

Automotive Climate Control Systems

This course covers the theory of automotive air conditioning and heating systems. Emphasis will be on the basic refrigeration cycle and diagnosis and repair of system malfunctions. Topics also cover EPA guidelines for refrigerant handling and new refrigerant replacements. This course may be taught manufacturer-specific.

Utilizing safety procedures, the student will explain the operation of the basic refrigeration cycle; diagnose and repair air distribution systems; demonstrate proper procedures for handling refrigerant; and describe the operation of air conditioning and heating controls.

STUDENT BEHAVIOR/CLASSROOM DECORUM: Students are encouraged to discuss, inquire, and express their thoughts and views during class. Classroom behavior that interferes with either the instructor's ability to conduct the class or the ability of students to benefit from the instruction is not acceptable. Students are required to turn off all cell phones or similar electronic devices (or place them on silent mode) before coming into the classroom. The instructor reserves the right to assign no credit for work on that day if a student talks or texts on a cell phone or similar electronic device. The classroom is not a place for children, and students are not to bring their family members into the classroom.

NETIQUETTE POLICY: This term is used to describe accepted, proper behavior on the Internet. Remember the following when communicating online (messages, discussion board, etc.):

- Never post profanity, racist, or sexist messages
- Be respectful of fellow students and instructors
- Never insult any person or their message content
- Never plagiarize or publish intellectual property
- Do not use text messaging abbreviations or slang
- Do not type in all CAPS (this is considered online yelling)

PROGRAM DRESS CODE:

Your appearance in the program must model industry expectations on a daily basis. The entire dress code will be covered during safety training. The following items are the minimum requirements for this course:

1. Belt, if required, to hold your pants up; should not have a metal buckle
2. No loose-fitting clothing
3. No wallet chains, keys, cell phone holders
4. Remove jewelry
5. Tie long hair back or keep it under a shop-type cap
6. Appropriate work boots/shoes are recommended

If you are caught without safety glasses, you will lose your daily points for the day as your first warning (you will not be allowed in the shop). On the second warning, you will be dismissed from class for that day. On the third warning, you will have to report to the Dean to discuss why you are not complying with this important safety rule.

Course Length

16, 8, and 5 week term offerings

Format for Delivery

F-2-F, Hybrid, and Online

Course Learning Objectives

Unit 1: Fundamental Principles of Heating & Air Conditioning Upon completion of this unit, students will be able to:

- Explain the basic laws of heat and the three methods of heat transfer.
- Define the term latent heat and discuss the difference between latent and sensible heat.
- Describe the difference between heat and temperature and how heat is measured.
- Explain the body's reaction to heat and humidity.
- Discuss the relationships between temperature and pressure concerning a liquid. (Closed System)
- Discuss the relationships between temperature and pressure concerning a gas. (Closed System)

- Discuss the difference between pressure and vacuum.
- Research applicable vehicle and service information, such as heating and A/C system operation, vehicle service history, service precautions, and TSBs.

Locate and interpret vehicle and major component identification numbers (VIN, vehicle certification labels, calibration decals).

Unit 2: Cooling and Heating System Servicing Upon completion of this unit, students will be able to:

- Determine coolant condition and coolant type for vehicle application; drain and recover coolant.
- Inspect engine/heater hoses and belts; perform necessary action.
- Perform cooling system, cap, and recovery system tests. (Includes pressure, CO, and temperature.); determine necessary

action.

- Inspect, test, and replace thermostat assembly.
- Flush system; refill system with recommended coolant; bleed system
- Inspect and test cooling fan assembly, fan shroud, and air dams; perform necessary action.
- Inspect and test heater control valve(s); perform necessary action.
- Diagnose passenger compartment temperature control problems.

Inspect and test an electric engine cooling fan, fan control system, and circuits; determine necessary action.

Unit 3: Electrical and Vacuum Passenger Compartment Air Flow Servicing Upon completion of this unit, students will be able to:

- Diagnose malfunctions in the electrical controls of heating, ventilation, and A/C systems; determine necessary action.
- Diagnose malfunctions in the vacuum and mechanical components and controls of the heating ventilation A/C system; determine necessary action.
- Inspect and test A/C-heater control panel assembly; determine necessary action.
- Inspect and test A/C-heater control cables and linkages; perform necessary action.
- Inspect and test A/C heater blower assembly and electrical components; perform necessary action.
- Test and diagnose A/C compressor clutch control systems; determine necessary action.
- Inspect, test, and repair A/C-heater air distribution devices.

Inspect A/C-heater ducts, doors, hoses, cabin filters, and outlets; perform necessary action.

Unit 4: System Components and Function, Equipment, Evacuation, Recycle, Recharge, and Leak Detection Upon completion of this unit, students will be able to:

- Discuss safety habits concerning the A/C system, including recycling.
- List the required properties of a refrigerant.
- Trace the refrigerant flow through an A/C system.
- Identify and discuss the function of the accumulator, receiver dryer, condenser, orifice tube, expansion valve, and evaporator.
- Describe how a Schrader valve operates.
- Name the positions of a three-position service valve.
- Describe the high and low gauges and their differences.
- Properly attach a manifold gauge set to a vehicle.
- Explain the necessity of evacuating an A/C system.
- Describe and perform the evacuation and discharge processes.
- Describe how to flush a contaminated system.
- List the different steps involved when charging an A/C system. Including Hybrid systems.
- Describe a charging station and know how to use one.
- Partially charge an A/C system.
- Perform oil check or injecting oil. Includes Hybrid Compressor
- Name the four methods of leak detection and the process for each method.

- Describe signs to look for when leak testing.
- Explain why refrigerant can leak slowly and not be apparent when tested for leaks.

Describe how to read air conditioning gauges and demonstrate the proper method for installing a gauge set on an A/C system.

Unit 5: Air Conditioner System Service, Diagnosis and Retrofitting. Upon completion of this unit, students will be able to:

- Discuss and demonstrate various methods of checking compressor oil. Including Hybrid compressors.
- Identify the properties of refrigerant oil.
- Identify various types of compressors. Including Hybrid vehicles.
- Remove a compressor head and determine the condition of the valves.
- Describe and demonstrate how to replace the compressor seal on at least two different types of compressors.
- Determine the condition of the compressor clutch and demonstrate how to check belt tension. Includes Hybrid systems
- Inspect compressor pulley bearing condition and demonstrate the procedure for replacing faulty bearings.
- Demonstrate how to remove an orifice tube.
- Test a thermostatic expansion valve temperature-sensing bulb.
- Locate the evaporator condensation drain and discuss how to clear any obstructions.
- Identify various types of mufflers.
- Inspect, test, and repair A/C controlled engine idle system.
- Performances test at least two A/C systems.
- Diagnose A/C system problems indicated by the sight glass.
- Diagnose A/C system problems indicated by pressure gauge readings.
- Diagnose A/C system problems indicated by visual and touch procedures.
- Diagnose A/C system pressure control problems.
- Diagnose A/C system high-pressure problems.
- Inspect, test, repair, and adjust an A/C compressor cut-off system.
- Explain why a sudden temperature change can indicate a blocked area.
- Flush the A/C system; determine the need for an additional filter; perform necessary action.

Discuss the proper procedures to retrofit an R-12 system to R134a.

Unit 6: Automatic and Semi-Automatic Systems Diagnosis Repair. Upon completion of this unit, students will be able to:

- Check the operation of automatic and semi-automatic heating, ventilation, and A/C control systems; determine necessary action. Includes Hybrid systems.
 - Inspect, test, and replace ambient air sensors.
 - Inspect, test, and replace power servo.
1. Inspect, test, and replace an automatic temperature control panel.

Required Textbooks

Today's Technician: Basic Automotive Service and Systems, Classroom Manual and Shop Manual 6th edition

By Chris Hadfield, John Witthauer

E-book included with Cengage Unlimited subscription, required for all AUMT courses.

SUPPLIES AND EQUIPMENT: Tool list to be provided by the instructor.

COPYRIGHT POLICY: Unless a student has obtained permission from the copyright holder, it is a violation of Copyright Law to print or photocopy chapters from a textbook that the student did not purchase. If the course requires the use of an electronic textbook, a student must look for a statement that allows for photocopying and/or printing of the eTextbook.

Evaluation Standards

Student success is measured by assessment techniques aligned to course goals and learning outcomes. A variety of techniques may be used, including but not limited to objective exams, written reports, performance charts, portfolios, oral presentations or demonstrations, and group projects. Individual faculty members are responsible for designing evaluation instruments to measure student mastery of course goals and learning outcomes and for indicating the nature of such instruments in the instructor's class requirements.

GRADING REQUIREMENTS:

30% Labsheet assignment completion

25% Skills test including final skills test

20% Written tests, including a final exam

10% Quizzes, including pop quizzes

5% Assignments, including e-learning modules, review questions, etc.

5% Participation in class and lab (affected by absences)

5% Properly following safety procedures and proper clean up of lab area

Written Tests: Acceptable written evaluations shall be completed with a minimum score of; 80% or higher. Safety-related written tests may require a higher score for mastery, and curriculum-specified best practices will be followed.

Performance Evaluations: Acceptable and safe completion of performance evaluations will be determined by the instructor according to accepted industry standards and the specified criteria. Performance evaluations meeting minimum industry standards will earn a grade of 70% (C or Satisfactory). Those exceeding "minimum" acceptance standards may earn higher grades subject to the instructors' approval. Students not meeting minimum acceptance standards must repeat each unacceptable performance evaluation until minimum skills are achieved. Students unable to meet minimum acceptance standards may be assigned an "F" grade for any incomplete competencies. However, all specified competencies **MUST** be completed to receive credit for this course, and any incomplete competencies may result in an "F" in the course.

Supplemental evaluations may include safe practices, student participation, quizzes, time management, workplace skills, and other instructor-specified content.

Drop Date

WITHDRAWAL POLICY: If you intend to withdraw from the course or resign from the college, you must initiate the action by logging into Coyote Connect. The instructor will not withdraw you automatically.

Absences

ATTENDANCE POLICY: It is the student's responsibility to maintain regular contact with instructors. Class attendance is the responsibility of the student. All students must be officially enrolled in any course that they attend. It is expected that students attend all classes and be on time. If an absence occurs, it is the responsibility of the student to make up examinations, obtain lecture notes, and otherwise compensate for what may have been missed. Students who stop attending class and do not officially drop, withdraw, or resign from the college may receive a grade of "F" for all coursework missed. Absences affect performance in this course and do not reflect well on participation. No student may substitute the attendance of another student.

Students should frequently check Canvas (Learning Management System) for notifications and updates to the course. Students are expected to use the online resources provided by WC to:

1. Track course assignments and progress

2. Discuss topics and issues with fellow students
3. Turn in assignments, quizzes, and tests
4. Check for any updates, changes, or alterations to the course
5. Access all course materials to include presentations, assignments, quizzes, and tests.

Instructional Methods

Lecture, demonstrations, lab exercises.

Disabilities

ADA Statement:

Any student with a documented disability (e.g. learning, psychiatric, vision, hearing, etc.) may contact the Office on the Weatherford College Weatherford Campus to request reasonable accommodations. *Phone:* 817-598-6350
Office Location: Office Number 118 in the Student Services Building, upper floor. *Physical Address:* Weatherford College 225 College Park Drive Weatherford, TX.

Academic Integrity

Academic Integrity is fundamental to the educational mission of Weatherford College, and the College expects its students to maintain high standards of personal and scholarly conduct. Academic dishonesty of any kind will not be tolerated. Academic dishonesty includes, but is not limited to, cheating on an examination or other academic work, plagiarism, collusion, and the abuse of resource materials including unauthorized use of Generative AI. Departments may adopt discipline specific guidelines on Generative AI usage approved by the instructional dean. Any student who is demonstrated to have engaged in any of these activities will be subject to immediate disciplinary action in accordance with institutional procedures.

Program Learning Outcomes

Upon completion of the program, graduates will be able to:

- Perform tasks to diagnose and repair components of electrical/electronic systems and heating, ventilation, and air conditioning systems.
- Perform tasks to diagnose and repair automotive engine and power train systems.
- Perform tasks to diagnose and repair components of automotive suspension and steering systems.
- Perform tasks to diagnose and repair components of hydraulic and anti-lock brake systems.

Performance Objectives: The student will develop entry-level skills and knowledge necessary to perform the following tasks:

- Demonstrate knowledge of correct safety procedures in the automotive lab in accordance with shop safety and dress code standards (1a, 1b, 2c, 2d);
- Demonstrate knowledge of proper procedures involving the operation and the cleaning of the Automotive Lab to the standards of the Instructor and the Industrial Division (2a, 2c, 2d, 2e);
- Acquire acceptable work skills and attitudes according to Industrial Division standards which will increase the student's chances of securing gainful employment in the Automotive industry (1a, 1b, 2a, 2c);
- Identify all hand and power tools used by craftsmen of the field that are needed to properly perform automobile repairs (1a, 1b, 2c, 2d);
- Identify and accurately implement automotive nomenclature and trade terms that are used by automotive manufacturers and craftsmen in the field (1a, 1b, 2a, 2c, 2d);
- Accurately measure tolerances to compare with the manufacturer's recommended specifications using various measuring devices (1a, 1b, 2c, 2d);
- Display the ability to distinguish and implement the various types of automotive fasteners with respect to size, type, grade, and application using shop manual procedures and manufacturer's specifications (1a, 1b, 2c, 2d);
- Be aware of the different job opportunities available within the automobile repair industry on the local, state, and national levels (2a, 2c, 2d, 2e);
- Properly road test an automobile according to the standards set forth by the instructor 1a, 1b, 2c, 2d).

SCANS

The Secretary's Commission on Achieving Necessary Skills (SCANS) identified competencies in the area of Resources, Interpersonal, Information, Systems, and Technology; and foundation skills in the areas of Basic Skills and Personal Qualities. This course is part of a program in which each of these competencies and skills are integrated. For the application of specific SCANS competencies and skills in this course,

1.
 1. **TIME** - Selects goal-relevant activities, ranks them, allocates time, prepares and follows schedules.
 2. **MONEY** - Uses or prepares budgets, makes forecasts, keeps records, and makes adjustments to meet objectives.
 3. **MATERIALS AND FACILITIES** - Acquires, stores, allocates, and uses materials or space efficiently.
 4. **HUMAN RESOURCES** - Assesses skills and distributes work accordingly, evaluates performances, and provides feedback.
- INFORMATION - Acquires and Uses Information**
1.
 5. Acquires and evaluates information. C-6 Organizes and maintains information.
- C-7 Interprets and communicates information. C-8 Uses computers to process information.
- INTERPERSONAL-Works With Others**
- C-9 Participates as members of a team and contributes to group effort. C-10 Teaches others new skills.
1.
 11. Serves Clients/Customers-works to satisfy customer's expectations.
 12. Exercises Leadership-communicates ideas to justify position, persuades and convinces others, and responsibly challenges existing procedures and policies.
 13. Negotiates-works toward agreements involving exchanges of resources; resolves divergent interests.
 14. Works With Diversity-works well with men and women from diverse backgrounds.
- SYSTEMS-Understands Complex Interrelationships**
1.
 15. Understands Systems-knows how social, organizational, and technological systems work and operate effectively with them.
 16. Monitors and Corrects Performance-distinguishes trends, predicts impacts on system operations, diagnoses systems performance, and corrects malfunctions.
 17. Improves or Designs Systems-suggests modifications to existing systems and develops new or alternative systems to improve performance.
- TECHNOLOGY-Works With a Variety of Technologies**
1.
 18. Selects Technology-chooses procedures, tools, or equipment, including computers and related technologies.
 19. Applies Technology to Task-understands overall intent and proper procedures for setup and operation of equipment.
 20. Maintains and Troubleshoots Equipment-prevents, identifies, or solves problems with equipment, including computers and other technologies.