El Camino College
COURSE OUTLINE OF RECORD – Approved

I. GENERAL COURSE INFORMATION

Subject and Number: **Engineering 12**
Descriptive Title: **Circuit Analysis Laboratory**
Course Disciplines: **Engineering**
Division: **Mathematic Sciences**

Catalog Description:
This course serves as an introduction to the construction, measurement, and design of elementary electrical circuits and basic operational amplifier circuits. Students gain familiarity with the basic use of electrical test and measurement instruments, including multimeters, oscilloscopes, power supplies, and function generators. Using principles of circuits analysis for direct current (DC), transient, and sinusoidal steady-state alternating current (AC) conditions, students develop data interpretation skills by using circuit simulations software and by direct measurements of circuits. Practical considerations such as component value tolerance and non-ideal aspects of laboratory instruments are also introduced.

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:	**0 hours per week**	**TBA**
Hours Laboratory:	**3.00 hours per week**	**TBA**
Course Units:	**1.00**	

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. CIRCUIT DESIGN AND ASSEMBLY: Demonstrate the ability to design and assemble simple circuits to complete a given task (i.e. amplify an electrical signal and filter out high frequencies).
2. ELECTRONIC EQUIPMENT UTILIZATION: Utilize electronic equipment (multimeter, power supply, oscilloscope, function generator) to verify analysis of circuits.
3. CIRCUIT SIMULATION PROGRAMS: Demonstrate ability to use circuit simulation programs and other computer application to describe circuit behavior.

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. 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.
    - Laboratory reports
2. Read circuit schematics and construct linear circuits using resistors, capacitors, inductors, and/or Op amps. Solve circuits containing two or more Op Amps.
    - Laboratory reports
3. Measure resistance, DC and AC voltages, current, and power, and experimentally verify the results for a variety of electrical circuits. Analyze sinusoidal steady-state circuits using phasor diagrams.
    - Laboratory reports
4. Test circuits, analyze data and compare measured performance to theory and simulation.
    - Laboratory reports
5. Use a circuit simulation program (PSPICE, MultiSIM) and other computer applications (MATLAB, MS Excel) to predict or describe circuit behavior.
    - Laboratory reports
6. Troubleshoot and repair simple electric circuits.
    - Laboratory reports
7. Record and document results of lab work using text and graphs.
    - Laboratory reports
8. Work effectively in groups by sharing responsibilities and collaborating on findings.
    - Laboratory reports

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
Lab	4	I	USING TEST AND MEASUREMENT EQUIPMENT A. Use and functionality of test equipment (e.g. power supplies). B. Use and functionality of measurement equipment (e.g. digital multimeters, oscilloscopes, function generators).
Lab	2	II	CIRCUIT CONSTRUCTION TECHNIQUES A. Circuit construction techniques for laboratory use ("breadboarding").
Lab	2	III	COMPONENT IDENTIFICATION AND LABELING A. Component identification and labeling; nominal and measured values; limitations on voltage, current, power dissipation
Lab	4	IV	CIRCUIT LAWS A. Kirchoff's Laws. B. Ohm's Law.
Lab	6	V	VOLTAGE, CURRENT, AND CIRCUIT TYPES A. Voltage Division. B. Current Division. C. Series Circuits. D. Parallel Circuits.
Lab	4	VI	EQUIVALENT CIRCUITS A. Equivalent circuits. B. Thevenin equivalent circuit.
Lab	4	VII	SUPERPOSITION AND POWER DISSIPATION A. Superposition. B. Power dissipation.
Lab	6	VIII	OPERATIONAL AMPLIFIERS A. Operational Amplifiers B. Practical voltage limits on the output of these devices. C. Practical current limits on the output of these devices.
Lab	8	IX	STEP RESPONSE A. Operation of Scope B. RL circuits. C. RC circuits. D. RLC circuits.
Lab	8	X	FREQUENCY RESPONSE (INCLUDING RESONANCE) A. Operation of scope B. RL circuits. C. RC circuits. D. RLC circuits.
Lab	4	XI	TRANSFORMER AND PHASOR TECHNIQUES A. Transformer techniques B. Phasor techniques.
Lab	2	XII	LABORATORY SAFETY A. Laboratory safety.

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

Excerpts of appropriate laboratory exercises are given below:

Kirchoff's Laws Analysis of Circuits

1. Build the circuit with a voltage source with the following resistor values: R1 = 100Ω, R2 = 470Ω, R3 = 1000Ω, R4 = 680Ω, R5 = 2200Ω, R6 = 100Ω. R1, R4, and R6 are in parallel. R2, R3, and R5 are in parallel. R2, R4, and R5 are in series. R1, R3, R6 are in series.

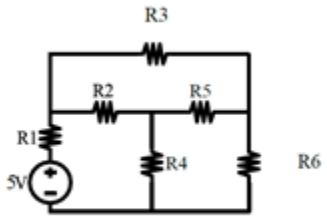

Fig.7. Kirchoff's Laws Analysis

C. COLLEGE LEVEL CRITICAL THINKING ASSIGNMENTS

1. Using Kirchoff's Voltage and Current Laws, find the theoretical values of the voltage and current across each resistor.

2. Measure each of the voltages and currents you have calculated and compare the theoretical and experimental values.

	V[V]	I[A]	R[Ω]
R1			
R2			
R3			
R4			
R5			
R6			

Discussion

1. Do your experimental results obey Kirchoff's Laws?

D. OTHER TYPICAL ASSESSMENT AND EVALUATION METHODS

Laboratory Reports

V. INSTRUCTIONAL METHODS

Group Activities
Lab
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

Estimated Study Hours Per Week:

VII. TEXTS AND MATERIALS

A. UP-TO-DATE REPRESENTATIVE TEXTBOOKS

Laboratory Manual for Introductory Circuit Analysis, 13th Edition, Boylestd, R.L., G. Kouourou, Pearson © 2015, ISBN: 0133923789 (industry standard)

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

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 11 (Circuit Analysis)	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 11** Have the theoretical background and apply to the circuit diagrams **ENGR 11 Objectives:** 1. Analyze DC circuits to find current, voltage, resistance, power, and/or energy. 2. Draw and label circuit diagrams and show thorough mathematical solutions. 3. Apply different circuit analysis techniques and demonstrate a process for selecting an appropriate technique for a given problem.

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 11/15/2019

BOARD APPROVAL DATE: 05/18/2020

LAST BOARD APPROVAL DATE:

Last Reviewed and/or Revised by