



El Camino College
COURSE OUTLINE OF RECORD – Official

Course Acronym:	ACR
Course Number:	5
Descriptive Title:	Electrical Applications
Division:	Industry and Technology
Department:	Air Conditioning and Refrigeration
Course Disciplines:	Air Conditioning and Refrigeration, Heating
Catalog Description:	This course focuses on basic electrical theory and training in installing, servicing, troubleshooting, and operating electrical control systems for air conditioning and refrigeration technology with the use of electrical diagrams. Single phase and three phase electrical power for air conditioning and refrigeration systems are covered in classroom discussions and laboratory assignments.
Prerequisite:	
Co-requisite:	
Recommended Preparation:	Air Conditioning and Refrigeration 21
Enrollment Limitation:	
Hours Lecture (per week):	3
Hours Laboratory (per week):	3
Outside Study Hours:	6
Total Course Hours:	108
Course Units:	4
Grading Method:	Letter Grade only
Credit Status:	Credit, degree applicable
Transfer CSU:	Yes
Effective Date:	Prior to July 1992
Transfer UC:	No
Effective Date:	
General Education: ECC	
Term:	
Other:	
CSU GE:	
Term:	
Other:	

	IGETC:
	Term:
	Other:
Student Learning Outcomes:	<p>SLO #1 Troubleshooting Units</p> <p>After reading the textbook and participating in class discussions, students will apply their knowledge of appropriate lab practices, concepts and theories by troubleshooting a faulty air conditioning unit with the use of a wiring schematic and voltmeter. After finding the problem they will run the unit and make sure it is operating at the manufacturer's specifications.</p> <p>SLO #2 Simple Wiring Diagrams</p> <p>After completion of this course students will have the basic skills necessary to read and interpret simple wiring diagrams in order to effectively troubleshoot and repair simple HVACR control and power related problems.</p> <p>SLO #3 HVACR Systems and Components</p> <p>Upon completion of this course, students will apply knowledge gained on diagrams and component operation to identify HVACR systems and components sequencing and operating conditions.</p>
Course Objectives:	<ol style="list-style-type: none"> 1. Score 100% accuracy on a safety test. 2. Evaluate and distinguish among the following terms: direct current, alternating current, inductance, capacitance, frequency, duty cycle, phase, resistance, ampere, conductor, insulator, impedance. 3. Analyze schematic diagrams to troubleshoot Heating, Ventilation, Air Conditioning and Refrigeration (HVACR) systems. 4. Troubleshoot HVACR systems with the use of a multimeter. 5. Analyze and troubleshoot various heating, air conditioning and refrigeration systems. 6. Explain the function of the primary controls of three phase air conditioning and refrigeration systems. 7. Create ladder diagrams for troubleshooting HVACR systems. 8. Measure and record voltages on HVACR systems using a digital voltmeter.
Major Topics:	<p>I. OVERVIEW OF SAFETY (2 hours, lecture)</p> <ol style="list-style-type: none"> A. Safety test B. Shop safety <p>II. ELECTRIC FUNDAMENTALS (11 hours, lecture)</p> <ol style="list-style-type: none"> A. Electron theory and magnetism B. Direct current C. Alternating current D. Ohm's law and Watt's law <p>III. ELECTRICAL COMPONENTS (4 hours, lecture)</p> <ol style="list-style-type: none"> A. Types

- B. Functions
- C. Applications

IV. ELECTRICAL COMPONENTS (9 hours, lab)

- A. Types
- B. Functions
- C. Applications

V. WIRING DIAGRAMS (6 hours, lecture)

- A. Symbols
- B. Pictorial diagrams
- C. Schematics
- D. Ladder diagrams

VI. WIRING DIAGRAMS (11 hours, lab)

- A. Symbols
- B. Pictorial diagrams
- C. Schematics
- D. Ladder diagrams

VII. TROUBLESHOOTING ELECTRICAL CIRCUITS (9 hours, lecture)

- A. Using wiring diagrams and test equipment
- B. Multimeter
- C. Ohmmeter
- D. Ammeter

VIII. TROUBLESHOOTING ELECTRICAL CIRCUITS (11 hours, lab)

- A. Using wiring diagrams and test equipment
- B. Multimeter
- C. Ohmmeter
- D. Ammeter

IX. PROBLEM SOLVING WITH WIRING DIAGRAMS (8 hours, lecture)

- A. HVACR systems
- B. Refrigeration systems
- C. Heating systems
- D. Energy management systems

X. PROBLEM SOLVING WITH WIRING DIAGRAMS (11 hours, lab)

- A. HVACR systems
- B. Refrigeration systems
- C. Heating systems
- D. Energy management systems

	<p>XI. CONSTRUCTING HVACR SIMULATION BOARDS (7 hours, lecture)</p> <ul style="list-style-type: none"> A. HVACR controls B. Sizing wires C. Transformers D. Thermostats E. Applying voltages <p>XII. CONSTRUCTING HVACR SIMULATION BOARDS (12 hours, lab)</p> <ul style="list-style-type: none"> A. HVACR controls B. Sizing wires C. Transformers D. Thermostats E. Applying voltages <p>XIII. CIRCUIT CONSTRUCTION (7 hours, lecture)</p> <ul style="list-style-type: none"> A. Series B. Parallel C. Series-parallel
Total Lecture Hours:	54
Total Laboratory Hours:	54
Total Hours:	108
Primary Method of Evaluation:	3) Skills demonstration
Typical Assignment Using Primary Method of Evaluation:	You have been provided with a work order to troubleshoot a package air conditioning system that includes gas heat. It is summer and the unit is in air conditioning mode. The complaint is the unit is not cooling. Create a process to troubleshoot the problem. Complete a one-page service report documenting troubleshooting results and submit to your instructor.
Critical Thinking Assignment 1:	Using the given schematic diagram for an air conditioning unit, create a wiring diagram of the parts of the system that controls the evaporator fan. Include the voltages involved, the controls and load parts of the circuit. Submit wiring diagram to your instructor.
Critical Thinking Assignment 2:	Sketch a wiring diagram or schematic diagram of a basic air conditioning system. Place all power voltages needed for the system in the diagram and provide all loads, switches, contacts and controlling devices. Submit wiring diagram to your instructor.
Other Evaluation Methods:	Class Performance Completion Homework Problems Matching Items Multiple Choice Other Exams Quizzes True/False Written Homework

Instructional Methods:	Lab Lecture Multimedia presentations
If other:	
Work Outside of Class:	Answer questions Required reading Skill practice Study
If Other:	
Up-To-Date Representative Textbooks:	Althouse, Turnquist Bracciano and Bracciano. <u>Modern Refrigeration and Air Conditioning</u> , 21st edition. Goodheart Willcox, 2021 (Textbook is available in printed text and digital text format.) Transition from 2021 edition to the 22nd edition will start Summer 2024 and will be effective Fall 2024
Alternative Textbooks:	
Required Supplementary Readings:	
Other Required Materials:	Safety glasses Safety gloves Workbook
Requisite:	
Category:	
Requisite course(s): List both prerequisites and corequisites in this box.	
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(s). If applicable	
Requisite course:	Air Conditioning and Refrigeration 21
Requisite and Matching skill(s):Bold the requisite skill. List the corresponding course objective under each skill(s).	Ability to troubleshoot and service electrical components in HVACR systems using electrical, electronic and mechanical analysis tools. ACR 21 - Interpret and apply schematic wiring diagrams for air conditioning applications. ACR 21 - Measure and relate units of electricity.

	<p>Ability to diagnose system operating controls, safeties, switches and components using schematic and ladder diagrams.</p> <p>ACR 21 - Diagnose operating and safety controls and switches.</p> <p>Ability to analyze, troubleshoot and perform service on refrigerant circuit components.</p> <p>ACR 21 - Demonstrate knowledge of system refrigeration components and refrigerant flow.</p>
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:	Vic Cafarchia
Date:	9/01/2001
Original Board Approval Date:	01/22/2002
Last Reviewed and/or Revised by:	Henry Der Antonian
Date:	10/03/2023
Last Board Approval Date:	04/15/2024 effective FALL 2025