AUME-795: AUTOMOTIVE HEATING, VENTILATION AND AIR CONDITIONING

Effective Term
Fall 2026

BOT Approval Date
05/15/2025

Discipline
AUME - Automotive/Transportation Tech
Course Number
795

Course Title
Automotive Heating, Ventilation and Air Conditioning

Short Title
Automotive HVAC

Credit Status (CB 04)
D - Credit - Degree applicable

Units

Lecture Units
3.00

Lab Units
1.00

Total Units
4.00

Hours

Lecture Contact Hours
48-54
Out of Class Hours Lecture
96-108

Lab Contact Hours
48-54
Out of Class Hours Lab
0.00

Total Contact Hours
96 - 108

Total Out of Class Hours
96 - 108

Total Student Learning Hours
192 - 216

Is this an existing Extensive Lab?
No

Do you want to propose this for Extensive Lab?

Yes

Distance Education

No

Catalog Description

This course provides an in-depth study of the components and theory of operation of contemporary automotive air conditioning and heating systems. Emphasis is placed on inspection, diagnosis and repair procedures needed to service these systems and includes an introduction to automatic A/C systems. This course also helps to better prepare the student to take and pass the ASE A7 (Air Conditioning and Heating) certification exam.

Requisites

Recommended Preparation

Recommended Preparation (note that students can enroll in the class even if they haven't take the recommended course)
AUME-700.

Codes

TOP Code (CB 03)

0948.00* - *Automotive Technology

CIP Code

47.0604 - Automobile/Automotive Mechanics Technology/Technician.

Repeatability Code

No

Grading Option

Letter grade OR P/NP

Minimum Qualifications

Minimum Qualifications	And/Or
Automotive Technology	End

Learning Objectives

Learning Objectives

Learning Objective
1. Display the proper use of chemicals, tools and fire protection equipment.
2. Manage the information provided by technical manuals to develop proper service and repair procedures.
3. Evaluate the operation of the HVAC system using the proper tools and equipment.
4. Assess the serviceability of individual system components.
5. Formulate the most efficient method to diagnose the operation of the HVAC system.
6. Organize, document, and explain diagnostic findings to a prospective customer.
7. Devise the procedure required to properly and safely evacuate and recharge an air conditioning system.
8. Evaluate the condition of the accessory drive belt (ABDS) system.
9. Inventory ways in which modern HVAC systems have reduced desertification, thus alleviating environmental equity issues, which affect the quality of life of marginalized populations worldwide.

Learning Outcome Information

Course Learning Outcomes

Learning Outcome
1. Students will be able to perform an HVAC system performance test.
2. Students will be able to select the correct refrigerant and lubricating oil used in various HVAC systems.
3. Students will be able to use a scan tool to evaluate the operation of the HVAC control system.
4. Students will be able to discuss how modern automotive HVAC systems have alleviated environmental equity issues, which has improved the quality of life of marginalized populations worldwide

Content

Course Lecture Content

1. General Information Related to Automotive Heating, Ventilation and Air Conditioning (HVAC) Service
    a. Research Vehicle Information
        i. Refrigerant Types and Capacities
        ii. Refrigerant System Lubricating Oil Types and Capacities
2. Refrigeration System Components
    a. Identification of A/C Compressor Types
        i. The Swash-Plate Type
        ii. The Scroll-Type
        iii. Variable Capacity Compressors
        iv. Electric Compressors for HEVs
            1. Special Service Precautions
            2. Specialized Refrigerants and Lubricants
    b. Thermal Expansion Valve (TXV) vs. Cycling Clutch Orifice Tube (CCOT) Systems
    c. Receiver/Dryer Units vs. Accumulator Type Systems
    d. Preserving Refrigerant and Lubricating Oil Balance
3. Heating, Ventilation and Engine Cooling Systems
    a. The Functions of the HVAC System
        i. Providing a Comfortable Cabin
            1. The Heater Core
            2. The Air Mix System
        ii. Filtering the Cabin Air
        iii. Dehumidifying the Cabin Air
4. Operating Systems and Related Controls
    a. Manual Type System Controls
    b. Automatic Climate Control Systems
    c. Dual-Range Climate Control Systems
5. Refrigerant Types, Recovery and Recycling Procedures and Proper Handling
    a. Progress Toward Environmentally Friendly Refrigerants and Climate Justice
        i. Refrigerant-12 and Ozone Damage
        ii. Refrigerant-134A and Global Climate Change
            1. Reduction in Skin Cancers for Poorer Populations Who Need to Work Outdoors
        iii. Refrigerant 1234-yf
            1. Reduction in Global Climate Change
                a. Decreased Desertification
                    i. Disproportionate impacts on the most vulnerable populations, Leading to Food Insecurity, Poverty, and Lack of Access to Clean water
    b. Optimizing Refrigerant Recovery Procedures
        i. In Order to Protect the Environment
        ii. In Order to Protect the Technician
        iii. In Order to Protect the Vehicle
    c. High-Voltage Circuits
        i. Identification of HV Circuits
            1. Precautions Required for HV Circuits

Course Lab Content

1. General Procedures Related to Automotive HVAC Service
    a. Determining the Refrigerant Type
        i. R-12 (Dichlorodiflouromethane Gas)
            1. The effect of R-12 on the Earth's ozone layer
            2. Increased incidence of skin cancers in those disadvantaged populations whose work primarily takes place outdoors
        ii. R-134A and Refrigerant Recovery Procedures
            1. The effects of R-134A as a greenhouse gas
            2. Decrease in Desertification
                a. Reduction in Diseases, such as Cholera, by Increasing the Amount of Clean Water Available to Poor Populations
        iii. R-1234yf
            1. The issue of flammability and safety
    b. Determining the Lubricating Oil Type
        i. Mineral Oil
        ii. PAG Oil
        iii. POE Oil
    c. Determining the System Type
        i. CCOT Types
        ii. TXV Types
    d. The HVAC System Performance Test
    e. Scan Tool Testing
    f. System Leak Testing
    g. Testing for the Presence of Stop-Leaks
2. Refrigeration System Component Service
    a. A/C Compressors and Clutches
        i. Inspection
        ii. Removal/Replacement
    b. A/C Condensers
        i. Inspection
        ii. Cleaning
        iii. Removal/Replacement
    c. A/C Evaporators
        i. Inspection
        ii. Disinfection Techniques
        iii. Removal and Replacement
    d. Expansion Valves
        i. Thermal Expansion Valves (TXV)
            1. Inspection
            2. Removal/Replacement
        ii. Orifice Tubes (CCOT)
            1. Inspection
            2. Removal/Replacement
    e. Accumulators and Receiver/Dryers
        i. Inspection
        ii. Removal/Replacement
3. Heating, Ventilation and Engine Cooling Systems
    a. Testing Heater Operation
        i. Testing Water Flow Control Valve Operation
        ii. Testing Coolant Flow in the Heater Core
        iii. Testing Cooling System Thermostat Operation
    b. Removal and Replacement
        i. Removal/Replacement of the Heater Core
        ii. Removal/Replacement of the Flow Control Valve
        iii. Removal/Replacement of the Thermostat
        iv. Burping the Cooling System
4. Operating Systems and Related Controls

a. Scan Tool Testing of Actuators and Sensors
b. Scan Tool Testing of HVAC Control Inputs
c. Servicing the Blower Motor
    i. Testing Blowers and Resistors
    ii. Removal and Replacement
5. Refrigerant Recovery, Recycling and Handling to Assure Environmental Equity
    a. Demonstrating Knowledge of the Requirement to Recover, Recycle and Handle Refrigerants and Chemicals Properly
        i. Environmental Responsibility
            1. Reduction in the incidence of skin cancers among marginalized populations
            2. Reduction in the effects of desertification in poorer regions of the world where arable land supports marginalized populations
        ii. Regulatory Compliance
            1. Recovery of all potentially hazardous gasses
            2. Recycling and Destruction of Contaminated Gasses
        iii. Identification of the Proper Equipment Required
            1. Recycling and Recovery Machines
            2. Refrigerant Type Identification Equipment
            3. Refrigerant Sealant Identification Equipment
    b. Refrigerant Identification/Evaluation
        i. Test for Sealants/Contaminants
    c. Refrigerant Recovery
    d. System Evacuation
    e. System Charging
        i. Adding Refrigerant
        ii. Adding Lubricating Oil
        iii. Preserving System Balance
    f. Recycling Refrigerants
        i. Proper/Legal Labelling
        ii. Proper/Safe Storage
        iii. Proper/Safe/Legal Disposal of Contaminated Refrigerants

Methods of Instruction

Method

Online Activity/Discussion

Integration

Students will need to access web-based software and service information in order to determine the type of HVAC system they are being asked to service, what its performance characteristics ought to be, and what procedures need to be followed in order to assure personal safety and compliance with environmental restrictions.

Method

Role Playing/Simulation

Integration

Students will be required to analyze a variety of case studies in discussion groups or in laboratory teams to perform a mock customer interview, an HVAC diagnostic procedure, and a refrigerant system repair on a bugged vehicle. Students will be required to document their work and produce a sample repair order complete with the estimated cost of the HVAC repair.

Method

Lab Activities

Integration

Students will perform a number of different hands-on activities, such as using an HVAC System Recovery machine to properly evacuate and recharge the refrigerant system.

Method

Observation and Demonstration

Integration

The instructor of the course will demonstrate many of the required tasks to the students before they actually perform the task on their own. For instance, the instructor will explain the importance of using a Refrigerant Sealant Detector to check for the presence of leak-sealing additives in the refrigerant system before recovery equipment is used. The presence of the sealant would ruin the equipment, resulting in property damage and eliminate the possibility that the students could actually perform the job afterwards. This will help to assure that a potentially destructive and environmentally hazardous task is performed correctly and in a safely, and provide the students with a standard of service excellence that they would be challenged to match.

Method

Reading

Integration

Students will be required to refer to the textbook and/or to the service information in order to determine the potential damage that could be done to the Earth's environment from the use of improper or illegal service techniques with special emphasis placed upon environmental equity issues. For example, the incidence of skin cancer would likely be higher among populations whose work requires them to be outdoors most of the time if R-12 is discharged into the atmosphere, and marginalized populations whose income is dependent on farming would be negatively affected by an increase in desertification through global climate change if R-134A is discharged into the atmosphere.

Methods of Evaluation

Method

Class Performance

Integration

Students will be required to perform refrigerant identification, recovery, recycling and storage procedures. Evaluation will be made according to the student's compliance with safety and governmental regulations intended to enforce environmental equity issues. The importance of reducing the effects of ozone layer depletion on poorer or marginalized populations whose work requires that they be exposed to a high degree of sunlight, or the effect of desertification on populations whose income is dependent upon the availability of arable land, both of which are affected by improper service methods, will be stressed.

Method

Final Performance

Integration

Students will be evaluated on their ability to set-up and execute an HVAC System performance test in compliance with the vehicle manufacturer's standards. Evaluation will be made according to the accuracy of the test and the timeliness with which it is performed.

Method

Exams/Tests

Integration

Quizzes and/or tests may be given at the end of each course module, and a final examination will be used to evaluate student knowledge and use of terminology, knowledge of subject matter, and ability to contrast and evaluate types of HVAC system diagnosis and service procedures. Evaluation will be based on the accuracy of the student's responses and the student's ability to complete the quizzes or exams on time.

Assignments

Assignment Type
Other

In-class and/or outside of class
In-class

Formative or Summative
Formative

Assignment
Research the type of Refrigerant and Lubricating Oil required for specific vehicles in order to preserve the operating integrity of the vehicle and ensure compliance with existing environmental regulations. You will need to document your findings on a lab sheet and also on a mock repair order.

Assignment Type
Reading

In-class and/or outside of class
Outside of class

Formative or Summative
Formative

Assignment
Read Chapter 6 of Auto Heating and Air Conditioning, which covers Refrigerants, Refrigerant Oils, and Related Chemicals. Quantify the reasons why different types of Air Conditioning System Refrigerants have been required over the years and what environmental and other hazards they posed, both to technicians and to the general population. Be prepared to discuss the way in which these gasses disproportionately impacted poorer populations around the world by contributing to such factors as desertification and other forms of global climate change, where this would expose those marginalized populations to increased poverty and disease due to a lack of access to clean water.

Assignment Type
Writing

In-class and/or outside of class
In-class

Formative or Summative
Formative

Assignment
Prepare a work order that complies with the specifications required by the State of California's Bureau of Automotive Repairs. This must include a customer complaint, the cause of that complaint and the correction which will be required to address that complaint. The repair order must also document the type and amount of any hazardous materials used during the performance of the work required.

Assignment Type
Other

In-class and/or outside of class
In-class

Formative or Summative

Summative

Assignment

Execute an HVAC System Performance Test to assess the function of a vehicle's Heating, Ventilation and Air Conditioning System. The test must refer to the vehicle manufacturer's published specifications and you will need to document your findings on a lab sheet under the supervision of your instructor.

Course Materials

Textbooks

Halderman, J.A. Automotive Heating, Ventilation and Air Conditioning, 9th ed. Pearson, 2023. ISBN: 9780137468829
Johanson, C. Auto Heating and Air Conditioning, 5th Edition. Goodheart and Willcox, 2021. ISBN:978-1-64564-174-2

Other Resources

ALLDATA Online Service Information
Mitchell ProDemand Online Service Information

Class Size Information

Class Size

24

Class Size Category

J - Specialty lab

Diversity and Inclusion

Course Design and Materials: Course will incorporate diverse perspectives, authors, and examples that reflect a variety of cultures, identities, and lived experiences. Instructional materials will be reviewed regularly to ensure representation, inclusivity, and alignment with equity-minded practices across disciplines.

Inclusive Learning Environment: Instructors will establish classroom norms and policies that promote respect, civil discourse, and belonging in both online and face-to-face classes. Clear expectations for communication and engagement will support a learning space where all students feel valued and heard.

Accessible Instruction: Course content will be delivered using accessible design. Materials will follow accessibility guidelines within the CMS, including captioned media, readable document formats, and multiple means of engagement to support diverse learning.

Equitable Teaching Practices: Instructors will use transparent and grading criteria, varied assessment methods, and timely feedback to promote fairness and student success. Opportunities for revision, reflection, and multiple demonstrations of learning may be incorporated when appropriate to the discipline.

Culturally Responsive Pedagogies: Instructional strategies will encourage critical thinking about diverse perspectives and systems of power relevant to the course content. Faculty will foster opportunities for students to connect course material to real-world contexts.

Ongoing Reflection and Improvement: Faculty will engage in continuous professional development related to IDEAA principles and reflect on course practices using metacognition to identify opportunities for increased equity, inclusion, and accessibility.

Explain how diversity and inclusion(e.g., gender, culture/race, sexuality, etc.) is infused into the course.

This course familiarizes the student with the story of how the development of modern automotive HVAC systems and their related refrigerants have produced an enhanced level of environmental justice by reducing the effects of global warming, decreasing the incidence of skin cancer among poorer populations whose work requires them to be exposed to sunlight much of the time, as well as the effects of desertification among marginalized populations, exacerbating difficulties with food insecurity, poverty, and unnecessary exposure to disease owing to the to lack of access to clean water.

Describe how assignments, instruction, evaluation, course content, and interactions are contextualized for diverse learners promoting an equitable course.

The content of this course is delivered through a combination of different methods: a mixture of hands-on instruction, classroom lectures and accessible video, live demonstration and informational research is used. This is intended to optimize the learning experience for every different type of student, from kinesthetic learners to visual and auditory or those who prefer reading and writing. For example, students will have a reading assignment describing refrigerant type and contamination identification; the instructor will then demonstrate the procedure for this process, and then have the opportunity to practice the identification test themselves. The instructor will be present to offer coaching about how the procedure could be better performed and documented, and the students will in turn document their results on a lab sheet before any refrigerant recovery or recycling can take place. Students are generally given the opportunity to improve their assessment scores by repeating the performance of their work and by giving them the ability to resubmit written assignments. The Automotive Department seeks to make this and all of our courses as accessible as possible to students from every background and who possess different strengths and abilities and make the possibility of success as equitable as possible.

Interactions

Explain how the course will incorporate student-to-student interaction.

Students in this course will need to perform many of their assignments as members of teams of three or four. A significant amount of interaction between the team members will be required in order to assure the proper performance of the required lab assignments within the amount of time allotted for the task; one student will need to prepare a work order describing the problem or service operation, while another will be responsible for researching the appropriate service information. Other members of the team will actually perform the task while the other team members document the procedure during the lab session, and all team members will be responsible for cleaning up after themselves and returning the tools and equipment required for the job. For example, a customer might present a vehicle with a complaint that the dial setting on the dashboard fails to provide comfort; one member of the team would conduct the customer interview and prepare a work order which would convey that information to the other members; yet another teammate would refer to the vehicle service information and retrieve the A/C system performance check procedure; this procedure is generally performed in two stages, and the other team members would be responsible for these. The first would evaluate the operation of the air conditioning compressor and expansion valves, while the second would be inside of the vehicle with a scan tool assessing the operation of the electronic controls that operate the mode and mixer doors. Again, all of the students would be responsible for the clean-up and equipment return procedures. These roles will rotate throughout the semester.

Explain how the course will incorporate instructor-to-student interaction.

This course will require that students come in contact with extremely hot or very cold components and with hazardous chemicals, often under extremely high pressure. Therefore, careful and close supervision on the part of the instructor will be absolutely essential. For example, while the students are responsible for actually attaching an air conditioning recovery and recycling machine to a vehicle being serviced, the instructor would need to sign off the worksheet indicating that the procedure has been done correctly before it could proceed to the next step, which would either involve refrigerant recovery or recharging. This ensures the safety of all involved. The instructor would also verify that the refrigerant operating pressures are correct; this is a crucial part of the procedure and is usually the one that requires a high degree of interpretation. The instructor's job is to act as a coach to the students under those circumstances in order to improve their diagnostic and critical thinking skills. Finally, the instructor of the course will provide students with feedback about their performance at the end of the lab session concerning the ways in which the recovery process might have been done more thoroughly or efficiently and whether the job was completed within the period generally prescribed by industry standards. Therefore, more than adequate instructor-to-student interaction will be an integral part of this course.

Explain how the course will incorporate student-to-content interaction.

Students will be required to perform a considerable amount of research and documentation during the time this course is being presented. For example, it will be necessary to identify the different HVAC system types used on individual vehicles in order to perform inspection and service procedures; it will also be necessary to identify refrigerant and lubricating oil types and to check those types against the information provided in the published service information for the vehicle in order to perform their work correctly. It will also be necessary to document how much, if any refrigerant needs to be added to the system and what type is necessary, whether it be R-134A or R-1234yf; finally, the student will need to at least be one of the participants in the final system performance evaluation, which will give the student pause to reflect about whether the recharge procedure produced the desired result, which is a system that operates according to the vehicle manufacturer's published specifications. As a result, students will need to incorporate a more than adequate amount of student to content interaction in order to be successful in this course.

Explain how the course will incorporate student-to-self interaction (metacognitive).

Automotive students in general need to check the quality of their work, both in terms of diagnostic ability and the ability to perform repairs in a correct way and in a timely fashion. Each student will need to ask themselves, not only whether the job turned out as expected, but whether a more efficient way to perform it existed and whether the job was actually necessary and proper to the situation. In the case of the situation mentioned above, for example, the student would need to verify a number of different things. First, the student would need to verify that the operating pressures of the system matched those required by the service specifications, and if they did not, the student would need to ask themselves why not. In particular, the student would need to assess their own performance to determine whether the recharge procedure had actually been performed correctly; a balance between the

amount of refrigerant and lubricant needs to be maintained, so the student would need to analyze the quality of their own work while performing the job if the operation did not have the desired results. This requires a considerable amount of self-reflection and an analysis of one's own skills and abilities; as a result of this, adequate student-to-self interaction would inevitably result.

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