El Camino College
COURSE OUTLINE OF RECORD – Approved

I. GENERAL COURSE INFORMATION

Subject and Number: **Engineering 11**
Descriptive Title: **Circuit Analysis**
Course Disciplines: **Engineering**
Division: **Mathematic Sciences**

Catalog Description:
This course serves as an introduction to the analysis of electrical circuits through the use of analytical techniques based on the application of circuit laws and network theorems. The course covers direct current (DC) and alternating current (AC) circuits containing resistors, capacitors, inductors, dependent sources, operational amplifiers, and/or switches. The analysis of these circuits includes natural and forced responses of first and second order resistor-inductor-capacitor (RLC) circuits, the use of phasors, AC power calculations, power transfer, and energy concepts.

Conditions of Enrollment:
Prerequisite: Physics 1C (or concurrent enrollment) and Math 270 (or concurrent enrollment)
Corequisite: Engineering 12

Course Length:	**X Full Term**	**Other (Specify number of weeks):**
Hours Lecture:	**3.00 hours per week**	**TBA**
Hours Laboratory:	**0 hours per week**	**TBA**
Course Units:	**3.00**	

Grading Method: **Letter**
Credit Status: **Associate Degree Credit**

Transfer CSU: **X Effective Date: 05/18/2020**
Transfer UC: **X Effective Date: Pending**

General Education:
El Camino College:
CSU GE:
IGETC:

II. OUTCOMES AND OBJECTIVES

A. COURSE STUDENT LEARNING OUTCOMES (The course student learning outcomes are listed below, along with a representative assessment method for each. Student learning outcomes are not subject to review, revision or approval by the College Curriculum Committee)

1. ANALYSIS OF CIRCUITS: Analyze AC and DC circuits using Kirchhoff's laws, mesh and nodal analysis, and network theorems.
2. IDENTIFICATION OF CIRCUIT COMPONENTS: When presented with a complex circuit diagram, identify and analyze key components, such as amplifier circuits, divider networks, and filters.
3. TRANSIENT ANALYSIS: Evaluate transient and complete responses of RL, RC and RLC circuits.

B. COURSE OBJECTIVES (The major learning objective for students enrolled in this course are listed below, along with a representative assessment method for each)

1. Analyze DC circuits to find current, voltage, resistance, power, and/or energy.
   - Homework, quizzes and exams.
2. Draw and label circuit diagrams and show thorough mathematical solutions.
   - Homework, quizzes and exams.
3. Apply different circuit analysis techniques and demonstrate a process for selecting an appropriate technique for a given problem.
   - Homework, quizzes and exams.
4. Solve circuits containing two or more Op Amps.
   - Homework, quizzes and exams.
5. Find the transient response and complete response for RC, RL, and RLC circuits involving DC sources.
   - Homework, quizzes and exams.
6. Analyze sinusoidal steady-state circuits using phasor diagrams.
   - Homework, quizzes and exams.
7. Calculate average and complex power for AC circuits.
   - Homework, quizzes and exams.

III. OUTLINE OF SUBJECT MATTER (Topics are detailed enough to enable a qualified instructor to determine the major areas that should be covered as well as ensure consistency from instructor to instructor and semester to semester.)

Lecture or Lab	Approximate Hours	Topic Number	Major Topic
Lecture	4	I	BASIC ELECTRICAL CONCEPTS A. Define basic electrical quantities: Voltage, current, and power. B. Understand the symbols for and definitions of independent and dependent sources. C. Calculate the power absorbed by a circuit element using the passive sign convention

Lecture	4	II	RESISTIVE CIRCUITS A. Use Ohm's Law to solve electric circuits. B. Apply Kirchhoff's Current Law (KCL) and Kirchhoff's Voltage Law (KVL) to solve electric circuits. C. Analyze single-loop and single-node-pair circuits. Combine resistors in series and parallel. D. Use voltage and current division to solve simple electric circuits E. Understand when and how to apply wye-delta transformation to solve electric circuits. Analyze electric circuits containing dependent sources.
Lecture	12	III	NODAL AND MESH ANALYSIS A. Calculate all currents and voltages in circuits that contain multiple nodes and loops. B. Employ Kirchhoff's Current Law (KCL) to perform a nodal analysis to determine all the node voltages in a circuit. C. Employ Kirchhoff's Voltage Law (KVL) to perform a loop analysis to determine all the loop currents in a network. D. Ascertain which of the two analysis techniques should be utilized to solve a particular problem. E. Thevenin and Norton Equivalents F. Superposition
Lecture	2	IV	OPERATIONAL AMPLIFIER A. Model the op-amp device. B. Analyze a variety of circuits that employ op-amps. C. Understand the use of the op-amp in a number of practical applications.
Lecture	4	V	CAPACITANCE AND INDUCTANCE A. Use circuit models for inductors and capacitors to calculate voltage, current, and power. B. Calculate stored energy for capacitors and inductors. Understand the concepts of continuity of current for an inductor and continuity of voltage for a capacitor. C. Calculate voltages and currents for capacitors and inductors in electric circuits with DC source.
Lecture	12	VI	FIRST ORDER CIRCUITS AND SECOND ORDER TRANSIENTS A. Calculate initial values for inductor currents B. Calculate capacitor voltage in transient circuits. C. Calculate voltages in first-order transient circuits. D. Calculate currents in first-order transient circuits. E. Calculate voltages in second-order transient circuits. F. Calculate currents in second-order transient circuits.
Lecture	8	VII	SINUSOIDAL STEADY-STATE ANALYSIS A. Understand the basic characteristics of sinusoidal functions. B. Perform phasor and inverse phasor transformation and draw phasor diagrams. C. Calculate impedance and admittance for our basic circuit elements Resistors, Inductor, Capacitors (RLC). D. Combine impedances and admittance in series and parallel.

Lecture	2	VIII	STEADY STATE POWER A. Calculate instantaneous and average power in AC circuits. B. Calculate the maximum average power transfer for a load in an AC circuit. C. Calculate the effective or rms value for a periodic waveform. D. Calculate real power, reactive power, complex power, and power factor in AC circuits.
Lecture	6	IX	LAPLACE TRANSFORM IN CIRCUIT ANALYSIS A. Determine the Laplace transform of signals common to electric circuits. B. Perform an inverse Laplace transform using partial fraction expansion. C. Recognize the concept of convolution. Apply the initial-value and final-value theorems. D. Use the Laplace transform to analyze transient circuits.
Total Lecture Hours		**54**	
Total Laboratory Hours		**0**	
Total Hours		**54**	

IV. PRIMARY METHODS OF EVALUATION AND SAMPLE ASSIGNMENTS

A. PRIMARY METHOD OF EVALUATION

Problem solving demonstrations (computational or non-computational)

B. TYPICAL ASSIGNMENT USING PRIMARY METHOD OF EVALUATION

A weekly homework assignment consisting of 5-15 problems such as:

1. A voltage source is connected with two parallel resistance of 2k ohms that are joined in series with a 3k ohm and a 5k ohm resistor; 3k and 5k resistors are in parallel. Find the Norton Equivalent circuit with respect to the 5 kΩ resistor.

2. A 500mH inductor is connected to a voltage source V(t). Find the phasor expression of the current in the circuit below if the voltage is given as $v(t) = 30 \cos(200t - 160°)$ V.

C. COLLEGE LEVEL CRITICAL THINKING ASSIGNMENTS

1. Assume the following op-amp is ideal.
   a. Describe the circuit configuration for a given op-am circuit?
   b. What is the voltage drop across the 3.3 kΩ resistor if va = 1 V, vb = 2 V and vc = –5 V?

D. OTHER TYPICAL ASSESSMENT AND EVALUATION METHODS

Objective Exam
Essay Exams
Quizzes
Homework Problems
Written Homework

V. INSTRUCTIONAL METHODS

Lecture
Group Activities
Discussion
Demonstration

Note: In compliance with Board Policies 1600 and 3410, Title 5 California Code of Regulations, the Rehabilitation Act of 1973, and Sections 504 and 508 of the Americans with Disabilities Act, instructional delivery shall provide access, full inclusion, and effective communication for students with disabilities.

VI. WORK OUTSIDE OF CLASS

Study
Answer questions
Skill practice
Required reading
Problem solving activity
Written work (such as essay/composition/report/analysis/research)

Estimated Study Hours Per Week: 6

VII. TEXTS AND MATERIALS

A. UP-TO-DATE REPRESENTATIVE TEXTBOOKS

Fundamentals of Electric Circuits, 6th ed. Alexander C., M. Sadiku, McGraw Hill Education © 2017, ISBN: 9780078928229

B. REQUIRED TEXTS (title, author, publisher, year)

Electric Circuits, 11th ed., Nilsson J. W., S. Reidel, Prentice Hall © 2018, ISBN: 978-0134746968
Electrical Engineering: Principles & Applications, 7th ed. Hambley, A. R., Prentice Hall © 2017, ISBN: 978-0134484143
Introductory Circuit Analysis, 13, Boylestad, R., Pearson © 2016, ISBN: 0133923606

C. REQUIRED SUPPLEMENTARY READINGS

D. OTHER REQUIRED MATERIALS

VIII. CONDITIONS OF ENROLLMENT

A. Requisites (Course and Non-Course Prerequisites and Corequisites)

Requisites	Category and Justification
Course Prerequisite Physics-1C (or concurrent enrollment)	Sequential This course requires specific knowledge related to problem solving that is essential to successfully passing the course. If a person does not have this knowledge and the associated skills, they may not succeed in the course.
Course Prerequisite Mathematics-270 (or concurrent enrollment)	Computation Skills This course requires specific knowledge related to problem solving that is essential to successfully passing the course. If a person does not have this knowledge and the associated skills, they may not succeed in the course
Corequisite Engineering 12 (Circuit Analysis Laboratory)	Corequisite This course requires specific knowledge related to problem solving that is essential to successfully passing the course. If a person does not have this knowledge and the associated skills, they may not succeed in the course

B. Requisite Skills - Match skills from prerequisite course/s or non-course prerequisites without which a student would be "highly unlikely to succeed."

Requisite Skills
PHYS 1C Students need to understand basics of electricity: potential, current, resistance and basic laws such as Ohm's law. **Physics 1C Objectives:** 1. Basic concepts of Electricity such as electrical potential and potential energy 2. Basic concepts of circuits (AC and DC) such as ohm's law, reactance, impedance and phase diagrams. **MATH 270** Be able to solve first and second order differential equations. **MATH 270 Objectives:** 1. Solve first order differential equations using integrating factors 2. Solve second order homogeneous differential equations **ENGR 12** Have the ability to draw and label circuit diagrams and schematics **ENGR 12 Objectives:** 1. Access and use the most basic functions of electrical test and measurement equipment including oscilloscopes, multimeters, function generators and power supplies. Draw and label circuit diagrams and show thorough mathematical solutions. 2. Read circuit schematics and construct linear circuits using resistors, capacitors, inductors, and/or Op amps. Solve circuits containing two or more Op Amps.

C. Recommended Preparations (Course and Non-Course)

Recommended Preparation	Category and Justification

D. Recommended Skills. Match skills from recommended courses or non-course prerequisite that would "enhance a students' ability to succeed in the courses".

Recommended Skills – Matching

E. Enrollment Limitations

Enrollment Limitations and Category	Enrollment Limitations Impact

Course created by Pavan Nagpal on 11/04/2019

BOARD APPROVAL DATE: 05/18/2020

LAST BOARD APPROVAL DATE:

Last Reviewed and/or Revised by