Course Acronym:	ACR
Course Number:	23
Descriptive Title:	Commercial Refrigeration Applications
Division:	Industry and Technology
Department:	Air Conditioning and Refrigeration
Course Disciplines:	Air Conditioning and Refrigeration
Catalog Description:	This course explores refrigeration theory, characteristics of refrigerants, temperature and pressure, tools and equipment, soldering, brazing, commercial refrigeration systems, system components, compressors, evaporators and metering devices. Instruction will include charging commercial systems with new Environmental Protection Agency (EPA) refrigerants and evaluate the proper operation of systems. Troubleshooting techniques are explained with the use of wiring diagrams and electric meters. Topics include learning to service and troubleshoot commercial refrigeration ice machines, coolers, walk-ins, refrigerators and freezers. Students will be introduced to a variety of commercial refrigeration systems and components.
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 Proper Freezer Temperatures** After reading the textbook and participating in class discussions, students will apply their knowledge of appropriate lab practices, concepts and theories to an operating low temperature walk-in freezer. Students will check proper freezer temperatures, amperage draw on the operating compressor, subcooling and superheat temperatures. **SLO #2 Special System Components** Students completing this course will apply their knowledge to the application, service and testing of special refrigeration system components. **SLO #3 Troubleshooting with Diagrams & Schematics** Students completing this course will apply their knowledge to service and troubleshooting using electrical diagrams and schematics specific to commercial refrigeration.
Course Objectives:	1. Score 100% accuracy on a safety test. 2. Describe the features of various types of commercial refrigeration compressors, condensers and evaporators. 3. Analyze and repair commercial hermetic compressors. 4. Compare and contrast the operation of various types of commercial metering devices and refrigerant flow controls. 5. Troubleshoot commercial refrigeration systems with the use of wiring diagrams and electric meters. 6. Rate the operation of various types of ice machines. 7. Demonstrate industry repair procedures on commercial refrigeration equipment.
Major Topics:	**I. OVERVIEW OF SAFETY (2.5 hours, lecture)** A. Safety test B. Shop safety C. Environmental Protection Agency (EPA) **II. SAFETY APPLICATIONS (2.5 hours, lab)** A. Tool safety 1. Electrical safety 2. Meter safety

3. Lab

III. COMMERCIAL REFRIGERATION COMPRESSORS (9 hours, lecture)

A. Reciprocating
B. Rotary
C. Compressor lubrication

IV. COMMERCIAL COMPRESSOR SERVICE (9 hours, lab)

A. Service
B. Troubleshooting
C. Operation
D. Repair

V. ICE MACHINE APPLICATIONS AND REPAIR (9 hours, lecture)

A. Scotsman
B. Manitowoc
C. Hoshizaki

VI. ICE MACHINES (9 hours, lab)

A. Service
B. Repair
C. Maintenance
D. Cleaning
E. Troubleshooting

VII. EXPANSION VALVE APPLICATIONS (6 hours, lecture)

A. Thermostatic expansion valve
B. Capillary tube
C. Automatic expansion valve

VIII. METERING DEVICES (6 hours, lab)

A. Service
B. Troubleshooting
C. Replacement
D. Identification
E. Repair

IX. CONTROLS AND ACCESSORIES (9 hours, lecture)

A. Temperature controls
B. Service valves
C. Pressure controls
D. Oil safety controls
E. Defrost controls

	X. CONTROLS AND AUXILIARY EQUIPMENT (9 hours, lab) A. Service B. Repair C. Troubleshoot D. Maintain **XI. REFRIGERATION SYSTEM TROUBLESHOOTING (9 hours, lecture)** A. Superheat B. Subcooling C. Inefficient compressor D. Overcharge E. Undercharge **XII. SYSTEM SERVICE (9 hours, lab)** A. Operational conditions B. System functional testing C. Efficiency testing D. System capacity analysis **XIII. WALK-IN REFRIGERATORS AND FREEZERS (6 hours, lecture)** A. Types and adjustments B. Walk-in box applications C. Troubleshooting walk-in problems **XIV. WALK-IN REFRIGERATORS AND FREEZERS (6 hours, lab)** A. Service B. Troubleshooting C. Repair D. Maintenance **XV. PRODUCT TEMPERATURES FOR PRESERVATION AND HEALTH (3.5 hours, lecture)** A. Health facts B. Minimum temperatures C. Problem areas and solutions **XVI. HEALTH CONCERNS (3.5 hours, lab)** A. System health requirements analysis B. System inspections C. Environmental quality inspections
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:	A Hoshizaki ice machine head pressure is high and the leaving water temperature is low. The water cooled condenser most likely has a thick layer of mineral buildup. What causes this buildup of thick minerals and what can you do to prevent this problem in the future? Document your findings in a written one-page data log report and submit to the instructor.
Critical Thinking Assignment 1:	Analyze the relationship between pressures and temperatures in the operational efficiencies of refrigeration system. Document system operating conditions in a two-page data log report and submit to the instructor.
Critical Thinking Assignment 2:	Analyze the operation of a refrigeration system. Document system operating conditions to determine proper system charge and efficiency in a one-page data log report and submit to the instructor. **CRITICAL THINKING ASSIGNMENT #3** Research on the internet for a schematics diagram based on a HVAC model number to understand and reverse engineer the findings. Provide a one- to two-page report summarizing the results from the research to the instructor.
Other Evaluation Methods:	Class Performance Completion Essay Exam 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 Problem solving activity Required reading Skill practice Study Written work (such as essay/composition/report/analysis/research)
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).	**Knowledge of proper use air conditioning and refrigeration tools, with safety in mind.** ACR 21 - Diagnose operating and safety controls and switches. ACR 21 - Measure and relate units of electricity. **Work with electrical meters.** 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. If students have work experience in basic air conditioning and refrigeration knowledge, they will be prepared to enroll in this course. If students do not have basic air conditioning and refrigeration experience, they will not succeed in this course.
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:	Robert Prather
Date:	09/01/1986
Original Board Approval Date:	FALL 1986
Last Reviewed and/or Revised by:	Henry Der Antonian
Date:	05/25/2023
Last Board Approval Date:	11/20/2023 effective FALL 2024