ENGR 16 Course Outline as of Fall 2016

CATALOG INFORMATION

Dept and Nbr: ENGR 16 Title: ELEC CIRC & DEVICES
Full Title: Electric Circuits and Devices
Last Reviewed: 1/25/2021

Units		Course Hours per Week		Nbr of Weeks	Course Hours Total	
Maximum	4.00	Lecture Scheduled	3.00	17.5	Lecture Scheduled	52.50
Minimum	4.00	Lab Scheduled	3.00	8	Lab Scheduled	52.50
		Contact DHR	0		Contact DHR	0
		Contact Total	6.00		Contact Total	105.00
		Non-contact DHR	0		Non-contact DHR	0

Total Out of Class Hours: 105.00 Total Student Learning Hours: 210.00

Title 5 Category:	AA Degree Applicable
Grading:	Grade Only
Repeatability:	00 - Two Repeats if Grade was D, F, NC, or NP
Also Listed As:	
Formerly:	

Catalog Description:
Fundamental principles of circuit analysis and an introduction to the theory and use of common electronic devices. Subjects covered include node and loop analysis, circuit simplification and equivalence, natural and forced response, operational amplifier behavior and circuits, semiconductor theory and behavior, diodes, transistor, and digital circuits. Mathematical concepts reviewed and applied include: matrices and system of equations solutions, binary and hexadecimal numbers, Fourier and Laplace transforms, complex numbers and phasors. Students are required to have a graphing calculator.

Prerequisites/Corequisites:
Course Completion of PHYS 42 AND Course Completion or Current Enrollment in MATH 2

Recommended Preparation:

Limits on Enrollment:

Schedule of Classes Information:
Description: Fundamental principles of circuit analysis and an introduction to the theory and use of common electronic devices. Subjects covered include node and loop analysis, circuit

simplification and equivalence, natural and forced response, operational amplifier behavior and circuits, semiconductor theory and behavior, diodes, transistor, and digital circuits. Mathematical concepts reviewed and applied include: matrices and system of equations solutions, binary and hexadecimal numbers, Fourier and Laplace transforms, complex numbers and phasors. Students are required to have a graphing calculator. (Grade Only)
Prerequisites/Corequisites: Course Completion of PHYS 42 AND Course Completion or Current Enrollment in MATH 2
Recommended:
Limits on Enrollment:
Transfer Credit: CSU;UC.
Repeatability: Two Repeats if Grade was D, F, NC, or NP

ARTICULATION, MAJOR, and CERTIFICATION INFORMATION:

AS Degree:	**Area**			Effective:	Inactive:
CSU GE:	**Transfer Area**			Effective:	Inactive:
IGETC:	**Transfer Area**			Effective:	Inactive:
CSU Transfer:	Transferable	Effective:	Fall 1981	Inactive:	
UC Transfer:	Transferable	Effective:	Fall 1981	Inactive:	

CID:

Certificate/Major Applicable:
Major Applicable Course

COURSE CONTENT

Student Learning Outcomes:
At the conclusion of this course, the student should be able to:
1. Apply the complete range of circuit analysis techniques to determine voltages, currents, and powers in alternating current, direct current, and transient response circuits.
2. Explain and mathematically characterize the operation of common electronic devices including operational amplifiers, timing and counter chips, digital building blocks, diodes, and transistors.
3. Demonstrate the proper use of electronic lab equipment such as oscilloscopes, multimeters, frequency generators, power supplies, and prototyping boards.
4. Apply professional documentation standards to lab experiment and technical analysis reports.

Objectives:
Upon Completion of the course, the student will be able to:
1. Draw schematic circuit diagrams, labeling and defining voltage and current variables according to standard conventions of component, loop, and nodal analysis.
2. Solve for the voltages and currents and power in complex direct current circuits with independent and dependent sources using Kirchoff's laws, node and loop analysis, voltage and current dividers.
3. Use parallel and series simplification relationships, Thevenin and Norton equivalence laws, and superposition and suppression principles to simplify circuits.
4. Apply complex numbers, phasor analysis and impedance to find the voltages, currents, and

power of complex alternating current circuits with independent and dependent sources.
5. Estimate and compute frequency response, construct and interpret Bode plots, and design, build, and test prototypes of passive and active alternating current filter circuits.
6. Find the transient and total responses caused by step inputs to first and second order circuits with given initial conditions.
7. Analyze and test diode circuits using the ideal, offset, graphical and data sheet modeling.
8. Analyze, design and construct bipolar junction transistor circuits using small and large signal models.
9. Construct and predict the output of digital circuits composed of gate, flip-flops, counters and decoders.
10. Model circuits using circuit simulation software.
11. Solder components on to a printed circuit board.
12. Set up and run lab experiments using standard electronic equipment including oscilloscopes, multimeters, frequency counters, signal generators, power supplies, and prototyping boards,
13. Use thorough and careful data collection and analysis techniques and apply industry standard report documentation to deliver professional quality technical reports.

Topics and Scope:

Lecture Topics & Scope

1. Principles and Techniques of Direct Current Circuit Analysis
    a. circuit elements and Kirchhoff's Laws
    b. voltage and current dividers
    c. mesh and nodal circuit analysis
    d. power calculations
    e. network theorems (Thevenin, Norton, and max power)
    f. graphical solutions for nonlinear circuit elements
    g. measurement instrumentation (voltmeter, ammeter, oscilloscope)
2. Alternating Current Circuit Analysis
    a. amplitude (root mean squared & peak), period, phase, and frequency
    b. sinusoidal voltages and currents
    c. periodic signals (e.g. square wave, sawtooth)
    d. review of complex numbers
    e. phasors
    f. impedance
    g. alternating current power
    h. frequency response and Bode plots
    i. natural response
    j. total response
    k. pole-zero diagrams
    l. practical applications (e.g. resonant circuits, impedance matching three-phase circuits)
3. Analog Building Blocks
    a. analog signals and systems
    b. dependent sources
    c. modeling concepts
    d. input and output resistance
    e. open-circuit voltage amplification
    f. practical applications (e.g. batteries and other real sources)
4. Semiconductors
    a. physical and chemical properties of doped semiconductors
    b. diodes, ideal and non-ideal behavior

c. transistors behavior and manufacturing
d. transistor biasing and modeling
e. graphical circuit analysis for non-linear elements
f. practical applications (e.g. amplifiers, logic gates)

5. Operational Amplifiers
    a. characteristics of operational amplifiers
    b. circuit analysis assuming ideal op amps
    c. non-ideal op amp behavior
    d. op amp realizations
    e. practical applications (e.g. op amp math circuits)
6. Digital Building Block
    a. digital signals and binary numbers
    b. logic gates (e.g. function and realization)
    c. logic chips (e.g. function, realization, and manufacture)
    d. digital systems (e.g. combinational logic and memory)
    e. practical applications (e.g. state machines, computers)
7. Example Laboratory Exercises
    a. resistance measurement and circuit simulation
    b. printed circuit board assembly
    c. sinusoidal voltage measurements
    d. superposition and Thevenin equivalence modeling
    e. alternating current analysis and filters
    f. operational amplifiers
    g. transient response
    h. diode rectification
    i. transistor biasing and amplification
    j. digital counter and display
    k. stoplight state machine

Assignment:

1. Homework problem sets (10 - 15)
2. Midterm examinations (2 - 5)
3. Lab reports and technical memos (4 - 16)
4. Comprehensive final examination
5. Quizzes (0 - 10)
6. Textbook reading (approximately 40 pages per week)

Methods of Evaluation/Basis of Grade:

Writing: Assessment tools that demonstrate writing skills and/or require students to select, organize and explain ideas in writing.

None, This is a degree applicable course but assessment tools based on writing are not included because problem solving assessments and skill demonstrations are more appropriate for this course.	Writing 0 - 0%

Problem Solving: Assessment tools, other than exams, that demonstrate competence in computational or non-computational problem solving skills.

Homework problem sets, lab reports and technical memos	Problem solving 25 - 40%

Skill Demonstrations: All skill-based and physical demonstrations used for assessment purposes including skill performance exams.

Soldering, lab equipment demonstrations	Skill Demonstrations 5 - 10%

Exams: All forms of formal testing, other than skill performance exams.

Problem solving exams and quizzes	Exams 45 - 70%

Other: Includes any assessment tools that do not logically fit into the above categories.

Participation	Other Category 0 - 10%

Representative Textbooks and Materials:

Principles and Applications of Electrical Engineering, Rizzoni, Giorgio. 6th ed., McGraw-Hill 2016
Electrical Engineering, Principles and Applications, Hambley, Allan. 6th ed., Pearson 2014
Instructor prepared materials