



## Level One

### MODULE 03101-07 – INTRODUCTION TO HVAC

1. Explain the basic principles of heating, ventilating, and air conditioning.
2. Identify career opportunities available to people in the HVAC trade.
3. Explain the purpose and objectives of an apprentice training program.
4. Describe how certified apprentice training can start in high school.
5. Describe what the *Clean Air Act* means to the HVAC trade.
6. Describe the types of regulatory codes encountered in the HVAC trade.
7. Identify the types of schedules/drawings used in the HVAC trade.

### MODULE 03102-07 – TRADE MATHEMATICS

1. Identify similar units of measurement in both the inch-pound (English) and metric systems and state which units are larger.
2. Convert measured values in the inch-pound system to equivalent metric values and vice versa.
3. Express numbers as powers of ten.
4. Determine the powers and roots of numbers.
5. Solve basic algebraic equations.
6. Identify various geometric figures.
7. Use the Pythagorean theorem to make calculations involving right triangles.
8. Convert decimal feet to feet and inches and vice versa.
9. Calculate perimeter, area, and volume.
10. Convert temperature values between Celsius and Fahrenheit.

### MODULE 03103-07 – COPPER AND PLASTIC PIPING PRACTICES

1. State the precautions that must be taken when installing refrigerant piping.
2. Select the right tubing for a job.
3. Cut and bend copper tubing.
4. Safely join tubing by using flare and compression fittings.
5. Determine the kinds of hangers and supports needed for refrigerant piping.
6. State the basic safety requirements for pressure-testing a system once it has been installed.
7. Identify types of plastic pipe and state their uses.
8. Cut and join lengths of plastic pipe.

## **MODULE 03104-07 – SOLDERING AND BRAZING**

1. Assemble and operate the tools used for soldering.
2. Prepare tubing and fittings for soldering.
3. Identify the purposes and uses of solder and solder fluxes.
4. Solder copper tubing and fittings.
5. Assemble and operate the tools used for brazing.
6. Prepare tubing and fittings for brazing.
7. Identify the purposes and uses of filler metals and fluxes used for brazing.
8. Braze copper tubing and fittings.
9. Identify the inert gases that can be used safely to purge tubing when brazing.

## **MODULE 03105-07 – FERROUS METAL PIPING PRACTICES**

1. Identify the types of ferrous metal pipes.
2. Measure the sizes of ferrous metal pipes.
3. Identify the common malleable iron fittings.
4. Cut, ream, and thread ferrous metal pipe.
5. Join lengths of threaded pipe together and install fittings.
6. Describe the main points to consider when installing pipe runs.
7. Describe the methods used to join grooved piping.

## **MODULE 03106-07 – BASIC ELECTRICITY**

1. State how electrical power is distributed.
2. Describe how voltage, current, resistance, and power are related.
3. Use Ohm's law to calculate the current, voltage, and resistance in a circuit.
4. Use the power formula to calculate how much power is consumed by a circuit.
5. Describe the difference between series and parallel circuits and calculate loads in each.
6. Describe the purpose and operation of the various electrical components used in HVAC equipment.
7. State and demonstrate the safety precautions that must be followed when working on electrical equipment.
8. Make voltage, current, and resistance measurements using electrical test equipment.
9. Read and interpret common electrical symbols.

## **MODULE 03107-07 – INTRODUCTION TO COOLING**

1. Explain how heat transfer occurs in a cooling system, demonstrating an understanding of the terms and concepts used in the refrigeration cycle.
2. Calculate the temperature and pressure relationships at key points in the refrigeration cycle.
3. Under supervision, use temperature- and pressure-measuring instruments to make readings at key points in the refrigeration cycle.
4. Identify commonly used refrigerants and demonstrate the proper procedures for handling these refrigerants.
5. Identify the major components of a cooling system and explain how each type works.
6. Identify the major accessories available for cooling systems and explain how each works.
7. Identify the control devices used in cooling systems and explain how each works.
8. State the correct methods to be used when piping a refrigeration system.

## **MODULE 03108-07 – INTRODUCTION TO HEATING**

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

## **MODULE 03109-07 – AIR DISTRIBUTION SYSTEMS**

1. Describe the airflow and pressures in a basic forced-air distribution system.
2. Explain the differences between propeller and centrifugal fans and blowers.
3. Identify the various types of duct systems and explain why and where each type is used.
4. Demonstrate or explain the installation of metal, fiberboard, and flexible duct.
5. Demonstrate or explain the installation of fittings and transitions used in duct systems.
6. Demonstrate or explain the use and installation of diffusers, registers, and grilles used in duct systems.
7. Demonstrate or explain the use and installation of dampers used in duct systems.
8. Demonstrate or explain the use and installation of insulation and vapor barriers used in duct systems.
9. Identify instruments used to make measurements in air systems and explain the use of each instrument.
10. Make basic temperature, air pressure, and velocity measurements in an air distribution system.

# Level Two

## MODULE 03201-07 – COMMERCIAL AIRSIDE SYSTEMS

1. Identify the differences in types of commercial all-air systems.
2. Identify the type of building in which a particular type of system is used.
3. Explain the typical range of capacities for a commercial air system.

## MODULE 03202-07 – 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.
8. Calculate the size of a vent required for a given application.
9. Adjust a thermostat heat anticipator.

## MODULE 03203-07 – INTRODUCTION TO THE HYDRONIC SYSTEMS

1. Explain the terms and concepts used when working with hot-water heating.
2. Identify the major components of hot-water heating.
3. Explain the purpose of each component of hot-water heating.
4. Demonstrate the safety precautions used when working with hot-water systems.
5. Demonstrate how to operate selected hot-water systems.
6. Demonstrate how to safely perform selected operating procedures on low-pressure systems.
7. Identify the common piping configurations used with hot-water heating.
8. Read the pressure across a water system circulating pump.
9. Calculate heating water flow rates
10. Select a pump for a given application.

## MODULE 03204-07 – AIR QUALITY EQUIPMENT

1. Explain why it is important to control humidity in a building.
2. Recognize the various kinds of humidifiers used with HVAC systems and explain why each is used.
3. Demonstrate how to install and service the humidifiers used in HVAC systems.
4. Recognize the kinds of air filters used with HVAC systems and explain why each is used.
5. Demonstrate how to install and service the filters used in HVAC systems.
6. Use a manometer or differential pressure gauge to measure the friction loss of an air filter.
7. Identify accessories commonly used with air conditioning systems to improve indoor air quality and reduce energy cost, and explain the function of each, including:
  - Humidity control devices
  - Air filtration devices
  - Energy conservation devices
8. Demonstrate or describe how to clean an electronic air cleaner.

## **MODULE 03205-07 – LEAK DETECTION, EVACUATION, RECOVERY, AND CHARGING**

1. Identify the common types of leak detectors and explain how each is used.
2. Perform leak detection tests using selected methods.
3. Identify the service equipment used for evacuating a system and explain why each item of equipment is used.
4. Perform system evacuation and dehydration.
5. Identify the service equipment used for recovering refrigerant from a system and for recycling the recovered refrigerant, and explain why each item of equipment is used.
6. Perform a refrigerant recovery.
7. Evacuate a system to a deep vacuum.
8. Identify the service equipment used for charging refrigerant into a system, and explain why each item of equipment is used.
9. Use nitrogen to purge a system.
10. Charge refrigerant into a system by the following methods:
  - Weight
  - Superheat
  - Subcooling
  - Charging pressure chart

## **MODULE 03206-07 – ALTERNATING CURRENT**

1. Describe the operation of various types of transformers.
2. Explain how alternating current is developed and draw a sine wave.
3. Identify single-phase and three-phase wiring arrangements.
4. Explain how phase shift occurs in inductors and capacitors.
5. Describe the types of capacitors and their applications.
6. Explain the operation of single-phase and three-phase induction motors.
7. Identify the various types of single-phase motors and their applications.
8. State and demonstrate the safety precautions that must be followed when working with electrical equipment.
9. Test AC components, including capacitors, transformers, and motors.

## **MODULE 03207-07 – BASIC ELECTRONICS**

1. Explain the basic theory of electronics and semiconductors.
2. Explain how various semiconductor devices such as diodes, LEDs, and photo diodes work, and how they are used in power and control circuits.
3. Identify different types of resistors and explain how their resistance values can be determined.
4. Describe the operation and function of thermistors and cad cells.
5. Test semiconductor components.
6. Identify the connectors on a personal computer.

## **MODULE 03208-07 – INTRODUCTION TO CONTROL CIRCUIT TROUBLESHOOTING**

1. Explain the function of a thermostat in an HVAC system.
2. Describe different types of thermostats and explain how they are used.
3. Demonstrate the correct installation and adjustment of a thermostat.
4. Explain the basic principles applicable to all control systems.
5. Identify the various types of electromechanical, electronic, and pneumatic HVAC controls, and explain their function and operation.
6. Describe a systematic approach for electrical troubleshooting of HVAC equipment and components.
7. Recognize and use equipment manufacturer's troubleshooting aids to troubleshoot HVAC equipment.
8. Demonstrate how to isolate electrical problems to faulty power distribution, load, or control circuits.
9. Identify the service instruments needed to troubleshoot HVAC electrical equipment.
10. Make electrical troubleshooting checks and measurements on circuits and components common to all HVAC equipment.
11. Isolate and correct malfunctions in a cooling system control circuit.

## **MODULE 03209-07 – TROUBLESHOOTING GAS HEATING**

1. Describe the basic operating sequence for gas heating equipment.
2. Interpret control circuit diagrams for gas heating systems.
3. Describe the operation of various types of burner ignition methods.
4. Identify the tools and instruments used when troubleshooting gas heating systems.
5. Demonstrate using the tools and instruments required for troubleshooting gas heating systems.
6. Isolate and correct malfunctions in gas heating systems.

## **MODULE 03210-07 – TROUBLESHOOTING COOLING**

1. Describe a systematic approach for troubleshooting cooling systems and components.
2. Isolate problems to electrical and/or mechanical functions in cooling systems.
3. Recognize and use equipment manufacturer's troubleshooting aids to troubleshoot cooling systems.
4. Identify and use the service instruments needed to troubleshoot cooling systems.
5. Successfully troubleshoot selected problems in cooling equipment.
6. State the safety precautions associated with cooling troubleshooting.

## **MODULE 03211-07 – HEAT PUMPS**

1. Describe the principles of reverse-cycle heating.
2. Identify heat pumps by type and general classification.
3. Describe various types of geothermal water loops and their application.
4. List the components of heat pump systems.
5. Describe the role and basic operation of electric heat in common heat pump systems.
6. Describe common heat pump ratings, such as Coefficient of Performance (COP), Heating Season Performance Factor (HSPF), and Seasonal Energy Efficiency Ratio (SEER).
7. Demonstrate heat pump installation and service procedures.
8. Identify and install refrigerant circuit accessories commonly associated with heat pumps.
9. Analyze a heat pump control circuit.
10. Isolate and correct malfunctions in a heat pump.

## **MODULE 03212-07 – BASIC INSTALLATION AND MAINTENANCE PRACTICES**

1. Identify, explain, and install threaded and non-threaded fasteners.
2. Identify, explain, remove, and install types of gaskets, packings, and seals.
3. Identify types of lubricants, and explain their uses.
4. Use lubrication equipment to lubricate motor bearings.
5. Identify the types of belt drives, explain their uses, and demonstrate procedures used to install or adjust them.
6. Identify and explain types of couplings.
7. Demonstrate procedures used to remove, install, and align couplings.
8. Identify types of bearings, and explain their uses.
9. Explain causes of bearing failures.
10. Demonstrate procedures used to remove and install bearings.
11. Perform basic preventive maintenance inspection and cleaning procedures.
12. List ways to develop and maintain good customer relations.

## **MODULE 03213-07 – SHEET METAL DUCT SYSTEMS**

1. Identify and describe the basic types of sheet metal.
2. Define properties of steel and aluminum alloys.
3. Describe a basic layout method and perform proper cutting.
4. Join sheet metal duct sections using proper seams and connectors.
5. Describe proper hanging and support methods for sheet metal duct.
6. Describe thermal and acoustic insulation principles.
7. Select, apply, and seal the proper insulation for sheet metal ductwork.
8. Describe guidelines for installing components such as registers, diffusers, grilles, dampers, access doors, and zoning accessories.
9. Install takeoffs and attach flexible duct to a sheet metal duct.

## **MODULE 03214-07 – FIBERGLASS AND FLEXIBLE DUCT SYSTEMS**

1. Identify types of fiberglass duct, including flexible duct.
2. Describe fiberglass duct layout and some basic fabrication methods.
3. Describe the various closure methods for sealing fiberglass duct.
4. Fabricate selected duct modules and fittings using the appropriate tools.
5. Describe hanging and support methods for fiberglass duct.
6. Describe how to repair major and minor damage to fiberglass duct.
7. Install takeoffs and attach flexible duct to a fiberglass duct.

# Level Three

## MODULE 03301-08 – REFRIGERANTS AND OILS

1. Identify the refrigerants in common use and state the types of applications in which each is used.
2. Explain the effects of releasing refrigerants into the atmosphere.
3. Explain how refrigerants are classified by their chemical composition.
4. Describe the color-coding scheme used to identify refrigerant cylinders.
5. Describe how azeotropes and near-azeotropes differ from each other and from so-called pure refrigerants.
6. Interpret a P-T chart for an azeotrope refrigerant.
7. Calculate superheat and subcooling.
8. Demonstrate refrigerant leak detecting methods.
9. Identify the different types of oils used in refrigeration systems and explain their relationships to the various refrigerants.
10. Explain how to add and remove oil from a system.
11. Describe how to test oil for contamination.
12. Perform a refrigerant retrofit.

## MODULE 03302-08 – COMPRESSORS

1. Identify the different types of compressors.
2. Demonstrate or describe the mechanical operation for each type of compressor.
3. Demonstrate or explain compressor lubrication methods.
4. Demonstrate or explain methods used to control compressor capacity.
5. Demonstrate or describe how compressor protection devices operate.
6. Perform the common procedures used when field servicing open and semi-hermetic compressors, including:
  - Shaft seal removal and installation
  - Valve plate removal and installation
  - Unloader adjustment
7. Demonstrate the procedures used to identify system problems that cause compressor failures.
8. Demonstrate the system checkout procedure performed following a compressor failure.
9. Demonstrate or describe the procedures used to remove and install a compressor.
10. Demonstrate or describe the procedures used to clean up a system after a compressor burnout.

## MODULE 03303-08 – METERING DEVICES

1. Explain the function of metering devices.
2. Describe the operation of selected fixed-orifice and expansion valves.
3. Identify types of expansion valves.
4. Describe problems associated with replacement of expansion valves.
5. Describe the procedure for installing and adjusting selected expansion valves.

## MODULE 03304-08 – RETAIL REFRIGERATION SYSTEMS

1. Describe the mechanical refrigeration cycle as it applies to retail refrigeration systems.
2. Explain the differences in refrigerants and applications in low-, medium-, and high-temperature refrigeration systems.

3. Identify and describe the primary refrigeration cycle components used in retail refrigeration systems.
4. Identify and describe the supporting components and accessories used in retail refrigeration systems.
5. Describe the various methods of defrost used in retail refrigeration systems.
6. Identify and describe the applications for the various types of retail refrigeration systems.
7. Describe the control system components used in retail refrigeration systems.
8. Explain the operating sequence of a retail refrigeration system.
9. Interpret wiring diagrams and troubleshooting charts to isolate malfunctions in retail refrigeration systems.

### **MODULE 03305-08 – COMMERCIAL HYDRONIC SYSTEMS**

1. Explain the terms and concepts used when working with hot-water heating and chilled-water cooling systems.
2. Identify the major components of hot-water heating, chilled-water cooling, and dual-temperature water systems.
3. Explain the purpose of each component of hot-water heating, chilled-water cooling, and dual-temperature water systems.
4. Demonstrate the safety precautions used when working with hot-water/chilled-water systems.
5. Explain the differences between reciprocating, rotary, screw, scroll, and centrifugal chillers.
6. Identify the common piping configurations used with hot-water heating and chilled-water cooling systems.
7. Explain the principles involved, and describe the procedures used, in balancing hydronic systems.
8. Select, calibrate, and properly use the tools and instruments needed to balance hydronic systems.
9. Read the pressure across a water system circulating pump.

### **MODULE 03306-08 – STEAM SYSTEMS**

1. Explain the terms and concepts used when working with steam heating systems.
2. Identify the major components of steam heating systems.
3. Explain the purpose of each component of steam heating systems.
4. Describe the basic steam heating cycle.
5. Safely perform selected operating procedures on low-pressure steam boilers and systems.
6. Install and maintain selected steam traps.
7. Identify the common piping configurations used with steam heating systems.
8. Identify the types of common piping configurations used with steam-heating systems.
9. Safely perform selected operating procedures on low-pressure steam boilers and systems.
10. Install and maintain selected steam traps.
11. Identify the types of common piping configurations used with steam-heating systems.

### **MODULE 03307-08 – PLANNED MAINTENANCE**

1. Describe planned maintenance and service procedures required for selected HVAC equipment and components.
2. Develop a planned maintenance and service checklist for selected HVAC equipment and accessories.
3. Perform identified service and maintenance tasks on selected HVAC equipment, components, and accessories.
4. Identify the tools and materials necessary for performing service and maintenance tasks.
5. State the safety practices associated with the servicing of selected HVAC equipment, components, and accessories.

## **MODULE 03308-08 – WATER TREATMENT**

1. Explain the reasons why water treatment programs are needed.
2. List symptoms in heating/cooling systems that indicate a water problem exists.
3. Describe the types of problems and related remedies associated with water problems that can occur in the different types of water and steam systems.
4. Recognize and perform general maintenance on selected mechanical types of HVAC equipment that are used to control and/or enhance water quality.
5. Use commercial water test kits to test water quality in selected water/steam systems.
6. Perform an inspection/evaluation of a cooling tower or evaporative condenser to identify potential causes and/or existing conditions that indicate water problems.
7. Clean open recirculating water systems and related cooling towers.
8. Inspect, blowdown, and clean steam boilers.

## **MODULE 03309-08 – TROUBLESHOOTING ELECTRONIC CONTROLS**

1. Describe the similarities and differences between electronic controls and conventional controls.
2. Analyze circuit diagrams and other manufacturers' literature to determine the operating sequence of microprocessor-controlled systems.
3. Use test equipment to diagnose a microprocessor-controlled comfort system.

## **MODULE 03310-08 – TROUBLESHOOTING OIL HEATING**

1. Describe the basic operating sequence for oil-fired heating equipment.
2. Interpret control circuit diagrams for an oil heating system.
3. Develop a troubleshooting chart for an oil heating system.
4. Identify the tools and instruments used in troubleshooting oil heating systems.
5. Correctly use the tools and instruments required for troubleshooting oil heating systems.
6. Isolate and correct malfunctions in oil heating systems.
7. Describe the safety precautions that must be taken when servicing oil heating systems.

## **MODULE 03311-08 – TROUBLESHOOTING HEAT PUMPS**

1. Describe the basic operating sequence for an air-to-air heat pump.
2. Interpret control circuit diagrams for heat pumps.
3. Develop a checklist for troubleshooting a heat pump.
4. Identify the tools and instruments used in troubleshooting heat pumps.
5. Correctly use the tools and instruments required for troubleshooting heat pumps.
6. Isolate and correct malfunctions in heat pumps.
7. Describe the safety precautions associated with servicing heat pumps.

## **MODULE 03312-08 – TROUBLESHOOTING ACCESSORIES**

1. Describe a systematic approach for troubleshooting HVAC system accessories.
2. Isolate problems with electrical and/or mechanical functions of HVAC system accessories.
3. Use equipment manufacturer's troubleshooting aids to troubleshoot HVAC system accessories.
4. Identify and properly use the service instruments needed to troubleshoot HVAC system accessories.
5. Troubleshoot problems in selected HVAC system accessories.
6. State the safety precautions associated with the troubleshooting of HVAC accessories.

# Level Four

## MODULE 03401-09 – CONSTRUCTION DRAWINGS AND SPECIFICATIONS

1. Read blueprints and architect's plans.
2. Compare mechanical plans with the actual installation of duct run fittings and sections.
3. Interpret specification documents and apply them to the plans.
4. Interpret shop drawings and apply them to the plans and specifications.
5. Describe a submittal, its derivation, routing, and makeup.
6. Develop a field set of as-built drawings.
7. Identify the steps required for transferring design information to component production.
8. Identify, develop, and complete takeoff sheets.
9. List and classify materials most commonly used in HVAC systems.
10. Complete takeoff procedures for HVAC systems.

## MODULE 03402-09– SYSTEM BALANCING

1. Explain the gas laws (Dalton, Boyle, and Charles) used when dealing with air and its properties.
2. Explain the fan and pump laws.
3. Use a psychrometric chart to evaluate air properties and changes in air properties.
4. Explain the principles involved in the balancing of air and water distribution systems.
5. Define common terms used by manufacturers when describing grilles, registers, and diffusers.
6. Identify and use the tools and instruments needed to balance air distribution systems.
7. Balance an air distribution system.
8. Change the speed of an air distribution system supply fan.

## MODULE 03403-09 – INDOOR AIR QUALITY

1. Explain the need for good indoor air quality.
2. List the symptoms of poor indoor air quality.
3. Perform an inspection/evaluation of a building's structure and equipment for potential causes of poor indoor air quality.
4. Identify the causes and corrective actions used to remedy common indoor air problems.
5. Identify the HVAC equipment and accessories that are used to sense, control, and/or enhance indoor air quality.
6. Use selected test instruments to measure or monitor the quality of indoor air.
7. Clean HVAC air system ductwork and components.

## **MODULE 03404-09 – ENERGY CONSERVATION EQUIPMENT**

1. Identify selected air-to-air heat exchangers and describe how they operate.
2. Identify selected condenser heat recovery systems and explain how they operate.
3. Identify a coil energy recovery loop and explain how it operates.
4. Identify a heat pipe heat exchanger and explain how it operates.
5. Identify a thermosiphon heat exchanger and explain how it operates.
6. Identify a twin tower enthalpy recovery loop system and explain how it operates.
7. Identify airside and waterside economizers and explain how each type operates.
8. Identify selected steam system heat recovery systems and explain how they operate.
9. Identify an ice bank-type off-peak hours energy reduction system.
10. Operate selected energy conversion equipment.

## **MODULE 03405-09 – BUILDING MANAGEMENT SYSTEMS**

1. Identify the parts of a building management system.
2. Operate a basic direct digital controller.
3. Identify the major components of a building management system and describe how they fit together.
4. List the types of information available on a typical front-end computer screen for a building management system.
5. List the typical steps required to install a building management system.
6. Demonstrate how to install typical sensors, actuators, power wiring, and communication wiring.

## **MODULE 03406-09 – SYSTEM STARTUP AND SHUTDOWN**

1. Prepare a boiler for dry storage.
2. Prepare a boiler for wet storage.
3. Clean, start up, and shut down a steam boiler.
4. Clean, start up, and shut down a hot-water boiler.
5. Start up and shut down a reciprocating liquid chiller and related water system.
6. Start up and shut down a selected centrifugal or screw liquid chiller and related water system.
7. Start up and shut down an air handler and related forced-air distribution system.
8. Test compressor oil for acid contamination.
9. Add or remove oil from a semi-hermetic or open reciprocating compressor.
10. Inspect and clean shell and tube condensers/ evaporators and other water-type heat exchangers.

## **MODULE 03407-09– HEATING AND COOLING SYSTEM DESIGN**

1. Identify and describe the steps in the system design process.
2. From construction drawings or an actual job site, obtain information needed to complete heating and cooling load estimates.
3. Identify the factors that affect heat gains and losses to a building and describe how these factors influence the design process.
4. With instructor supervision, complete a load estimate to determine the heating and/or cooling load of a building.
5. State the principles that affect the selection of equipment to satisfy the calculated heating and/or cooling load.
6. With instructor supervision, select heating and/or cooling equipment using manufacturers' product data.
7. Identify the various types of duct systems and explain why and where each type is used.
8. Demonstrate the effect of fittings and transitions on duct system design.
9. Use a friction loss chart and duct sizing table to size duct.
10. Install insulation and vapor barriers used in duct systems.
11. Following proper design principles, select and install refrigerant and condensate piping.
12. Estimate the electrical load for a building and calculate the effect of the comfort system on the electrical load.

## **MODULE 03408-09 – COMMERCIAL AND INDUSTRIAL REFRIGERATION SYSTEMS**

1. Identify different types of refrigerated coolers and display cases and describe each one's common application.
2. Compare the basic components used in commercial/industrial refrigeration systems with those used in retail refrigeration systems.
3. Identify single, multiple, and satellite compressor systems. Describe the applications, installation considerations, and advantages and disadvantages of each type.
4. Identify packaged condensing units and unit coolers. Describe their applications, operation, and installation considerations.
5. Identify two-stage compressors and explain their operation and applications.
6. Identify the various accessories used in commercial refrigeration systems. Explain why each is used and where it should be installed in the system.
7. Identify the various refrigeration control devices. Explain the purpose of each type and how it works.
8. Compare the components used in ammonia systems with those used in halocarbon-based refrigerant systems.

## **MODULE 03409-09 – ALTERNATIVE HEATING AND COOLING SYSTEMS**

1. Describe alternative technologies for heating, including:
  - In-floor
  - Direct-fired makeup unit (DFMU)
  - Solar
  - Air turnover
  - Corn or wood pellet burners
  - Waste oil/multi-fuel
  - Fireplace inserts
2. Describe alternative technologies for cooling, including:
  - Ductless system (DX/hydronic)
  - Computer room
  - Chilled beams
  - Multi-zone

## **MODULE 03410-09 – INTRODUCTORY SKILLS FOR THE CREW LEADER**

1. Describe the skills necessary to be a supervisor.
2. List the characteristics and behavior of effective leaders, as well as the different leadership styles.
3. Explain the difference between problem solving and decision making.
4. Describe ways to deal with common leadership problems, such as absenteeism and turnover.
5. Identify a supervisor's safety responsibilities.
6. Describe the signals of substance abuse.
7. List the essential parts of an accident investigation.