# Scope & Sequence

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| Course Name: Heating, Ventilation, and Air Conditioning (HVAC) and Refrigeration Technology I **PEIMS Code:** 13005800 | | | **Course Credit:** 1.0  **Course Requirements:** This course is recommended for students in Grades 10-12.  **Prerequisites:** None.  **Recommended Prerequisites:** Principles of Architecture, Principles of Construction, or Construction Technology I. |
| **Course Description:** In Heating, Ventilation, and Air Conditioning (HVAC) and Refrigeration Technology I, students will gain knowledge and skills needed to enter the industry as technicians in the HVAC and refrigeration industry or building maintenance industry, prepare for a postsecondary degree in a specified field of construction management, or pursue an approved apprenticeship program. Students will acquire knowledge and skills in safety, principles of HVAC theory, use of tools, codes, and installation of HVAC and refrigeration equipment. | | | |
| **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** | 175 Periods  7,875 Minutes  131.25 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**  **130.59 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: Principles of HVAC**  Students will understand the basic operation of an HVAC system is conducted by three main components – air handler, heating and cooling system, and heat exchanger. Students will learn that the capacity of an HVAC system is dependent upon its functionality, i.e. heating, cooling, humidifying, dehumidifying, cleaning, or air movement. Students will analyze and describe the impact that the Clean Air Act has on the HVAC industry. | 15 Periods  675 Minutes | 2. The student learns the basic principles of HVAC and refrigeration. The student is expected to:  (A) explain the basic principles of HVAC;  (B) describe what the Clean Air Act means to the HVAC and refrigeration industry; and  (C) identify the types of schedules and drawings used by the HVAC and refrigeration industry | |
| **Unit 3: Academic Knowledge and Skills for Manufacturing**  This unit will include lessons on terminology and skills that are associated with mathematics and science knowledge specifically pertaining to HVAC concepts. Students will focus on understanding, interpreting, analyzing and knowing how to correctly use units of measure, mathematics concepts, and science principles in order to solve problems. | 10 Periods  450 Minutes | 3. The student applies knowledge and skills in mathematics as they relate to HVAC and the principles of refrigeration. The student is expected to:  (A) identify similar units of measurement in both English and the International System (SI) of units;  (B) calculate and convert measured values and volumes expressed in mathematical equations and formulas; and  (C) convert temperature values between Celsius and Fahrenheit | |
| **Unit 4: Basic Electrical Theory**  This unit will include lessons on terminology and skills that are associated with mathematics and science knowledge specifically pertaining to electrical systems. Students will differentiate between types of circuits including series, parallel, and combined series-parallel. Students will understand and apply electrical concepts such as voltage, current, resistance, and power. Students will focus on understanding, interpreting, analyzing and knowing how to correctly use electrical formulas, interpret symbols, mathematics concepts, and science principles in order to solve problems. | 15 Periods  675 Minutes | 6. The student knows electrical principles, power generation and distribution, electrical components, direct current circuits, and electrical safety. The student is expected to:  (A) explain how electrical power is distributed;  (B) describe how voltage, current, resistance, and power are related;  (C) calculate the current, voltage, and resistance in a circuit using Ohm's law;  (D) calculate how much power is consumed by a circuit using the power formula;  (E) describe the differences between series and parallel circuits and calculate loads in each;  (F) describe the purpose and operation of the various electrical components used in HVAC equipment;  (G) state and demonstrate the safety precautions that must be followed when working on electrical equipment;  (H) make voltage, current, and resistance measurements using electrical test equipment; and  (I) read and interpret common electrical symbols | |
| **Unit 5: Piping and Fittings**  Students will be able to identify the proper type of piping, tubing, and supports for plumbing projects. Students will describe procedures and precautions that must be taken when preparing and installing HVACR piping.  Students will demonstrate the proper and safe cutting, connecting, and installation of plastic, steel, iron, and copper pipes and fittings. Students will understand the importance of pressure-testing of an installed plumbing project and utilize different techniques to do so. | 25 Periods  1,125 Minutes | 4. The student selects, prepares, connects, and installs copper and plastic piping and fittings. The student is expected to:  (A) state the precautions that must be taken when installing refrigerant piping;  (B) select, cut, and bend the right copper tubing for the job;  (C) safely connect tubing, using flare and compression fittings;  (D) determine the correct hardware and supports needed for refrigerant pipe installations;  (E) describe the basic requirements needed to identify and install various types of plastic pipe and state their uses;  (F) demonstrate various methods used to pressure test HVAC systems;  (G) identify types of plastic pipe and state their uses; and  (H) cut and join lengths of plastic pipe. | |
| **Unit 6: Soldering and Brazing**  Students will understand the concepts of brazing and soldering; joining processes that use a combination of heat, filler metal, and typically a flux to join many similar and dissimilar materials. Students will demonstrate brazing and soldering ferrous metal tubing and fittings in a safe and professional manner. Students will also describe the method to using couplings to join grooved piping to create a pressure-tight piping system. | 25 Periods  1,125 Minutes | 5. The student cuts, threads, and joins ferrous piping. The student is expected to:  (A) assemble and operate the tools used for soldering;  (B) prepare tubing and fittings for soldering;  (C) identify the purposes and uses of solder and solder fluxes;  (D) solder copper tubing fittings;  (E) assemble and operate the tools used for brazing;  (F) prepare tubing and fittings for brazing;  (G) identify the purposes and uses of filler metals and fluxes used for brazing;  (H) braze copper tubing and fittings;  (I) identify the inert gases that can be used safely to purge tubing when brazing;  (J) identify the types of ferrous metal pipes;  (K) accurately measure the sizes of ferrous metal pipes;  (L) identify the common malleable iron fittings;  (M) cut, ream, and thread ferrous metal pipe;  (N) join lengths of threaded pipe together and install fittings;  (O) describe the main points to consider when installing pipe runs; and  (P) describe the methods used to join grooved piping | |
| **Unit 7: Cooling Systems**  Students will describe how an HVACR system conditions and cools the air within a specified space. Students will demonstrate an understanding of the basic refrigeration cycle. Students will recognize the major components of a cooling system and explain how they operate. Students will identify and describe refrigerants and demonstrate procedures for safe handling of them. Students will use temperature and pressure measuring instruments to evaluate the condition of the system. | 25 Periods  1,125 Minutes | 7. The student learns the principles of heat transfer, refrigeration, pressure temperature relationships, and the components and accessories used in air conditioning systems. The student is expected to:  (A) explain how heat transfer occurs in a cooling system, demonstrating an understanding of the terms and concepts used in the refrigeration cycle;  (B) calculate the temperature and pressure relationships at key points in the refrigeration cycle;  (C) under supervision, use temperature- and pressure-measuring instruments to make readings at key points in the refrigeration cycle;  (D) identify commonly used refrigerants and demonstrate the procedures for handling these refrigerants;  (E) identify the major components of a cooling system and explain how each type works;  (F) identify the major accessories available for cooling systems and explain how each works;  (G) identify the control devices used in cooling systems and explain how each works; and  (H) demonstrate the correct methods to be used when piping a refrigeration system | |
| **Unit 8: Heating Fundamentals**  Students will describe how an HVACR system conditions and heats the air within a specified space. Students will explain the three methods of heat transfer. Students will recognize the major components of a forced air furnace (gas and electric) and explain their function. Students will state the factors that must be considered when installing a furnace. Students will demonstrate performing preventive maintenance procedures such as cleaning and filter replacement. Students will demonstrate an understanding of the sequence of operation of a gas furnace. Students will demonstrate an understanding of how to adjust a gas valve. | 25 Periods  1,125 Minutes | 8. The student learns heating fundamentals, types and designs of furnaces and their components, and basic procedures for installing and servicing furnaces. The student is expected to:  (A) explain the three methods by which heat is transferred and give an example of each;  (B) describe how combustion occurs and identify the by-products of combustion;  (C) identify the various types of fuels used in heating;  (D) identify the major components and accessories of an induced draft and condensing gas furnace and explain the function of each component;  (E) describe the factors that must be considered when installing a furnace;  (F) identify the major components of a gas furnace and describe how each works;  (G) use a manometer under supervision to measure and adjust manifold pressure on a gas furnace;  (H) identify the major components of an oil furnace and describe how each component works; and  (I) perform furnace preventive maintenance procedures such as cleaning and filter replacement under supervision | |
| **Unit 9: Air Distribution**  Students will research the various types of air distribution systems, as well as the air terminals and air source equipment used in these systems; accessories commonly used with air distribution systems are also covered. Students will understand that air distribution systems are required to control the airflow path, the air temperature and the force of the air entering a designated space and does so through duct systems. Students will demonstrate the use of air system measurement instruments. | 25 Periods  1,125 Minutes | 9. The student gains knowledge and skills related to air distribution systems. The student is expected to:  (A) describe the airflow and pressures in a basic forced-air distribution system;  (B) explain the differences between propeller and centrifugal fans and blowers;  (C) identify the various types of duct systems and explain why and where each type is used;  (D) demonstrate or explain the installation of metal, fiberboard, and flexible duct;  (E) demonstrate or explain the installation of fittings and transitions used in duct systems;  (F) demonstrate or explain the use and installation of diffusers, registers, and grilles used in duct systems;  (G) demonstrate or explain the use and installation of dampers used in duct systems;  (H) demonstrate or explain the use and installation of insulation and vapor barriers used in duct systems;  (I) identify the instruments used to make measurements in air systems and explain the use of each instrument; and  (J) make accurate temperature, air pressure, and velocity measurements in an air distribution system | |