Course Acronym:	ECHT
Course Number:	110
Descriptive Title:	Introduction to Direct and Alternating Current Circuits
Division:	Industry and Technology
Department:	Electronics and Computer Hardware Technology
Course Disciplines:	Electronic Technology, Electronics
Catalog Description:	This course examines advanced topics in the principles of direct and alternating current electricity through the correlation of theory and laboratory experiments. Basic circuit analysis forms the core of the course. Included in this class are the use of calculators, computer circuit simulation and many types of electrical/electronic test equipment to perform electrical measurements and yield analysis.
Prerequisite:	Electronics and Computer Hardware Technology 11 with a minimum grade of C
Co-requisite:	
Recommended Preparation:	
Enrollment Limitation:	
Hours Lecture (per week):	2
Hours Laboratory (per week):	4
Outside Study Hours:	4
Total Course Hours:	108
Course Units:	3
Grading Method:	Letter Grade only
Credit Status:	Credit, degree applicable
Transfer CSU:	Yes
Effective Date:	3/18/2002
Transfer UC:	No
Effective Date:	
General Education: ECC	
Term:	
Other:	
CSU GE:	
Term:	
Other:	

IGETC:	
Term:	
Other:	
Student Learning Outcomes:	**SLO #1 Measuring Voltage, Current & Resistance** The student will make advanced "in- circuit" measurements: Alternating Current/Direct Current (AC/DC), Voltages, Currents, and Resistance, using both a Bench and Portable Digital Multimeter (DMM). **SLO #2 Direct & Alternating Currents** The student will use an Electronic Simulation Software Package similar to Multi-SIM or "P" Spice to supplement both the understanding and analysis of Direct and Alternating Current Circuits. **SLO #3 Circuit Analysis Calculations** The student will be able to use various circuit analysis calculations to predict basic circuit operation.
Course Objectives:	1. Plan and use schematic diagrams to assemble and connect specific electric circuits and perform electrical measurements of all parameters. 2. Verify the basic principles of Ohm's Law and electric power law by means of calculations, measurements and graphing. 3. Calculate and measure the practical implications of Kirchhoff's Laws in relation to series and parallel circuits, and compound circuits. 4. Apply Thevenin's, Norton's and the Superposition Theorems in solution to a multi-source circuit. 5. Relate the circuit concepts of reactance and impedance to the analysis and measurement of alternating current circuits through the use of the Pythagorean Theorem. 6. Demonstrate the correct electrical measurement techniques of using the Voltage Ohm Meter (VOM) and Digital Multimeter (DMM). 7. Measure voltage and frequency using an oscilloscope. 8. Operate a Personal Computer (PC) system, enter and run simple programs to perform electrical calculations and simulations, use a standard circuit analysis program and access supplementary computer-based instruction. 9. Use transformers to change voltages and match impedances. 10. Evaluate and troubleshoot high and low filters.
Major Topics:	**I. ELECTRIC QUANTITIES AND MEASUREMENTS (2 hours, lecture)** A. Introduction of metric system and resistor color code B. Component symbols and schematic diagrams C. Introduction to circuit simulation software D. Electrical units - volts, amperes, ohms, coulombs, watts, kilowatt hours E. Ohm's Law F. Series circuit analysis G. Kirchhoff's Voltage Law **II. SERIES CIRCUIT ANALYSIS (4 hours, lab)**

A. Resistance measurements for Direct Current (DC) series circuits
B. Voltage measurements for DC series circuits
C. Current measurements for DC series circuits
D. Analysis through formal lab report

III. PARALLEL CIRCUIT ANALYSIS (2 hours, lecture)

A. Total resistance calculations for DC parallel circuits
B. Parallel circuits using branch currents
C. Kirchhoff's Current Law

IV. PARALLEL CIRCUIT ANALYSIS (4 hours, lab)

A. Total resistance measurements for DC parallel circuits
B. Parallel circuit measurements
C. Verification of Kirchhoff's Current Law
D. Analysis through formal lab report

V. COMPOUND CIRCUIT ANALYSIS (2 hours, lecture)

A. Parallel series versus series parallel analysis
B. Compound circuit equivalencies
C. Maximum power transfer

VI. COMPOUND CIRCUIT ANALYSIS (4 hours, lab)

A. Compound circuit equivalencies through both calculations and measurements
B. Complex circuit wiring techniques
C. Analysis through formal lab report

VII. SUPERPOSITION THEOREM (2 hours, lecture)

A. Analysis of multi-source circuits by using a circuit overlay method, superposition analysis
B. Aiding and opposing circuits

VIII. SUPERPOSITION THEOREM (4 hours, lab)

A. Current measurements
B. Voltage measurements
C. Analysis through formal lab report

IX. THEVENIN'S THEOREM (2 hours, lecture)

A. Analysis of multi-source circuits by using Thevenin's equivalent voltage method
B. Thevenin's equivalent resistance

X. THEVENIN'S THEOREM (4 hours, lab)

A. Current measurement

B. Voltage measurements
C. Analysis through lab report

XI. NORTON'S THEOREM (2 hours, lecture)

A. Analysis of multi-source circuits by using Norton's equivalent current method
B. Norton's equivalent resistance

XII. NORTON'S THEOREM (4 hours, lab)

A. Current measurements
B. Voltage measurements
C. Analysis through formal lab report

XIII. MILLMAN'S THEOREM (2 hours, lecture)

A. Analysis of multi-source circuits by using Millman's voltage equivalent current method
B. Millman's equivalent voltage

XIV. MILLMAN'S THEOREM (4 hours, lab)

A. Current measurements
B. Voltage measurements
C. Analysis through formal lab report

XV. RESISTOR CAPACITOR (RC) AND INDUCTOR RESISTOR (RL) (2 hours, lecture)

A. Capacitors in series and parallel DC circuit calculations
B. Inductors in series and parallel DC circuit calculations
C. RC and RL timing circuits charge and discharge calculations
D. Asymptotic relationships exhibited in RC and RL charge and discharge states

XVI. RC AND RL (6 hours, lab)

A. Capacitors in series and parallel DC circuit measurements
B. Inductors in series and parallel DC circuit measurements
C. RC and RL timing circuits charge and discharge measurements
D. Analysis through formal lab report

XVII. INTRODUCTION TO ALTERNATING CURRENT (AC) CIRCUIT ANALYSIS (2 hours, lecture)

A. Period and frequency
B. Peak-to-Peak, Peak, Root Mean Square (RMS) and average voltage, current, and power
C. Instantaneous voltages and currents

XVIII. AC CIRCUIT ANALYSIS (6 hours, lab)

A. Period and frequency measurements using and oscilloscope and frequency counter
B. Peak-to-Peak, Peak, RMS and average voltage, current, and power measurements
C. Instantaneous voltages and current measurements
D. Analysis through formal lab report

XIX. RC, RL AND RESISITOR, CAPACITOR AND INDUCTOR (RCL) IMPEDANCE (4 hours, lecture)

A. Capacitive reactance calculations
B. Inductive reactance calculations
C. Current and voltage lead-lag
D. Conversion of rectangular numbers and polar numbers
E. Low, high, band-pass and band-stop filters
F. Series resonance

XX. RC AND CAPACITOR, RL AND RESISTOR AND RESISTOR CAPACITOR (RCL) IMPEDANCES (12 hours, lab)

A. Current measurements for series RL, RC, and RCL series impedance circuits
B. Voltage measurements for series RL, RC, and RCL series impedance circuits
C. Analysis through formal lab report

XXI. PARALLEL RC, RL AND RCL (6 hours, lecture)

A. Capacitive reactance calculations
B. Inductive reactance calculations
C. Current and voltage lead-lag
D. Conversion of rectangular numbers and polar numbers
E. Low, high, band-pass and band-stop filters
F. Parallel resonance

XXII. PARALLEL RC, RL AND RCL (12 hours, lab)

A. Current measurements for series RL, RC and RCL parallel impedance circuits
B. Voltage measurements for series RL, RC, and RCL parallel impedance circuits
C. Analysis through formal lab report

XXIII. SERIES PARALLEL RC, RL AND RCL (8 hours, lecture)

A. Equivalent impedance derived from a series/parallel RC, RL, and RCL series/parallel circuit
B. Current and voltage lead-lag
C. Series equivalent circuit from a series/parallel RC, RL, and series/parallel circuit

	XXIV. SERIES PARALLEL RC, RL AND RCL (8 hours, lab) A. Current measurements for series RL, RC and, RCL series parallel impedance circuits B. Voltage measurement for series RL, RC, and RCL parallel impedance circuits C. Analysis through formal lab report
Total Lecture Hours:	36
Total Laboratory Hours:	72
Total Hours:	108
Primary Method of Evaluation:	2) Problem solving demonstrations (computational or non-computational)
Typical Assignment Using Primary Method of Evaluation:	Following a circuit schematic, plan the Protoboard circuit layout, connect the circuit components on a Protoboard and measure voltages and currents for all components. Verify data using calculations and report findings in a two-page lab report and submit to the instructor. Laboratory performance and lab report will be evaluated.
Critical Thinking Assignment 1:	Given a group of resistors of specific values of resistance, configure the resistors in various predetermined circuit configurations, i.e. series, parallel, and series- parallel. Once all three circuits have been configured, synthesize and verify an equivalent circuit that encompasses the same loading effects of all three circuits using one resistor, one source and one current flow. Report findings in a three-page lab report and submit to the instructor for evaluation.
Critical Thinking Assignment 2:	Calculate and measure the amount of current voltage a load resistor would see when being sourced by two photovoltaic panels (12v) wired in both series and parallel. Verify that the measured results meet circuit specifications. Report findings, both experimental and calculated values, on a two-page lab report using an Excel spreadsheet and line graph to compare measured versus calculated values. Examine the original circuit design and determine if the circuit could be made safer, efficient, more reliable and/or cost effective. Submit lab report and Excel spreadsheet to the instructor for evaluation.
Other Evaluation Methods:	Performance Exams Other Exams Embedded Questions Quizzes Laboratory Reports Class Performance Homework Problems Multiple Choice Completion Matching Items True/False Other (specify): Presentation
Instructional Methods:	Demonstration Discussion Laboratory Lecture Multimedia presentations

If other:	Computer circuit simulations
Work Outside of Class:	Study Required reading Problem solving activities
If Other:	
Up-To-Date Representative Texts:	Michael Schultz, Grob's Basic Electronics, 13th edition, McGraw Hill, 2021
Alternative Texts:	
Required Supplementary Readings:	
Other Required Materials:	Scientific calculator
Requisite:	Prerequisite
Category:	sequential
Requisite course(s): List both prerequisites and corequisites in this box.	Electronics and Computer Hardware Technology-11
Requisite and Matching skill(s):Bold the requisite skill. List the corresponding course objective under each skill(s).	**Make electric circuit calculations using a scientific calculator with engineering notation.** ECHT 11 - Use a scientific calculator and a computer to calculate circuit values with data expressed using engineering notation. **Understand the resistor color code system and apply it to the determination of resistor tolerance specifications.** ECHT 11 - Differentiate color codes and component symbols to build a circuit. **Understand the proper use and connections of electric meters.** ECHT 11 - Demonstrate the use of various types of test equipment, including DMMs, signal generators, power supplies, and oscilloscope to make various circuit measurements. **Understand schematic component symbols and diagrams. Be able to relate the symbol to the component and its location in the circuit.** ECHT 11 - Apply fundamental circuit theories AC and DC to compute component values and voltages, resistances, currents, and power in various circuit configurations. **Understand electrical safety concepts and be able to take appropriate precautions to protect humans and delicate components.** ECHT 11 - Recognize dangerous situations in handling electric circuits and chemicals used in normal electronic work environment.

	Operate a modern computer in making circuit calculations and using software. ECHT 11 - Use a scientific calculator and a computer to calculate circuit values with data expressed using engineering notation.
Requisite Skill:	
Requisite Skill and Matching Skill(s): Bold the requisite skill(s). If applicable	
Requisite course:	
Requisite and Matching skill(s):Bold the requisite skill. List the corresponding course objective under each skill(s).	
Requisite Skill:	
Requisite Skill and Matching skill(s): Bold the requisite skill. List the corresponding course objective under each skill(s). If applicable	
Enrollment Limitations and Category:	
Enrollment Limitations Impact:	
Course Created by:	Jim Alward
Date:	09/01/2001
Original Board Approval Date:	03/18/2002
Last Reviewed and/or Revised by:	Arnulfo Runas
Date:	10/18/2023
Last Board Approval Date:	01/17/2024
Effective Term:	FALL 2024