



El Camino College
 COURSE OUTLINE OF RECORD – Official

Course Acronym:	ATEC
Course Number:	81
Descriptive Title:	Automotive Air Conditioning
Division:	Industry and Technology
Department:	Automotive Technology
Course Disciplines:	Automotive Technology
Catalog Description:	This course covers the theory and operation, diagnosis, service, and repair of automotive heating, ventilation, and air conditioning systems.
Prerequisite:	
Co-requisite:	
Recommended Preparation:	Automotive Technology 1 and Automotive Technology 22B or Automotive Technology 25 and Automotive Technology 26 and Eligibility for English 1A
Enrollment Limitation:	
Hours Lecture (per week):	2
Hours Laboratory (per week):	4
Outside Study Hours:	4
Total Course Hours:	108
Course Units:	3
Grading Method:	Letter Grade only
Credit Status:	Credit, degree applicable
Transfer CSU:	Yes
Effective Date:	Prior to July 1992
Transfer UC:	Yes
Effective Date:	
General Education:	
ECC	
Term:	
Other:	
CSU GE:	
Term:	
Other:	
IGETC:	

Term:	
Other:	
Student Learning Outcomes:	<p>SLO #1 Safety Exam</p> <p>Given an in class exam, based on readings, classroom discussions and demonstrations, the student will be able to work in the Automotive Shop safely and pass the Automotive Safety Exam with 100% accuracy.</p> <p>SLO #2 A/C System Analysis</p> <p>The student will perform an analysis of automotive system using an air conditioning gauge set to manufacturer specifications and complete a lab sheet.</p> <p>SLO #3 Evacuation and Recharge</p> <p>The student will perform an evacuation and recharge of the refrigerant from the automotive air conditioning system according to industry standards and complete a lab sheet.</p>
Course Objectives:	<ol style="list-style-type: none"> 1. Complete a safety test with 100% accuracy. 2. Connect a gauge set to an operable system, analyze collected data, and create plans for repair or service. Test components, analyze collected data, and formulate plans for repair or service. 3. Select testing strategies to confirm the proper operation of computerized automatic air conditioning systems. 4. Prepare an operable system for a performance test, and test the system for leaks, pressure, and temperature. 5. Diagram a functioning air conditioning system which includes temperatures and pressures. 6. Recover and recycle refrigerants in accordance to the Environmental Protection Agency (EPA) standards.
Major Topics:	<p>I. Shop Policies Safety, Automotive Service Industry Terms, Precision Measuring and Tools (2 hours, lecture)</p> <ol style="list-style-type: none"> A. Safety information and test <ol style="list-style-type: none"> 1. Course requirements 2. Safety and Pollution Prevention (SP2) 3. Shop policies B. Automotive service industry terms <ol style="list-style-type: none"> 1. Service information resources 2. Requirements for Automotive Service Excellence (ASE) certification 3. Legal rights and responsibilities under repair orders C. Precision measuring, tools and instruments <ol style="list-style-type: none"> 1. Pressure gauges 2. Digital thermometers 3. Pyrometers D. Measurements for a technician in Heating and Air Conditioning ASE A7 <p>II. Precision measuring, Tool, Safety and Repair Orders (4 hours, lab)</p>

- A. Precision measuring
 - 1. Metric and U.S. customary systems for pressure, volume and temperature
- B. Tools and equipment
 - 1. Diagnostic tools for heating and air conditioning
 - 2. Safety practices
 - 3. Hazardous materials
 - 4. Occupational Safety and Health Administration (OSHA)
- C. Repair orders
 - 1. Vehicle inspections
 - 2. Service repair order
 - 3. Parts and labor calculations
 - 4. Using workshop, electronic or other service information

III. Heating and Air Conditioning Environment, Temperature and Pressure and Engine Cooling and Comfort (4 hours, lecture)

- A. Heating and air conditioning environment
 - 1. Ozone layer
 - 2. Ozone protection regulations
 - 3. Chlorofluorocarbon CFC-12 (R-12)
 - 4. Hydrofluorocarbon HFC-134a (R-134a)
 - 5. Hydrofluro-Olefins HFO-1234yf (R-1234yf)
 - 6. Toxic gases
- B. Temperature and pressure
 - 1. Sensible, latent and specific heat
 - 2. Heat flow radiation, conduction and convection
 - 3. Humidity versus relative humidity
 - 4. Temperature versus pressure
- C. Engine cooling and comfort
 - 1. Engine cooling system
 - 2. Anti-freeze coolant
 - 3. Safety hazards

IV. Engine Cooling and Comfort Heating (8 hours, lab)

- A. Component identification
- B. Radiator types
- C. Coolant types
- D. Freeze protection
- E. Testing various components
- F. Troubleshooting procedures
- G. Hazards with cooling-system service

V. Case and Duct Systems (4 hours, lecture)

- A. Types
- B. Air distribution
- C. Defrost, heat and cool mode
- D. Temperature control
- E. Heating, Ventilation and Air Conditioning (HVAC) odor
- F. Cabin air filters

- G. Mode door actuators and operation

VI. Case and Duct Systems (8 hours, lab)

- A. Removal and replacement
- B. Blower motors and resistor
- C. Heater core and evaporator
- D. Odor control treatment
- E. Vacuum system schematics and testing
- F. Temperature control door testing and adjustment
- G. Replacing cabin air filter
- H. Water drain service
- I. In-vehicle modes troubles shoot, service and adjust

VII. System Controls (4 hours, lecture)

- A. Electrical circuit protection
- B. Manual master control assembly
- C. Blower motor and control
- D. Electromagnetic clutch
- E. Refrigerant pressure sensors
- F. Vacuum control system
- G. Automatic temperature control
- H. Scan tool diagnosis
- I. Controller Area Network (CAN) and Local Area Network (LAN)

VIII. System Controls (8 hours, lab)

- A. Component identification
- B. Compressor clutch malfunctions
- C. Blower motors
- D. Pressure and temperature actuated controls
- E. Automatic temperature control function and troubleshooting
- F. Self-diagnostic test mode
- G. Scan tool to diagnose

IX. Air-Conditioning System Operating Principles (4 hours, lecture)

- A. Heat into the refrigerant system
- B. Effects of humidity
- C. Pressure and vacuum
- D. Role of refrigerant
- E. Pressure versus temperature relationship
- F. Refrigerant in areas of the refrigerant system and its physical state
- G. Pressure and temperature
- H. Environmental Protection Agency (EPA) 609 Technician Certification

X. The Manifold and Gauge Set (8 hours, lab)

- A. Handling of refrigerants
- B. Manifold and gauge set nomenclature, function
- C. Scaling of the gauges

- D. Connecting
- E. Performance testing

XI. Refrigerant System Components (4 hours, lecture)

- A. Operation of compressors
- B. States of refrigerant in the system
- C. Changing the state of the refrigerant
- D. Receiver-drier
- E. Accumulator
- F. Thermostatic Expansion Valve (TXV)
- G. Fixed-Orifice Tube (FOT)

XII. Refrigerant System Components (8 hours, lab)

- A. Customer complaints system malfunctions
- B. Hoses
- C. Fittings
- D. Metering devices
- E. Driers
- F. Accumulators
- G. Compressors
- H. Condensers
- I. Evaporators
- J. Pressure switches

XIII. Compressors and Clutches (4 hours, lecture)

- A. Principles of reciprocating, scroll and rotary compressors
- B. Magnetic clutch
- C. Fixed or variable displacement
- D. Electric motor driven compressor

XIV. Compressors and Clutches (8 hours, lab)

- A. Various models of compressors
- B. Oil level
- C. Shaft seals
- D. Shell or fitting leaks
- E. Mechanical repairs to clutch coils and rotors

XV. Refrigerant System Servicing and Testing (4 hours, lecture)

- A. Performance test
- B. Moisture in an air conditioning system
- C. Non-condensable gas contamination
- D. Leak test procedures soap, electronic or dye solutions
- E. Charging with refrigerant
- F. Refrigerant oil

XVI. Refrigerant System Servicing and Testing (8 hours, lab)

	<ul style="list-style-type: none"> A. Refrigerant system contamination B. Performance test C. Leak test using soap, electronic or dye solution D. Evacuating refrigerant E. Charge with refrigerant F. Non-condensable gas contamination <p>XVII. Diagnosis of the Refrigeration System (4 hours, lecture)</p> <ul style="list-style-type: none"> A. Gauge readings B. System malfunctions by low-side and high-side of the air conditioning system C. Temperature-pressure charts D. Relationships for R-12 and R-134a <p>XVIII. Diagnosis of the Refrigeration System (8 hours, lecture)</p> <ul style="list-style-type: none"> A. Malfunction due to electrical or mechanical failure B. Refrigerant "state-of-charge" C. Cycling clutch or non-cycling clutch D. Functional testing electrical or mechanical systems E. Troubleshooting procedures and practices <p>XIX. Retrofit and Future Trends (R-12 to R-134a) (2 hours, lecture)</p> <ul style="list-style-type: none"> A. Hydrofluro-Olefins HFO-1234yf (R-1234yf) B. Carbon dioxide CO2 (R744) C. Refrigerants approved to replace R-12 D. Contaminated refrigerant E. Components variances between refrigerants <p>XX. Retrofit and Future Trends (R-12 to R-134a) (4 hours, lab)</p> <ul style="list-style-type: none"> A. Refrigerant purity testing and recovery B. Saddle valves C. R-12 evacuation, recovery and storage procedures D. R-134a charging procedures
Total Lecture Hours:	36
Total Laboratory Hours:	72
Total Hours:	108
Primary Method of Evaluation:	3) Skills demonstration
Typical Assignment Using Primary Method of Evaluation:	Create and draw a one-page diagram of the Cycling Clutch Orifice Tube (CCOT) and simple clutching cycling systems. Include the five major components in the proper sequence of refrigerant flow, indicate the low side from the high side, and include the low and high side pressures for a normal operating system. Submit completed diagram to the instructor.

Critical Thinking Assignment 1:	Complete a 7-10 page worksheet packet that covers specific National Automotive Technicians Education Foundation (NATEF) tasks for Automotive Service Excellence (ASE) A7 automotive heating and air conditioning. Once the worksheet packet is completed, submit to the instructor.
Critical Thinking Assignment 2:	Prepare a one-to two-page report on an interview with an automotive employer on the needed skills to be marketable in the automotive industry. Submit report to the instructor.
Other Evaluation Methods:	Class Performance Completion Homework Problems Laboratory Reports Matching Items Multiple Choice Performance Exams Reading Reports Term or Other Papers True/False Written Homework
Instructional Methods:	Demonstration Discussion Group Activities Guest Speakers Lab Lecture Multimedia Presentations
If other:	Internet Presentation/Resources
Work Outside of Class:	Answer questions Required reading Skill practice Study Written work (such as essay/composition/report/analysis/research)
If Other:	Review class notes Apply skills and knowledge Online website based e-learning
Up-To-Date Representative Textbooks:	James Halderman, <u>Automotive Heating and Air Conditioning</u> , 8th edition, Pearson, 2018.
Alternative Textbooks:	
Required Supplementary Readings:	
Other Required Materials:	Notebook Safety glasses Enclosed toe shoes
Requisite:	
Category:	

<p>Requisite course(s): List both prerequisites and corequisites in this box.</p>	
<p>Requisite and Matching skill(s): Bold the requisite skill. List the corresponding course objective under each skill(s).</p>	
<p>Requisite Skill:</p>	
<p>Requisite Skill and Matching Skill(s): Bold the requisite skill(s). If applicable</p>	<p>Automotive Technology 1</p> <p>Automotive Technology 22B or</p> <p>Automotive Technology 25 and</p> <p>Automotive Technology 26</p>
<p>Requisite course:</p>	<p>Ability to safely use automotive tools.</p> <p>ATEC 1 - Complete a safety test with 100% accuracy.</p> <p>ATEC 1 - Select and use the proper tools.</p> <p>Understand automotive charging and cooling systems.</p> <p>ATEC 1 - Service, test, and evaluate a liquid cooling system.</p> <p>ATEC 22B - Diagnose and repair cooling systems.</p> <p>ATEC 1 - Test and evaluate a charging system in accordance with industry standards.</p> <p>Understand an automotive electrical system.</p> <p>ATEC 22B - Perform engine diagnosis using a flow chart.</p> <p>ATEC 22B - Evaluate, diagnose and repair electrical systems.</p> <p>ATEC 25 - Diagnose electrical circuits (Automotive Service Excellence (ASE) tests).</p> <p>Understand and repair an automotive computer controlled system.</p> <p>ATEC 22B - Evaluate, test, diagnose and repair computer controlled systems.</p> <p>ATEC 25 - Evaluate computer controlled components.</p> <p>ATEC 25 - Diagnose and repair computer controlled systems.</p>

	<p>ATEC 26 - Test, diagnose and repair computer controlled systems.</p> <p>ATEC 26 - Analyze computer controlled engine data and recommend repairs.</p> <p>Understand automotive electrical components.</p> <p>ATEC 25 - Diagnose and repair electrical circuits.</p> <p>ATEC 25 - Examine electrical components.</p> <p>ATEC 25 - Analyze electrical testing data and recommend needed repairs.</p> <p>ATEC 26 - Analyze electrical testing data and recommend repairs.</p>
Requisite and Matching skill(s): Bold the requisite skill. List the corresponding course objective under each skill(s).	
Requisite Skill:	Eligibility for English 1A
Requisite Skill and Matching skill(s): Bold the requisite skill. List the corresponding course objective under each skill(s). If applicable	<p>Ability to read automotive related material. Summarize, analyze, evaluate, and synthesize college-level texts.</p> <p>Ability to write an automotive report. Write a well-reasoned, well-supported expository essay that demonstrates application of the academic writing process.</p>
Enrollment Limitations and Category:	
Enrollment Limitations Impact:	
Course Created by:	Hiram Hironaka
Date:	06/20/2016
Original Board Approval Date:	02/11/1991
Last Reviewed and/or Revised by:	Ed Matykiewicz
Date:	03/08/2022
Last Board Approval Date:	06/20/2022