ILLINOIS VALLEY COMMUNITY COLLEGE

COURSE OUTLINE

DIVISION: Workforce Development

COURSE: ATO 2250: Heating and Air Conditioning

Date: Spring 2014

Credit Hours: 3

Prerequisite(s): None

Delivery Method:	☒ **Lecture**	**2 Contact Hours (1 contact = 1 credit hour)**
	☐ **Seminar**	**0 Contact Hours (1 contact = 1 credit hour)**
	☒ **Lab**	**2 Contact Hours (2 contact = 1 credit hour)**
	☐ **Clinical**	**0 Contact Hours (3 contact = 1 credit hour)**
	☐ **Online**	
	☐ **Blended**	

Offered: ☐ **Fall** ☐ **Spring** ☒ **Summer**

IAI Equivalent –***Only for Transfer Courses***-go to *http://www.itransfer.org*:

CATALOG DESCRIPTION:
This course covers the theory, construction, operation and servicing of the air conditioning, heating and cooling systems found on the automobile. Emphasis will be placed on testing, troubleshooting and servicing of the air conditioning system using appropriate manuals, tools, equipment and safety practices. The recovery and recycling of refrigerant, laws governing R-12 and R-134a, and technician refrigerant certification will receive special emphasis.

GENERAL EDUCATION GOALS ADDRESSED

[See the last page of this form for more information.]

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

[Choose those goals that apply to this course.]

☐ To apply analytical and problem solving skills to personal, social and professional issues and situations.
☒ To communicate orally and in writing, socially and interpersonally.
☐ To develop an awareness of the contributions made to civilization by the diverse cultures of the world.
☒ To understand and use contemporary technology effectively and to understand its impact on the individual and society.
☒ To work and study effectively both individually and in collaboration with others.
☒ To understand what it means to act ethically and responsibly as an individual in one's career and as a member of society.
☐ To develop and maintain a healthy lifestyle physically, mentally, and spiritually.
☐ To appreciate the ongoing values of learning, self-improvement, and career planning.

EXPECTED LEARNING OUTCOMES AND RELATED COMPETENCIES:

[Outcomes related to course specific goals.]

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

NATEF Tasks:

HEATING AND AIR CONDITIONING:

A. A/C System Diagnosis and Repair
   1. Diagnose unusual operating noises in the A/C system; determine needed repairs
   2. Conduct a performance test of the A/C system; determine needed repairs.
   3. Leak test A/C system; determine needed repairs.
   4. Inspect the condition of discharged oil.
   5. Select oil type; measure and add oil to the A/C system as needed.

B. Refrigeration System Component Diagnosis and Repair
   1. Compressor and Clutch
      a. Diagnose A/C system problems that cause the protection devices (pressure, thermal, and PCCM) to interrupt system operation; determine needed repairs.
      b. Inspect A/C compressor drive belts; replace and adjust as needed.
      c. Inspect, test, and replace A/C compressor clutch components or assembly.
      d. Remove and replace A/C compressor and mountings.
      e. Inspect and replace A/C compressor shaft seal assembly (ies).

   2. Evaporator, Receiver/Drier, Condenser, Etc.
      a. Diagnose A/C system problems caused by too much moisture in the refrigerant; determine needed repairs.
      b. Install A/C system filter.
      c. Remove and inspect A/C system mufflers, hoses, lines, fittings, o-rings, seals, and service valves; replace as needed.

d. Inspect A/C condenser for airflow restrictions; service as required.
e. Inspect receiver/drier or accumulator/drier; replace as needed.
f. Inspect and test expansion valve or orifice (expansion) tube; replace as needed.
g. Inspect evaporator housing water drain; repair as needed.

C. Heating and Engine Cooling Systems Diagnosis and Repair
1. Diagnose temperature control problems in the heater/ventilation system; determine needed repairs.
2. Perform cooling system, cap, and recovery system tests (pressure, combustion leakage, and temperature); determine needed repairs.
3. Inspect engine cooling and heater system hoses and belts; replace as needed.
4. Inspect, test, and replace thermostat and housing.
5. Determine coolant condition; drain and recover.
6. Flush system and refill with recommended coolant; bleed system.
7. Clean, inspect, and test fan, fan clutch (electrical and mechanical), fan shroud, and air dams; replace as needed.
8. Inspect and test heater control valve(s); replace as needed.

D. Operating systems and Related Controls Diagnosis and Repair
1. Electrical
a. Diagnose failures in the electrical controls of heating and A.C systems; determine needed repairs
b. Inspect and test A/C-heater blower, motors, resistors, switches, relays, wiring, and protection devices; repair or replace as needed.
c. Test A/C compressor load cut-off systems; determine needed repairs.

2. Vacuum/Mechanical
a. Diagnose failures in the vacuum and mechanical controls of the heating and A/C system; determine needed repairs.
b. Inspect and test A/C-heater control panel assembly; replace as needed.
c. Inspect and test A/C-heater control cables and linkages; adjust or replace as needed.
d. Inspect and test A/C-heater vacuum control switches, hoses, diaphragms (motors), vacuum reservoir, check valve, and restrictors; replace as needed.
e. Inspect and test A/C-heater ducts, doors, hoses, and outlets; replace as needed.

3. Automatic and Semi-Automatic Temperature Controls
a. Check operation of automatic and semi-automatic heating, ventilation, and air conditioning (HVAC) control systems; determine needed repairs.

E. Refrigerant Recovery, Recycling, and Handling
1. Verify correct operation and maintenance of refrigerant handling equipment.
2. Identify and recover A/C system refrigerant.
3. Recycle refrigerant.
4. Label and store refrigerant.
5. Test recycled refrigerant for non-condensable gases.

6. Evacuate and charge A/C system.

COURSE TOPICS AND CONTENT REQUIREMENTS:

I. Cooling System
   A. Basic Theory
      1. Purpose of System
         a. Operating temperature (too cool)
         b. Operating temperature (too hot)
      2. Coolant
         a. 50-50 mix (Ethylene glycol and water)
         b. Maintenance
         c. Additives
      3. Component parts
         a. Radiator
            1) Construction
            2) Purpose
            3) Downflow
            4) Crossflow
            5) Transmission cooler
            6) Service (flushing)
         b. Water pump
            1) Construction
            2) New and rebuild
            3) Replacement
            4) Drive belts
         c. Water jackets
            1) Design
            2) Air cooled
         d. Pressure caps
            1) Purpose
            2) Testing
            3) Coolant recovery
         e. Hoses
            1) Inspection
            2) Replacement
         f. Thermostat
            1) Purpose
            2) Types
            3) Testing
         g. Fans
            1) Thermostatic
            2) Fluid
            3) Variable pitch
            4) Shrouds
            5) Electrical

II Heating System
   A. Basic Theory

1. Heater Core
    a. Construction
    b. Location
    c. Service
    d. Air flow circuits
2. Vacuum Controls
    a. Temperature doors
    b. Switches
    c. Diagrams
    d. Heater control valve
3. Electrical circuits
    a. Blower motors
    b. Cable controls (temperature)
    c. Auto temperature control
4. Thermostats
    a. Operation
    b. Three types
    c. Replacement

III. The A/C System
  A. Basic Theory
    1. Atmospheric Pressure
    2. Vacuum
    3. Heat
        a. Transfer
        b. Pressure-temperature relationship
        c. BTU
        d. Latent-hear
    4. Humidity
    5. Refrigerant
        a. R-12
        b. HFC-134a
        c. EPA Approved Blend refrigerants
        d. Montreal protocol
        e. CO2 as a Refrigerant
        f. Ozone layer
        g. Ozone depletion
  B. Component Parts
    1. Compressor
        a. Purpose
        b. Types
            1) Piston
            2) Rotary Vane
            3) Scroll
            4) Variable displacement
        c. Service (seals, bearings and clutches)
        d. Replacement
        e. Controls
            1) Ambient temperature switch

2) Pressure cycling switch
3) Thermostatic cycling switch
4) Low pressure cut-off
5) High pressure cut-off
6) ECM/PCM

2. Evaporator
   a. Purpose and construction
   b. Types
   c. Replacement
3. Controls
   1) Expansion valve
   2) Orifice Tube
   3) Variable Orifice Tube
   4) Suction Control Valve
   d. Replacement
4. Condensor
   1) Purpose
   2) Construction
   3) Receiver drier
   4) Replacement
5. Servicing the system
   1) Safety precautions
   2) Use of gauge set
   3) Use of recovery/recycling/recharging machine
   4) Proper recovery of refrigerant
   5) Evacuation
   6) Charging
   7) Leak testing
   8) Performance testing
      a) Diagnosis
      b) Repair
6. Common malfunctions and diagnosis
   1) Low Referigerant Level
   2) System overcharged
   3) Air in system
   4) Moisture in system (freezing up)
   5) Condensor blockage
   6) Faulty compressor
   7) Expansion valve stuck
      a) Open
      b) Closed
   8) Internal restrictions in the system
   9) Defective cycling switch
   10) Clogged receiver drier
7. Retro-fitting R-12 systems to R134a
   1) EPA requirements
   2) Proper procedure
   3) Lubricants
   4) Replacement of o-rings

5) Replacement of dessicant
6) Testing

C. Certification
1. Clean Air Act, Section 609
2. Society of Engineering Standards
   a. J1989
   b. J1990
   c. J1991
3. Refrigerant Recovery and Recycling Certification exam

INSTRUCTIONAL METHODS:
Lecture
Demonstrations
Mobile Air Cnditioning Society Videotapes
Power Point Presentations
ATO 2250 - Workbook

INSTRUCTIONAL MATERIALS:
Text
Workbook
Handouts
Videos

STUDENT REQUIREMENTS AND METHODS OF EVALUATION:
Complete Lab Objectives (NATEF Tasks)
Satisfactory Performance on written Exams
Safety Practices
Work Habits
Attendance
Attitude
Class Participation

OTHER REFERENCES

Course Competency/Assessment Methods Matrix

ATO 2250: Heating and Air Conditioning	**Assessment Options**																																
For each competency/outcome place an "X" below the method of assessment to be used.	**Assessment of Student Learning**	Article Review	Case Studies	Group Projects	Lab Work	Oral Presentations	Pre-Post Tests	Quizzes	Written Exams	Artifact Self Reflection of Growth	Capstone Projects	Comprehensive Written Exit Exam	Course Embedded Questions	Multi-Media Projects	Observation	Writing Samples	Portfolio Evaluation	Real World Projects	Reflective Journals	Applied Application (skills) Test	Oral Exit Interviews	Accreditation Reviews/Reports	Advisory Council Feedback	Employer Surveys	Graduate Surveys	Internship/Practicum /Site Supervisor Evaluation	Licensing Exam	In Class Feedback	Simulation	Interview	Written Report	Assignment
Assessment Measures – Are direct or indirect as indicated. List competencies/outcomes below.	**Direct/ Indirect**	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	I	I	I	I	D	D							
HEATING AND AIR CONDITIONING: Diagnose unusual operating noises in the A/C system; determine needed repairs.					X																												
HEATING AND AIR CONDITIONING: Conduct a performance test of the A/C system; determine needed repairs.					X																												
HEATING AND AIR CONDITIONING: Leak test A/C system; determine needed repairs.					X																												
HEATING AND AIR CONDITIONING: Inspect the condition of discharged oil.					X																												

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HEATING AND AIR CONDITIONING: Select oil type; measure and add oil to the A/C system as needed.					X																											
HEATING AND AIR CONDITIONING: Diagnose A/C system problems that cause the protection devices (pressure, thermal, and PCCM) to interrupt system operation; determine needed repairs.					X																											
HEATING AND AIR CONDITIONING: Inspect A/C compressor drive belts; replace and adjust as needed.					X																											
HEATING AND AIR CONDITIONING: Inspect, test, and replace A/C compressor clutch components or assembly.					X																											

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HEATING AND AIR CONDITIONING: Remove and replace A/C compressor and mountings.					X																											
HEATING AND AIR CONDITIONING: Inspect and replace A/C compressor shaft seal assembly (ies).					X																											
HEATING AND AIR CONDITIONING: Diagnose A/C system problems caused by too much moisture in the refrigerant; determine needed repairs.					X																											
HEATING AND AIR CONDITIONING: Install A/C system filter.					X																											

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HEATING AND AIR CONDITIONING: Remove and inspect A/C system mufflers, hoses, lines, fittings, o-rings, seals, and service valves; replace as needed.					X																											
HEATING AND AIR CONDITIONING: Inspect A/C condenser for airflow restrictions; service as required.					X																											
HEATING AND AIR CONDITIONING: Inspect receiver/drier or accumulator/drier; replace as needed.					X																											
HEATING AND AIR CONDITIONING: Inspect and test expansion valve or orifice (expansion) tube; replace as needed.					X																											

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HEATING AND AIR CONDITIONING: Inspect evaporator housing water drain; repair as needed.					X																										
HEATING AND AIR CONDITIONING: Perform cooling system, cap, and recovery system tests (pressure, combustion leakage, and temperature); determine needed repairs.					X																										
HEATING AND AIR CONDITIONING: Inspect engine cooling and heater system hoses and belts; replace as needed.					X																										
HEATING AND AIR CONDITIONING: Inspect, test, and replace thermostat and housing.					X																										

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HEATING AND AIR CONDITIONING: Determine coolant condition; drain and recover.					X																										
HEATING AND AIR CONDITIONING: Flush system and refill with recommended coolant; bleed system.					X																										
HEATING AND AIR CONDITIONING: Clean, inspect, and test fan, fan clutch (electrical and mechanical), fan shroud, and air dams; replace as needed.					X																										
HEATING AND AIR CONDITIONING: Inspect and test heater control valve(s); replace as needed.					X																										

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HEATING AND AIR CONDITIONING: Diagnose failures in the electrical controls of heating and A.C systems; determine needed repairs					X																											
HEATING AND AIR CONDITIONING: Inspect and test A/C-heater blower, motors, resistors, switches, relays, wiring, and protection devices; repair or replace as needed.					X																											
HEATING AND AIR CONDITIONING: Test A/C compressor load cut-off systems; determine needed repairs.					X																											
HEATING AND AIR CONDITIONING: Diagnose failures in the vacuum and mechanical controls of the heating and A/C system; determine needed repairs.					X																											

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HEATING AND AIR CONDITIONING: Inspect and test A/C-heater control panel assembly; replace as needed.					X																											
HEATING AND AIR CONDITIONING: Inspect and test A/C-heater control cables and linkages; adjust or replace as needed.					X																											
HEATING AND AIR CONDITIONING: Inspect and test A/C-heater vacuum control switches, hoses, diaphragms (motors), vacuum reservoir, check valve, and restrictors; replace as needed.					X																											
HEATING AND AIR CONDITIONING: Inspect and test A/C-heater ducts, doors, hoses, and outlets; replace as needed.					X																											

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HEATING AND AIR CONDITIONING: Check operation of automatic and semi-automatic heating, ventilation, and air conditioning (HVAC) control systems; determine needed repairs.					X																												
HEATING AND AIR CONDITIONING: Verify correct operation and maintenance of refrigerant handling equipment.					X																												
HEATING AND AIR CONDITIONING: Identify and recover A/C system refrigerant.					X																												
HEATING AND AIR CONDITIONING: Recycle refrigerant.					X																												
HEATING AND AIR CONDITIONING: Label and store refrigerant.					X																												

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HEATING AND AIR CONDITIONING: Test recycled refrigerant for non-condensable gases.					X																										
HEATING AND AIR CONDITIONING: Evacuate and charge A/C system.					X																										