



**Alabama  
Department of  
Postsecondary Education**

**Representing the Alabama Community College System**

**STATEWIDE CAREER/TECHNICAL EDUCATION COURSE ARTICULATION REVIEW MINUTES**

Articulation Agreement Identifier: ACR 112 (2006-1) Identifier is the postsecondary course prefix followed by Plan-of-Instruction version number (e.g.; INT 100 (2007-1)).

Applicable CIP code(s): 15.0501, 47.0201

Postsecondary course prefix, number, and title: ACR112/ASC112 – HVACR Service Procedures

Secondary Education course(s) title and number: 431806/430126 - Refrigerants – Introduction to Heating, Ventilation + 431801/430121 - Air-Conditioning, and Refrigeration + 431805/430125 - HVACR Electrical Components and Controls + 431804/430124 - Introduction to Electricity to HVACR Systems

Initial Review: Oct 1, 2009 Annual DPE Review: January 25, 2012

Effective dates: Fall Semester 2011.

Course Content Analysis (all postsecondary course objectives must be sufficiently addressed in the secondary courses):

**Notes:**

- 1 Skills and knowledge contained in the postsecondary course objectives must be present in the corresponding secondary objectives for a “match” to occur.**
- 2. Postsecondary and Secondary objectives must reflect similar content and performance levels before the course articulation agreement will be recommended to the TEDAC Oversight Committee.**
- 3. More than one Secondary course may be used in order to articulate to a Postsecondary course.**

Postsecondary Course Objectives	Secondary Course(s) and Objectives	TEDAC Comments
<p><b>MODULE A – INTRODUCTION TO SERVICE PROCEDURES</b></p> <p><b>Competency:</b> A1.0 Value the importance of following safety precautions.</p> <p><b>Performance Objective – None</b></p> <p><b>Learning Objectives:</b> A1.1.1 State the importance of following safety precautions.</p> <p><b>Competency:</b> A2.0 Perform tasks in a safe manner.</p> <p><b>Performance Objective:</b> A2.1 Given a variety of lab situations, perform assigned tasks in a safe manner</p> <p><b>Learning Objectives:</b> A2.1.1 Explain the use of personal protective equipment. A2.1.2 Explain hazards associated with HVAC/R systems. A2.1.3 Explain lockout/tag out procedures. A2.1.4 Explain hazards associated with specific types of equipment and tools.</p> <p><b>Competency:</b> A3.0 Use tools properly.</p> <p><b>Performance Objective:</b> A3.1 Given a variety of lab situations, use the proper tools to perform HVAC/R service procedures.</p> <p><b>Learning Objectives:</b> A3.1.1 Describe the characteristics and functions of common refrigerant service tools.</p> <p><b>Competency:</b> A4.0 Identify comm. HVAC/R mechanical components.</p> <p><b>Performance Objective – None</b></p> <p><b>Learning Objective:</b> A4.1.1 Describe the characteristics of system components. A4.1.2 Differentiate between the types and applications of various types of refrigerants. A4.1.3 Differentiate between the types and applications of various types of refrigerant oils. A4.1.4 Explain the purpose of Material Safety Data Sheets (MSDS)</p>	<p><b>Refrigerants</b></p> <p><b>Unit 1 – Safety</b></p> <p><b>Content Standard(s)</b></p> <ol style="list-style-type: none"> <li>1. Demonstrate safety rules, regulations, and procedures for handling refrigerants.</li> </ol> <p><b>Learning Objective(s)</b></p> <ol style="list-style-type: none"> <li>1. Explain the role that safety plays on the job-site.</li> <li>2. Explain the appropriate safety precautions to take around common job-site hazards.</li> <li>3. Demonstrate the use and care of appropriate personal protective equipment (PPE).</li> <li>4. Properly don and remove personal protective equipment (safety goggles, hearing protection, hard hat, and personal fall protection).</li> <li>5. Explain the importance of Hazard Communications (HazCom) and material safety data sheets (MSDSs).</li> <li>6. Describe fire prevention and firefighting techniques.</li> <li>7. Define safe work procedures to use around electrical hazards.</li> <li>8. Demonstrate correct selection and use of electrical and hand tools.</li> </ol>	

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<p><b>MODULE B – REFRIGERANT RECOVERY PROCEDURES</b></p> <p><b>Competency:</b> B1.0 Perform service on HVAC/R systems.</p> <p><b>Performance Objective:</b> B1.1 Given various HVACR systems, perform recovery, evacuation, and recharging procedures.</p> <p><b>Learning Objectives:</b> B1.1.1 State EPA rules and regulations related to refrigerant recovery. B1.1.2 Explain considerations for performing refrigerant recovery procedures.</p>	<p><b>Unit 2-7 – Chemical Properties</b></p> <p><b>Content Standard(s)</b></p> <ol style="list-style-type: none"> <li>2. Describe different classes of refrigerants.</li> <li>3. Explain physical and chemical properties of refrigerants.</li> <li>4. Identify azeotropic mixtures and blends.</li> <li>5. Identify the color and classification of refrigerants using the Pantone Matching System (PMS) color number.</li> <li>6. Describe saturation pressure and temperature, including single element refrigerant, azeotropic, zeotropic, and blends.</li> <li>7. Identify saturation pressure and temperatures for different types of refrigerants.</li> </ol> <p><b>Learning Objectives</b></p> <ol style="list-style-type: none"> <li>1. Identify different refrigerants by color-coded tanks.</li> <li>2. Identify different refrigerants by using gauges and temperature.</li> <li>3. Demonstrate proper use of the Pressure Temperature Chart.</li> <li>4. Identify different chemicals used in refrigerants.</li> <li>5. Explain why blended refrigerants have different evaporation pressures.</li> <li>6. Describe why blended refrigerants must be charged into a system as a liquid.</li> <li>7. Demonstrate proper disposal of used refrigerants.</li> <li>8. Demonstrate tools and equipment used for different types of refrigerants.</li> </ol>	
<p><b>MODULE C – TROUBLESHOOTING AND SERVICE TECHNIQUES</b></p> <p><b>Competency:</b> C1.0 Perform service on HVAC/R systems.</p> <p><b>Performance Objectives:</b> C1.1 Perform basic mechanical troubleshooting and service on HVAC/R systems.</p> <p><b>Learning Objectives:</b></p>	<p><b>Introduction to Heating, Ventilation, Air-Conditioning, and Refrigeration</b></p> <p><b>Unit 3 – Components</b></p> <p><b>Content Standard(s)</b></p> <ol style="list-style-type: none"> <li>3. Construct fittings, including flare connections and swage joints to specifications.</li> </ol> <p><b>Learning Objective(s)</b></p> <ol style="list-style-type: none"> <li>1. Explain the function of various components of HVAC/R</li> </ol>	

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<p>C1.1.1 Describe considerations for performing preventive maintenance on HVAC/R systems.</p> <p>C1.1.2 Describe considerations for performing basic mechanical troubleshooting procedures on various types of HVAC/R systems.</p>	<p>systems.</p> <ol style="list-style-type: none"> <li>2. Identify fittings used in HVAC/R systems.</li> <li>3. Explain the process removing, installing, and testing various HVAC/R components.</li> <li>4. Safely remove and install HVAC/R components and test for proper operation.</li> </ol> <p><b>Unit 4 – Tubing</b> Content Standard(s)</p> <ol style="list-style-type: none"> <li>4. Demonstrate the process of bending tubing for specific angles.</li> </ol> <p><b>Learning Objective(s)</b></p> <ol style="list-style-type: none"> <li>1. State the precautions that must be taken when installing refrigerant piping.</li> <li>2. Select the right tubing for a job.</li> <li>3. Cut and bend tubing.</li> <li>4. Safely join tubing by using flare and compression fittings.</li> <li>5. Determine the kinds of hangers and supports needed for refrigerant piping.</li> <li>6. State the basic requirements for pressure-testing a system once it has been installed.</li> </ol> <p><b>Unit 7 – Pipe</b> Content Standard(s)</p> <ol style="list-style-type: none"> <li>7. Demonstrate techniques for cutting and threading galvanized and black iron pipe to specification.</li> </ol> <p><b>Learning Objective(s)</b></p> <ol style="list-style-type: none"> <li>1. Identify the types of ferrous metal pipes.</li> <li>2. Measure the sizes of ferrous metal pipes.</li> <li>3. Identify the common malleable iron fittings.</li> <li>4. Cut, ream, and thread ferrous metal pipe.</li> <li>5. Join lengths of threaded pipe together and install fittings.</li> <li>6. Describe the main points to consider when installing pipe runs.</li> <li>7. Describe the method used to join grooved piping.</li> </ol> <p><b>Unit 8 – Blueprints and Terms</b></p>	

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	<p><b>Content Standard(s)</b>                      8. Interpret blueprints for HVACR, including symbols, components, and specifications.</p> <p><b>Learning Objective(s)</b></p> <ol style="list-style-type: none"> <li>1. Define terms associated with HVAC/R.</li> <li>2. Identify HVAC/R measurement instruments.</li> <li>3. Explain the use of various HVAC/R measurement instruments.</li> <li>4. Explain theory and principles of refrigeration.</li> <li>5. Explain heat flow and direction.</li> <li>6. Explain methods of heat transfer.</li> <li>7. Differentiate between reference points of temperature.</li> <li>8. Differentiate between latent and sensible heat.</li> <li>9. Explain heat and cool storage.</li> <li>10. Explain BTUs.</li> <li>11. Interpret refrigeration symbols and components found on blueprints and schematics.</li> <li>12. Interpret HVAC/R symbols and components found on blueprints.</li> </ol> <p><b>Unit 9 – HVAC-R Math</b></p> <p><b>Content Standard(s)</b>                      9. Demonstrate the use of basic technical mathematics skills.</p> <p><b>Learning Objective(s)</b></p> <ol style="list-style-type: none"> <li>1. Compute temperature-pressure problems.</li> <li>2. Calculate total heat in BTU's.</li> <li>3. Convert English and metric numbering systems.</li> </ol> <p><b>Introduction to Electricity for HVACR Systems</b></p> <p><b>Unit 2 – Hand and Power Tools</b></p> <p><b>Content Standard(s)</b>                      2. Demonstrate use of hand tools and power tools related to HVACR systems.</p> <p><b>Learning Objective(s)</b></p>	

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	<ol style="list-style-type: none"> <li>1. Obtain safe operation skills regarding tools and equipment.</li> <li>2. Identify hand and power tool functions and applications.</li> <li>3. Inspect and maintain tools and equipment for safe operation.</li> <li>4. Accomplish safe hands-on use of tools and equipment.</li> <li>5. Demonstrate the safe and appropriate use and maintenance of various portable power tools.</li> <li>6. Demonstrate the safe and appropriate use and maintenance of various stationary power tools.</li> <li>7. Demonstrate the safe and appropriate use and maintenance of various pneumatic power tools.</li> <li>8. Demonstrate the safe and appropriate use and maintenance of various powder actuated power tools.</li> </ol> <p><b>Unit 3-6 – Test Equipment</b></p> <p><b>Content Standard(s)</b></p> <ol style="list-style-type: none"> <li>3. Use various meters to measure electrical values.</li> <li>4. Demonstrate the use of Ohm’s law and Joule’s law.</li> <li>5. Demonstrate procedures for testing fuses and capacitors.</li> <li>6. Demonstrate procedures for building series, parallel, and series-parallel circuits.</li> </ol> <p><b>Learning Objective(s)</b></p> <ol style="list-style-type: none"> <li>1. Obtain safe operation skills regarding the use of electrical meters and measuring devices.</li> <li>2. Demonstrate the ability to calculate resistance, amperage, voltage using Ohm’s Law and derivatives of Ohm’s Law such as the Power Circle</li> <li>3. Demonstrate the ability to measure resistance, amperage, voltage with analog and digital multi-meters.</li> <li>4. Demonstrate the ability to test electrical components</li> <li>5. Build and test electrical circuits.</li> </ol> <p><b>Unit 7-9 – Components</b></p> <p><b>Content Standard(s)</b></p> <ol style="list-style-type: none"> <li>7. Determine the functional condition of motor windings in a single-phase compressor.</li> </ol>	

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	<p>8. Demonstrate testing procedures for electrical components, including fan relays, contactor relays, capacitors, and motor windings.</p> <p>9. Determine procedures for measuring heat anticipator amperes.</p> <p><b>Learning Objective(s)</b></p> <ol style="list-style-type: none"> <li>1. Explain the function of motor windings</li> <li>2. Discuss motor winding condition</li> <li>3. Test motor windings</li> <li>4. Identify relays, contactors, capacitors</li> <li>5. Discuss the function of relays, contactors, capacitors</li> <li>6. Test relays, contactors, capacitors</li> <li>7. Discuss procedures measuring heat anticipator amperes</li> <li>8. Measure heat anticipator amperes.</li> </ol> <p><b>Unit 10-13 – Installations</b></p> <p><b>Content Standard(s)</b></p> <ol style="list-style-type: none"> <li>10. Demonstrate procedures for installing heating and cooling thermostats.</li> <li>11. Explain conductors, insulators, and related symbols used in HVACR.</li> <li>12. Demonstrate procedures for making proper electrical connections.</li> <li>13. Explain various types of wiring diagrams, including pictorial, line, and schematic used in HVACR.</li> </ol> <p><b>Learning Objective(s)</b></p> <ol style="list-style-type: none"> <li>1. Explain the function of heating and cooling thermostats.</li> <li>2. Explain procedures for installing heating and cooling thermostats.</li> <li>3. Install heating and cooling thermostats.</li> </ol> <ol style="list-style-type: none"> <li>4. Explain the function of conductors and insulators</li> <li>5. Identify and define electrical related symbols used in HVACR.</li> <li>6. Discuss the importance of making proper electrical</li> </ol>	

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	<p>connections.</p> <ol style="list-style-type: none"> <li>7. Demonstrate the ability to make proper electrical connections.</li> <li>8. Explain various types of wiring diagrams, including pictorial, line, and schematic used in HVACR.</li> </ol> <p><b>HVACR Electrical Components and Controls</b>  <b>Content Standard(s)</b>  <b>Unit 2 – Motors</b></p> <ol style="list-style-type: none"> <li>2. Demonstrate techniques involved with assembly and disassembly of a single-phase motor.</li> </ol> <p><b>Learning Objective(s)</b></p> <ol style="list-style-type: none"> <li>1. Identify different types of electric motors.</li> <li>2. Identify different parts of electric motor.</li> <li>3. Explain single phase motor types and their construction.</li> <li>4. Explain three phase motor types and their construction.</li> </ol> <p><b>Unit 3 – Motor Windings</b>  <b>Content Standard(s)</b></p> <ol style="list-style-type: none"> <li>3. Determine resistance of windings in a split-phase motor to identify start-run windings.</li> </ol> <p><b>Learning Objective(s)</b></p> <ol style="list-style-type: none"> <li>1. Multi-meter use</li> <li>2. Ohm meter use</li> <li>3. Taking a variety of different ohm meter readings</li> <li>4. Terminal identification</li> </ol> <p><b>Unit 4 –Motor Terminals</b>  <b>Content Standard(s)</b></p> <ol style="list-style-type: none"> <li>4. Determine common start and run terminals of a single-phase compressor motor.</li> </ol> <p><b>Learning Objective(s)</b></p> <ol style="list-style-type: none"> <li>1. Determine condition of windings.</li> <li>2. Identify terminals.</li> <li>3. Motor construction</li> </ol>	



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	<p><b>Unit 5 – Preventive Maintenance</b>  <b>Content Standard(s)</b>                      5. Demonstrate preventive maintenance procedures for a window air conditioner.</p> <p><b>Learning Objective(s)</b>                      1. Explain the importance of routine maintenance.                      2. Explain routine maintenance procedures.                      3. Wash coils and oil motors.                      4. Discuss safety precautions to be employed while conducting maintenance tasks.                      5. Identify chemicals used for cleaning coils.                      6. Demonstrate preventive maintenance procedures for a window air conditioner.</p> <p><b>Unit 6-9 – Troubleshooting and Repair</b>  <b>Content Standard(s)</b>                      6. Demonstrate the procedure for replacing a double-shaft fan motor.                      7. Demonstrate troubleshooting techniques to solve electrical problems encountered in HVACR electrical systems.                      8. Demonstrate procedures used for replacing electrical components in an HVACR system.                      9. Interpret schematic wiring diagrams for HVACR systems and system components.</p> <p><b>Learning Objective(s)</b>                      1. Select replacement motor.                      2. Discuss motor characteristics.                      3. Interpret wiring diagrams.                      4. Wire replacement motor.                      5. Practice electrical troubleshooting                      6. Use schematic drawings to help solve electrical problems                      7. Replace electrical components</p>	