San Bernardino Valley college
Curriculum Approved: January 27, 2003
Last Updated: December 2002

I. COURSE DESCRIPTION:

A. Department Information:

Division:	Technical
Department:	Automotive
Course ID:	AUTO 056
Course Title:	Automotive Heating and Air Conditioning
Units:	4
Lecture:	3 Hours
Laboratory:	3 Hours
Prerequisite:	None

B. Catalog and Schedule Description:
Principles of automotive air conditioning and heating systems. Detail topics include repairing and replacing all components, diagnosis of both manual and automatic heater and air conditioning systems.

II. NUMBER OF TIMES COURSE MAY BE TAKEN FOR CREDIT: One

III. EXPECTED OUTCOMES FOR STUDENTS:

Upon completion of the course, the student will be able to:

A. Identify safety requirements and recognize safety signs and symbols.
B. Describe the principles of heat energy.
C. Identify basic air conditioning components and how they function.
D. Perform basic service on air conditioning system and identify alternate refrigerants.
E. Service air conditioning compressor and clutch assemble.
F. Repair or replace evaporator, condenser, and expansion values.
G. Perform repair on the engine cooling system.
H. Inspect, test, and repair electrical components of the automotive heating and air conditioning systems.
I. Diagnose automatic and semiautomatic heating and cooling control systems.
J. Explain the need for air conditioning system retrofits and perform the two types of retrofits.

IV. COURSE CONTENT:

A. Shop Safety:
   1. Hazardous materials
   2. Material Safety Data Sheets
   3. Machinery hazards
B. Principles of Automotive Air Conditioning:
   1. Principles of heat energy
   2. Define air conditioning
   3. Basic heat exchangers within the air conditioning system and manner in which they function
C. Automotive Air Conditioning System Design:
   1. Five basic operational phases of an air conditioning system
   2. Components of an automotive air conditioning system
   3. Thermal expansion valve design
   4. Orifice system design
   5. Controls found in automotive air conditioning systems
D. Automotive Air Conditioning System Service:
   1. Recent changes in automotive air conditioning service
   2. Types of refrigerants used
   3. Appropriate safety procedures for diagnosing and servicing air conditioning system

4. Identify system service ports and valves
5. Characteristics of sight glass
6. Precautions that need to be considered when working with alternate refrigerants
7. Usage conditions of alternate refrigerants

E. Servicing the Automotive Air Conditioning System:
1. Procedure for inspecting and determining the system state-of-charge
2. Procedures for diagnosing the automotive air conditioning
3. Servicing the automotive air conditioning system
4. Proper labeling and storage of refrigerants

F. Automotive Air Conditioning Compressor and Compressor Clutch:
1. Removing and replacing a compressor
2. Inspecting and servicing and air conditioning compressor
3. Servicing an air conditioning compressor clutch assembly
4. Identify various types of air conditioning hoses and seals

G. Repairing and Replacing the Evaporator, Condenser, Thermal Expansion Valve, and Receiver-Driver:
1. Procedures for inspecting, testing, repairing, or replacing high and low pressure air conditioning components

H. The Automotive Heating System and Engine Cooling System:
1. Principles by which heater core operates
2. Principles by which the engine cooling system operates
3. Diagnosing heating system problems

I. Repairing the Automotive Heating and Engine Cooling System:
1. Procedures for inspecting, pressure testing, flushing, and replacing heating core components
2. Procedures for inspecting, testing, and replacing the heater core coolant control valve
3. Procedures for pressure test, inspecting, and repairing the engine coolant system

J. Electrical Components of Automotive Air Conditioning and Heating System:
1. Various types of automotive air conditioning switches and the principles by which they operate
2. Types of automotive air conditioning load devices and the principles by which they operate
3. Identify the air conditioning sensors and its control devices
4. Testing procedures for typical air conditioning circuits

K. Diagnosing and Repairing Automotive Heating and Air Conditioning Control Devices:
1. Air distribution principles
2. Principles by which vacuum switches, solenoids, and reservoirs operate
3. Principles by which a vacuum motor operates
4. Principles by which mechanical cable and mechanical linkage operate
5. Inspecting and testing vacuum and mechanical control units

L. Diagnosing Automatic and Semiautomatic Control Systems:
1. Identify automatic and semiautomatic heating and cooling system components
2. Basic operation of automatic and semiautomatic heating and cooling control system
3. Actuators and their purpose
4. Procedures that distinguish automatic and semiautomatic heating and cooling control system
5. Testing automatic and semiautomatic heating and cooling control systems

M. Air Conditioning System Retrofits:
1. Explain why retrofits are necessary

2. Two types of retrofits
3. Two lubricant replacements associated with retrofits
4. Basic rules of retrofits
5. Procedures for performing retrofits

V. METHODS OF INSTRUCTION:

A. Lecture
B. Computer assisted instruction and shop manuals
C. Class and group discussion
D. Manufacturer's video instruction
E. Daily lab demonstrations

VI. TYPICAL ASSIGNMENTS:

A. Read assigned chapters and answer questions at the end of each chapter.
Typical Question: Describe the process of heat exchange in a basic air conditioning system.

B. Class discussion:
Typical Topic: Properties of Refrigerants, R-12, R134a, Alternate Refrigerants

C. Videotapes:
Typical Assignment: Take notes, outline key points of discussion

D. Lab assignments:
Complete NATEF task sheets as per NATEF standards
Typical Assignments:
1. Inspect, test, and replace a/c compressor clutch component or assembly.
2. Remove and install receiver/drier or accumulator/drier.
3. Inspect, test, and replace thermostat and housing.

VII. EVALUATION(S):

A. Methods of evaluation:
1. Chapter review questions
2. Quizzes (Multiple Choice, Essay and True /False)
3. Mid-term examination (Multiple Choice)
4. Final examination (Multiple Choice and Essay)
Typical Question:
Describe how the compressor cycle is controlled on an orifice tube air conditioning system.
5. Assigned lab task as per NATEF standards (A-7 Sections A, B, C, D, E)
A–7 Heating and Air Conditioning
Section A: A/C System Diagnosis and Repair, Task 1-5
Typical Task:
Leak test A/C system; determine necessary action.
Section B: Refrigeration System Component Diagnosis and Repairs, Task 1-10
Typical Task:
Determine need for A/C system filter; perform necessary action.
Section C: Heating, Ventilation, and Engine Cooling System Diagnosis and Repair, Task 1-9
Typical Task:
Inspect and test electric fan control system.
Section D: Operating System and Related Controls Diagnosis and Repair, Task 1-8
Typical Task:
Inspect and test A/C heater control cables and linkages; perform necessary action.

Section E: Refrigerant Recovery, Recycling, and Heating, Task 1-6
Typical Task:
Recycle refrigerant.

B. Frequency of evaluation:
1. One mid-term examination
2. One final examination
3. Weekly quizzes
4. Bi-weekly text book chapter review questions
5. Daily NATEF task assignments (Lab)

VIII. TYPICAL TEXT(S):

Boyce Dwiggins, Automotive Heating and Air Conditioning, 2nd Edition, Albany, New York: Delmar Publishers, 2001

Mitchell Information Services, Heating and Air Conditioning System, Englewood Cliffs, New Jersey, Prentice-Hall, 1998

Mitchell International, Automotive Air Conditioning Basic Service Training Manuel, 29th Edition, San Diego, California: Mitchell International, 1998

Arthur G. Hobbs, Retrofit R – 12 Versus R – 134a, Coppell, Texas: Four Seasons, 1995

IX. OTHER SUPPLIES REQUIRED OF STUDENTS:

Safety equipment and adequate clothing