HEAT PUMPS
Course Syllabus

Course Number: ARCO-1146
OHLAP Credit: No
OCAS Code: None
Course Length: 30 Hours
Career Cluster: Architecture & Construction
Career Pathway: Maintenance/Operations
Career Major(s): HVAC Technician

Pre-requisite(s): Air Conditioning Systems, Refrigerants and Lubricants, Refrigerant Recovery, HVAC/R Solid State Electronics, HVAC/R Controls, and Electricity for HVAC/R

Course Description: This course covers the essential knowledge necessary to install, service, troubleshoot, and repair heat pumps. Emphasis will be placed on air-to-air systems, but ground source systems will be introduced and briefly examined. Topics will include a review of the refrigeration cycle, reversing valves, the defrost cycle, defrost timers including electromechanical as well as solid state devices, balance point, and backup heat systems.

Refrigeration & Air Conditioning Technology, 7th Ed, (2013), Whitman /Johnson/ Tomczyk Silberstein / Publisher Delmar Cengage


Course Objectives: A. Understand the Basic Principles and Components of Heating Pumps.

1. Review the history of heat pumps.¹
2. Explain the basic theory of the air source heat pump system.¹
3. Explain the basic theory of the water source heat pump system.¹
4. Explain the basic theory of geothermal source heat pump system.¹
5. Identify and explain the function of the electrical and mechanical components of the heat pump systems.¹
6. Explain terms typically used for heat pumps:¹
   a. Seasonal Energy Efficiency Ratio (SEER)¹
   b. Coefficient of Performance (COP)¹
   c. Heating Seasonal Performance Factor (HSPF)¹
   d. Balance Points¹
   e. Outdoor Design Temperature (ODT)¹
   f. Optimizer¹
7. Analyze and explain the refrigerant cycle in both cooling and heating -- identifying the pressure and state of the refrigerant at any point in the refrigerant circuit.¹
8. Explain the different types of defrost methods.¹
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9. Describe the operation of the time clock in a defrost control.  
10. Identify which three components of a heat pump system are controlled directly during a defrost cycle.  
11. Describe a heat pump thermostat function.  
12. Check reversing valve for proper temperatures.  
13. Calculate both economic and thermal balance points.  
15. Check refrigerant charge using charging chart.  
16. Check sequence of operation of an air-to-air split system heat pump for cooling, heating, and defrost modes.

B. Discuss the Applications of Heating Pumps.
1. Identify and describe different types of heat pump systems:  
   a. Air-cooled  
   b. Water-source  
      1. Open loop  
      2. Closed loop  
      3. Air-to-water  
      4. Water-to-water  
      5. Geothermal  
2. Analyze and compare the operation and performance of the different types of Heat Pump Systems:  
   a. Explain the integration and operation of the air-to-air heat pump with electric resistance heat.  
   b. Explain the integration and operation of the water-to-air heat pump with electric resistance heat.  
   c. Explain the integration and operation of the air-to-air heat pump with a fossil fuel unit.  
   d. Explain applications for open vs. closed loop geothermal heat pump systems.  
3. Mechanically and electrically connect and check out:  
   a. Air-to-air heat pump  
   b. Water-to-water heat pump

C. Demonstrate and Apply Knowledge of Heat Pumps.
1. Describe the principles of reverse-cycle heating.  
2. Identify heat pumps by type and general classification.  
3. List the components of heat pump systems.  
4. Demonstrate heat pump installation and service procedures.  
5. Identify and install refrigerant circuit accessories commonly associated with heat pumps.  
6. Analyze a heat pump control circuit.

1. List the components of a heat pump.  
2. Explain how a reversing valve works.  
3. Compare electric heat to a heat pump.  
4. State the various heat sources for heat pumps.  
5. State how heat pump efficiency is rated.  
6. Discuss the terminology of heat pump components.  
8. Explain auxiliary heat.  
9. Differentiate between auxiliary and emergency heat.  
10. Describe the control sequence of a heat pump.
11. Interpret various wiring diagrams of heat pumps.
12. Trace out wiring of a heat pump and draw a pictorial and ladder type diagram.

E. **Check and Adjust Refrigerant Charges.**
1. Check charge in unit with a fixed metering device (superheat method).
2. Check charge in unit with a TEV (subcooling method).
3. Check charge in unit using a charging chart during cooling and heating modes.

F. **Initiate and Evaluate Defrost Cycles.**
1. Explain the defrost cycle.
2. Describe various types of defrost controls.
3. Jump the defrost initiation control.
4. Determine that the reversing valve shifted.
5. Verify that auxiliary heat is on.
6. Verify that outdoor fan is off.
7. Time the defrost cycle until it is automatically terminated.
8. Verify that all ice has been removed for outdoor coil.

G. **Plot Balance Points on Chart and Determine Supplemental Heat Needs.**
1. Define balance point.
2. Determine the C.O.P. of a heat pump at a given design temperature using a heat pump performance curve.
3. Plot balance points for a heat pump at given design conditions.
4. Calculate amount of auxiliary heat needed at each balance point.
5. Calculate total amount of auxiliary heat needed to assist heat pump during extremely cold outdoor temperatures.
6. List the advantages of controlled auxiliary heat stages.
7. Adjust outdoor thermostats to stage auxiliary heat at balance points calculated.

H. **Troubleshoot and Repair a Heat Pump.**
1. Evaluate heat pump performance in heat and cool modes.
2. Check operation of emergency heat.
3. Check operation of reversing valve during heat and cool modes.
4. Replace a reversing valve.
5. Troubleshoot electrical problems in heat and cool modes.
6. Replace a thermostat.
7. Wire low voltage controls.
8. Troubleshoot a problem in the defrost mode.
9. Replace a defrost timer.
10. Replace electronic defrost control.
11. Check heating anticipator in thermostat and adjust if needed.
12. Troubleshoot various types of mechanical problems.

1 ODCTE objective
2 NCCER objective
All unmarked objectives are TTC instructor developed.

**Teaching Methods:** The class will primarily be taught by the lecture and demonstration method and supported by various media materials to address various learning styles. There will be question and answer sessions over material covered in lecture and media presentations. Supervised lab time is provided for students to complete required projects.
Grading Procedures: 1. Students are graded on theory and shop practice and performance.
2. Each course must be passed with seventy (70%) percent or better.
3. Grading scale: A=90-100%, B=80-89%, C=70-79%, D=60-69%, F=50-59%.

Description of Classroom, Laboratories, and Equipment: Tulsa Technology Center campuses are owned and operated by Tulsa Technology Center School District No. 18. All programs provide students the opportunity to work with professionally certified instructors in modern, well-equipped facilities.

Available Certifications/College Credit: The student may be eligible to take state, national or industry exam after completion of the program. College credit may be issued from Oklahoma State University-Okmulgee or Tulsa Community College. See program counselor for additional information.

College Credit Eligibility: The student must maintain a grade point average of 2.0 or better.