ELEC A112: A.C. CIRCUITS

Item	Value
Curriculum Committee Approval Date	10/30/2024
Top Code	093400 - Electronics and Electric Technology
Units	3 Total Units
Hours	90 Total Hours (Lecture Hours 36; Lab Hours 54)
Total Outside of Class Hours	0
Course Credit Status	Credit: Degree Applicable (D)
Material Fee	No
Basic Skills	Not Basic Skills (N)
Repeatable	No
Open Entry/Open Exit	No
Grading Policy	Standard Letter (S)

Course Description

An in depth study of Alternating Current (AC) electrical circuits. This course of study focuses on the math describing AC circuits, specifically the relationship between impedance, resistance, and reactance. Students will use these concepts to anticipate power factor and learn how to mitigate large inductive loads. Students will design, analyze, build, and test RLC circuits, inductance motor drivers, and filter circuits for audio signals. The lab work will focus on validating theoretical calculations by building circuits and testing them for expected performance. ADVISORY: ELEC A111. Transfer Credit: CSU.

Course Level Student Learning Outcome(s)

1. Students will be proficient at using electronic test equipment to measure and analyze the performance of AC circuits.
2. Students will be able to communicate the results of their analysis in a professional manner using industry standard schematics and report formats.
3. Students will be able to employ mathematical tools and fundamental laws to conduct analysis of complex AC circuits.

Course Objectives

- 1. Describe the current theories that attempt to explain: atomic particles, electromagnetic, electro-static, induction and coupling.
- 2. Explain, analyze, and calculate critical values of wave theory: critical points, slope, wave shape, wave length, time period, frequency, phase shifts, distortion, power factor, duty cycle, pulse width,and decibels.
- 3. Describe, calculate, and select critical values for A.C. components: inductors transformers, capacitors, resistors, conductors, insulators, electro-mechanical and solid state devices.
- 4. Analyze, calibrate diagnose and effect modifications to the operation of Alternating Current and Amplitude Changing (A.C.) power circuits.
- 5. Analyze, calibrate diagnose and effect modifications to the operation of RLC filters: high pass, low pass, and crossover, filters networks.
- 6. Explain, calculate, and measure wave modulation including: Pulse Width PMW, Amplitude AM, and Frequency FM. Describe how the Nyquist criterion determines the relationship between: carrier frequency, resolution, and bandwidth.
- 7. Explain, analyze, and calculate critical values for series, parallel, complex Resistive, Inductive, Capacitive, (RLC) circuits including: 1) total values for: resistance, inductance, capacitance, impedance, reactance, phase shift, and values in the imaginary plane associated with the circuit.
- 8. Explain, analyze, and calculate critical values for A.C. circuit designs including: Transients of switching circuits, power transformer selection, coupling transformer selection, Q of resonant filters, decibels / decade of RLC filters.
- 9. Describe and express in mathematical/verbal form, fundamental concepts and relationships in passive (resistor, capacitor, inductor) AC circuits.
- 10. Solve quantitative problems and predict the action of passive AC circuits through detailed analysis employing algebraic, trigonometric and/or complex number techniques.
- 11. Perform laboratory exercises by following written directions including breadboarding circuits from schematic diagrams, performing circuit measurements and analyzing results.
- 12. Operate, adjust and calibrate voltmeters, ammeters, ohmmeters, oscilloscopes, signal generators and power supplies for circuits experiments.
- 13. Analyze results and explain the source of errors incurred in laboratory experiments.

Lecture Content

Electro-Magnetism Series and Parallel Circuits Review The Mathematics of Wave Functions Alternating Voltage and Current Frequency Spectrums Audible Spectrum Electromagnetic Spectrum Modulation Amplitude Modulation Frequency Modulation Pulse Width Modulation Lissajous Wave Analysis Impedance Impedance vs. Resistance Inductive Reactance Capacitive Reactance Phase Shift Inductance Transformers AC DC Conversion Inductive Circuits - Low Pass filters 5.4 Line filters Capacitance Capacitive Reactance Capacitive Circuits High Pass Filters Decibels Line Filters RLC Circuits Resonance Time Constants Filtering Frequency Domain Graphing

Lab Content

Relay Project Induction transients Switching frequency Oscillators and Function Generators Alternating Voltage and Current Modulation Exercises Amplitude Modulation Frequency Modulation Pulse Width Modulation Lissajous Wave Analysis Transformer Project Stepping Up/ Down AC Voltages Effect on current Conversion to DC via Rectifier Circuit Inductive Circuit - Low Pass Filter Capacitive Circuit- High Pass Filter RLC Filter Circuit Bandpass Bandstop Time Constant Experiment Capstone Project- Timer relay using 555 Timer

Method(s) of Instruction

- Lecture (02)
- DE Live Online Lecture (02S)
- DE Online Lecture (02X)
- Lab (04)
- DE Live Online Lab (04S)
- DE Online Lab (04X)

Instructional Techniques

Lecture Detailed whiteboard lectures with opportunity for student engagement. Independent in-class problem solving assignments with immediate review. Group based in-class problem solving assignments with immediate review. In-class review of previously assigned homework. Discussion of media provided and assigned via Canvas. Review of material prior to exams. Lab Students build and test electronic circuits individually and as groups. Lab projects reinforce lecture topics and are paced to coincide or lag the lecture content. Lab projects generate content that students use to generate reports and documentation, enhancing writing and critical thinking skills.

Reading Assignments

Provided via Canvas

Writing Assignments

Keep a journal of chronological notes taken during research, lecture, and laboratory experience. Author a technical report for each project written to industry standards for technical reports.

Out-of-class Assignments

Students will spend approximately 5 hours per week on out-of-class assignments, including: Researching topics as assigned Preparing technical documents prior to laboratory projects Completing of technical reports after each project Maintaining a portfolio of projects throughout the semester.

Demonstration of Critical Thinking

Electrical circuit analysis and problem solving assignments. Group problem solving projects Quizzes administered at the end of each topic to demonstrate mastery of the specific objective. Midterm and final exam administered to test ability to retain problem solving skills. Perform diagnostics procedures to evaluate circuit performance.

Required Writing, Problem Solving, Skills Demonstration

Exercises Group and individual Projects Quizzes Midterm Exam Final Exam Keep a journal of chronological notes taken during: a) research b) lecture c) laboratory experience. Maintain a portfolio of technical reports, research and class notes. Submit technical reports for lab projects containing results and analysis.

Eligible Disciplines

Electricity (electrical power distribution): Any bachelor's degree and two years of professional experience, or any associate degree and six years of professional experience. Electronic technology (radio, television, computer repair, avionics): Any bachelor's degree and two years of professional experience, or any associate degree and six years of professional experience. Electronics: Any bachelor's degree and two years of professional experience, or any associate degree and six years of professional experience.

Textbooks Resources

1. Required Grob, B.. Basic Electronics, 12th ed. ed. New York: McGraw-Hill, 2015 Rationale: - 2. Required Boylestad, Robert L.. Introductory Circuit Analysis, 13 ed. Upper Saddle River, NJ: Prentice Hall, 2015

Other Resources

1. Canvas Course