



ILLINOIS VALLEY COMMUNITY COLLEGE

COURSE OUTLINE

DIVISION: Workforce Development

COURSE: ATO 2250 Heating and Air Conditioning

Date: Spring 2022

Credit Hours: 3

Complete all that apply or mark "None" where appropriate:

Prerequisite(s): None

Enrollment by assessment or other measure? Yes No

If yes, please describe:

Corequisite(s): None

Pre- or Corequisite(s): None

Consent of Instructor: Yes No

Delivery Method: **Lecture** **2 Contact Hours** (1 contact = 1 credit hour)
 Seminar **0 Contact Hours** (1 contact = 1 credit hour)
 Lab **2 Contact Hours** (2-3 contact = 1 credit hour)
 Clinical **0 Contact Hours** (3 contact = 1 credit hour)
 Online
 Blended
 VCM

Offered: **Fall** **Spring** **Summer**

CATALOG DESCRIPTION and IAI NUMBER (if applicable):

This course covers the theory, construction, operation and servicing of the air conditioning, heating and cooling systems found on the automobile. Emphasis will be placed on testing, troubleshooting and servicing of the air conditioning system using appropriate manuals, tools, equipment and safety practices. The recovery and recycling of refrigerant, laws governing R-12 and R-134a, and technician refrigerant certification will receive special emphasis.

ACCREDITATION STATEMENTS AND COURSE NOTES:

The Automotive Technology program at Illinois Valley Community College is a ASE Education Foundation Master Certified Automotive Technology Program.

The program goes through an on-site evaluation every five years and the ASE Education Foundation tasks that are taught in this course are also updated every five years to align with any changes made by the ASE Education Foundation national automotive advisory council.

COURSE TOPICS AND CONTENT REQUIREMENTS:

I. Cooling System

A. Basic Theory

1. Purpose of System
 - a. Operating temperature (too cool)
 - b. Operating temperature (too hot)
2. Coolant
 - a. 50-50 mix (Ethylene glycol and water)
 - b. Maintenance
 - c. Additives
3. Component parts
 - a. Radiator
 - 1) Construction
 - 2) Purpose
 - 3) Downflow
 - 4) Crossflow
 - 5) Transmission cooler
 - 6) Service (flushing)
 - b. Water pump
 - 1) Construction
 - 2) New and rebuild
 - 3) Replacement
 - 4) Drive belts
 - c. Water jackets
 - 1) Design
 - 2) Air cooled
 - d. Pressure caps
 - 1) Purpose
 - 2) Testing
 - 3) Coolant recovery
 - e. Hoses
 - 1) Inspection
 - 2) Replacement
 - f. Thermostat
 - 1) Purpose
 - 2) Types
 - 3) Testing
 - g. Fans
 - 1) Thermostatic
 - 2) Fluid
 - 3) Variable pitch

- 4) Shrouds
- 5) Electrical

II Heating System

A. Basic Theory

1. Heater Core
 - a. Construction
 - b. Location
 - c. Service
 - d. Air flow circuits
2. Vacuum Controls
 - a. Temperature doors
 - b. Switches
 - c. Diagrams
 - d. Heater control valve
3. Electrical circuits
 - a. Blower motors
 - b. Cable controls (temperature)
 - c. Auto temperature control
4. Thermostats
 - a. Operation
 - b. Three types
 - c. Replacement

III. The A/C System

A. Basic Theory

1. Atmospheric Pressure
2. Vacuum
3. Heat
 - a. Transfer
 - b. Pressure-temperature relationship
 - c. BTU
 - d. Latent-heat
4. Humidity
5. Refrigerant
 - a. R-12
 - b. HFC-134a
 - c. R-1234yf
 - d. EPA Approved Blend refrigerants
 - e. Montreal protocol
 - f. CO₂ as a Refrigerant
 - g. Ozone layer
 - h. Ozone depletion

B. Component Parts

1. Compressor
 - a. Purpose
 - b. Types
 - 1) Piston
 - 2) Rotary Vane

- 3) Scroll
 - 4) Variable displacement
- c. Service (seals, bearings and clutches)
- d. Replacement
- e. Controls
 - 1) Ambient temperature switch
 - 2) Pressure cycling switch
 - 3) Thermostatic cycling switch
 - 4) Low pressure cut-off
 - 5) High pressure cut-off
 - 6) ECM/PCM
- 2. Evaporator
 - a. Purpose and construction
 - b. Types
 - c. Replacement
- 3. Controls
 - 1) Expansion valve
 - 2) Orifice Tube
 - 3) Variable Orifice Tube
 - 4) Suction Control Valve
- d. Replacement
- 4. Condensor
 - 1) Purpose
 - 2) Construction
 - 3) Receiver drier
 - 4) Replacement
- 5. Servicing the system
 - 1) Safety precautions
 - 2) Use of gauge set
 - 3) Use of recovery/recycling/recharging machine
 - 4) Proper recovery of refrigerant
 - 5) Evacuation
 - 6) Charging
 - 7) Leak testing
 - 8) Performance testing
 - a) Diagnosis
 - b) Repair
- 6. Common malfunctions and diagnosis
 - 1) Low Refrigerant Level
 - 2) System overcharged
 - 3) Air in system
 - 4) Moisture in system (freezing up)
 - 5) Condensor blockage
 - 6) Faulty compressor
 - 7) Expansion valve stuck
 - a) Open
 - b) Closed
 - 8) Internal restrictions in the system
 - 9) Defective cycling switch

- 10) Clogged receiver drier
- 7. Retro-fitting R-12 systems to R134a
 - 1) EPA requirements
 - 2) Proper procedure
 - 3) Lubricants
 - 4) Replacement of o-rings
 - 5) Replacement of dessicant
 - 6) Testing

C. Certification

- 1. Clean Air Act, Section 609
- 2. Society of Engineering Standards
 - a. J1989
 - b. J1990
 - c. J1991
- 3. Refrigerant Recovery and Recycling Certification exam

INSTRUCTIONAL METHODS:

Lecture
 Demonstrations
 Videos
 Power Point Presentations

EVALUATION OF STUDENT ACHIEVEMENT:

Complete Lab Objectives (ASE Educational Foundation Tasks)
 Satisfactory Performance on written Exams
 Safety Practices
 Work Habits
 Attendance
 Attitude
 Class Participation

INSTRUCTIONAL MATERIALS:

Textbooks

Electude Online software

Resources

- 1. Pro-Demand – Information System
- 2. All Data Pro - Information System

LEARNING OUTCOMES AND GOALS:

Institutional Learning Outcomes

- 1) Communication – to communicate effectively;
- 2) Inquiry – to apply critical, logical, creative, aesthetic, or quantitative analytical reasoning to formulate a judgement or conclusion;
- 3) Social Consciousness – to understand what it means to be a socially conscious person, locally and globally;
- 4) Responsibility – to recognize how personal choices affect self and society.

Course Outcomes and Competencies

VII. HEATING, VENTILATION, AND AIR CONDITIONING (HVAC)

A. General

1. Research vehicle service information, including refrigerant/oil/fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS).
2. Identify heating, ventilation, and air conditioning (HVAC) components and configurations.
3. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed.
4. Perform A/C system performance test; interpret results; determine needed action.
5. Identify abnormal operating noises in the A/C system; determine needed action.
6. Leak test A/C system; determine needed action.
7. Identify and interpret heating and air conditioning problems; determine needed action.
8. Identify refrigerant type; test for sealant; select and connect proper gauge set/test equipment; record temperature and pressure readings.
9. Inspect condition/quantity of refrigerant oil removed from A/C system; determine needed action.
10. Determine recommended oil and oil capacity for system application and component(s) replacement.

VII. HEATING, VENTILATION, AND AIR CONDITIONING (HVAC)

B. Refrigeration System Components

1. Inspect, remove, and/or replace A/C compressor drive belts, pulleys, tensioners; determine needed action.
2. Inspect for proper A/C condenser airflow; determine needed action.
3. Inspect evaporator housing condensation drain; determine needed action.
4. Inspect, test, and/or service A/C compressor clutch components and/or assembly; determine needed action.
5. Remove, inspect, reinstall, and/or replace A/C compressor and mountings; determine recommended oil type and quantity.
6. Remove and inspect A/C system mufflers, hoses, lines, fittings, O-rings, seals, and service valves; determine needed action.
7. Remove, inspect, and replace receiver/drier or accumulator/drier; determine recommended oil type and quantity.
8. Remove, inspect, and install expansion valve or orifice (expansion) tube.
9. Diagnose A/C system conditions that cause the protection devices (pressure, thermal, and/or control module) to interrupt system operation; determine needed action.
10. Determine procedure to remove and reinstall evaporator; determine required oil type and quantity.
11. Remove, inspect, reinstall, and/or replace condenser; determine required oil type and quantity.

VII. HEATING, VENTILATION, AND AIR CONDITIONING (HVAC)

C. Heating, Ventilation, and Engine Cooling Systems

1. Inspect engine cooling and heater systems hoses and pipes; determine needed action.

2. Inspect and test heater control valve(s); determine needed action .
3. Diagnose temperature control problems in the HVAC system related to the engine cooling system, including electric heating; determine needed action.
4. Determine procedure to remove, inspect, reinstall, and/or replace heater core; properly refill system.

VII. HEATING, VENTILATION, AND AIR CONDITIONING (HVAC)

D. Operating Systems and Related Controls

1. Inspect HVAC system ducts, doors, hoses, cabin filters, and outlets; determine needed action.
2. Identify the source of HVAC system odors.
3. Inspect and test HVAC system blower motors, resistors, switches, relays, wiring, and protection devices; determine needed action.
4. Diagnose A/C compressor control systems; determine needed action.
5. Diagnose malfunctions in the vacuum, mechanical, and/or electrical components and controls of the HVAC system; determine needed action.
6. Inspect, test, remove and/or replace HVAC system control panel; determine needed action.
7. Check operation of automatic HVAC control systems; determine needed action.

VII. HEATING, VENTILATION, AND AIR CONDITIONING (HVAC)

E. Refrigerant Recovery, Recycling, and Handling

1. Demonstrate awareness of the need to recover, recycle, and handle refrigerants using proper equipment and procedures
2. Use and maintain refrigerant handling equipment according to equipment manufacturer's standards.
3. Identify A/C system refrigerant; test for sealants; recover, evacuate, and charge A/C system; add refrigerant oil as required.
4. Recycle, label, and store refrigerant.

FOUNDATIONAL TASKS – 2022

Shop and Personal Safety

1. Identify general shop safety rules and procedures.
2. Utilize safe procedures for handling of tools and equipment.
3. Identify and use proper placement of floor jacks and jack stands.
4. Identify and use proper procedures for safe lift operation.
5. Utilize proper ventilation procedures for working within the lab/shop area.
6. Identify marked safety areas.
7. Identify the location and the types of fire extinguishers and other fire safety equipment; demonstrate knowledge of the procedures for using fire extinguishers and other fire safety equipment.
8. Identify the location and use of eye wash stations.
9. Identify the location of the posted evacuation routes.
10. Comply with the required use of safety glasses, ear protection, gloves, and shoes during lab/shop activities.
11. Identify and wear appropriate clothing for lab/shop activities.

12. Secure hair and jewelry for lab/shop activities.
13. Identify vehicle systems which pose a safety hazard during service such as: supplemental restraint systems (SRS), electronic brake control systems, stop/start systems, and remote start systems.
14. Identify vehicle systems which pose a safety hazard during service due to high voltage such as: hybrid/electric drivetrain, lighting systems, ignition systems, A/C systems, injection systems, etc.
15. Locate and demonstrate knowledge of safety data sheets (SDS).

Tools and Equipment

1. Identify tools and their usage in automotive applications.
2. Identify standard and metric designation.
3. Demonstrate safe handling and use of appropriate tools.
4. Demonstrate proper cleaning, storage, and maintenance of tools and equipment.

Preparing for Vehicle Service

1. Identify information needed and the service requested on a repair order.
2. Identify purpose and demonstrate proper use of vehicle protection such as: fender covers, mats, seat, and steering wheel covers.
3. Perform a vehicle walk-around inspection; identify and document existing vehicle conditions such as body damage, paint damage, windshield damage.
4. Perform a vehicle multi-point inspection and complete a vehicle inspection report.
5. Demonstrate use of the three C's (concern, cause, and correction).
6. Create a plan of action for each specific service or diagnostic situation.
7. Review vehicle service history.
8. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction.

Preparing Vehicle for Customer

1. Ensure vehicle is prepared to return to customer per school/company policy (floor mats, steering wheel cover, etc.).

Personal Standards

1. Reports to work daily on time; able to take directions and motivated to accomplish the task at hand.
2. Dresses appropriately and uses language and manners suitable for the workplace.
3. Maintains personal hygiene appropriate for the workplace.
4. Meets and maintains employment eligibility criteria, such as drug/alcohol-free status, clean driving record, etc.
5. Demonstrates honesty, integrity, and reliability.

Work Habits / Ethic

1. Complies with workplace policies/laws.
2. Contributes to the success of the team, assists others and requests help when needed.
3. Works well with all customers and coworkers.

4. Negotiates solutions to interpersonal and workplace conflicts.
5. Contributes ideas and initiative.
6. Follows directions.
7. Communicates effectively, both in writing and verbally, with customers and coworkers.
8. Reads and interprets workplace documents; writes clearly and concisely.
9. Analyzes and resolves problems that arise in completing assigned tasks.
10. Organizes and implements a productive plan of work.
11. Uses scientific, technical, engineering and mathematics (STEM) principles and reasoning to accomplish assigned tasks.
12. Identifies and addresses the needs of all customers, providing helpful, courteous, and knowledgeable service and advice as needed.
13. Respectful of tools and property used in school and workplace environment.
14. Contributes to an inclusive environment where every coworker and customer feels welcomed, heard, and valued.