Course Acronym:	ACR
Course Number:	25
Descriptive Title:	Energy Efficient Residential, Commercial and Industrial Air Conditioning
Division:	Industry and Technology
Department:	Air Conditioning and Refrigeration
Course Disciplines:	Air Conditioning and Refrigeration
Catalog Description:	This course covers energy efficient green technology (high efficiency), advanced residential, commercial and industrial air conditioning. Labs include the use of air conditioning test equipment, installation, repair and maintenance of various types of air conditioning systems. Topics include various techniques of troubleshooting electrical and mechanical problems; equipment operational efficiencies and building envelope condition; performing indoor air-quality and system efficiency testing; and system airflow and operational efficiencies.
Prerequisite:	Air Conditioning and Refrigeration 21 with a minimum grade of C or equivalent
Co-requisite:	
Recommended Preparation:	
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:	**SLO #1 Taking Readings and Applying Data** After reading the textbook and participating in class discussions, students will apply their knowledge of appropriate lab practices, concepts and theories to an operating 2 ton 13 SEER Air Conditioning Package Unit. Students will take air temperature readings, compressor amperage draw, subcooling and superheat readings and apply the data to the appropriate lab exercise. **SLO #2 Human Senses Function Test** After reading the textbook and participating in classroom discussions, students will apply their knowledge of how to check an A/C unit by using their senses to see if it operating close to what it should be. Instruments and tools will determine if the A/C units are operating correctly. These are quick checks to see if a unit is not operating. **SLO #3 Charging an A/C Unit** After reading the textbook and participating in classroom discussions, students will apply their knowledge of how to properly charge an A/C unit.
Course Objectives:	1. Complete a safety test with 100% accuracy. 2. Analyze electrical problems with the aid of meters. 3. Troubleshoot systems with the aid of electrical wiring diagrams. 4. Differentiate between electrical and mechanical problems on high efficiency versus standard air conditioning systems. 5. Perform pressure testing, evacuation and charging of air conditioning systems. 6. Distinguish Seasonal Energy Efficiency Ratio (SEER) ratings on high efficiency air conditioning equipment. 7. Analyze system operational efficiencies. 8. Evaluate and report building envelope operating conditions and provide for analysis to instructor.
Major Topics:	**I. OVERVIEW OF SAFETY (3 hours, lecture)** A. Safety exam B. Shop safety **II. SAFETY (3 hours, lab)** A. Laboratory safety B. Proper operation of tools C. Meter usage **III. REFRIGERATION APPLIED TO HIGH EFFICIENCY AIR CONDITIONING (10 hours, lecture)**

A. Energy efficiency ratings for heating ventilation and air conditioning equipment rating
B. Superheaing and subcooling

IV. ENERGY EFFICIENCY I (12 hours, lab)

A. System efficiency calculations
B. Building envelope analysis
C. Indoor air quality
D. System capacity and performance analysis
E. System charge analysis

V. ENERGY EFFICIENCY II (6 hours, lab)

A. Data log system performance
B. Evaluating system requirements
C. Performing air system testing
D. Performing system charge
E. Calculating system efficiencies

VI. TROUBLESHOOTING AIR CONDITIONING ELECTRICAL PROBLEMS (8 hours, lecture)

A. Wiring schematics
B. Electric meters

VII. SYSTEM ELECTRICAL ANALYSIS (10 hours, lab)

A. Reading and interpreting system schematic diagrams
B. Use of electrical meters and troubleshooting and servicing Heating Ventilation Air Conditioning Refrigeration (HVACR) equipment

VIII. RESIDENTIAL, COMMERCIAL AND INDUSTRIAL HIGH EFFICIENCY PACKAGE AIR CONDITIONING (8 hours, lecture)

A. Proper equipment operations
B. Installation
C. System building envelope analysis

IX. AIR DISTRIBUTION AND BALANCE (10 hours, lecture)

A. Design duct systems
B. Air flow

X. SYSTEM AND BUILDING ENVELOPE (12 hours, lab)

A. Indoor air quality
B. System efficiency testing
C. Energy efficiency testing

	XI. TYPICAL HIGH EFFICIENCY AND STANDARD AIR CONDITIONING OPERATING CONDITIONS (6 hours, lecture) A. Split and packaged systems B. Energy efficient testing and ratings C. System performance analysis **XII. HIGH EFFICIENCY AIR CONDITIONING CONTROLS (9 hours, lecture)** A. Electronic boards B. Light Emitting Diode (LED) diagnostics C. Diagnose system error indicators **XIII. SYSTEM DIAGNOSTICS (11 hours, lab)** A. Identifying system diagnostic indicators reports B. Troubleshooting using system diagnostics C. Identifying error codes and corrective measures
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:	Test an air conditioning system for proper operation. Include the following: manifold gauges for proper pressures, correct air flow through supply and return ducts with the aid of thermometers, and ammeter application to check current draw for correct motor and compressor operation. Conduct system efficiency analysis and report readings to the instructor.
Critical Thinking Assignment 1:	Use psychometric meters to measure the parameters, such as Dry Bulb, Wet Bulb, Air velocity, Air Pressure, Relative Humidity, of the air. Provide a one- to two-page report summarizing the results of the psychometric measurement reading to the instructor.
Critical Thinking Assignment 2:	Working with a high efficiency air conditioning system, evaluate superheat and subcooling by taking pressure and temperature readings with a manifold gauge set. Report readings and conclusions on a one-page data log report and submit to the instructor.
Other Evaluation Methods:	Class Performance Completion Laboratory Reports Matching Item Multiple Choice Other Exams Performance Exams Quizzes True/False Written Homework

Instructional Methods:	Demonstration Lab Lecture Multimedia presentations
If other:	
Work Outside of Class:	Answer questions Problem solving activity Required reading Skill practice Study
If Other:	
Up-To-Date Representative Textbooks:	Althouse, Turnquist, Bracciano, Bracciano, and Bracciano, Modern Refrigeration and Air Conditioning, 21st edition. Goodheart Willcox, 2021 (Textbook is available in print and digital formats.)
Alternative Textbooks:	
Required Supplementary Readings:	
Other Required Materials:	Safety glasses Safety gloves Workbook
Requisite:	Prerequisite
Category:	sequential
Requisite course(s): List both prerequisites and corequisites in this box.	Air Conditioning and Refrigeration-21
Requisite and Matching skill(s):Bold the requisite skill. List the corresponding course objective under each skill(s).	**Understand the workings of a refrigeration cycle.** ACR 21 - Demonstrate knowledge of system refrigeration components and refrigerant flow. **Demonstrate brazing skills with copper and steel tubing.** ACR 21 - Create piping project diagram that demonstrates the students brazing, bending, flaring, and swaging skills. **Employ the use of electric meters to test resistance.** ACR 21 - Measure and relate units of electricity.
Requisite Skill:	or equivalent
Requisite Skill and Matching Skill(s): Bold the requisite skill(s). If applicable	If a student has not taken ACR 21 at El Camino College but has taken an equivalent course at another college, the student will be prepared to enroll in this course. In order to be successful in this course students must understand the refrigeration and have knowledge of system refrigeration components and refrigerant flow.
Requisite course:	

Requisite and Matching skill(s):Bold the requisite skill. List the corresponding course objective under each skill(s).	
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Enrollment Limitations and Category:	
Enrollment Limitations Impact:	
Course Created by:	Robert Prather
Date:	09/01/1986
Original Board Approval Date:	FALL 1986
Last Reviewed and/or Revised by:	Henry Der Antonian
Date:	05/28/2023
Last Board Approval Date:	11/20/2023 effective FALL 2024