



Format CO COURSE OUTLINE

Automotive Air-conditioning and Comfort Heating
Course Title

AM216
Dept. & Course No.

I COURSE DESCRIPTION

This course covers the knowledge, skills and attitude required to service and repair automotive comfort heating and air-conditioning system and their associated components for both fix orifice valve and thermostatic expansion valve. And it also includes reading and interpreting air-conditioning system electrical circuit diagram and troubleshooting comfort heating and air-con sensors, actuators, switches, and control module circuit problems.

II SEMESTER CREDITS: 3

III CONTACT HOURS PER WEEK:

	<u>1</u>	<u>6</u>	<u>7</u>
	Lecture	Laboratory	Total

IV PREREQUISITE: AM112, AM113, and AM125

V STUDENTS LEARNING OUTCOMES

Upon completion of this course the student will be able, with 65% level of accuracy, to:

1. Name engine cooling and comfort heating system parts and components and explain their functions as per repair manual specification.
2. Explain the operating principle of engine cooling and comfort heating system as per manual specification.

VI. COURSE CONTENT

- A. Engine cooling and comfort heating system parts and components and their functions.
 1. Radiator tank assembly
 2. Radiator hoses
 3. By-pass hose
 4. Water pump assembly
 5. Water pump belt
 6. Thermostat
 7. Engine coolant
 8. Heater core
 9. Radiator fan and motors
 10. Condenser fan and motor
 11. Shrouds
 12. Overflowing tank
 13. Heater control valve
 14. Radiator cap
- B. Engine cooling and comfort heating system operating principle
 1. When engine temperature is low
 2. When engine temperature is high
 3. When comfort heating is on or off

3. Service comfort heating system as per vehicle specification.
 4. Name tools and equipment for automotive air-conditioning system and explain their functions as per manual specification.
 5. Name automotive air-conditioning system parts and components and explain their functions as per repair manual specification.
 6. Explain automotive air-conditioning system operating principle as per manual specification.
- C. Engine cooling and heating comfort servicing.
 1. Radiator tank assembly
 2. Radiator hoses
 3. By-pass hose
 4. Water pump assembly
 5. Water pump belt
 6. Thermostat
 7. Engine coolant
 8. Heater core
 9. Radiator fan and motors
 10. Condenser fan and motor
 11. Shrouds
 12. Overflowing tank
 13. Heater control valve
 14. Radiator cap
 - D. Tools and equipment for automotive air-conditioning system and their functions.
 1. Manifold gauge
 2. Vacuum pump
 3. Refrigerant recovery
 4. Safety goggles
 5. Basic hand tools
 6. Refrigerant gas analyzer
 7. Leak detector (tracer dye detector, halogen leak detector, or bubbles check)
 8. Nitrogen tank
 - E. Automotive air-conditioning system parts and components and their functions.
 1. Compressor assembly
 2. Condenser unit
 3. Receiver drier
 4. Evaporator unit
 5. Thermostatic expansion valve
 6. Low side pressure lines
 7. High side pressure lines
 8. Blower
 9. Condenser fan motor
 10. Freon (134-a)
 11. Refrigeration oil
 - F. Automotive air-conditioning system operating principle.
 1. Refrigeration cycle
 2. Heat transfer
 3. Heat absorb
 4. Dehumidification

7. Troubleshoot automotive air-conditioning system cooling problems in correct procedure.
 8. Service automotive air-conditioning system as per repair manual specification.
 9. Name air-con compressor parts and components and explain their functions as per repair manual specification.
 10. Explain air-con compressor operating principle as per repair manual specification.
 11. Troubleshoot air-con compressor assembly mechanical and electrical problems as per repair manual specification.
 12. Service air-con compressor assembly as per repair manual specification.
 13. Name air duct and case system parts and components and explain their functions as per repair manual specification.
- G. Troubleshooting automotive air-conditioning cooling problems
 - a. High and low side pressures
 - b. High and low side temperature
 - c. Relative humidity
 - H. Service automotive air-conditioning system
 1. Evacuating refrigerant
 2. Checking leakage
 3. Charging refrigerant
 4. Checking component temperatures
 - I. Air-con compressor parts and components and their functions.
 1. Reciprocating type
 2. Rotary type
 3. Scroll type
 4. Variable displacement compressor
 - J. Air-con compressor operating principle.
 1. Reciprocating type
 2. Rotary type
 3. Scroll type
 4. Variable displacement compressor
 - K. Troubleshooting air-con compressor problem.
 - a. Mechanical components
 - b. Compressor clutch
 - c. Compressor clutch electrical circuit
 - d. Compressor oil and contaminations
 - L. Servicing air-con compressor
 1. Removing and replacing compressor
 2. Adding oil to compressor
 3. Removing and replacing magnetic clutch
 4. Replacing pulley / rotor bearing
 5. Installing shaft oil seal
 6. Checking compressor leakage
 - M. Air duct and case system parts and their functions.
 1. Types of case assemblies
 2. Air intake section
 3. Core section
 4. Heating section

5. Cooling section
 6. Distribution section
 7. Combined case
 8. Control panel
 9. Mode selector switch
 10. Evaporator drain
 11. Cabin air filter
 12. Door control
14. Service air duct and case system (electrical and cable controlled).
 15. Name air-con electrical components and explain their functions as per repair manual specification.
 16. Diagnose air-con electrical circuitry and component functionality as per repair manual specification.
 17. Read air-con electrical circuit diagram as per manual specification.
- N. Air duct and case system servicing
 1. Replacing blower motor
 2. Replacing the heater core
 3. Replacing evaporator core
 4. Testing door control
 5. Clean cabin air filter
 - O. Air-con electrical components and their functions.
 1. Fuses and circuit breakers
 2. Thermostat
 3. Magnetic clutch
 4. Low-Pressure cut-off switch
 5. High pressure cut-off switch
 6. Blower control
 7. Automatic temperature control
 8. Clutch control
 9. Climate control system sensors
 10. Evaporator temperature control
 11. Sun load sensor
 12. Infrared temperature sensor
 13. Coolant temperature sensor
 14. Ambient temperature sensor
 15. In-car temperature sensor
 16. Temperature and mode door control
 - P. Air-con electrical circuitry and component functionality.
 1. Compressor
 2. Blower
 3. Condenser fan motor
 4. Evaporator sensor
 5. Pressure switch
 6. Magnetic clutch
 - Q. Air-con electrical circuit diagram
 1. Toyota air-conditioning system
 2. Nissan air-conditioning system
 3. Honda air-conditioning system
 4. Mazda air-conditioning system
 5. Suzuki air-conditioning system

18. Service air-con motor, switches, actuators, and sensors as per repair manual specification.
- R. Air-con motor, switches, actuators, and sensors servicing.
1. Fuses and circuit breakers
 2. Thermostat
 3. Magnetic clutch
 4. Low-Pressure cut-off switch
 5. High pressure cut-off switch
 6. Blower control
 7. Automatic temperature control
 8. Clutch control
 9. Climate control system sensors
 10. Evaporator temperature control
 11. Sun load sensor
 12. Infrared temperature sensor
 13. Coolant temperature sensor
 14. Ambient temperature sensor
 15. In-car temperature sensor
 16. Temperature and mode door control

VII MATERIALS AND EQUIPMENT

Materials	Equipments
Sandpaper # 120 Sand paper # 1000 Refrigerant 134-A/R-12 Sun Pag oil -134A Compressor oil O-ring 5/16, 5/8, 1/2 Insulation Tape Flushing solution Coil Cleaner Nitrogen Hand gloves Electrical tape Masking tape Automotive rags	Crocodile jack 3 ton Vehicle sedan type Vehicle pick-up 4x4 Jack stand Rubber stopper Car lifter Digital multimeter Refrigerant leak detecting equipment, Thermometers Gauge manifold set Vacuum pump (1/8 or 1/4 HP) Charging cylinder/charging station Thickness gauge Clutch plate remover/installer Universal adjustable spanner wrench Evacuation equipment Heating/soldering equipment Refrigerant recovery and/or recycling equipment On-board diagnostic generation 2 (OBD-2) Bearing puller

VIII TEXT AND REFERENCES

A Required Text:

Mark Schnubel; Automotive Heating and Air-conditioning 5th Edition
Delmar Cengage Learning Publishing Company 2013
ISBN-13: 978-1-133-01743-1
ISBN-10: 1-133-01743-6

James E. Duffy, Modern Automotive Technology, Tinley Park Illinois,
GOODHEART-WILLCOX COMPANY, INC. 2004
ISBN-10: 1-59070-186-0
ISBN-13: 978-1-59070-186-7

IX METHOD OF INSTRUCTION

- A. Lecture
- B. Visual Aid
- C. Demonstration
- D. Discussion

X METHOD OF EVALUATION:

1.) The components with corresponding weight in percent included in the computation of the final grade are:

Course work (quizzes / class works / homework / projects)	30%
Skill Tests	40%
Exam (Midterm and final exam)	30%

	100%

2.) The transmutation of the total percent to a letter grade is as of follows:

90 – 100	A
80 – 89	B
70 – 79	C
65 – 69	D
0 – 64	F

contaminations problem.	
<p>5. Service air-con compressor assembly as per repair manual specification.</p> <ul style="list-style-type: none"> a. Remove and replace air-con compressor assembly b. Add oil to compressor c. Remove and replace magnetic clutch d. Replace air-con compressor pulley / rotor bearing e. Install shaft oil seal f. Check compressor leakage 	10 hours
<p>6. Service air duct and case system (electrical and cable controlled).</p> <ul style="list-style-type: none"> a. Replace blower motor b. Replace blower speed resistor c. Replace the heater core d. Replace evaporator core e. Test door control f. Check control panel g. Clean cabin air filter 	12 hours
<p>7. Read air-con electrical circuit diagram as per manual specification.</p> <ul style="list-style-type: none"> a. Read air-con electrical circuit diagram of Toyota air-conditioning system b. Read air-con electrical circuit diagram of Nissan air-conditioning system c. Read air-con electrical circuit diagram of Honda air-conditioning system d. Read air-con electrical circuit diagram of Mazda air-conditioning system e. Read air-con electrical circuit diagram of Suzuki air-conditioning system 	4 hours
<p>8. Service air-con motor, switches, actuators, and sensors as per repair manual specification.</p> <ul style="list-style-type: none"> a. Check Compressor clutch functionality and circuitry b. Check Blower performance c. Check Condenser fan motor functionality d. Check Evaporator sensor resistance value e. Check Pressure switch f. Check Fuses and circuit breakers g. Check Thermostat h. Check Low-Pressure cut-off switch i. Check High pressure cut-off switch j. Check Blower control functionality k. Check Automatic temperature control functionality l. Check Clutch control functionality 	16 hours

<ul style="list-style-type: none"> m. Check Climate control system sensors functionality n. Check Evaporator temperature control functionality o. Check Sun load sensor functionality p. Check Infrared temperature sensor functionality q. Check Coolant temperature sensor functionality r. Check Ambient temperature sensor functionality s. Check In-car temperature sensor functionality 	
<p>9. Diagnose Automotive Air-conditioning and Comfort Heating problems</p> <ul style="list-style-type: none"> a. Analyze comfort heating performance b. Analyze low cooling or no cooling problem c. Analyze low side and high side pressure readings d. Analyze air inlet and air outlet temperature readings e. Solve odor problems from Air-con system air duct 	<p>20 hours</p>



PALAU COMMUNITY COLLEGE
AM216 Automotive Air-conditioning and Comfort Heating
COURSE LEARNING OUTCOMES

During the course experience, the course learning outcomes (CLO's) will be assessed through the use of signature assignments. A rating scale will be used to determine the students' proficiency level of each CLO using specifically aligned assignments. The numerical ratings of 3, 2, and 1 are not intended to represent the traditional school grading system of A, B, C, D, and F. The descriptions associated with each of the numbers focus on the level of student performance of each of the course learning outcomes listed below:

Rating Scale:

- 3 Highly Competent 85% to 100%
- 2 Competent 70% to 84%
- 1 Beginner Below 70%

Course Learning Outcome #1: Service automotive comfort heating system.

Paper based assessment: Name automotive comfort heating system parts and components and explain their functions, and Explain the operating principle of automotive comfort heating system, and analyze cause and effect involving automotive comfort heating problems.

Authentic Assessment: Check engine Thermostat, check heater core control valve for functionality, Change Engine coolant, Check Heater core for leakage and fins air flow, Check Radiator fan motor, and/or Condenser fan motor functionality and circuitry.

Numerical Value	
Highly Competent 3 (10 points)	Student demonstrates the knowledge and skills in servicing automotive comfort heating system with 85% to 100% performance accuracy.
Competent 2 (7 points)	Student demonstrates the knowledge and skills in servicing automotive comfort heating system with 70% to 84% performance accuracy.
Beginner 1 (3 points)	Student demonstrates the knowledge and skills in servicing automotive comfort heating system with below 70% performance accuracy.

Course Learning Outcome #2: Service automotive air-conditioning system

Paper based assessment: Name tools and equipment for automotive air-conditioning system and explain their functions, Name automotive air-conditioning system parts and components and explain their functions, and Explain automotive air-conditioning system operating principle and analyze cause and effect involving automotive air-conditioning system problems.

Authentic Assessment: Check High and low side pressures for leakage, Check High and low side temperature, Check Relative humidity, evacuate refrigerant, and/or perform evacuation and charging Freon refrigerant.

Numerical Value	
Highly Competent 3 (10 points)	Student demonstrates the knowledge and skills in servicing automotive air-conditioning system with 85% to 100% performance accuracy.
Competent 2 (7 points)	Student demonstrates the knowledge and skills in servicing automotive air-conditioning system with 70% to 84% performance accuracy.
Beginner 1 (3 points)	Student demonstrates the knowledge and skills in servicing automotive air-conditioning system with below 70% performance accuracy.

Course Learning Outcome #3: Service air-con compressor and condensing unit

Paper based assessment: Name air-con compressor and condensing unit parts and components, and explain their functions, and Explain air-con compressor operating principle, explain the operating principle of condensing unit, and analyze cause and effect involving air-con compressor and condensing unit problems.

Authentic Assessment: Overhaul Air-con compressor unit, Check Compressor oil quality and performance, Check condenser for leakage and/or check filter drier for clogged and contamination.

Numerical Value	
Highly Competent 3 (10 points)	Student demonstrates the knowledge and skills in servicing air-con compressor and condensing unit with 85% to 100% performance accuracy.
Competent 2 (7 points)	Student demonstrates the knowledge and skills in servicing air-con compressor and condensing unit with 70% to 84% performance accuracy.
Beginner 1 (3 points)	Student demonstrates the knowledge and skills in servicing air-con compressor and condensing unit with below 70% performance accuracy.

Course Learning Outcome #4: Service air duct and case system.

Paper based assessment: Name air duct and case system parts and components and explain their functions, explain the operating principle of control panel, blower motors and speed resistor switch, air ducting's mechanism, expansion valve, evaporator fins sensor, and door control for fresh, hot and cooled air, and analyze cause and effect involving air duct and case system problems.

Authentic Assessment: Check heater core, evaporator core, expansion valve, and evaporator fins sensor, expansion valve, door control mechanism, actuators, and control panel for functionality, rationality, circuitry, and/or clean cabin air filter.

Numerical Value	
Highly Competent 3 (10 points)	Student demonstrates the knowledge and skills in servicing air duct and case system with 85% to 100% performance accuracy.
Competent 2 (7 points)	Student demonstrates the knowledge and skills in servicing air duct and case system with 70% to 84% performance accuracy.
Beginner 1 (3 points)	Student demonstrates the knowledge and skills in servicing air duct and case system with below 70% performance accuracy.

Course Learning Outcome #5: Service Automotive Air-con Electrical System

Paper based assessment: Name car air-con electrical system parts and components and explain their uses, Explain Car Air-conditioning Temperature Control operating principle, and analyze cause and effect involving car air-con electrical system problem.

Authentic Assessment: Check Compressor clutch electrical circuit, evaporator Blower, Condenser fan motor, Evaporator sensor, Pressure switch, Fuses, circuit breakers, Thermostat, Low-Pressure cut-off switch, High pressure cut-off switch, Blower control, Automatic temperature control, Clutch control, Climate control system, Evaporator temperature control, Sun load sensor, Infrared temperature sensor, Coolant temperature sensor, Ambient temperature sensor, and In-car temperature sensor for functionality, rationality, and circuitry, and/or replace thermostatic cycling switch.

Numerical Value	
Highly Competent 3 (10 points)	Student demonstrates the knowledge and skills in servicing Automotive Air-con Electrical System with 85% to 100% performance accuracy.
Competent 2 (7 points)	Student demonstrates the knowledge and skills in servicing Automotive Air-con Electrical System with 70% to 84% performance accuracy.
Beginner 1 (3 points)	Student demonstrates the knowledge and skills in servicing Automotive Air-con Electrical System with below 70% performance accuracy.