# HEATING SYSTEMS
## Course Syllabus

<table>
<thead>
<tr>
<th>Course Number:</th>
<th>ARCO-0922</th>
<th>OHLAP Credit:</th>
<th>No</th>
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<tbody>
<tr>
<td>OCAS Code:</td>
<td>None</td>
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<tr>
<td>Course Length:</td>
<td>120 Hours</td>
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<tr>
<td>Career Cluster:</td>
<td>Architecture &amp; Construction</td>
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<td>Career Pathway:</td>
<td>Maintenance/Operations</td>
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<tr>
<td>Career Major(s):</td>
<td>HVAC Technician</td>
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<td>Pre-requisite(s):</td>
<td>HVAC/R Solid State Electronics</td>
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## Course Description:
This course covers the essential knowledge and skills of installing, maintaining, servicing, troubleshooting, and repair of various heating systems, including forced air, convection, hydronic, and radiant. Gas LP, Natural gas, and electrical systems will be examined. Emphasis will be placed on gas and electric forced air systems, but heat pumps (air to air and ground source) will be introduced. Hands-on labs will be an extensive part of the course.

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

## Course Objectives:

### A. Complete an Introduction to Heating.
1. Explain the three methods by which heat is transferred and give an example of each.²
2. Describe how combustion occurs and identify the by-products of combustion.²
3. Identify the various types of fuels used in heating.²
4. Identify the major components and accessories of a forced-air furnace and explain the function of each component.²
5. State the factors that must be considered when installing a furnace.²
6. Identify the major components of a gas furnace and describe how each works.²
7. With supervision, use a manometer to measure and adjust manifold pressure on a gas furnace.²
8. Identify the major components of an oil furnace and describe how each works.²
9. Describe how an electric furnace works.²
10. With supervision, perform basic furnace preventive maintenance procedures such as cleaning and filter replacement.²

### B. Draw Wiring Diagrams of Gas Furnaces.
1. Identify major components of a gas furnace and explain their purpose.
2. List fuels burned in gas furnaces and characteristics of each.
3. Discuss gas pressure measurement and how to use a manometer.
4. Explain gas combustion.
5. Discuss the function of an automatic combination gas valve.
6. Compare the standing pilot and automatic pilot ignition type systems.
7. List reasons for delay in starting and stopping the indoor fan.
8. State the purpose of a limit switch.
9. Describe flue-gas venting systems.
10. Size a gas piping system.
11. Sketch a basic wiring diagram for a gas furnace.
12. Draw a pictorial and ladder type diagram of a gas furnace.

C. Perform Maintenance on Gas Furnaces.
1. Remove pilot assembly and clean.
2. Remove gas burners and clean.
3. Check flame color and adjust combustion air at burners.
4. Check manifold gas pressure.
5. Lubricate fan motor.
6. Check air filter.
7. Check for cracks in heat exchanger.

D. Determine Efficiency of Gas Furnaces.
1. Compare the designs of a high-efficiency gas furnace and conventional furnace.
2. List three flame-proving devices and describe the operation of each.
3. Compare ignition systems.
4. Discuss flame rectification when used with electric spark-to-pilot ignition systems.
5. Describe procedures for taking flue-gas carbon dioxide and temperature readings.
6. Analyze flue gasses and evaluate furnace efficiency.

E. Troubleshoot and Repair Gas Furnaces.
1. Perform basic tests in troubleshooting electrical and mechanical problems.
2. Check and adjust manifold gas pressure.
3. Replace pilot assembly.
4. Check thermocouple voltage output and replace if needed.
5. Replace gas valve.
6. Adjust and/or replace fan-limit switch.
7. Troubleshoot igniter module on auto-ignition type furnace.
8. Adjust gap at igniter electrode.
9. Troubleshoot flame sensor.
10. Check furnace air flow using temperature rise method.

F. Understand Electric Heating.
1. Describe and explain the basic operation of a fan coil equipped with electric heating elements.
2. Identify and describe the functions of major components of a fan coil equipped with electric heating elements.
3. Identify and describe the functions of electric heating controls.
4. Measure resistances and check components and controls for operation and safety.
5. Determine the cubic feet per minute (cfm) using the temperature rise method.
6. Describe and explain the basic operation of other electric heating systems.
G. Operate and Record Data from Electric Furnaces.
1. Discuss efficiency and operating costs of an electric furnace.
2. List types of electric heat and their uses.
3. Describe how sequencers operate in electric forced-air furnaces.
4. Trace the circuitry in a diagram of an electric furnace.
5. Record electrical power usage of unit and convert to BTU’s of heat.
6. Draw wiring diagrams of electrical furnace.

H. Troubleshoot and Repair Electric Furnaces.
1. Perform basic tests in troubleshooting electrical problems.
2. Replace a heat sequencer.
3. Replace a heating element.
4. Replace safety controls in heating element circuit.

I. Install and Service Humidifiers.
1. Explain relative humidity.
2. List reasons for providing humidification in winter.
3. Compare evaporative and atomizing humidifiers.
4. Describe other types of humidifiers.
5. List factors to consider when sizing humidifiers.
6. Install a humidifier in a heating unit.
7. Troubleshoot and repair a humidifier.

J. Work with Chimneys, Vents, and Flues.
1. Describe the principles of combustion and explain complete and incomplete combustion.
2. Describe the content of flue gas and explain how it is vented.
3. Identify the components of a furnace vent system.
4. Describe how to select and install a vent system.
5. Perform the adjustments necessary to achieve proper combustion in a gas furnace.
6. Describe the techniques for venting different types of furnaces.
7. Explain the various draft control devices used with natural-draft furnaces.

K. Understand Forced Warm Air Systems.
1. Check the operation of the ignition system.
2. Derate or change over a gas burner.
3. Adjust burner flame for proper fuel/air ratio.
4. Check for proper temperature rise through the furnace.
5. Test all safety controls.
6. Remove, install and adjust blower motor and/or belt.
7. Clean pilot assembly.
8. Oil motor(s) and bearings.
9. Check and adjust heat anticipator of thermostat.
10. Use orifice sizing charts.
11. Test induced draft pressure switches.
12. Check all safety controls.
13. Check operation of sequence.

L. Work with Hydronic Systems.
1. Identify types of hydronic piping systems.
2. Identify types of boilers.
3. Check circulator for alignment and lubrication.
4. Set aquastat.
5. Check water pressure regulating valve (PRV).
6. Check the zone valve operation.
7. Remove air from system.
8. Check backflow preventer.
9. Check compression/expansion tank.
10. Check water temperature rise across the boiler.
11. Check and adjust water level in pressure tanks.
12. Check automatic air vent operation.
13. Wire multizone/multipump hydronic systems.

M. Test and Balance Equipment.
1. Perform pressure checks on air distribution system.
2. Perform pressure checks on fuel system.
3. Perform efficiency test and adjust to recommended rate:
   a. check draft
   b. check smoke (if applicable)
   c. check stack temp
   d. check CO2
   e. check O2
   f. check CO
4. Perform balance method for an air distribution system.
5. Perform balance method for a hydronic system.

N. Understand Humidification.
1. Explain importance of humidification.
2. Describe different types of humidifiers.
3. Explain factors affecting humidity in business and residence.
4. Select proper humidification equipment.
5. Check operation of humidification equipment.
6. Perform maintenance on humidification equipment.
7. Determine relative humidity using a psychrometer.
8. Determine dew point using a psychrometer.

O. Understand Unitary Combination Heating and Cooling Equipment.
1. Describe the sequence of operation of a heating system.
2. Use and read various tools and instruments needed for checking and testing combination air-conditioning and heating systems.

P. Become Familiar with Oil Furnaces.
1. Explain and check the sequence of operation of oil stack switches.
2. Explain and check the sequence of operation of Electronic Primary Controls.
3. Understand how to replace oil filters.
4. Understand how to purge water from oil storage tanks.
5. Understand how to oil motors.
6. Replace oil nozzle and adjust electrodes.
7. Perform combustion test and adjust to optimum efficiency.
8. Perform safety shutdown check.
9. Replace oil nozzles with proper size replacements.
10. Inspect and adjust electrodes replacing when necessary.
11. Test and adjust oil pumps and couplers.

Q. Become Familiar Electric Furnaces.
1. Understand the use of sequencers in electric furnaces.
2. Understand the effects of air flow on temperature rise.
HEATING SYSTEMS

3. Inspect heating elements and insulators.¹
4. Test thermal fuses.¹
5. Inspect all electrical connections.¹
6. Check for proper temperature.¹
7. Oil motors.¹
8. Test sequence of operation of electric furnaces.¹

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.