

# AUTO 167: AUTOMOTIVE HVAC SERVICE, DIAGNOSIS & REPAIR

## Citrus College Course Outline of Record

Heading	Value
Effective Term:	Fall 2021
Credits:	4.5
Total Contact Hours:	153
Lecture Hours :	45
Lab Hours:	108
Hours Arranged:	0
Outside of Class Hours:	90
Prerequisite:	AUTO 166.
Transferable to CSU:	Yes
Transferable to UC:	No
Grading Method:	Standard Letter

## Catalog Course Description

Intended for those seeking a career in the automotive service and repair industry. This National Automotive Technicians' Education Foundation certified course is one component of the Toyota Technical Education Network and Technicians' Education Cooperative programs. This class covers essential heating, ventilation and air conditioning system theory, along with inspection, diagnosis, service and repair of specific HVAC subsystems including: refrigeration, air distribution and automatic temperature control. This course prepares students for ASE Heating and Air Conditioning (A7) certification. 45 lecture hours, 108 lab hours.

## Course Objectives

- A. A/C System Diagnosis and Repair 1. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction. P-1 2. Identify and interpret heating and air conditioning concern; determine necessary action. P-1 3. Research applicable vehicle and service information, such as heating and air conditioning system operation, vehicle service history, service precautions, and technical service bulletins. P-1 4. Locate and interpret vehicle and major component identification numbers. P-1 5. Performance test A/C system; identify A/C system malfunctions. P-1 6. Identify abnormal operating noises in the A/C system; determine necessary action. P-2 7. Identify refrigerant type; select and connect proper gauge set; record temperature and pressure readings. P-1 8. Leak test A/C system; determine necessary action. P-1 9. Inspect the condition of refrigerant oil removed from the system; determine necessary action. P-2 10. Determine recommended oil and oil capacity for system application. P-1 11. Using scan tool, observe and record related HVAC data and trouble codes. P-1
- B. Refrigeration System Component Diagnosis and Repair 1. Diagnose A/C system conditions that cause the protection devices (pressure, thermal, and PCM) to interrupt system operation; determine necessary action. P-2 2. Inspect and replace A/C compressor drive belts, pulleys, and tensioners; determine necessary action. P-1 3. Inspect, test, and/or replace A/C compressor clutch components and/or assembly; check compressor clutch air gap

and adjust as needed. P-2 4. Remove, inspect, and reinstall A/C compressor and mountings; determine required oil quantity. P-1 5. Identify hybrid vehicle A/C system electrical circuits, service and safety precautions. P-3 6. Determine the need for an additional A/C system filter; perform necessary action. P-3 7. Remove and inspect A/C system mufflers, hoses, lines, fittings, O-rings, seals, and service valves; perform necessary action. P-2 8. Inspect A/C condenser for airflow restrictions; perform necessary action. P-1 9. Remove, inspect, and reinstall receiver/drier or accumulator/drier; determine required oil quantity. P-1 10. Remove, inspect, and install expansion valve or orifice (expansion) tube. P-1 11. Inspect evaporator housing water drain; perform necessary action. P-2 12. Remove, inspect, and reinstall evaporator; determine required oil quantity. P-3 13. Remove, inspect, and reinstall condenser; determine required oil quantity. P-3

- C. Heating, Ventilation, and Engine Cooling Systems Diagnosis and Repair 1. Diagnose temperature control problems in the heater/ventilation system; determine necessary action. P-2 2. Perform cooling system pressure tests; check coolant condition, inspect and test radiator, cap (pressure/vacuum), coolant recovery tank, and hoses; perform necessary action. P-1 3. Inspect engine cooling and heater system hoses and belts; perform necessary action. P-1 4. Inspect, test, and replace thermostat and gasket/seal. P-1 5. Determine coolant condition and coolant type for vehicle application; drain and recover coolant. P-1 6. Flush system; refill system with recommended coolant; bleed system. P-2 7. Inspect and test cooling fan, fan clutch, fan shroud, and air dams; perform necessary action. P-1 8. Inspect and test electric cooling fan, fan control system and circuits; determine necessary action. P-1 9. Inspect and test heater control valve(s); perform necessary action. P-2 10. Remove, inspect, and reinstall heater core. P-3
- D. Operating Systems and Related Controls Diagnosis and Repair 1. Diagnose malfunctions in the electrical controls of heating, ventilation, and A/C (HVAC) systems; determine necessary action. P-2 2. Inspect and test A/C-heater blower, motors, resistors, switches, relays, wiring, and protection devices; perform necessary action. P-1 3. Test and diagnose A/C compressor clutch control systems; determine necessary action. P-1 4. Diagnose malfunctions in the vacuum, mechanical, and electrical components and controls of the heating, ventilation, and A/C (HVAC) system; determine necessary action. P-2 5. Inspect and test A/C-heater control panel assembly; determine necessary action. P-3 6. Inspect and test A/C-heater control cables, motors, and linkages; perform necessary action. P-3 7. Inspect A/C-heater ducts, doors, hoses, cabin filters and outlets; perform necessary action. P-2 8. Identify the source of A/C system odors. P-2 9. Check operation of automatic or semi-automatic heating, ventilation, and air-conditioning (HVAC) control systems; determine necessary action. P-2
- E. Refrigerant Recovery, Recycling, and Handling 1. Perform correct use and maintenance of refrigerant handling equipment according to equipment manufacturer's standards. P-1 2. Identify and recover A/C system refrigerant. P-1 3. Recycle, label, and store refrigerant. P-1 4. Evacuate and charge A/C system; add refrigerant oil as required. P-1

## Major Course Content

1. HVAC theory
  - a. Body comfort
  - b. Thermodynamic principles of heat, matter and pressure
  - c. Refrigerant
  - d. Refrigeration systems
2. Service equipment & procedures

- a. Safety working with refrigerants and vehicle electrical systems
  - b. Moisture & moisture removal
  - c. Refrigerant recovery & recycling
  - d. Diagnostics using pressure and temperature differentials within system
- 3. Air distribution control
  - a. Air inlet control
  - b. Air outlet control
  - c. Air speed control
  - d. Air mix control
  - e. Humidity control
- 4. Compressors
- 5. Metering devices
- 6. Automatic temperature control
  - a. Input sensors
  - b. Output actuators
  - c. Control systems
  - d. Self diagnostics
  - e. Multi-zone air distribution/temperature control
- 7. Hybrid and Electric vehicle refrigeration and cooling systems
  - a. High voltage refrigeration safety and servicing requirements
  - b. High voltage compressor controls
  - c. Inverter and traction battery cooling system servicing

pertain to one of the topics identified for that weeks' study. A copy of the article will be turned in, along with a word processed document that includes a 1-paragraph summary and a 1-paragraph response written in your own words (for format requirements, see below.)

#### Minimum Word-Processing Requirements

All written assignments (essays, research papers, reports, technical-article summaries, etc.) shall be word-processed and include student name, course number, and date single-spaced in the upper right-hand corner. The text of the assignment will be justified (text aligned on the left and right) with 1-inch margins (left, right, top & bottom), double-spaced, and shall use a twelve-point font. Students will be assigned industry based technical article evaluation from trade journals.

## Examples of Outside Assignments

technical article evaluation Student will use electronic service information to complete guided discovery based learning.

## Instruction Type(s)

Lecture, Lab, Online Education Lecture

## Lab Content

- 1. Diagnosis, service and repair
  - a. Moisture & moisture removal
  - b. Refrigerant recovery & recycling
  - c. System pressure measurement & analysis
- 2. Air distribution control testing
  - a. Air inlet control testing
  - b. Air outlet control testing
  - c. Air speed control testing
  - d. Air mix control testing
- 3. Compressor diagnosis, service and repair
- 4. Condenser and evaporator diagnosis, service and repair
- 5. Metering device diagnosis, service and repair
- 6. Automatic temperature control diagnosis, service and repair
  - a. Input sensor testing
  - b. Output actuator testing
  - c. Diagnostic trouble code retrieval
  - d. Multi-zone air distribution/temperature control functional testing

## Suggested Reading Other Than Required Textbook

electronic journals, printed material, on-line resources Student will complete instructor selected University of Toyota e-learning modules that are related to the subject matter.

## Examples of Required Writing Assignments

Each week, you must read at least one automotive related technical article from a magazine or web-site of your choice. The article should