SYLLABUS FOR AUMT 1445
AUTOMOTIVE HEATING AND AIR CONDITIONING
Instructor: Rafael Rodriguez
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SEMESTER HOURS CREDIT: 4

I. INTRODUCTION

A. Theory of automotive air conditioning and heating systems. Emphasis on the basic refrigeration cycle and diagnosis and repair of system malfunctions. Covers EPA guidelines for refrigerant handling and new refrigerant replacements.

B. Automotive Heating and Air Conditioning (AUMT 1445) is a required course for the completion of a two year Associate of Applied Science degree in Automotive Mechanic/Technician or a Level I or Level II certificate of completion in the Automotive Technician Program.

C. This course is occupationally related and serves as a preparation for a career in the Automotive Service and Repair field.

D. Prerequisites: This course has a prerequisite of AUMT 2437 or consent of the Dept. Chair.

E. Alphanumeric coding used throughout this module book denotes integration of SCANS occupational competencies and Foundation skills.

II. LEARNING OUTCOMES

Upon successful completion of this course, Automotive Heating and Air Conditioning the student will:

A. Discuss what industry is doing about the ozone depletion problem.

B. Identify potential hazards in the automotive shop.

C. Recognize the hazards associated with the automotive repair industry.

D. Describe safe and unsafe tools and discuss the philosophy regarding health and safety.
E. Discuss the fundamentals of temperature and pressure.

F. Describe the differences between sensible, latent, and specific heat values.

G. Explain the effects of radiation, conduction, and convection on personal comfort.

H. Identify required and alternative services and the special tools required.

I. Discuss how to use and interpret service information procedures and specifications.

J. Explain the operation of the basic refrigeration cycle.

K. Understand the basic function of the various air conditioning components.

L. Describe the nomenclature and function of the manifold and gauge set.

M. Utilize appropriate safety procedures while inspecting and connecting a manifold and gauge set to an automotive air conditioning system.

N. Explain the engine cooling system and its components.

O. Discuss the requirements for a closed cooling system.

P. Identify the major components of the automotive engine cooling and comfort heating system.

Q. Understand and utilize the procedures to test various cooling system components.

R. Explain the purpose and operation of an automotive air conditioner compressor.

S. Discuss the two changes of state of the refrigerant in the automotive air conditioning system.

T. Compare the function of the thermostatic expansion valve (TXV) to the fixed orifice tube.

U. Diagnose air conditioning system malfunctions based on customer complaints.

V. Identify the different types of automotive air conditioning systems.

W. Utilizing appropriate safety procedures remove and replace automotive air conditioning system components, such as hoses and fittings, metering devices, driers and accumulators, compressors, condensers and evaporators, and pressure switches.

X. Describe the leak test procedures for an automotive air conditioning system using soap trace solutions, electronic leak detectors, halogen leak detectors and dye solutions.
Y. Leak test an air conditioning system using soap solution, dye solution, and using a halogen leak detector.

Z. Evacuate an air conditioning system using the single evacuation method.

AA. Demonstrate the proper procedures for handling refrigerant while charging a system with refrigerant HFC-134a (R134a).

BB. Diagnose six system malfunctions by gauge readings.

CC. Read and understand temperature-pressure charts.

DD. Understand the proper handling of refrigeration oil.

EE. Discuss and explain the operating principals of various types of A.C. compressors.

FF. State the purpose and describe the function and operation of a magnetic clutch in an air conditioning system.

GG. Compare fixed-and variable-displacement compressors.

HH. Identify and troubleshoot various makes and models of compressors used in automotive air conditioning service.

II. Troubleshoot and make mechanical repairs to clutch coils and rotor assemblies.

JJ. Diagnose and discuss the air flow through the air distribution system for the defrost, heat, and the cool modes.

KK. Understand Mode Door Actuator operation: cable, Vacuum, and electric.

LL. Describe the operation of controlling the air conditioning system using pressure-and temperature–actuated controllers.

MM. Recognize and understand the components of an automatic temperature control system.

NN. Understand and demonstrate the methods used to diagnose and repair compressor clutch malfunctions.

OO. Understand the function of and be able to demonstrate the ability to troubleshoot the components of the automatic temperature control system.

PP. Discuss the various refrigerants approved to replace R-12 in automotive air conditioning systems.
Understand the problems associated with contaminated refrigerant.

Compare components used in R-134a systems with those used in R-12 systems.

Recognize the difference between pure and impure refrigerant by interpreting gauge pressures relating to ambient temperature.

Determine the purity of refrigerant in an air conditioning system or container.

III. INSTRUCTIONAL MATERIALS

A. Instructional materials for this course may be found at www.cted.edu/books

B. Supplemental Reading: As assigned by the instructor.

C. Audio-visual aids: See resource list at end of this module book.

D. Other instructional material: as selected by the instructor.

IV. COURSE REQUIREMENTS

A. This course is being taught in a self-paced mode. It differs from the traditional college course in that you are allowed to work on your own and at your own speed within limitation. This course is 128 clock hours in length. The student may set his/her own schedule within the time frame the course is offered. You must attend class on the days and at the times you selected when you enrolled in the course.

You will have an assigned instructor. If at any time you do not understand a reading assignment, audio visual presentation or lab work, ask your instructor for assistance. He is there for you!

This module book is designed to inform you of the sequence in which this course will be presented. You must follow this sequence and you must do what the module book says. It contains reading assignments, written assignments, audio visual presentations and lab assignments that you must complete or watch. Written assignments will be turned in as directed by the instructor. Late assignments will not be accepted. You must let your instructor know when you are ready to do a learning activity, performance exam or take a scheduled exam.

B. The student must take notes when viewing filmstrips, slides, or videos. Exams may be taken from audio visual aids, reading and lab assignments. If instructor notes or handouts are given to you, you must study them; exams may be taken from these notes also.

C. The instructor may give written assignments or “pop” quizzes as he deems necessary.

D. Performance Exams:
Each student will clean all tools and equipment that they use and properly store them and clean their work area after the completion of each task.

Certificate Students: All lab work will be completed on an individual basis. The student will receive a “pass” or “fail” on the task. Students who fail to complete a task correctly to industry standards must repeat the task. The instructor will date and initial each performance exam task as it is satisfactorily completed. NOTE: Students who have selected the alphanumeric grading system will be graded as outlined for degree students (see below).

Degree Students: Laboratory tasks (performance exam) will be completed on an individual basis except when limited by tools and/or materials. Each performance exam is worth a maximum of 3.3 points. The maximum lab grade is 100 points. The instructor will deduct points from each lab task score for failure to follow safety precautions and/or a failure to complete the project to industry standards. The instructor will date, initial, and post the points earned for each performance exam as it is completed.

E. The following is part of the course requirements: Each student will assist in lab clean-up at the close of the evening classes and will assist in unloading and storing supply shipments. Failure to do so will result in a failure to complete all course requirements and the student could receive a “F” or “N” for the course.

F. There will be seven (7) written examinations in this course (6 module/unit exams and an exit exam). Written exams must be completed before taking the performance exam for each module. The exit exam is a comprehensive exam that covers the entire course. Certificate students must score 70% on the exit exam. Certificate students will be allowed to take the exit exam a maximum of three (3) times. Failure to achieve a 70% score on the exit exam in three (3) tries will result in an "N" for the course and the student must retake the course. Degree Students should refer to the "grading" section of this outline for guidance.

G. The student must complete the written assignments to receive a grade. Written assignments for each unit will be turned into the instructor prior to starting performance exams for that module. Degree students must complete reading and written assignments at home.

H. If you have special needs because of learning disabilities or other kinds of disabilities, please feel free to discuss this with the instructor. The instructor will attempt to meet your needs with the assistance of counselors, tutors (Project Mainstream), and the assistance of the Disabilities Services Office. Program/course integrity will not be sacrificed. Students must meet all course requirements.

GRADING

Certificate Students: Students will be graded using the standard Skills Center "Pass-Fail" system used for self-paced programs. To satisfactorily complete the written exams, the student must score 80% on tests (except the exit exam, 70%). Students who fail to make the 80% on any exam (except the exit exam) must retake the exam. The current test re-take policy will apply to all certificate
students. The student must satisfactory complete all written and performance exams to receive a passing grade ("P").

Degree Students: Students will be graded using an "alpha-numeric" system as outlined below. Grades made on performance and written exams will be the grade received, including the exit exam. Students will not be allowed to retake written exams or redo performance exams.

A. Written exams: Average of written exams will count 40% of the final grade.

B. Completion of written assignments/activities will count 10% of the student’s final grade.

C. Performance Exams (Lab work) will count 50% of the final grade.

D. Grade Computations: (Example)
   Written Exam Scores: (There will be 7 written exams)
   Exam 1 90
   Exam 2 80
   Exam 3 70
   240 divided by 3 = 80 (Average Written Exams)

   Written Exam Score Average   80 x 40% = 32 points
   Written Assignments           100 x 10% = 10 points Performance
   Exam Score                    80 x 50% = 40 points

   Total = 82 points =B

V. NOTES AND ADDITIONAL INSTRUCTIONS FROM THE COURSE INSTRUCTOR

A. Course Withdrawal: It is the student’s responsibility to officially withdraw from a course if circumstances prevent attendance. Any student who desires to, or must, officially withdraw from a course after the first scheduled class meeting must file a Central Texas College Application for Withdrawal (CTC Form 59). The withdrawal form must be signed by the student.

   CTC Form 59 will be accepted at any time prior to Friday of the 12th week of classes during the 16-week fall and spring semesters. The deadline for sessions of other lengths is:

   10-week session Friday of the 8th week
   8-week session Friday of the 6th week
   5-week session Friday of the 4th week

   The equivalent date (75% of the semester) will be used for sessions of other lengths. The specific last day to withdraw is published each semester in the Schedule Bulletin.
A student who officially withdraws will be awarded the grade of “W” provided the student’s attendance and academic performance are satisfactory at the time of official withdrawal. Students must file a withdrawal application with the College before they may be considered for withdrawal.

A student may not withdraw from a class for which the instructor has previously issued the student a grade of “F”, “N”, “FN”, or “XN” for nonattendance.

B. Administrative Withdrawal: An administrative withdrawal may be initiated when the student fails to meet College attendance requirements. The instructor will assign the appropriate grade on CTC Form 59 for submission to the registrar.

C. Incomplete Grade: The College catalog states, “An incomplete grade may be given in those cases where the student has completed the majority of the coursework but, because of personal illness, death in the immediate family, or military orders, the student is unable to complete the requirements for a course. Prior approval from the instructor is required before the grade of “I” for Incomplete is recorded. A student who merely fails to show for the final examination will receive a zero for the final and an “F” for the course.

D. Cellular Phones and Beepers: Cellular phones and beepers will be turned off while the student is in the classroom or laboratory.

E. American’s With Disabilities Act (ADA): Disability Support Services provide services to students who have appropriate documentation of a disability. Students requiring accommodations for class are responsible for contacting the Office of Disability Support Services (DSS) located on the central campus. This service is available to all students, regardless of location. Explore the website at www.ctcd.edu/disability-support for further information. Reasonable accommodations will be given in accordance with the federal and state laws through the DSS office.

F. Instructor Discretion: The instructor reserves the right of final decision in course requirements.

G. Civility: Individuals are expected to be cognizant of what a constructive educational experience is and respectful of those participating in a learning environment. Failure to do so can result in disciplinary action up to and including expulsion.

H. Absence from the class may be unavoidable in some situations. These include illness, military/civilian job requirements, or a death in the immediate family. Documentation is required in the case of excused absences for job requirements. Excuses will be on company letterhead stationary signed by the immediate supervisor stating the reason for the absence for civilian jobs. Excuses for military personnel must be signed by the 1st Sergeant or the Company Commander. NOTE: This does not apply to VA, VA/Voc, or Financial Aid students. There are no excused absences for these students. Talk to your funding agency if you have questions.
Disability Support Services provides services to students who have appropriate documentation of a
disability. Students requiring accommodations for class are responsible for contacting the Office of
Disability Support Services (DSS) located on the central campus. This service is available to all students,
regardless of location. Review the website at www.ctcd.edu/disability-support for further information.
Reasonable accommodations will be given in accordance with the federal and state laws through the DSS
office.

VI. FIRST CLASS MEETING

A. The instructor will introduce the course and show the student the textbook.

B. The instructor will verify the class roster/enrollment form:
   1. Call roll
   2. Have each student verify the spelling of his/her name and the social security number
      by initializing the class roster/enrollment form.
      NOTE: When a student’s name does not appear on the degree program class roster,
      they must bring it to the attention of the instructor and must present the instructor
      with CTC Form 29 (Add/Drop Slip) reflecting that he/she has properly registered for
      the course.

C. The instructor will have the student read and sign the course requirements sheet.

D. The instructor will discuss the following topics with the student:
   1. Course requirements, objectives and how the course works
   2. Policy letters
   3. Student handouts
   4. Lab sheet and lab work (Learning activities, Performance exams, competency
      profile)
   5. Exam, grading, reading and written assignments.
   6. Absences
   7. Shop/classroom cleanup–tools
   8. Dress code
   9. Parking
   10. Sign-in computer
   11. Course outline/fact sheets/student handouts
   12. Hazardous communications/MSDS information
   13. Shop safety

COURSE OUTLINE OR SEQUENCE
I. Module 1445-01: Introduction, Safety, Tools, Procedures, Temperature and Pressure Fundamentals

A. Time
   Degree Students: 1 (1*) Weeks
   Certificate Students: 12 Clock Hours

B. Module Learning Outcomes: Upon completion of this module the student will:

1. Discuss what industry is doing about the ozone depletion problem.
2. Identify potential hazards in the automotive shop.
3. Recognize the hazards associated with the automotive repair industry.
4. Describe safe and unsafe tools and discuss the philosophy regarding health and safety.
5. Discuss the fundamentals of temperature and pressure.
6. Describe the differences between sensible, latent, and specific heat values.
7. Explain the effects of radiation, conduction, and convection on personal comfort.
8. Identify required and alternative services and the special tools required.
9. Discuss how to use and interpret service information procedures and specifications.

C. Read Chapters 1, 2, and the Glossary in Resource 1445-01 and Chapters 1, 2, and the Glossary, and the Appendix in Resource 1445-02. On separate paper; define all Terms to know and answer all of the review questions at the end of each chapter in each resource. Indicate pages where answers may be verified.

D. Have your Instructor demonstrate and answer questions concerning the special tools used for servicing and diagnosing automotive air conditioning systems (use Fact Sheet 1445-0101 and 1445-01-02)

E. View Audio Visuals: (See your instructor) Student must take notes

1. "Air Conditioning Principles", Tape 1, Bergwall Productions, #LA421, Resource 1445-03 (Video)
2. "Air Conditioning Principles and Systems", Four Seasons, #FS5713, Resource 1445-04 (Video)
3. “Automotive Air Conditioning Systems Explained”, Bergwall #DA42-31-87 Disc #1, Resource 1405-17 (2 CD ROMS)

F. Read any handouts that the instructor may have given you that pertain to this module.

G. See your instructor and ask him to explain any part of the reading assignment that you do not understand.
H. Ask him to show you and demonstrate to you the special tools and equipment used to service air conditioning systems (Fact Sheet 1445-01-01). Student must watch Equipment demo videos assigned by instructor prior to demonstration.

I. Refer to the Laboratory Learning Activities (Lab Sheet) in this module book and complete the learning activities for this module. (See your instructor)

J. Ask your instructor if there is any additional information that you should read or see that pertains to this module.

K. Review for Module 1445-01. Written exam: Study all previous assignments in this module. See your instructor and ask him to explain any area that you do not understand.

L. Module 1445-01 written exam: (See your instructor)

M. Critique Module 1445-01 written exam: (See your instructor).

N. Performance Exam 1445-01: Refer to the Laboratory Learning Activities (Lab Sheet) in this module book and complete the Performance exam for this module. (See your instructor)

O. Degree students must complete this exam by the end of the 1st (1st*) week. Certificate students should complete this exam by the end of the 12th clock hour.

II. Module 1445-02 History and Purpose, Engine Cooling and Comfort Systems, Manifold Gauge Sets

A. Time
   Degree Students: 1 (1*) Week
   Certificate Students: 12 Clock Hours

B. Module Learning Outcomes: Upon completion of this module the student will:
   1. Explain the operation of the basic refrigeration cycle.
   2. Understand the basic function of the various air conditioning components.
   3. Describe the nomenclature and function of the manifold and gauge set.
   4. Utilize appropriate safety procedures while inspecting and connecting a manifold and gauge set to an automotive air conditioning system.
   5. Explain the engine cooling system and its components.
   6. Discuss the requirements for a closed cooling system.
   7. Identify the major components of the automotive engine cooling and comfort heating system.
   8. Understand and utilize the procedures to test various cooling system components.

C. Read Chapters 3, 4 and the Glossary in Resource 1445-01 and Chapters 3, 4, and the
Glossary, and the Appendix in Resource 1445-02. On separate paper; define all Terms to know and answer all of the review questions at the end of each chapter in each resource. Indicate pages where answers may be verified.

D. Read any handouts that the instructor may have given you that pertain to this module.

E. See your instructor and ask him to explain any part of the reading assignment that you do not understand. Ask him to show you the various air conditioning systems on vehicles located in the lab. Ask him to point out the components of each system and explain any part that you do not understand.

F. Refer to the Laboratory Learning Activities (Lab Sheet) in this module book and complete the learning activities for this module. (See your instructor)

G. Ask your instructor if there is any additional information that you should read or see that pertains to this module.

H. Review for Module 1445-02 written exam: Study all previous assignments in this module. See your instructor and ask him to explain any area that you do not understand.

I. Module 1445-02 written exam: (See your instructor)

J. Critique Module 1445-02 written exam: (See your instructor)

K. Performance Exam 1445-02: Refer to the Laboratory Learning Activities (Lab Sheet) in this module book and complete the Performance exam for this module. (See your instructor)

L. Degree students must complete this exam by the end of the 2nd (3rd*) week. Certificate students should complete this exam by the end of the 24th clock hour.

III. Module 1445-03 System Components, Servicing and Testing

A. Time
   Degree Students         3 (1*) Weeks
   Certificate Students    24 Clock Hours

B. Module Learning Outcomes: Upon completion of this module the student will:

1. Explain the purpose and operation of an automotive air conditioner compressor.
2. Discuss the two changes of state of the refrigerant in the automotive air conditioning system.
3. Compare the function of the thermostatic expansion valve (TXV) to the fixed orifice tube (FOT).
4. Diagnose air conditioning system malfunctions based on customer complaints.
5. Identify the different types of automotive air conditioning systems.
6. Utilizing appropriate safety procedures remove and replace automotive air
conditioning system components, such as hoses and fittings, metering devices, driers and accumulators, compressors, condensers and evaporators, and pressure switches.

7. Describe the leak test procedures for an automotive air conditioning system using soap trace solutions, electronic leak detectors, halogen leak detectors and dye solutions.

8. Leak test an air conditioning system using soap solution, dye solution, and using a halogen leak detector.

9. Evacuate an air conditioning system using the single evacuation method.

10. Demonstrate the proper procedures for handling refrigerant while charging a system with refrigerant HFC-134a (R134a).

C. Read Chapters 5 and 6 in Resource 1445-01 and Chapters 5 and 6 in Resource 1445-02. On separate paper; define all Terms to know and answer all of the review questions at the end of each chapter in each resource. Indicate pages where answers may be verified.

D. Read Fact Sheet 1445-03-01. Discuss usage of this information with your instructor

E. Watch Audio Visuels: (See your instructor) Student must take notes

1. “System Servicing”, Bergwall Productions, #LA421 Tape 3, Resource 1445-09 (Video) AUMT 1445-09
2. Part 2 “Services”, Mitchell Automotive Air Conditioning Training Program (Video) AUMT 1445-10.
3. “Air Conditioning Diagnostics” Four Seasons #FS5714 (Video) AUMT 1445-15—Primarily R-12 info, principles apply to all systems

F. Read any handouts that the instructor may have given you that pertain to this module.

G. See your instructor and ask him to explain any part of the reading assignment that you do not understand. Ask him to show you the air conditioning controls and engine cooling and heating comfort systems on vehicles in the lab. Ask him to clarify any questions that you may have about controls and cooling and heating comfort systems.

H. Refer to the Laboratory Learning Activities (Lab Sheet) in this module book and complete the learning activities for this module. (See your instructor)

I. Ask your instructor if there is any additional information that you should read or see that pertains to this module.

J. Review for Module 1445-03 written exam: Study all previous assignments in this module. See your instructor and ask him to explain any area that you do not understand.

K. Module 1445-03 written exam: (See your instructor)

L. Critique Module 1445-03 written exam: (See your instructor.)
M. Performance Exam 1445-03: Refer to the Laboratory Learning Activities (Lab Sheet) in this module book and complete the Performance exam for this module. (See your instructor)

N. Degree students must complete this exam by the end of the 5th (4th*) week. Certificate students should complete this exam by the end of the 48th clock hour.

IV. Module 1445-04 Automotive Refrigeration systems, Compressors and Clutches

A. Time
   Degree Student 4 (4*) Weeks
   Certificate Student 28 Clock Hours

B. Module Learning Outcomes: Upon completion of this module the student will:

1. Diagnose six system malfunctions by gauge readings.

2. Read and understand temperature-pressure charts.

3. Understand the proper handling of refrigeration oil.

4. Discuss and explain the operating principals of various types of A.C. compressors.

5. State the purpose and describe the function and operation of a magnetic clutch in an air conditioning system.

6. Compare fixed-and variable-displacement compressors.

7. Identify and troubleshoot various makes and models of compressors used in automotive air conditioning service.

8. Troubleshoot and make mechanical repairs to clutch coils and rotor assemblies.

C. Read Chapter 7 and 8 in Resource 1445-01 and Chapter 7 and 8 in Resource 1445-02. On separate paper; define all Terms to know and answer all of the review questions at the end of each chapter in each resource. Indicate pages where answers may be verified.

D. Read Fact Sheet 1445-04-01 and review Fact Sheet 1445-01-02 and 1445-01-03, as needed.

E. View Audio Visuals: (See your instructor) Student must take notes


2. "The Compressor-Removing the Seal, Replacing Seals and Leak Testing Evac and Recharge", VOC Media Ass, # 31037, Resource 1445-07 (Video)
1. “Refrigeration and Troubleshooting Section of: “Automotive Air Conditioning”

F. Read any handouts that the instructor may have given you that pertain to this module.

G. See your instructor and ask him to explain any part of the reading assignment that you do not understand. Also have him demonstrate the proper use of tools and equipment associated with servicing and testing of common automotive air conditioning systems.

H. Refer to the Laboratory Learning Activities (Lab Sheet) in this module book and complete the learning activities for this module. (See your instructor)

I. Ask your instructor if there is any additional information that you should read or see that pertains to servicing and testing of common automotive air conditioning systems.

J. Review for Module 1445-04 written exam: Study all previous assignments in this module. See your instructor and ask him to explain any area that you do not understand.

K. Module 1445-04 written exam: (See your instructor)

L. Critique Module 1445-04 written exam: See your instructor.

M. Performance Exam 1445-04: Refer to the Laboratory Learning Activities (Lab Sheet) in this module book and complete the Performance exam for this module. (See your instructor)

N. Degree students must complete this exam by the end of the 9 (8th*) week. Certificate students should complete this exam by the end of the 76th clock hour.

V. Module 1445-05: Air Conditioning Case and Duct Systems and System Controls

A. Time
   Degree Students: 4 (2*) Weeks
   Certificate Students: 28 Clock Hours

B. Module Learning Outcomes: Upon completion of this module the student will:

   1. Diagnose and discuss the air flow through the air distribution system for the defrost, heat, and the cool modes.

   2. Understand Mode Door Actuator operation: cable, Vacuum, and electric.

   3. Describe the operation of controlling the air conditioning system using pressure and temperature –actuated controllers.
4. Recognize and understand the components of an automatic temperature control system.

5. Understand and demonstrate the methods used to diagnose and repair compressor clutch malfunctions.

6. Understand the function of and be able to demonstrate the ability to troubleshoot the components of the automatic temperature control system.

C. Read Chapter 9 and 10 in Resource 1445-01 and Chapter 9 and 10 in Resource 1445-02 and answer the review questions at the end of each chapter in each resource. Indicate pages where answers may be verified.

D. Read Fact Sheet AUMT 1445-05-01

E. View Audio Visuals: (See your instructor) Student must take notes
   1. “System Controls”, Bergwall Productions, #LA421, Tape 3 (Video)
   3. “Domestic Automotive Temperature Control self Diagnostics”, Four Seasons #FS5524 (Video) AUMT 1445-15

E. Read any handouts that the instructor may have given you that pertain to this module.

F. See your instructor and ask him to explain any part of the reading assignment that you do not understand. Also have him demonstrate the proper use of tools and equipment associated with servicing and testing of common automotive air conditioning systems.

G. Refer to the Laboratory Learning Activities (Lab Sheet) in this module book and complete the learning activities for this module. (See your instructor)

H. Ask your instructor if there is any additional information that you should read or see that pertains to servicing and testing of common automotive air conditioning systems.

I. Review for Module 1445-04 written exam: Study all previous assignments in this module. See your instructor and ask him to explain any area that you do not understand.

J. Module 1445-04 written exam: (See your instructor)

K. Critique Module 1445-04 written exam: See your instructor.

M. Performance Exam 1445-04: Refer to the Laboratory Learning Activities (Lab Sheet) in this module book and complete the Performance exam for this module. (See your instructor)
N. Degree students must complete this exam by the end of the 13 (8th*) week. Certificate students should complete this exam by the end of the 104th clock hour.

VI. Module 1445-06: Retrofitting Automotive Air Conditioning Systems from CFC-12 to HFC134a

A. Time
   Degree Students: 2 (2*) Weeks
   Certificate Students: 18 Clock Hours

B. Module Learning Outcomes: Upon completion of this module the student will:

1. Discuss the various refrigerants approved to replace R-12 in automotive air conditioning systems.
2. Understand the problems associated with contaminated refrigerant.
3. Compare components used in R-134a systems with those used in R-12 systems.
4. Recognize the difference between pure and impure refrigerant by interpreting gauge pressures relating to ambient temperature.
5. Determine the purity of refrigerant in an air conditioning system or container.

C. Read Chapter 11 in Resource 1445-01 and Chapter 11 in Resource 1445-02. On separate paper; define all Terms to know and answer all of the review questions at the end of each chapter in each resource. Indicate pages where answers may be verified.

D. View Audio Visuals: (See your instructor) Student must take notes
   "Retrofit Training" IMACA Training Tape, Resource 1445-16 (Video)

E. Read any handouts that the instructor may have given you that pertain to this module.

F. See your instructor and ask him to explain any part of the reading assignment that you do not understand. Also ask him to show you the equipment used to retrofit the air conditioning system of a vehicle. Ask him to point out and explain the function of any component that you do not understand.

G. See your instructor and ask him to demonstrate the proper use of tools and equipment associated with retrofitting an automotive air conditioning system.

H. Refer to the Laboratory Learning Activities (Lab Sheet) in this module book and complete the learning activities for this module. (See your instructor)
I. Ask your instructor if there is any additional information that you should read or see that pertains to this module.

J. Review for Module 1445-06 written exam: Study all previous assignments in this module. See your instructor and ask him to explain any area that you do not understand.

K. Module 1445-06 written exam: (See your instructor)

L. Critique Module 1445-06 written exam: (See your instructor).

M. Performance Exam 1445-06: Refer to the Laboratory Learning Activities (Lab Sheet) in this module book and complete the Performance exam for this module. (See your instructor)

N. Degree students must complete this exam by the end of the 15th (10th*) week. Certificate students should complete this exam by the end of the 122nd clock hour.

VII. Module 1445-07 Exit Exam

A. Time:
   Degree Students: 1 Week
   Certificate Students: 6 Clock Hours

B. Module Learning Outcomes: Upon completion of this module the student will:
   1. Use basic thinking skills and demonstrate personal qualities and work practices used in the work place.
   2. Complete the Exit Exam.

C. Review for Exit Exam: Review all previous assignments.

D. See your instructor and ask him to explain anything that you do not understand about service and repair of automotive air conditioning systems.

E. Module 1445-07 (Exit) Exam: (See your instructor) Degree students must complete this exam by the end of the 16th (11th*) week. Certificate students must complete this exam by the end of the 128th clock hour.

F. Critique Module 1445-07 Written (Exit) Exam: (See your instructor.)

G. There is no performance exam for this module.

H. End of Course Critique and enrollment in the next course in the program. (See your instructor)