusoidal AC circuits, and AC power. Laboratory work supports the theory, and introduces basic lab practices and tools (e.g., oscilloscopes and signal generators).

Prerequisite
"C" grade or higher or "Pass" in MATH 280, PHYC 202 or equivalent

Entrance Skills
Without the following skills, competencies and/or knowledge, students entering this course will be highly unlikely to succeed:
1) Calculate electric and magnetic forces and fields.
2) Understand the basic concepts of voltage, current and power.
3) Understand the basic concepts of resistance, capacitance and inductance.
4) Solve for current, voltage, power and time constants in DC circuits consisting of resistors, capacitors, inductors and batteries.
5) Use Maxwell's equations to solve problems in electricity and magnetism.
6) Apply appropriate differentiation and integration techniques appropriate to analyzing responses of inductors and capacitors in electrical circuits.

Course Content
1) Fundamental concepts: current, voltage, power, dependent and independent sources, resistance
2) Simple circuits: Ohm's Law, Kirchoff's Law, circuit reduction, voltage and current dividers
3) Network analysis: nodal analysis, mesh analysis, source transformations, superposition, Thevenin's and Norton's theorems
4) Ideal and real operational amplifiers
5) Natural and step response of first and second order RLC circuits
6) Sinusoidal concepts: phasor concepts and complex algebra, complex impedance and admittance, phasor diagrams
7) Alternating current network analysis: nodal analysis, mesh analysis, source transformations
8) Energy and power: instantaneous and average power, root-mean-square and average voltage and current, complex power

Course Objectives
Students will be able to:
1) Explain the voltage and current relationships for the following circuit elements: independent and dependent voltage and current sources, resistors, capacitors, inductors.
2) Analyze DC circuits using node-voltage and mesh-current methods.
3) Analyze DC circuits using theorems of source transformation, Thevenin and Norton equivalents, maximum power transfer, and superposition.
4) Analyze simple circuits containing ideal and real operational amplifiers.
5) Analyze the natural and step responses of both RC and RL circuits.

6) Analyze the natural and step responses of both series and parallel RLC circuits.
7) Analyze circuits containing passive elements and powered by steady-state sinusoidal sources using node-voltage and mesh-current methods, source transformations, and superposition.
8) Explain and perform steady-state power calculations including instantaneous and average power.
9) Safely perform electrical measurements in a laboratory setting, using standard lab equipment such as oscilloscopes and signal generators.
10) Document results from electrical laboratory experiments, and compare those results to theoretical predictions.

Method of Evaluation
A grading system will be established by the instructor and implemented uniformly. Grades will be based on demonstrated proficiency in subject matter determined by multiple measurements for evaluation, one of which must be essay exams, skills demonstration or, where appropriate, the symbol system.
1) Classroom assessment tools, such as reading quizzes, concept quizzes, attention quizzes, muddiest point questions, and one-minute papers, that measure students' ability to apply concepts just discussed in class. An example would be a multiple choice question answered using an audience response system in which students determine whether an RLC circuit is underdamped, overdamped, or critically damped.
2) Homework assignments that measure students' ability to interact with the course material outside the classroom and to extend the classroom and reading experience to novel situations. Questions are almost exclusively word problems. An example would be a problem in which students use the node-voltage method to determine the currents and voltages everywhere in a resistive circuit.
3) Periodic quizzes and exams that evaluate student learning and retention of the material on the time scale of weeks. Questions are mostly word problems, but with some short answer conceptual questions. An example would be a problem in which students determine the output voltage of an ideal operational amplifier circuit.
4) Final examination that evaluates students' ability to integrate the course material as a whole and to assess overall retention of the material. Questions are mostly word problems, but with some short answer conceptual questions. An example would be a problem in which students determine the steady-state AC voltages and currents everywhere in a linear circuit composed of resistors, inductors, and capacitors by determining the complex impedance of each component, then applying the node-voltage method.
5) Laboratory notebooks that document students' ability to apply theory from text and lecture to the testing of real working circuits. An example would be to perform a study of superposition, in which the behavior of a circuit with two voltage sources is predicted theoretically for each voltage source separately, then with both simultaneously, and then this prediction is tested both using circuit simulation software and with a real circuit.

Special Materials Required of Student
Scientific graphical calculator

Minimum Instructional Facilities
1) Smart classroom with document camera
2) Electrical circuits laboratory with one lab station (oscilloscope, signal generator, power supply, etc.) for every two students
3) Computers running circuit simulation software (e.g., Multisim)

Method of Instruction
1) Lecture and discussion
2) Laboratory assignments
3) Homework
4) Group problem-solving

Out-of-Class Assignments
1) Weekly homework including reading and writing assignments
2) Laboratory reports

Texts and References
1) Required (representative example): Alexander, Charles and Matthew Sadiku. *Fundamentals of Electric Circuits*. 6th edition. McGraw-Hill, 2017.
2) Supplemental: None

Exit Skills
Students having successfully completed this course exit with the following skills, competencies and/or knowledge:
1) Explain the voltage and current relationships for the following circuit elements: independent and dependent voltage and current sources, resistors, capacitors, inductors.
2) Analyze DC circuits using node-voltage and mesh-current methods.
3) Analyze DC circuits using theorems of source transformation, Thevenin and Norton equivalents, maximum power transfer, and superposition.
4) Analyze simple circuits containing ideal and real operational amplifiers.
5) Analyze the natural and step responses of both RC and RL circuits.
6) Analyze the natural and step responses of both series and parallel RLC circuits.
7) Analyze circuits containing passive elements and powered by steady-state sinusoidal sources using node-voltage and mesh-current methods, source transformations, and superposition.
8) Explain and perform steady-state power calculations including instantaneous and average power.
9) Safely perform electrical measurements in a laboratory setting, using standard lab equipment such as oscilloscopes and signal generators.
10) Document results from electrical laboratory experiments, and compare those results to theoretical predictions.

Student Learning Outcomes
Upon successful completion of this course, students will be able to:
1) Explain the voltage and current relationships for the following circuit elements: independent and dependent voltage and current sources, resistors, capacitors, inductors and operational amplifiers.
2) Analyze DC and AC circuits using theorems of source transformation, Thevenin and Norton equivalents, maximum power transfer, superposition, node-voltage and mesh-current methods.
3) Analyze the natural and step responses of RC, RL and RLC circuits.
4) Safely perform electrical measurements in a laboratory setting, using standard lab equipment such as multi-meters, oscilloscopes and signal generators.