



El Camino College
COURSE OUTLINE OF RECORD – Official

Course Acronym:	ACR
Course Number:	27
Descriptive Title:	Heating Technologies
Division:	Industry and Technology
Department:	Air Conditioning and Refrigeration
Course Disciplines:	Air Conditioning and Refrigeration, Heating
Catalog Description:	This course covers the principles of gas, electric, radiant and boiler operated heating systems. Classroom discussions focus on maintenance, repair and service techniques for furnaces, steam and hot water boilers. Laboratory exercises emphasize the use of test instruments and safety controls.
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:	01/22/2002
Transfer UC:	No
Effective Date:	
General Education: ECC	
Term:	
Other:	
CSU GE:	
Term:	
Other:	
IGETC:	

Term:	
Other:	
Student Learning Outcomes:	<p>SLO #1 High Efficiency Gas Furnaces</p> <p>After reading the textbook and participating in class discussions, students will apply their knowledge of appropriate lab practices, concepts and theories to an operating High Efficiency Gas Furnace. Students will take gas pressure readings with a manometer and record the readings with the appropriate lab assignment and compare the reading with manufacturer's specifications.</p> <p>SLO #2 Strip-Heating System Ladder Diagram</p> <p>After reading the textbook and participating in classroom discussions, students will apply their knowledge of electric strip-heating system. Students will draw a ladder diagram of an electric strip-heating system. They will collect and analyze data, and present the sequence of operations of the system.</p> <p>SLO #3 HVAC Charging Checklist</p> <p>After reading the textbook and participating in classroom discussions, students will apply their knowledge of air source heat pump systems to collect data on the unit using a HVAC charging checklist.</p>
Course Objectives:	<ol style="list-style-type: none"> 1. Score 100% accuracy on a safety test. 2. Maintain and repair forced air furnaces. 3. Describe the operation of gas, electric and radiant heating systems. 4. Differentiate between hot water and steam boilers. 5. Repair and troubleshoot heat pumps. 6. Analyze and interpret heating and boiler wiring diagrams. 7. Demonstrate proper use of heating controls and accessories. 8. Perform combustion analysis and document results for instructor review. 9. Analyze the efficiency analysis of gas and electric heating systems.
Major Topics:	<p>I. OVERVIEW OF HEATING TECHNOLOGY (6 hours, lecture)</p> <ol style="list-style-type: none"> 1. <ol style="list-style-type: none"> A. Safety instructions B. Opportunities in the heating trade C. Fundamentals of gas furnaces <p>II. HEATING FUNDAMENTALS (33 hours, lab)</p> <ol style="list-style-type: none"> 1. <ol style="list-style-type: none"> A. Gas systems B. Electric systems C. Hydronic heating systems <p>III. BOILER FUNDAMENTALS (18 hours, lecture)</p> <ol style="list-style-type: none"> 1. <ol style="list-style-type: none"> A. Operation and safety B. Maintenance

	<ul style="list-style-type: none"> C. Low pressure boilers D. High pressure boilers E. Hot water boilers F. Steam boilers/pumps <p>IV. TROUBLESHOOTING BOILER OPERATION (21 hours, lab)</p> <ul style="list-style-type: none"> A. Wiring diagrams B. Controls <p>V. HEATING CONTROLS (14 hours, lecture)</p> <ul style="list-style-type: none"> 1. <ul style="list-style-type: none"> A. Gas furnaces B. Electric heating <p>VI. HEAT PUMPS (16 hours, lecture)</p> <ul style="list-style-type: none"> A. Valve B. Indoor coil C. Outdoor coil D. Controls and operation E. Defrost control
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:	Assuming all the switches on a high efficiency gas furnace are in the closed position, list on a one-page data log report other control components that could fail and keep the system from accessing the heating mode. Submit report to the instructor
Critical Thinking Assignment 1:	The indoor blower on a gas furnace does not operate, yet the induced draft blower does. After jumping terminals R and G, a voltage of 120 Volt Alternating Current (VAC) is read between terminals N and A, yet the blower does not come on. Report repair suggestions on a one-page data log report and submit report to the instructor.
Critical Thinking Assignment 2:	Perform a gas heating system combustion analysis and analyze the results. Provide your instructor with a detailed two-page data log report of your findings.
Other Evaluation Methods:	<p>Class Performance</p> <p>Completion</p> <p>Homework Problems</p> <p>Matching Items</p> <p>Multiple Choice</p>

	Other Exams Quizzes True/False
Instructional Methods:	Demonstration Lab Lecture Multimedia presentations
If other:	
Work Outside of Class:	Problem solving activity Required reading Study
If Other:	
Up-To-Date Representative Textbooks:	Althouse, Turnquist, Bracciano, Bracciano, <u>Modern Refrigeration and Air Conditioning</u> . 22nd edition. Goodheart Willcox, 2025 Textbook is available in printed text and digital text 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).	Ability to work with digital multimeters. ACR 21 - Measure and relate units of electricity. Ability to understand basic electrical theory. ACR 21 - Interpret and apply schematic wiring diagrams for air conditioning applications. Ability to safely use heating, ventilating, and air conditioning (HVAC) tools and equipment. ACR 21 - Diagnose operating and safety controls and switches. ACR 21 - Interpret and apply schematic wiring diagrams for air conditioning applications.

	ACR 21 - Perform and log refrigeration system operations.
Requisite Skill:	or equivalent
Requisite Skill and Matching Skill(s): Bold the requisite skill(s). If applicable	If students have completed Air Conditioning and Refrigeration 21 at another college, students will be prepared to enroll in this course. If students have experience in basic electrical theory and heating, ventilating and air conditioning tools and equipment, they will be prepared to enroll in this course. Students must understand basic electrical theory as well as safely use Heating, Ventilating, and Air Conditioning (HVAC) tools and equipment to succeed in this course.
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:	Vic Cafarchia
Date:	09/01/2001
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