COURSE OUTLINE

Course Number	Course Title	Credits
AUT 212	Automotive Air Conditioning	3
Hours: Lecture/Lab/Other	**Co- or Pre-requisite**	**Implementation Semester & Year**
2/2	AUT 110 and AUT 111	Spring 2022

Catalog description: This course focuses on automotive air conditioning and heating systems. Fundamentals of refrigeration, automatic temperature control (ATC) system operation, proper diagnosis and repair of systems and components will be covered. Federal and State environmental policies will be discussed in detail as to his or her impact and implementation during system services.

General Education Category: **Non GenEd**

Course coordinator: Jason Evans, 609-570-3776, evansj@mccc.edu

Required texts & Other materials: Halderman, James D, Automotive Heating and Air Conditioning, 8th Edition, Pearson Education, 2018. ISBN-13: 9780134603698

A basic calculator capable of adding, subtracting, multiplying, and dividing numbers. Cell phone calculators are not allowed during quizzes and exams.

Access to a personal laptop computer, tablet, or Chromebook is strongly recommended during class and lab.

Students must purchase safety glasses, work boots, and appropriate clothing to work in the automotive lab. This requirement is reviewed with the students on the first day of class. These items are not needed for the first class meeting of the term.

The following is provided at no charge to the students:
Vehicle service information provided though Stellantis, Subaru of America, Audi of America, or ALLDATA.

Accreditation Statement:
The Automotive Technology, Mopar CAP, Program is Master Automotive Service Technology (MAST) accredited by Automotive Service Excellence Education Foundation.
https://www.aseeducationfoundation.org/

Course Student Learning Outcomes (SLO):

Upon successful completion of this course the student will be able to: [Supports ILG # ; PLO #]

1. Demonstrate his or her ability to perform automotive service and repair following EPA guidelines for personal safety and the safety of others working in the repair facility or auto shop. [Supports ILG # 1,10 ; PLO # 3]
2. Explain the fundamental theories of operation of the heating and cooling system. [Supports ILG # 3, 4, 10; PLO # 1, 4]
3. Identify failures based of scan tool data and verify proper operation of system components. [Supports ILG # 2, 3, 4, 10, 11 ; PLO # 1, 2]
4. Use electronic service information resources to diagnosis and/or repair automobile systems. [Supports ILG # 4, 10, 11 ; PLO # 1, 2, 3]
5. Demonstrate his or her ability to communicate with automotive repair professionals in a manner that follows standards of the automotive repair industry. [Supports ILG # 1 ; PLO # 2, 4]
6. Show professionalism by understanding the legal requirement to be licensed in refrigerant handling prior to performing air conditioning repairs for his or her employer. [Supports ILG # 3, 4; PLO # 3]
7. Discuss the differences in application for the use of R-12, R-134a and R-1234yf refrigerants and the associated environmental concerns for each refrigerant. [Supports ILG # 2, 3, 4, 10 ; PLO # 1]
8. Explain the purpose, function, and operation of the A/C system components. [Supports ILG # 4, 10, 11 ; PLO # 1, 3]
9. Show proficiency in ability to safely recover, evacuate, and recharge an automotive air conditioning system using a refrigerant recovery and recycling machine. [Supports ILG # 3, 4,11 ; PLO # 1, 3]
10. Analyze a heating system malfunction to determine the root cause of system failure. [Supports ILG # 4, 10, 11 ; PLO # 1, 3]
11. Demonstrate his or her ability to properly remove, rebuild, and install an air conditioning compressor clutch and field coil. [Supports ILG # 2, 4, 10, 11 ; PLO # 1, 3]
12. Demonstrate his or her ability to remove and install vehicle heater core, condenser, and evaporator. [Supports ILG # 4, 10, 11 ; PLO # 1, 3]

Course-specific Institutional Learning Goals (ILG):

Institutional Learning Goal 1. Written and Oral Communication in English. Students will communicate effectively in both speech and writing.
Institutional Learning Goal 2. Mathematics. Students will use appropriate mathematical and statistical concepts and operations to interpret data and to solve problems.
Institutional Learning Goal 3. Science. Students will use the scientific method of inquiry, through the acquisition of scientific knowledge.
Institutional Learning Goal 4. Technology. Students will use computer systems or other appropriate forms of technology to achieve educational and personal goals.
Institutional Learning Goal 10. Information Literacy: Students will recognize when information is needed and have the knowledge and skills to locate, evaluate, and effectively use information for college level work.
Institutional Learning Goal 11. Critical Thinking: Students will use critical thinking skills understand, analyze, or apply information or solve problems.

Program Learning Outcomes for Automotive Technology (PLO)

1. Diagnose, service, and repair current automotive technologies.
2. Demonstrate desirable attitudes and work habits while working individually or with others.
3. Obtain service repair information and procedures from online websites and electronic databases.
4. Communicate effectively and professionally with customers and fellow technicians.

Units of study in detail – Unit Student Learning Outcomes:

Unit I **Fundamentals of Refrigeration [Supports Course SLOs # 2, 8]**

Learning Objectives

The student will be able to:

- Explain hazards associated with the use and handling of automotive refrigerants.
- Demonstrate professionalism by understanding the legal requirement to be licensed in refrigerant purchase and handling while working in a commercial repair setting.
- Describe heat transfer principles and change-of-state properties related to the heating and air conditioning system.

Unit II **R-12, R-134a and 1234-Yf Refrigerants [Supports Course SLOs # 1, 5, 6, 7]**

Learning Objectives

The student will be able to:

- Demonstrate his or her ability to adhere to safety and environmental protocols while handling automotive refrigerants.
- Distinguish the differences in application of R-134a and R-1234yf refrigerants.
- Identify refrigerant type used in each vehicle before servicing.
- Demonstrate his or her ability to perform the process of refrigerant leak detection.
- Explain the changes between solid, liquid, and gas and how the A/C systems use the state of change to remove heat from the passenger compartment.
- Give examples of what might cause an automotive air conditioning system to fail or create a customer concern.

Unit III **Air Conditioning System Components and Operation**

[Supports Course SLOs # 2, 4, 8, 9]

Learning Objectives

The student will be able to:

- Explain the purpose and function of the compressor, condenser, evaporator, metering device, and desiccant.
- Show proficiency in operation of refrigerant recovery and charging equipment.
- Demonstrate his or her ability to safely recover, evacuate, and charge an automotive air conditioning system using a refrigerant recovery, recycling, and charging machine.
- Explain the refrigerant flow in an automotive air conditioning system.

Unit IV **Heating Systems [Supports Course SLOs # 1, 2, 4]**

Learning Objectives

The student will be able to:

- Demonstrate his or her ability to explain the function and operation of automotive heating system components.
- Indicate the purpose and function of antifreeze found in a vehicle's liquid cooling system.
- Explain the result of engine overheating.
- Demonstrate his or her ability to diagnose heating system failures under the hood and in the passenger compartment.

Unit V **Heater Diagnosis and Service [Supports Course SLOs # 3, 4, 5, 10]**

Learning Objectives

The student will be able to:

- Analyze a heating system malfunction to determine the root cause of system failure.
- Demonstrate his or her knowledge of air distribution in all heating, ventilation, and air conditioning (HVAC) modes.
- Demonstrate his or her ability to remove and install a vehicle's heater core.

- Demonstrate how to explain system operation and causes of system failure to others who have limited or no technical background.

Unit VI **Air Conditioning Diagnosis [Supports Course SLOs # 1, 3, 4, 9, 12]**

Learning Objectives

The student will be able to:

- Pinpoint the cause of an air conditioning malfunction.
- Demonstrate his or her ability to complete a visual system inspection, A/C performance testing, and leak detection test as part of the diagnostic process.
- Demonstrate his or her ability to remove and install a vehicle's air conditioning evaporator.
- Explain the function of each air conditioning component and elaborate on what may cause the component to malfunction.

Unit VII **Air Conditioning System Service and Compressor Service [Supports Course SLOs # 4, 9, 10, 11]**

Learning Objectives

The student will be able to:

- Demonstrate his or her ability to safely remove refrigerant from the air conditioning system using the appropriate machine.
- Understand and follow all service procedures when servicing other systems related to the air conditioning system.
- Analyze an air conditioning system to determine refrigerant type to prevent damage to air conditioning service equipment and to prevent personal injury.
- Demonstrate his or her ability to properly remove and install an air conditioning compressor clutch and field coil.
- Apply his or her knowledge to disassemble a compressor clutch and coil, measure clutch air gap, and assemble a clutch and coil.

Unit VIII **Manual Temperature Control (MTC) and Automatic Temperature Control (ATC) [Supports Course SLOs # 3, 4, 5]**

Learning Objectives

The student will be able to:

- Classify the inputs and outputs of an ATC module that allows automatic temperature control in the passenger compartment.
- Use a scan tool's actuator test function to diagnosis and troubleshoot heating and air conditioning system concerns.
- Demonstrate a diagnostic strategy for an ATC system failure.
- Describe difference between the ATC and MTC HVAC system and the different diagnostic procedures for each system design.

Evaluation of student learning:

Students are evaluated using weekly quizzes, a mid-term exam, a final exam, graded homework assignments, and hands-on work assignments in the automotive laboratory. Students are expected to read the assigned textbook chapters, handouts, and complete vehicle manufacturers' training material (if applicable) outside of class and at appropriate times throughout the course.

Please note that:

- Any student who scores below a 60% (D) on the final exam must repeat the course.
- Students enrolled in the any automotive program option sponsored by a vehicle manufacturer (Mopar CAP, Subaru University, or Audi AEP) must complete all vehicle manufacturer web courses, post-tests, and proctored assessments assigned at the start of the semester. The assigned web courses, post-test, and proctored assessments are in addition to the standard course assignments shown below. Due dates for each assigned web course, post-test, and proctored assessment is discussed in class, but all of them must be finished and passed before the beginning of the last week of the term.

Below is a list of the tools used for assessing student learning outcomes in this course. The percentages shown after each assessment tool refers to the weight each assessment has on a student's final course grade. Percentages are approximate.

Exams 35%
Quizzes 15%
Hands-On Lab Assignments 40%
Homework 10%

Policy Statement for Missed Lab Demonstrations:

Due to the concerns for student and staff safety, a student who does not attend tool, equipment, and procedure demonstrations performed by the course instructor, prior to a hands-on learning activity, may be excluded from participating in the hands-on activity. This occurs because the tools, equipment, and chemicals necessary to complete automotive diagnosis and service often present safety hazards for users and observers if the correct handling procedures are not followed.

Reasons for not attending demonstrations may include full or partial absence during the demonstration, or if a student does not give his or her full attention during the demonstration. Enforcement of this classroom policy is at the discretion of the course instructor, and is based largely on the dangers involved with the use of the necessary tools, equipment, and chemicals required to complete the hands-on activity, and the time necessary to complete a make-up demonstration.