AUTO G160: HEATING AND AIR CONDITIONING

Item	Value
Curriculum Committee Approval Date	02/01/2022
Top Code	094800 - Automotive Technology
Units	4 Total Units
Hours	108 Total Hours (Lecture Hours 54; Lab Hours 54)
Total Outside of Class Hours	0
Course Credit Status	Credit: Degree Applicable (D)
Material Fee	No
Basic Skills	Not Basic Skills (N)
Repeatable	No
Grading Policy	Standard Letter (S)

Course Description

This course will cover the theory, knowledge, and skills necessary to understand automotive Heating, Ventilation, and Air Conditioning (HVAC) systems. Instruction is given and lab experience provided which will enable students to successfully perform diagnostics and repair on both manual and automatic HVAC systems. EPA-accepted techniques for recovering and recycling R134 and R1234YF refrigerants will also be covered. Coursework is based on the Automotive Service Excellence (ASE) Tasks and Standards intended to prepare students for the ASE A-7 Heating and Air Conditioning certification examination. Transfer Credit: CSU.

Course Level Student Learning Outcome(s)

1. Course Outcomes
2. Diagnose automotive HVAC system and related components for correct system operation.
3. Use diagnostic tools and equipment designed for HVAC systems repair.
4. Evaluate system pressures and discriminate between mechanical and/or electrical faults.

Course Objectives

- 1. Pass the required shop and environmental safety exams.
- 2. Utilize manufacture specific service information to perform maintenance and service related to HVAC systems and components.
- 3. Use diagnostic, service and maintenance procedures on HVAC related systems and components.
- 4. Analyze HVAC systems using industry-accepted testing procedures, and diagnostic tools and equipment.
- 5. Pass the (Environmental Protection Agency) EPA Section 609 Refrigerant Handling Certificate Exam.

Lecture Content

Safety Basic Automotive shop safety instruction and demonstrations SP-2 Mechanical Safety module and exam SP-2 Environmental Pollution Prevention module and exam HVAC Basic Theory and Concepts Measuring heat Human comfort level parameters and related topics Heat Transfer Theory Heat Movement Conduction Convection Radiation States of matter as applied to HVAC system Molecules Solid, liquid, and gas States of heat Latent and sensible heat Boiling points (BP) Saturated vapor and pressure-temperature relationship Air pressure Vacuum and pressure concepts Gauge and absolute pressure System internal fluids Refrigerants: R-12, R-134a, and R-1234yf Compressor oils: PAG, Ester, and SUVA Leak tracing dyes Refrigerants and the Environment Ozone layer, O3 (Ozone) Legislation Recovery and recycling Refrigerants Global warming potential Tank color identification Hazards Flammability Toxicity Principles of Heat versus Cooling Theory of heat transfer Heat and cooling load factors Compression and expansion effects on heating and cooling Air Conditioning Components Compressor Condenser Evaporator Expansion device Receiver drier, or accumulator drier Muffler and filters Lines and hoses System sensors and switches Aux/Rear HVAC units Aftermarket HVAC systems Heating Systems System components and ope ration Aux/rear heating systems Aftermarket heating systems Electric heating elements HVAC Ducting and Air Management System Main and remote controls Plastic/composite cases and ducts Automatic Temperature Control (ATC) Rear window defroster HVAC System Inspection and Troubleshooting Initial checks A/C Performance testing using ambient, vent temperatures Visual inspection "Touch Test," of A/C lines and hoses Temperature testing using various thermometers A/C pressure checks Gauge sets and system fittings Gauge connections: high side versus low side Verifying system charge level Thermal Expansion Valve (TXV) and orifice tube testing Refrigerant leak tests Checking for refrigerant "witness marks" Use of dyes to trace refrigerant leak locations Vacuum leak-down test Heating and Air Management System Inspection and Diagnosis Basic electrical theory and checks System electronic controls HVAC system circuits Measuring electrical values Circuit faults: shorts, opens, and unwanted resistance Circuit repairs Electronic self-diagnosis A/C Refrigerant Maintenance and Service Operations Safety Identifying refrigerant type, recovery, and recycling System evacuation process Inline filter installation System flushing process System charging process Labeling and storing A/C refrigerant Retrofitting R-12 to R-134a A/C System Parts and Components: Diagnostics and Repairs Compressor Hoses/ lines and fittings Components remove and replace (R R) Vehicle Cooling System Engine and radiator heat transfer concepts and theory Parts and component operation Coolant types Electric engine block heaters Use of infrared thermometer to check system temperatures Cooling System Inspection, Service and Diagnosis Maintenance operation System inspection Trouble diagnosis Service and repair System flush and fill Practice Sample (A-6) ASE Heating and Air Conditioning Certification Exam

Lab Content

A/C System Diagnosis and Repair Complete vehicle repair order that includes, concern, cause, and correction as related to HVAC concerns. Analyze heating and air conditioning concerns and determine necessary action. Research applicable vehicle Service Information for HVAC system operating specifications, service history, service precautions, and technical service bulletins. Performance test A/C system to identify A/C system malfunctions. Identify abnormal operating noises in the A/C system and determine necessary action. Identify refrigerant type, select and connect compatible manifold gauges, record temperature and pressure readings. Leak test A/C system and determine necessary action. Inspect the condition of the refrigerant oil removed the system and determine necessary action. Determine recommended oil type and capacity for system application. Use a scan tool to observe and record HVAC related data and trouble codes. Refrigeration System Component Diagnosis and Repair Diagnose A/C system conditions that cause the circuit protection devices to interrupt system operation. Inspect and

replace A/C compressor drive belt, pulley, and belt tensioner to determine necessary action. Inspect, test, and/or replace A/C compressor clutch components to determine necessary action. Measure A/C clutch air gap and compare to factory specifications. Remove, inspect and reinstall A/C compressor assemble and adjust oil balance as needed. Identify hybrid vehicle A/C system electrical circuit service and safety precautions. Determine the need for an additional A/C system filter and perform necessary action. Remove and inspect A/C system mufflers, hoses, lines, fittings, seals, and service ports, and determine necessary action. Inspect for A/C condenser airflow restrictions and determine necessary action. Remove, inspect, and reinstall receiver/drier, or accumulator/drier with specified oil capacity added. Remove, inspect, and reinstall expansion valve or orifice tube. Inspect evaporator housing water drain and perform necessary action. Remove, inspect, and reinstall evaporator core assembly including proper oil type and capacity. Remove, inspect, and reinstall condenser core assembly, including proper oil type and capacity. Heating, Ventilation, and Engine Cooling System Diagnosis and Repair Diagnose temperature control problems in the heater/ventilation system and determine necessary action. Inspect coolant condition then pressure test the cooling system and radiator cap and determine necessary action. Inspect engine cooling system and heater hoses and belts to determine necessary action. Inspect test and replace thermostat assembly including gasket/seal. Determine type for vehicle application. Drain flush and refill cooling system with manufacture specified coolant. Inspect and test mechanical fan clutches cooling fans including shrouds and air dams for proper operation. Inspect and test electric cooling fans, fan control system, and circuits to determine necessary action. Inspect and test heater flow control valve(s) and perform necessary action. Remove, inspect and reinstall heater core assembly. Operating System and Related Controls Diagnosis and Repair Diagnose malfunctions in the electrical controls of HVAC systems and determine necessary action. Inspect and test HVAC blower motor circuit components and perform necessary action. Test and diagnose A/C compressor clutch control system and determine necessary action. Diagnose malfunctions in the vacuum, mechanical, and elec trical controls of the HVAC system. Inspect and test A/C heater control panel assembly and determine necessary action. Inspect and test A/C heater control cables, electrical actuators, and linkages to determine necessary action. Inspect A/C heater ducts, doors, hoses, cabin filters and vent outlets for proper operation. Identify the source of HVAC related odors. Check the operation of automatic or semi-automatic HVAC control systems to determine necessary action. Refrigerant Recover, Recycling, and Handling Perform correct use and maintenance of refrigerant handling equipment according to equipment manufactures standards. Identify and recover A/C system refrigerant. Recycle, label, and store refrigerant. Evacuate and charge A/C system, add refrigerant oil as required.

Method(s) of Instruction

- Lecture (02)
- DE Live Online Lecture (02S)
- Lab (04)
- DE Live Online Lab (04S)

Reading Assignments

Textbook Reading Assignments

Writing Assignments

Complete written repair orders related to various on-vehicle lab assignments.

Out-of-class Assignments

Reading Assignments Interactive Web-based Training Modules Worksheets

Demonstration of Critical Thinking

Demonstrate theoretical troubleshooting of HVAC refrigeration system. Use HVAC Performance test to analyze system operation. Analyze wiring schematic diagrams to create diagnostic testing plans.

Required Writing, Problem Solving, Skills Demonstration

Create vehicle repair orders that include written explanations of work completed, math calculations for parts and labor charges. Use specifications to verify refrigerant and compressor oil charge values, and to predict operational pressures.

Eligible Disciplines

Automotive technology: Any bachelors degree and two years of professional experience, or any associate degree and six years of professional experience.

Textbooks Resources

1. Required James D. Halderman. Automotive Heating and Air Conditioning, 8th ed. Pearson, 2018

Other Resources

1. GWC AutoTech Uniform Shirt