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COURSE OUTLINE

AUTOMOTIVE AIR CONDITIONING

Course Title

AM-213

Dept. & Course No.

I COURSE DESCRIPTION

This course helps the learner understand how automotive air conditioning system or units vary in their design and application from stationary system. It also covers practical skills in servicing and repairing automotive air conditioning.

II SEMESTER CREDITS: 3

III CONTACT HOURS PER WEEK:

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

IV PREREQUISITE: None

V STUDENTS LEARNING OUTCOME

VI. COURSE CONTENT

At the end of the semester, the student with a combined accuracy of 65% should be able to:

1. Service Car Air-conditioning System

- A. Components of Car Air-conditioning System and their operating principle**
1. Principles of refrigeration
 2. Basic parts of car air-conditioning system and their function
 3. Types of automotive Freon and their characteristic
 4. Refrigerant oil
 5. Basic refrigeration cycle

2. Service Car Air-con Compressor Unit

- B. Car Air-con Compressor Unit and their specification**
1. Air-con compressors principles of operation
 2. Construction and operation of air con compressors
 3. Air-con compressor lubricants
 4. Types of air-con compressor
 5. Magnetic clutch principles of operation
 6. Compressor protection and control switches

3. Service Car Air-con Cooling Unit
 7. Compressor installing procedure
 8. Service valves
- C. Car Air-con Evaporator Unit and their specification
 1. Thermistor
 2. Expansion valve
 3. Types of evaporator assembly
 4. Liquid tube
 5. Refrigerant lines
 6. Pressure switch
 7. Accumulator
4. Service Car Air-con Condensing Unit
 - D. Car Air-con Condensing Unit and their specification
 1. Condenser and their function
 2. Types of Condenser and fins
 3. Condenser tubes
 4. Receiver drier
 5. Types of fittings
 6. Relationship of pressure and temperature
5. Service Car Air-conditioning Temperature Control Switch
 - E. Car Air-conditioning Temperature Control and their specification
 1. Manual temperature control principle of operation
 2. Automatic temperature control
 3. Air-conditioner amplifier
 4. Cycling switches
 5. A/C actuator operation and their function
6. Service Car Air-con Electrical System
 - F. Car Air-con Electrical components and their function
 1. Condenser cooling fan and motor
 2. Evaporator blower and motor
 3. Engine cooling fan and motor
 4. A/C relay and switches
 5. Vacuum switching valve
 6. Water temperature switch
 7. Magnetic clutch

7. Troubleshoot Car Air-conditioning System

G. Automotive air-conditioning failure cause and effect

1. Cooling unit failure
2. Condensing unit failure
3. A/C compressor low compression
4. Air, Moisture, and Foreign matter contaminants on A/C system
5. High and low side pressure specification
6. High side and low side temperature specification
7. Refrigerant leakage
8. Refrigerant lines
9. Freon and Freon oil
10. Air flow system of blower and cooling fan

VII MATERIALS AND EQUIPMENT

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

VIII TEXT AND REFERENCES

- A Required Text:
Martin W. Stockel and Martin T. Stockel, **Automotive Fundamentals**,
Tinley Park Illinois, GOODHEART-WILLCOX COMPANY, INC. 2005

James E. Duffy, **Modern Automotive Technology**, Tinley Park Illinois,
GOODHEART-WILLCOX COMPANY, INC. 2004

- B Supplementary References:

Althouse, A.D., et. al. Modern Refrigeration and Air Conditioning.
South Holland, Ill., Goodheart Wilcox Publishing Company, Inc., 2000.

Hinerman, Ivan D., et. al. Automotive Air Conditioning and Heating.
Mission Hills, California: Glencoe Publishing Company, 1987

Toyota Motor Corporation: Repair manual for;

- Toyota sedan
- Toyota RAV-4
- Toyota SURF

Printed by: Toyota Motor Corporation, 1997

Nissan Motor: Repair manual for;

- Nissan QUEST
- Nissan sedan
- Nissan SUV

Printed by: Nissan North America, Inc. 1992

General Motors Corporation; Repair manual for Chevy Trucks Chassis

Printed by: General Motors Corporation USA 1993 to 1998

Mitchell International for domestic cars service and repair

- Engine Performance
- Chassis electrical
- Engine electrical
- Chassis repair
- Engine repair
- Electrical components locator

MITCHELL San Diego, California 1992 to 1998 edition.

James E. Duffy, **Automotive Electricity and Electronics Technology**,
Tinley Park Illinois, GOODHEART-WILLCOX COMPANY, INC. 2000.

IX METHOD OF INSTRUCTION

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

X METHOD OF EVALUATION:

Mastery of concepts is tested through written examination. Performance on laboratory and shop projects is measured through the following criteria:

- A. Accuracy 25%
- B. Time 10%
- C. Technique 10%
- D. Appearance 10%
- E. Completion 35%
- F. Knowledge 10%

Total: 100%

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

- A. Participation (shop projects) 20%
- B. Quizzes and homework 10%
- C. Midterm / Final Exam 20%
- D. Laboratory (Based on task list) 50%

Total: 100%

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

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

Form NC-2
TASK LISTING SHEET

AM-213 AUTOMOTIVE AIR CONDITIONING

Course No. & Title

Credits: 1 6 96
Lec. Lab Total lab hours

Laboratory objectives	Time allotment
1. Service Car Air-conditioning System a. Perform A/C refrigerant recovery and evacuation b. Charge A/C refrigerant c. Add refrigerant oil d. Check refrigerant lines for leakage	15 hours
2. Service Car Air-con Compressor Unit a. Check A/C compressor internal leakage b. Check A/C compressor external leakage c. Check A/C compressor unusual noise d. Check A/C compressor magnetic clutch operation e. Service A/C compressor assembly	10 hours
3. Service Car Air-con Cooling Unit a. Clean A/C evaporator assembly for blockage and leakage b. Check and replace expansion valve assembly c. Check thermistor resistance value d. Clean and install glove box compartment drain hose e. Service A/C evaporator blower	15 hours
4. Service Car Air-con Condensing Unit a. Clean and check A/C condenser assembly for blockage and leakage b. Check and replace receiver drier assembly c. Check cooling fan motor operation	10 hours
5. Service Car Air-conditioning Temperature Control Switch a. Service Manual temperature switch b. Check / Replace automatic temperature switch c. Check / Replace A/C amplifier d. Check / Replace thermostatic cycling switch e. Check / replace pressure cycling switch f. Check and adjust A/C actuator	15 hours
6. Service Car Air-con Electrical System a. Service A/C electrical main components b. Check / replace A/C relay e. Check / replace Vacuum switching valve f. Check / replace water temperature switch g. Check magnetic clutch circuit	15 hours
7. Troubleshoot Car Air-conditioning System a. Identify A/C system leakage b. Identify low / no cooling on A/C system c. Test A/C system performance d. Identify A/C system unusual sound during operation	16 hours

RUBRICS

AM-213 AUTOMOTIVE AIR CONDITIONING

Students Name: _____

Semester / Year: _____

Instructor's Name: _____

Direction: Evaluate the student using the rating scale below and check the appropriate numbers to indicate the degree of competency. The numerical rating of 5, 4, 3, 2, and 1 are not intended to represent the traditional school grading system of A, B, C, D, and F. The description associated with each of the number focus on the level of student performance for each of the competencies listed below.

Rating Scale: 5 Excellent Skilled
4 Above average
3 Average
2 Below average
1 Unacceptable

DESCRIPTION	RATING				
A. Service Car Air-conditioning System	1	2	3	4	5
B. Service Car Air-con Compressor Unit	1	2	3	4	5
C. Service Car Air-con Cooling Unit	1	2	3	4	5
D. Service Car Air-con Condensing Unit	1	2	3	4	5
E. Service Car Air-conditioning Temperature Control Switch	1	2	3	4	5
F. Service Car Air-con Electrical System	1	2	3	4	5
G. Troubleshoot Car Air-conditioning System	1	2	3	4	5

I certify that the student has completed all the competencies in this course and has achieved the competency ratings as shown above.

Instructor's Signature

Date

RUBRICS
AM-213 AUTOMOTIVE AIR CONDITIONING

A. Service Car Air-conditioning System _____

5. The student demonstrates knowledge and skills in performing A/C refrigerant recovery and evacuation, charging A/C refrigerant, adding refrigerant oil, and checking refrigerant lines for leakage with 90% to 100% performance accuracy.
4. The student demonstrates knowledge and skills in performing A/C refrigerant recovery and evacuation, charging A/C refrigerant, adding refrigerant oil, and checking refrigerant lines for leakage with 80% to 89% performance accuracy.
3. The student demonstrates knowledge and skills in performing A/C refrigerant recovery and evacuation, charging A/C refrigerant, adding refrigerant oil, and checking refrigerant lines for leakage with 70% to 79% performance accuracy.
2. The student demonstrates knowledge and skills in performing A/C refrigerant recovery and evacuation, charging A/C refrigerant, adding refrigerant oil, and checking refrigerant lines for leakage with 65% to 69% performance accuracy.
1. The student demonstrates knowledge and skills in performing A/C refrigerant recovery and evacuation, charging A/C refrigerant, adding refrigerant oil, and checking refrigerant lines for leakage with below 65% performance accuracy.

B. Service Car Air-con Compressor Unit _____

5. The student demonstrates knowledge and skills in checking A/C compressor internal leakage, checking A/C compressor external leakage, checking A/C compressor unusual noise, checking A/C compressor magnetic clutch operation, and servicing A/C compressor assembly with 90% to 100% performance accuracy.
4. The student demonstrates knowledge and skills in checking A/C compressor internal leakage, checking A/C compressor external leakage, checking A/C compressor unusual noise, checking A/C compressor magnetic clutch operation, and servicing A/C compressor assembly with 80% to 89% performance accuracy.
3. The student demonstrates knowledge and skills in checking A/C compressor internal leakage, checking A/C compressor external leakage, checking A/C compressor unusual noise, checking A/C compressor magnetic clutch operation, and servicing A/C compressor assembly with 70% to 79% performance accuracy.
2. The student demonstrates knowledge and skills in checking A/C compressor internal leakage, checking A/C compressor external leakage, checking A/C compressor unusual noise, checking A/C compressor magnetic clutch operation, and servicing A/C compressor assembly with 65% to 69% performance accuracy.

1. The student demonstrates knowledge and skills in checking A/C compressor internal leakage, checking A/C compressor external leakage, checking A/C compressor unusual noise, checking A/C compressor magnetic clutch operation, and servicing A/C compressor assembly with below 65% performance accuracy.

C. Service Car Air-con Cooling Unit

5. The student demonstrates knowledge and skills in cleaning and checking A/C evaporator assembly for blockage and leakage, checking and replacing expansion valve assembly, checking thermistor resistance value, cleaning and installing glove box compartment drain hose, and servicing A/C evaporator blower with 90% to 100% performance accuracy.
4. The student demonstrates knowledge and skills in cleaning and checking A/C evaporator assembly for blockage and leakage, checking and replacing expansion valve assembly, checking thermistor resistance value, cleaning and installing glove box compartment drain hose, and servicing A/C evaporator blower with 80% to 89% performance accuracy.
3. The student demonstrates knowledge and skills in cleaning and checking A/C evaporator assembly for blockage and leakage, checking and replacing expansion valve assembly, checking thermistor resistance value, cleaning and installing glove box compartment drain hose, and servicing A/C evaporator blower with 70% to 79% performance accuracy.
2. The student demonstrates knowledge and skills in cleaning and checking A/C evaporator assembly for blockage and leakage, checking and replacing expansion valve assembly, checking thermistor resistance value, cleaning and installing glove box compartment drain hose, and servicing A/C evaporator blower with 65% to 69% performance accuracy.
1. The student demonstrates knowledge and skills in cleaning and checking A/C evaporator assembly for blockage and leakage, checking and replacing expansion valve assembly, checking thermistor resistance value, cleaning and installing glove box compartment drain hose, and servicing A/C evaporator blower with below 65% performance accuracy.

D. Service Car Air-con Condensing Unit

5. The student demonstrates knowledge and skills in cleaning and checking A/C condenser assembly for blockage and leakage, checking and replacing receiver drier assembly, checking cooling fan motor operation with 90% to 100% performance accuracy.
4. The student demonstrates knowledge and skills in cleaning and checking A/C condenser assembly for blockage and leakage, checking and replacing receiver drier assembly, checking cooling fan motor operation with 80% to 89% performance accuracy.

- 3 The student demonstrates knowledge and skills in cleaning and checking A/C condenser assembly for blockage and leakage, checking and replacing receiver drier assembly, checking cooling fan motor operation with 70% to 79% performance accuracy.
2. The student demonstrates knowledge and skills in cleaning and checking A/C condenser assembly for blockage and leakage, checking and replacing receiver drier assembly, checking cooling fan motor operation with 65% to 69% performance accuracy.
1. The student demonstrates knowledge and skills in cleaning and checking A/C condenser assembly for blockage and leakage, checking and replacing receiver drier assembly, checking cooling fan motor operation with below 65% performance accuracy.

E. Service Car Air-conditioning Temperature Control Switch

5. The student demonstrates knowledge and skills in servicing manual temperature switch, checking / replacing automatic temperature switch, checking A/C amplifier for voltage supply, checking / replacing thermostatic cycling switch, checking / replacing pressure cycling switch, checking and adjusting A/C actuator assembly with 90% to 100% performance accuracy.
4. The student demonstrates knowledge and skills in servicing manual temperature switch, checking / replacing automatic temperature switch, checking A/C amplifier for voltage supply, checking / replacing thermostatic cycling switch, checking / replacing pressure cycling switch, checking and adjusting A/C actuator assembly with 80% to 89% performance accuracy.
- 3 The student demonstrates knowledge and skills in servicing manual temperature switch, checking / replacing automatic temperature switch, checking A/C amplifier for voltage supply, checking / replacing thermostatic cycling switch, checking / replacing pressure cycling switch, checking and adjusting A/C actuator assembly with 70% to 79% performance accuracy.
2. The student demonstrates knowledge and skills in servicing manual temperature switch, checking / replacing automatic temperature switch, checking A/C amplifier for voltage supply, checking / replacing thermostatic cycling switch, checking / replacing pressure cycling switch, checking and adjusting A/C actuator assembly with 65% to 69% performance accuracy.
1. The student demonstrates knowledge and skills in servicing manual temperature switch, checking / replacing automatic temperature switch, checking A/C amplifier for voltage supply, checking / replacing thermostatic cycling switch, checking / replacing pressure cycling switch, checking and adjusting A/C actuator assembly with below 65% performance accuracy.

F. Service Car Air-con Electrical System

5. The student demonstrates knowledge and skills in servicing A/C electrical main components, checking / replacing A/C relay, checking / replacing vacuum switching valve, checking / replacing water temperature switch, and checking magnetic clutch circuit with 90% to 100% performance accuracy.
4. The student demonstrates knowledge and skills in servicing A/C electrical main components, checking / replacing A/C relay, checking / replacing vacuum switching valve, checking / replacing water temperature switch, and checking magnetic clutch circuit with 80% to 89% performance accuracy.
3. The student demonstrates knowledge and skills in servicing A/C electrical main components, checking / replacing A/C relay, checking / replacing vacuum switching valve, checking / replacing water temperature switch, and checking magnetic clutch circuit with 70% to 79% performance accuracy.
2. The student demonstrates knowledge and skills in servicing A/C electrical main components, checking / replacing A/C relay, checking / replacing vacuum switching valve, checking / replacing water temperature switch, and checking magnetic clutch circuit with 65% to 69% performance accuracy.
1. The student demonstrates knowledge and skills in servicing A/C electrical main components, checking / replacing A/C relay, checking / replacing vacuum switching valve, checking / replacing water temperature switch, and checking magnetic clutch circuit with below 65% performance accuracy.

G. Troubleshoot Car Air-conditioning System

5. The student demonstrates knowledge and skills in identifying A/C system leakage, identifying low / no cooling on A/C system, testing A/C system performance, and identifying A/C system unusual sound during operation with 90% to 100% performance accuracy.
4. The student demonstrates knowledge and skills in identifying A/C system leakage, identifying low / no cooling on A/C system, testing A/C system performance, and identifying A/C system unusual sound during operation with 80% to 89% performance accuracy.
3. The student demonstrates knowledge and skills in identifying A/C system leakage, identifying low / no cooling on A/C system, testing A/C system performance, and identifying A/C system unusual sound during operation with 70% to 79% performance accuracy.
2. The student demonstrates knowledge and skills in identifying A/C system leakage, identifying low / no cooling on A/C system, testing A/C system performance, and identifying A/C system unusual sound during operation with 65% to 69% performance accuracy.
1. The student demonstrates knowledge and skills in identifying A/C system leakage, identifying low / no cooling on A/C system, testing A/C system performance, and identifying A/C system unusual sound during operation with below 65% performance accuracy.