# Scope & Sequence

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| Course Name: Heating, Ventilation, and Air Conditioning (HVAC) and Refrigeration Technology II **PEIMS Code:** 13005900 | | | **Course Credit:** 2.0  **Course Requirements:** This course is recommended for students in Grades 11-12.  **Prerequisites:** Heating Ventilation, and Air Conditioning (HVAC) and Refrigeration Technology I.  **Recommended Prerequisites:** Principles of Architecture or Principles of Construction. |
| **Course Description:** In Heating, Ventilation, and Air Conditioning (HVAC) and Refrigeration Technology II, students will gain advanced knowledge and skills needed to enter the industry as HVAC and refrigeration technicians or building maintenance technicians or supervisors, prepare for a postsecondary degree in a specified field of construction or construction management, or pursue an approved apprenticeship program. Students will acquire knowledge and skills in safety, electrical theory, use of tools, codes, installation of commercial HVAC equipment, heat pumps, troubleshooting techniques, various duct systems, and maintenance practices. | | | |
| **NOTE:** This is a suggested scope and sequence for the course content. This content will work with any textbook or instructional materials. If locally adapted, make sure all TEKS are covered. | | | |
| **Total Number of Periods**  **Total Number of Minutes**  **Total Number of Hours** | 350 Periods  15,750 Minutes  262.5 Hours\* | \*Schedule calculations based on 175/180 calendar days. For 0.5 credit courses, schedule is calculated out of 88/90 days. Scope and sequence allows additional time for guest speakers, student presentations, field trips, remediation, extended learning activities, etc. | |
| **Unit Number, Title, and Brief Description** | **# of Class Periods\***  (assumes 45-minute periods)  Total minutes per unit | **TEKS Covered**  **130.60 Knowledge and Skills** | |
| **Unit 1: Career Development**  Students will identify interests, abilities, aptitudes, values, and personality traits as they relate to career planning, to develop a keen understanding of the value and benefit of work, and to differentiate between jobs and careers. This unit will help students better understand the various career opportunities within the Architecture and Construction industry. Students will develop a career plan designed to achieve their career goals within this industry. Students will explore the job titles, job expectations, salaries, education needed and forecast for the industry. | 10 Periods  450 Minutes | 1. The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:  (A) identify job opportunities with their accompanying job duties in occupations such as electrician, building maintenance technician or manager, and electrical engineer; and  (B) research career pathways along with the education, job skills, and experience required to achieve a career goal | |
| **Unit 2: Overview of Commercial Air Systems**  Students will compare types of commercial air systems and explain the typical capacity range for each system. Students will identify the buildings for which each type of system is used for. | 15 Periods  675 Minutes | 2. The student learns the principles of commercial air systems. The student is expected to:  (A) identify the differences between types of commercial air systems;  (B) identify the type of building in which a particular type of system is used; and  (C) explain the typical range of capacities for a commercial air system | |
| **Unit 3: Venting Fossil-Fuel Furnaces**  Students will learn about combustion and incomplete combustion understanding that it occurs in the presence of a fuel source and oxidant to produce a gaseous product. Students will analyze the contents of flue gas and explain the necessity of it being vented. Students will compare and contrast traditional and modern furnace venting methods. Students will calculate the required vent size for the furnace system, and explain the furnace control devices. | 25 Periods  1,125 Minutes | 3. The student knows the principles of venting fossil-fuel furnaces and the proper methods for selecting and installing vent systems for gas-fired heating equipment. The student is expected to:  (A) describe the principles of combustion and explain complete and incomplete combustion;  (B) describe the content of flue gas and explain how it is vented;  (C)identify the components of a furnace vent system;  (D) describe how to select and install a vent system;  (E) perform the adjustments necessary to achieve proper combustion in a gas furnace;  (F) describe the techniques for venting different types of furnaces;  (G) explain the various draft control devices used with natural-draft furnaces;  (H) calculate the size of a vent required for a given application; and  (I) adjust a thermostat heat anticipator | |
| **Unit 4: Hot Water Heating Systems**  Students will learn the technical terms associated with hot-water heating. Students will identify the major components of a hot-water heating system and the functionality of each including common piping configurations. Students will demonstrate safe operations of hot-water heating systems. Students will be able to select the proper pump used to circulate water throughout the system, and they will learn to read the pressure throughout. | 25 Periods  1,125 Minutes | 4. The student gains knowledge of hot water heating systems, focusing on safe operation of the low-pressure boiler and piping systems commonly used in residential applications. The student is expected to:  (A) explain the terms and concepts used when working with hot-water heating;  (B) identify the major components of hot-water heating;  (C) explain the purpose of each component of hot-water heating;  (D) demonstrate the safety precautions used when working with hot-water systems;  (E) demonstrate how to operate selected hot-water systems;  (F) demonstrate how to safely perform selected operating procedures on low-pressure systems;  (G) identify the common piping configurations used with hot-water heating;  (H) explain how to read the pressure across a water system circulating pump;  (I) calculate heating water flow rates; and  (J) select a pump for a given application | |
| **Unit 5: HVAC Humidity Control**  Students will explain the importance of humidity control as a part of an HVAC system. Students will recognize the various kinds of humidifiers and their associated air filters. Students will identify accessories used with HVAC systems to improve air quality including humidity control devices, air filtration devices, and energy conservation devices. Students will demonstrate how to install and service air filters and electronic air cleaners. | 25 Periods  1,125 Minutes | 5. The student learns the basic principles, processes, and devices used to control humidity and air clean-lines as well as devices used to conserve energy in HVAC systems. The student is expected to:  (A) explain why it is important to control humidity in a building;  (B) recognize the various kinds of humidifiers used with HVAC systems and explain why each is used;  (C) demonstrate how to install and service the humidifiers used in HVAC systems;  (D) recognize the kinds of air filters used with HVAC systems and explain why each is used;  (E) demonstrate how to install and service the filters used in HVAC systems;  (F) use a manometer or differential pressure gauge to measure the friction loss of an air filter;  (G) 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, and energy conservation devices; and  (H) demonstrate or describe how to clean an electronic air cleaner | |
| **Unit 6: Refrigerant Handling**  Students will obtain knowledge and skills pertaining to the safe and proper handling of refrigerant. Students will compare and contrast common types of leak detectors and service equipment. Students will demonstrate refrigerant recovery, evacuation, and dehydration. Students will learn how to charge refrigerant into a system using different techniques include weight, superheat, sub-cooling, and charging pressure chart. | 25 Periods  1,125 Minutes | 6. The student gains the knowledge and skills in the handling of refrigerant and equipment servicing procedures to service HVAC systems in an environmentally safe manner. The student is expected to:  (A) identify the common types of leak detectors and explain how each is used;  (B) perform leak detection tests using selected methods;  (C) identify the service equipment used for evacuating a system and explain why each item of equipment is used;  (D) perform system evacuation and dehydration;  (E) 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;  (F) perform a refrigerant recovery;  (G) evacuate a system to a deep vacuum;  (H) identify the service equipment used for charging refrigerant into a system and explain why each item of equipment is used;  (I) use nitrogen to purge a system; and  (J) charge refrigerant into a system using various methods, including weight, superheat, sub-cooling, and charging pressure chart | |
| **Unit 7: Electrical Circuits and Components**  Students will describe power distribution through transformers. Students will describe single-phase and three-phase wiring arrangements and how phase shifts occur in inductors and capacitors. Students will demonstrate safety when working with electrical equipment and testing AC components including capacitors, transformers, and motors. | 25 Periods  1,125 Minutes | 7. The student gains knowledge of transformers, single-phase and three-phase power distribution, capacitors, theory and operation of induction motors, and instruments and techniques used in testing alternating current circuits and components. The student is expected to:  (A) describe the operation of various types of transformers;  (B) explain how alternating current is developed and draw a sine wave;  (C) identify single-phase and three-phase wiring arrangements;  (D) explain how phase shift occurs in inductors and capacitors;  (E) describe the types of capacitors and their applications;  (F) explain the operation of single-phase and three-phase induction motors;  (G) identify the various types of single-phase motors and their applications;  (H) state and demonstrate the safety precautions that must be followed when working with electrical equipment; and  (I) test alternating current components, including capacitors, transformers, and motors | |
| **Unit 8: Solid State Devices**  Students will understand the theory of electronics and semiconductors including diodes, light emitting diodes, and photo diodes. Students will identify different types of resistors, thermistors, and cad cells and explain their operation and function. Students will be able to identify and understand the connectors on personal computers. | 25 Periods  1,125 Minutes | 8. The student learns the theory of solid-state electronics as well as the operation, use, and testing of the various electronic components used in HVAC equipment. The student is expected to:  (A) explain the theory of electronics and semiconductors;  (B) explain how various semiconductor devices such as diodes, light emitting diodes, and photo diodes work and how the devices are used in power and control circuits;  (C) identify different types of resistors and explain how their resistance values can be determined;  (D) describe the operation and function of thermistors and cad cells;  (E) test semiconductor components; and  (F) identify the connectors on a personal computer | |
| **Unit 9: HVAC Control Systems**  Identify and describe various devices used for sensing temperature, pressure, velocity, and humidity as a part of HVAC control systems. Students will understand how conventional and electronic thermostats operate, and how pneumatic and electrical circuits are used to control mechanical systems. Students will be able to analyze circuit diagrams and identify electronic and microprocessor-based controls. | 25 Periods  1,125 Minutes | 9. The student learns the operation, testing, and adjustment of conventional and electronic thermostats as well as the operation of common electrical, electronic, and pneumatic circuits used to control HVAC systems. The student is expected to:  (A) explain the function of a thermostat in an HVAC system;  (B) describe different types of thermostats and explain how the thermostats are used;  (C) demonstrate the correct installation and adjustment of a thermostat;  (D) explain the principles applicable to all control systems;  (E) identify the various types of electromechanical, electronic, and pneumatic HVAC controls and explain their function and operation;  (F) describe a systematic approach for electrical troubleshooting of HVAC equipment and components;  (G) recognize and use equipment manufacturers' troubleshooting aids to troubleshoot HVAC equipment;  (H) demonstrate how to isolate electrical problems to faulty power distribution, load, or control circuits;  (I) identify the service instruments needed to troubleshoot HVAC electrical equipment;  (J) make electrical troubleshooting checks and measurements on circuits and components common to all HVAC equipment; and  (K) isolate and correct malfunctions in a cooling system control circuit | |
| **Unit 10: Gas Heating**  Students will interpret circuit diagrams and analyze information for gas heating systems. Students will describe proper operating sequence for gas heating equipment including various burner ignition methods. Students will identify common malfunctions of gas heating systems, and utilize tools and instruments for troubleshooting. | 25 Periods  1,125 Minutes | 10. The student learns the tools, instruments, and techniques used in troubleshooting gas heating appliances, including how to isolate and correct faults. The student is expected to:  (A) describe the operating sequence for gas heating equipment;  (B) interpret control circuit diagrams for gas heating systems;  (C) describe the operation of various types of burner ignition methods;  (D) identify the tools and instruments used when troubleshooting gas heating systems;  (E) demonstrate using the tools and instruments required for troubleshooting gas heating systems; and  (F) isolate and correct malfunctions in gas heating systems | |
| **Unit 11: Cooling Equipment**  Students will identify common electrical and mechanical malfunctions of cooling equipment systems, and utilize tools and instruments for troubleshooting. Students will demonstrate techniques utilizing equipment for troubleshooting cooling equipment and analyzing system temperatures and pressures to isolate faults. | 25 Periods  1,125 Minutes | 11. The student learns the techniques and equipment used in troubleshooting cooling equipment and analyzing system temperatures and pressures in order to isolate faults. The student is expected to:  (A) describe a systematic approach for troubleshooting cooling systems and components;  (B) isolate problems to electrical and mechanical functions in cooling systems;  (C) recognize and use equipment manufacturers' troubleshooting aids to troubleshoot cooling systems;  (D) identify and use the service instruments needed to troubleshoot cooling systems;  (E) troubleshoot selected problems in cooling equipment; and  (F) state the safety precautions associated with cooling troubleshooting | |
| **Unit 12: Heat Pumps**  Students will compare and contrast heat pumps by describing ratings, performance factor, seasonal energy efficiency ratio. Students will describe principles of reverse cycle heating and heat pump operation. Students will demonstrate heat pump installation and isolate and correct heat pump malfunctions. | 25 Periods  1,125 Minutes | 12. The student learns the principles of reverse-cycle heating, the operation of various types of heat pumps, and the mechanisms of heat pump control circuits and learns to install and service heat pumps. The student is expected to:  (A) describe the principles of reverse-cycle heating;  (B) identify heat pumps by type and general classification;  (C) describe various types of geothermal water loops and their application;  (D) list the components of heat pump systems;  (E) describe the role and operation of electric heat in common heat pump systems;  (F) describe common heat pump ratings such as coefficient of performance, heating season performance factor, and seasonal energy efficiency ratio;  (G) demonstrate heat pump installation and service procedures;  (H) identify and install refrigerant circuit accessories commonly associated with heat pumps;  (I) analyze a heat pump control circuit; and  (J) isolate and correct malfunctions in a heat pump | |
| **Unit 13: Application and Installation HVAC Support System**  Students will identify the hardware involved in HVAC support systems including various types of fasteners, gaskets, seals, and lubricants as well as different types of belt drives, bearings, and couplings. Students will demonstrate proper maintenance, inspection, and cleaning procedures for HVAC support systems. | 25 Periods  1,125 Minutes | 13. The student selects the application and installation of various types of fasteners, gaskets, seals, and lubricants as well as the installation and adjustment of different types of belt drives, bearings, and couplings. The student is expected to:  (A) identify, explain, and install threaded and non-threaded fasteners;  (B) identify, remove, and install types of gaskets, packings, and seals;  (C) identify types of lubricants and explain their uses;  (D) use lubrication equipment to lubricate motor bearings;  (E) identify the types of belt drives, explain their uses, and demonstrate procedures used to install or adjust them;  (F) identify and explain types of couplings;  (G) demonstrate procedures used to remove, install, and align couplings;  (H) identify types of bearings and explain their uses;  (I) explain causes of bearing failures;  (J) demonstrate procedures used to remove and install bearings;  (K) perform preventive maintenance inspection and cleaning procedures; and  (L) list ways to develop and maintain good customer relations | |
| **Unit 14: Sheet Metal**  Students will demonstrate the ability to identify and measure different types of metals used in sheet metal duct work including alloys and pure metals and their properties. Students will obtain proficiency using sheet metal measuring gauges. Demonstrate proper assembly of ductwork and components such as register, diffusers, grilles, dampers, access doors, and zoning accessories. | 25 Periods  1,125 Minutes | 14. The student demonstrates how to lay out, fabricate, install, and join sheet metal ductwork. The student is expected to:  (A) identify and describe the types of sheet metal;  (B) define properties of steel and aluminum alloys;  (C) describe a layout method and perform proper cutting;  (D) join sheet metal duct sections using proper seams and connectors;  (E) describe proper hanging and support methods for sheet metal ductwork;  (F) describe thermal and acoustic insulation principles;  (G) select, apply, and seal the proper insulation for sheet metal ductwork;  (H) describe guidelines for installing components such as register, diffusers, grilles, dampers, access doors, and zoning accessories; and  (I) install takeoffs and attach flexible duct to a sheet metal duct | |
| **Unit 15: Fiberglass Ductwork**  Students will identify types of fiberglass duct. Students will describe various layout, fabrication, and closure methods for fiberglass ducts. Students will describe proper hanging an support methods for fiberglass ducts, as well as how to repair major and minor damage. | 25 Periods  1,125 Minutes | 15. The student gains the knowledge and skills to lay out, fabricate, install, join, attach, and support fiberglass ductwork and fittings. The student is expected to:  (A) identify types of fiberglass duct, including flexible duct;  (B) describe fiberglass duct layout and some basic fabrication methods;  (C) describe the various closure methods for sealing fiberglass duct;  (D) fabricate selected duct modules and fittings using the appropriate tools;  (E) describe hanging and support methods for fiberglass duct;  (F) describe how to repair major and minor damage to fiberglass duct; and  (G) install takeoffs and attach flexible duct to a fiberglass duct | |