



Burlington County Institute of Technology

Medford Campus

Westampton Campus

Career and Technical Programs

Career Cluster: *Architecture and Construction*

Program Name: Heating, Air Conditioning & Refrigeration. Maintenance Technology

Program Title: *HVAC/R*

CIP Code: *470201*

Board Approval Date: September, 2024



Program of Study

→ Grade 9

- ◆ Introduction to HVAC I
- ◆ Introduction to HVAC II

→ Grade 10

- ◆ Fundamentals of Cooling
- ◆ Fundamentals of Heating
- ◆ EPA Certification - Core and Type I

→ Grade 11

- ◆ Employability and Customer Communication
- ◆ Heat Pumps, Hydronics, and Oil Heat Fundamentals
- ◆ EPA 608 Certification - Type II and Type III

→ Grade 12

- ◆ Air Distribution and Duct Systems Fundamentals
- ◆ System Sizing, Stainless Steel Tubing, and Green HVAC Practices
- ◆ Residential Split System/ Gas Furnace Proficiency
- ◆ Codes and Ordinances



→ Program Descriptor

- ◆ HVAC/R involves equipment used for heating, cooling, and cleaning indoor air as well as equipment for preserving food and other perishable products. Students will learn about furnaces and air conditioners used in homes and businesses, as well as the heating and cooling systems used in large buildings. It includes equipment used in retail, commercial, and industrial enterprises for the preservation and packaging of food and other perishables. One of the most serious issues affecting the craft is the damage that can be done to Earth's ozone layer by the misuse of refrigerants. HVACR technicians form an important line of defense in the fight to improve energy efficiency and to reduce harmful chemical emissions into the atmosphere. Technicians will receive training in this course to obtain an EPA certification for safe and proper refrigerant usage. Because of the widespread use of HVACR equipment, there are many career opportunities in the craft. Jobs are available with small local firms, commercial and industrial companies, and businesses that manufacture HVACR equipment. This course provides an opportunity to learn the trade through a combination of hands-on training and related classroom instruction.

→ Program Outcome

- ◆ Graduates of the HVAC program will possess the skills and competencies required for entry level employment as well as a foundation for pursuing post secondary education. Upon completion of the course, students can earn an EPA Universal certification for refrigerant purchasing and handling. In addition students can receive a certification for R-410a Safety and Handling, and Tracpipe flexible gas piping.

→ Work Based Learning Opportunities

- ◆ Career Preparation: Simulated Workplace Environment
- ◆ Career Preparation: Cooperative Education



→ Industry Valued Credentials

- ◆ EPA Refrigerant Certification (Section 608)
- ◆ OSHA 10

Course Descriptions

1. Grade 9

- a. *Introduction to HVAC I:* This course includes Introduction to Basic Safety, Hand Tools and Hardware, Basic Copper and Plastic Piping Practices, Soldering and Brazing, and Carbon Steel piping Practices. This course instructs students in the identification, use, and care of hand tools. Developing the knowledge to properly choose and safely use hand tools and hardware such as screws, bolts, and anchors is an essential part of the HVAC industry as well as identifying and following safe work practices and procedures and how to properly inspect and use safety equipment. Students will be introduced to the various types of copper tubing and plastic piping and the various fittings that are used with them in the HVAC industry. This section explains soldering and brazing as the two methods used for joining copper tubing and fittings. It reviews the safety equipment, tools, and materials needed for soldering and brazing copper tubing in various applications. This section also includes the basic knowledge and skills needed to thread and install carbon steel piping systems.
- b. *Introduction to HVAC II:* This course includes Introduction to HVAC, and Basic Electricity. It includes the most basic operating principles of HVAC systems along with a review of technician licensing and trade-governmenting regulations. This section also introduces the concepts of power generation and



distribution, common electrical components, AC and DC circuits, and electrical safety as it relates to the HVAC field. It presents the basic concepts of alternating current generation and use. It also discusses how single and three phase alternating current is used to power resistive and inductive circuits in HVAC equipment.

2. Grade 10

- a. *Fundamentals of Cooling*: This course includes Introduction to Cooling and Troubleshooting Cooling . This section also introduces the fundamental concepts of the mechanical refrigeration cycle and examples of the primary components required to make it work. This section presents refrigerant compressors performance and reliability. It discusses common compressors failures and their causes, the various types of compressors used in the HVAC industry, and how to correctly identify problems that can affect compressor operation. It discusses the refrigerant oils used in modern HVAC systems and reviews the new handling and service requirements that HVAC technicians must be familiar with. Students will be provided with guidance related to servicing the refrigerant circuit of HVAC systems. In addition information related to the US EPA's requirements for providing the necessary services in an environmentally sound manner. Students will also learn the metering devices used in the mechanical refrigeration cycle. The primary function of metering devices is presented, along with related components such as the distributor, and the process of selecting and installing thermal expansion valves.
- b. *Fundamentals of Heating*: This course includes Intro to Heat and Troubleshooting Furnaces. Students will learn an overview of common residential heating systems. Fundamental concepts of heating and combustion systems are described with the emphasis on gas forced air systems. This section also provides students with the information and skills needed to troubleshoot gas fired furnaces and boilers. This section describes the construction and operation of oil fired heating systems and their components.
- c. *EPA 608 Certification - Core and Type I*: The EPA Universal Certification requires all individuals who open a system or container holding a controlled refrigerant to be certified with the EPA Section 608 Certifications. Within Section 608 Certifications, there are four types of certifications that HVAC technicians will need before they can begin professionally servicing, repairing, or disposing of the appliances they will be trained to work with. Core Certification- is required as a fundamental knowledge test of basic safety and the dangers HVAC/R refrigerants can cause to the student and the environment. Type I Certification - A Type I certification is required for HVAC technicians primarily servicing small



appliances such as domestic refrigerators, window air conditioners, and vending machines. The EPA Core/Type I Certification exam consists of 50 multiple-choice questions: 25 Core questions, 25 Type I questions. A score of 72% is required to pass each section, which means 18 of the 25 questions must be answered correctly in order to obtain each certification.

3. Grade 11

- a. *Employability and Customer Communication*: This section provides students with guidance related to finding and searching a position in the HVAC trade. It includes areas of problem solving and effective interaction with others to ensure their success in the HVAC industry. It shows the importance of establishing good relations with customers and provides guidance on how to achieve that goal. It focuses on good first impressions and describes how to communicate in a positive way with customers. This module provides students with the information and skills needed to communicate effectively and clearly in the HVAC industry.
- b. *Heat Pumps, Hydronics, and Oil Heat Fundamentals*: This course includes Heat Pumps, Introduction to Hydronic Systems, Troubleshooting Oil Heating, and HCs/ HFOs. Students will learn an overview of common alternative residential heating systems. Students will be introduced to the operation of heat pump systems in detail with the emphasis on the most common form of supplemental heat, electric resistance heating elements. Introduces hydronic heating systems operation, various pumps, various instruments and the fluids used with hydronic heating. This section describes the construction and operation of oil fired heating systems and their components. HydroCarbon and Hydrofluro-Olefins are becoming the new standard in refrigerants. Students will learn safety and standards for using HCs and HFOs.
- c. *EPA 608 Certification - Type II and Type III*: The EPA Universal Certification requires all individuals who open a system or container holding a controlled refrigerant to be certified with the EPA Section 608 Certifications. Within Section 608 Certifications, there are four types of certifications that HVAC technicians will need before they can begin professionally servicing, repairing, or disposing of the appliances they will be trained to work with. Type II Certification - A Type II certification is required for HVAC technicians primarily servicing and disposing equipment using a high pressure refrigerant. Examples of such equipment include residential air conditioners and heat pumps, supermarket



refrigeration and process refrigeration. Type III Certification - A Type III certification is required for HVAC technicians primarily servicing and disposing equipment using a low pressure refrigerant. These units are primarily chillers. The EPA Type II/Type III Certification exam consists of 50 multiple-choice questions: 25 Type II questions, 25 Type III questions. A score of 72% is required to pass each section, which means 18 of the 25 questions must be answered correctly in order to obtain each certification. If the student has passed all four sections of the EPA test, a EPA Universal Certification will be granted - A Universal certification is required for HVAC technicians who service all types of equipment.

4. Grade 12

- a. *Air Distribution and Duct Systems Fundamentals*: This course includes Air Distribution Systems, Basic Maintenances, Indoor Air Quality and Sheet Metal Duct Systems. Students will be introduced to fundamental concepts of air movement and how these concepts form the basis for air distribution system design. This module reviews air distribution components and various air measurement devices with interpreting charts related to air distribution. This section introduces the student to the common tasks associated with basic maintenance activities. Reviewed in detail are proper procedures in lubrication of HVAC components and belt installation. Required tasks to complete a thorough maintenance inspection of a gas furnace and common cooling/Heat pump systems. This section covers sheet metal duct systems advantages, their low resistance to airflow, strength, durability, assembly methods, and how to properly seal and insulate to prevent heat loss or gain in the duct system.
- b. *System Sizing, Stainless Steel Tubing, and Green HVAC Practices*: This course includes TracPipe, Manual J/D, Basic Maintenances, Green Systems. Students will be introduced to the use of corrugated stainless steel tubing and best practices. This module describes the use of manual J and D and their importance when sizing systems. This section introduces the student to the common tasks associated with basic maintenance activities. Reviewed in detail is proper procedures in lubrication of HVAC components and belt installation. Becoming Green HVAC/R certified demonstrates to customers, peers, and potential employers that you are aware of and possess a basic understanding of the principles behind energy conservation and how it relates to the heating and cooling industry.
- c. *Residential Split System/ Gas Furnace Proficiency*: Upon completion of the HVAC program, students must be able to install, troubleshoot, and test systems for efficiency. Throughout this course, students will be required to show proficiency with installation, troubleshooting, and testing system efficiency of residential split systems and gas furnaces. Students will work through a series of labs where they will



demonstrate basic skills required to work in HVAC as well as advanced techniques to troubleshoot and analyze system efficiency.

- d. *Codes and Ordinances:* This course provides students with a comprehensive understanding of the local, state, and national codes and ordinances governing HVAC systems. Students will learn to interpret and apply building codes, safety regulations, and industry standards critical for HVAC installation, maintenance, and compliance. Emphasis is placed on understanding zoning laws, energy efficiency standards, and environmental regulations. This course prepares students to ensure that HVAC systems meet all legal and safety requirements in real-world scenarios.



Curriculum Maps

Course: Safety

Unit: OSHA 10

Length: 1 Week

Standards

- 9.3.12.AG-FD.1 Develop and implement procedures to ensure safety, sanitation and quality in food product and processing facilities.
- 9.3.12.AC-CST.5 Apply practices and procedures required to maintain jobsite safety.
- 9.3.12.AR.2 Analyze the importance of health, safety and environmental management systems, policies and procedures common in arts, audio/video technology and communications activities and facilities.
- 9.3.12.ED.4 Evaluate and manage risks to safety, health and the environment in education and training settings.
- 9.3.HT-RFB.2 Demonstrate safety and sanitation procedures in food and beverage service facilities.
- 9.3.HU-ED.5 Evaluate safety and sanitation procedures associated with the early childhood education environment to assure compliance and prevent potential hazards.
- 9.3.LW.4 Conduct law, public safety, corrections and security work tasks in accordance with employee and employer rights, obligations and responsibilities, including occupational safety and health requirements.
- 9.3.LW-ENF.8 Explain the appropriate techniques for managing crisis situations in order to maintain public safety.
- 9.3.MN.3 Comply with federal, state and local regulations to ensure worker safety and health and environmental work practices.
- 9.3.MN-HSE.3 Demonstrates a safety inspection process to assure a healthy and safe manufacturing environment.
- 9.3.MN-HSE.5 Evaluate continuous improvement protocols and techniques in health, safety and/or environmental practices.
- 9.3.12.TD.5 Describe transportation, distribution and logistics employee rights and responsibilities and employers' obligations concerning occupational safety and health.



- 9.3.12.TD-HSE.1 Describe the health, safety and environmental rules and regulations in transportation, distribution and logistics workplaces.
- 9.3.12.TD-OPS.3 Comply with policies, laws and regulations in order to maintain safety, security and health and mitigate the economic and environmental risk of transportation operations.

Essential Question(s)

- Why is it important to practice safety?
- What do safe practices look like in my industry?
- How can I keep myself and others safe?

Content

- Walking working surfaces
- Emergency action plans
- Fire protection
- Electrocution hazards
- Personal protective equipment
- Hazard communication
- Materials handling, storage, use and disposal.

Skills

- Explain why OSHA is important to workers.
- Explain workers rights under OSHA
- Discuss employer responsibilities under OSHA.
- Discuss the use of OSHA standards.
- Explain how OSHA inspections are conducted.
- Utilize helpful worker safety and health resources.
- Identify hazards in the workplace associated with walking and working surfaces.



- Identify best practices for eliminating or controlling hazards associated with walking and working surfaces in the workplace.
- Recognize employer requirements to protect workers from walking and working surface hazards.
- Recognize benefits of an Emergency Action Plan.
- Identify elements of the Fire Protection Plan.
- Identify conditions under which evacuation actions may be necessary in an emergency situation.
- Identify conditions under which shelter-in-place may be necessary in an emergency situation.
- Identify characteristics of an effective emergency escape route.
- Recognize the five types of fire extinguishers, including the types of fires they can extinguish.
- Review requirements for proper maintenance of portable fire extinguishers.
- Identify major electrical hazards.
- Describe types of electrical hazards.
- Describe electrical protection methods.
- Recognize employer requirements to protect workers from electrical hazards.
- Recall employer responsibilities toward affected employees regarding PPE.
- Identify when face and head protection should be used.
- Recall which types of hand and foot protection should be used in a specific situation.
- Recognize the differences between respirator types.
- Identify the differences between full-body protection levels.
- Identify the employer's responsibilities under the HCS, including training requirements.
- Identify components of a Hazard Communication program.
- Describe requirements of the different types of Hazard Communication labels.
- Locate pertinent information about chemicals on labels, including other forms of hazard communication, to ensure "right to understanding" provisions of GHS requirements.
- Identify types of material handling equipment.
- Describe hazards associated with material handling activities (e.g., storage, use, and disposal).
- Identify methods to prevent hazards associated with material handling equipment.
- Recognize employer requirements to protect workers from material handling hazards
- Identify the main causes of machinery accidents.



- Recognize basic machinery parts that expose workers to hazards.
- Recognize workplace situations involving machinery that requires guarding.
- Identify the requirements for safeguards.
- Identify types of machine guards including types of devices used to safeguard machines.
- Identify strategies to control chemical hazards.
- Identify strategies to control biological hazards.
- Identify strategies to control physical hazards.
- Identify strategies to control ergonomic hazards.
- Identify OSHA requirements pertaining to bloodborne pathogens.
- List the potential routes of exposure from bloodborne pathogens.
- Identify the risks associated with Human Immunodeficiency Virus (HIV), Hepatitis B, and Hepatitis C Virus.
- Identify methods of preventing transmission of bloodborne pathogens & managing occupational exposures.
- Restate methods of the safe disposal of sharps.
- Recount steps which should be taken in the event of an exposure to a potential bloodborne pathogen.
- Recognize risk factors associated with work-related musculoskeletal disorders (MSD)s.
- Identify good posture.
- Describe safe lifting techniques.
- Identify ergonomic control methods for eliminating/reducing work-related MSDs.
- Identify the number one cause of death for U.S. teens.
- List eight risk factors for young drivers.
- Identify the biggest risk factor for young drivers.
- Define distracted driving.
- Provide examples and/or causes of distracted driving.
- Identify the biggest risk factor for distracted driving
- Discuss the risk of having other young passengers in the car.
- List some actions employers should take to keep employees safe while driving.
- List some actions employees can take to safely drive on the job.
- Define the term violence.
- Recall who is at risk for encountering workplace violence.



- Describe workplace violence prevention strategies.
- Identify how to StartSafe and StaySafe to prevent or lessen workplace violence.
- Recognize the costs of workplace accidents.
- Recognize the benefits of implementing an effective safety and health program.
- Describe the elements of an effective safety and health program.
- Identify three methods to prevent workplace hazards.

Assessments

- OSHA 10 Assessment and Certificate

Course: CTE

Unit: Career Awareness

Length: Woven Throughout

Standards

- 9.2.12.CAP.1: Analyze unemployment rates for workers with different levels of education and how the economic, social, and political conditions of a time period are affected by a recession.
- 9.2.12.CAP.2: Develop college and career readiness skills by participating in opportunities such as structured learning experiences, apprenticeships, and dual enrollment programs.
- 9.2.12.CAP.3: Investigate how continuing education contributes to one's career and personal growth.
- 9.2.12.CAP.4: Evaluate different careers and develop various plans (e.g., costs of public, private, training schools) and timetables for achieving them, including educational/training requirements, costs, loans, and debt repayment.
- 9.2.12.CAP.5: Assess and modify a personal plan to support current interests and postsecondary plans. •
- 9.2.12.CAP.6: Identify transferable skills in career choices and design alternative career plans based on those skills.



- 9.2.12.CAP.7: Use online resources to examine licensing, certification, and credentialing requirements at the local, state, and national levels to maintain compliance with industry requirements in areas of career interest.
- 9.2.12.CAP.8: Determine job entrance criteria (e.g., education credentials, math/writing/reading comprehension tests, drug tests) used by employers in various industry sectors.
- 9.2.12.CAP.9: Locate information on working papers, what is required to obtain them, and who must sign them.
- 9.2.12.CAP.10: Identify strategies for reducing overall costs of postsecondary education (e.g., tuition assistance, loans, grants, scholarships, and student loans)
- 9.2.12.CAP.11: Demonstrate an understanding of Free Application for Federal Student Aid (FAFSA) requirements to apply for postsecondary education
- 9.2.12.CAP.12: Explain how compulsory government programs (e.g., Social Security, Medicare) provide insurance against some loss of income and benefits to eligible recipients.
- 9.2.12.CAP.13: Analyze how the economic, social, and political conditions of a time period can affect the labor market.
- 9.2.12.CAP.14: Analyze and critique various sources of income and available resources (e.g., financial assets, property, and transfer payments) and how they may substitute for earned income
- 9.2.12.CAP.15: Demonstrate how exemptions, deductions, and deferred income (e.g., retirement or medical) can reduce taxable income.
- 9.2.12.CAP.16: Explain why taxes are withheld from income and the relationship of federal, state, and local taxes (e.g., property, income, excise, and sales) and how the money collected is used by local, county, state, and federal governments. •
- 9.2.12.CAP.17: Analyze the impact of the collective bargaining process on benefits, income, and fair labor practice. •
- 9.2.12.CAP.18: Differentiate between taxable and nontaxable income from various forms of employment (e.g., cash business, tips, tax filing and withholding). •
- 9.2.12.CAP.19: Explain the purpose of payroll deductions and why fees for various benefits (e.g., medical benefits) are taken out of pay, including the cost of employee benefits to employers and self-employment income.
- 9.2.12.CAP.20: Analyze a Federal and State Income Tax Return



- 9.2.12.CAP.21: Explain low-cost and low-risk ways to start a business.
- 9.2.12.CAP.22: Compare risk and reward potential and use the comparison to decide whether starting a business is feasible.
- 9.2.12.CAP.23: Identify different ways to obtain capital for starting a business

Essential Question(s)

- How does one prepare for a career?
- How does one improve marketability?
- Why is career planning important?
- What are the risks in starting a business?

Content

- There are strategies to improve one's professional value and marketability.
- Career planning requires purposeful planning based on research, self-knowledge, and informed choices.
- An individual's income and benefit needs and financial plan can change over time.
- Securing an income involve an understanding of the costs and time in preparing for a career field, interview and negotiation skills, job searches, resume development, prior experience, and vesting and retirement plans
- Understanding income involves an analysis of payroll taxes, deductions and earned benefits.
- There are ways to assess a business's feasibility and risk and to align it with an individual's financial goals

Skills

- Act as a responsible and contributing community member and employee.
- Attend to financial well-being.
- Consider the environmental, social and economic impacts of decisions.
- Demonstrate creativity and innovation.
- Utilize critical thinking to make sense of problems and persevere in solving them.
- Model integrity, ethical leadership and effective management.
- Plan education and career paths aligned to personal goals.



- Use technology to enhance productivity, increase collaboration and communicate effectively.
- Work productively in teams while using cultural/global competence.

Assessments

- Career Research Project
- Resume/Cover Letter

Course: Introduction to HVAC I

Length: Semester

Standards

- 9.1.12.C.1: Demonstrate the ability to safely operate hand and power tools.
- 9.1.12.C.2: Apply knowledge of safety procedures to prevent accidents and injuries.
- 9.1.12.C.3: Utilize appropriate materials and techniques for constructing and repairing various systems.
- 9.2.12.C.1: Identify and explore career pathways in various industries.
- 9.2.12.C.2: Understand the role of different components and systems in various applications.
- 9.3.12.C.1: Apply technical skills and knowledge in work-based or simulated environments.
- 9.3.12.C.2: Demonstrate proficiency in the installation, maintenance, and troubleshooting of systems through hands-on practice.
- 9.4.A.1: Use tools and techniques specific to system installation and repair.
- 9.4.A.2: Implement best practices for working with various materials.
- 9.4.A.3: Follow safety protocols related to system maintenance and repair.

Essential Question(s)



- What are the key safety practices and procedures that must be followed when working with HVAC systems, and how do these practices ensure a safe working environment?
- How do different types of hand tools and hardware, such as screws, bolts, and anchors, contribute to the installation and maintenance of HVAC systems, and what are the best practices for their use and care?
- What are the primary techniques and considerations for working with copper and plastic piping in HVAC systems, and how do these materials impact system performance and longevity?
- How do soldering and brazing differ in their applications for joining copper tubing and fittings, and what are the necessary safety measures, tools, and materials for each method?
- What are the fundamental steps and skills required for threading and installing carbon steel piping systems, and how do these processes fit into the broader scope of HVAC system installation and maintenance?

Content

- Identify and describe basic safety procedures related to working in HVAC environments, including personal protective equipment (PPE) and safe handling of tools and materials.
- Demonstrate proper use and care of hand tools commonly used in HVAC installations and maintenance, such as wrenches, screwdrivers, and pliers.
- Explain the function and application of various types of hardware, including screws, bolts, and anchors, in HVAC systems.
- Understand and apply safe work practices and procedures for handling HVAC tools and materials to prevent accidents and injuries.
- Inspect and maintain safety equipment used in HVAC work, ensuring it is in good condition and properly utilized.
- Differentiate between types of copper and plastic piping used in HVAC systems, including their characteristics, applications, and advantages.
- Demonstrate proper techniques for cutting, fitting, and installing copper and plastic pipes, ensuring secure and leak-proof connections.
- Understand the principles of soldering and brazing, including the differences between the two methods and their specific applications in HVAC systems.



- Identify and use the necessary tools and materials for soldering and brazing, including safety equipment, flux, and soldering rods.
- Demonstrate proper soldering and brazing techniques for joining copper tubing and fittings, including surface preparation and temperature control.
- Describe the characteristics and uses of carbon steel piping in HVAC systems, including its benefits and limitations compared to other piping materials.
- Demonstrate basic skills for threading and installing carbon steel piping systems, including measuring, cutting, and joining pipe sections.
- Understand the importance of proper pipe installation practices for ensuring system efficiency and longevity, including alignment, support, and securing methods.
- Explain the role of proper pipe sizing and fitting selection in maintaining optimal system performance and preventing common issues such as leaks or pressure loss.
- Apply knowledge of safety procedures and best practices to real-world HVAC scenarios, including troubleshooting common issues and performing routine maintenance tasks

Skills

- Identify and properly use a range of hand tools commonly used in HVAC work, including wrenches, screwdrivers, and pliers.
- Select and apply appropriate hardware, such as screws, bolts, and anchors, for various HVAC installations.
- Implement safe work practices and procedures to minimize risks and prevent accidents in HVAC environments.
- Inspect and maintain safety equipment to ensure its effectiveness and compliance with safety standards.
- Cut, fit, and install copper and plastic piping accurately and securely, following industry standards.
- Use tools and techniques for soldering and brazing copper tubing, ensuring strong and leak-proof joints.
- Prepare surfaces for soldering and brazing by cleaning and applying flux correctly.
- Thread and install carbon steel piping systems, including cutting, measuring, and joining pipe sections.
- Align and support pipes properly to prevent stress and ensure system integrity.
- Select and install the appropriate fittings and connectors for copper and plastic piping systems.
- Apply proper techniques for pipe sizing and fitting selection to optimize system performance.



- Demonstrate proficiency in using measuring and marking tools to ensure accurate pipe installation.
- Troubleshoot and resolve common issues related to pipe installations, such as leaks or misalignments.
- Perform routine maintenance tasks on HVAC systems, including inspections and minor repairs.
- Follow industry best practices for handling and disposing of HVAC materials and waste safely.

Assessments

- 1. Practical Skills Assessment: Students will complete a hands-on assessment where they demonstrate their proficiency in using HVAC tools and installing piping systems. This will include identifying and using hand tools correctly, cutting and fitting copper and plastic pipes, performing soldering and brazing, and threading and installing carbon steel pipes. Emphasis will be placed on following safety procedures, maintaining a clean workspace, and ensuring the accuracy and durability of their installations.
- Written Examination: The written exam will test students' theoretical knowledge of HVAC fundamentals. It will include questions on safety procedures, tool and hardware identification, piping techniques, and the characteristics and installation of carbon steel piping. Students will also be required to troubleshoot common issues in piping installations. This assessment will evaluate their understanding of course content and their ability to apply theoretical concepts to practical scenarios.

Course: Introduction to HVAC II

Length: Semester

Standards

- 9.3.12.AC-CST.3: Examine and summarize the approval procedures required for successful completion of a construction project.



- 9.3.12.AC-MO.3: Apply planning and project management skills to ensure the successful completion of a project.
- 9.3.12.EL-ENG.3: Troubleshoot electrical/electronic systems to resolve operating problems.
- 9.3.12.EL-ENG.4: Demonstrate the operation of electrical/electronic systems.
- 9.4.12.TL.1: Demonstrate employability skills required by business and industry.
- 9.2.12.CAP.3: Investigate how continuing education, training, certifications, and licensure can enhance career advancement.
- 9.2.12.CAP.4: Evaluate how the changing nature of work requires the use of new knowledge and skills.
- 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem-solving.

Essential Question(s)

- What are the fundamental operating principles of HVAC systems, and how do they relate to the overall functionality and efficiency of these systems?
- How do technician licensing and trade regulations impact the HVAC industry, and why is it important for professionals to be aware of and comply with these regulations?
- What are the basic concepts of power generation and distribution, and how do they apply to the operation and maintenance of HVAC systems?
- What are the key differences between AC and DC circuits, and how do these differences affect their use in HVAC equipment?
- How does alternating current (AC) generation and the use of single and three-phase AC power influence the operation of resistive and inductive circuits in HVAC systems?

Content

- Understand the basic operating principles of HVAC systems, including how they regulate temperature and airflow.
- Explain the importance of technician licensing and trade regulations, and how these standards ensure safety and compliance in HVAC work.



- Identify and describe common electrical components used in HVAC systems, such as switches, relays, and circuit breakers.
- Understand the basic concepts of power generation and distribution, including how electricity is generated and delivered to HVAC systems.
- Differentiate between AC (alternating current) and DC (direct current) circuits, including their characteristics and applications in HVAC systems.
- Describe the principles of electrical safety as they relate to HVAC work, including proper use of personal protective equipment (PPE) and safety procedures.
- Understand how alternating current (AC) is generated and its role in powering HVAC equipment.
- Explain the concepts of single-phase and three-phase AC power, and how each type is used in HVAC systems.
- Identify the key components of resistive circuits, such as resistors, and understand their role in HVAC systems.
- Describe the operation of inductive circuits, including components like inductors and their application in HVAC systems.
- Understand the relationship between electrical circuits and HVAC equipment performance, including how circuit design affects system efficiency and reliability.
- Explain the role of electrical controls and automation in HVAC systems, including how they enhance system operation and energy management.
- Identify common electrical faults and troubleshooting methods used in HVAC systems to ensure proper operation and maintenance.
- Describe the process of electrical power distribution in an HVAC system, including how power is routed and managed throughout the system.
- Understand the impact of electrical power quality on HVAC system performance, including issues related to voltage, current, and frequency stability.

Skills

- Safely operate and troubleshoot basic electrical components used in HVAC systems, such as switches, relays, and circuit breakers.
- Apply technician licensing and trade regulations in practical scenarios to ensure compliance and safety in HVAC work.



- Understand and apply basic electrical concepts to HVAC systems, including power generation, distribution, and circuit design.
- Differentiate between AC and DC circuits and apply the appropriate circuit design for various HVAC applications.
- Demonstrate safe work practices when handling electrical systems, including the proper use of personal protective equipment (PPE).
- Generate and interpret AC power concepts, including single-phase and three-phase systems, to properly power HVAC equipment.
- Identify and describe the function of resistive and inductive components in HVAC circuits and systems.
- Assemble and test electrical circuits to ensure correct operation and adherence to design specifications in HVAC systems.
- Use electrical measurement tools, such as multimeters and oscilloscopes, to diagnose and troubleshoot HVAC electrical issues.
- Apply electrical safety protocols in hands-on tasks, including proper lockout/tagout procedures and the use of appropriate safety gear.
- Interpret electrical schematics and diagrams for HVAC systems to facilitate installation, maintenance, and troubleshooting.
- Perform basic electrical maintenance tasks, such as replacing faulty components and adjusting system settings, to ensure optimal HVAC performance.
- Configure and calibrate electrical controls and automation systems used in HVAC equipment to enhance operational efficiency.
- Identify and resolve common electrical faults in HVAC systems, such as circuit shorts, open circuits, and component failures.
- Monitor and maintain electrical power quality in HVAC systems, including voltage, current, and frequency stability, to ensure reliable operation.

Assessments

- Hands-On Electrical Troubleshooting Assessment
-



- Students will diagnose and repair an electrical issue in an HVAC system, using proper safety protocols and tools. They will troubleshoot components like relays or circuit breakers, ensuring correct operation and compliance with system specifications.
- Scenario-Based Compliance Assessment
 - Students will respond to written scenarios that test their knowledge of technician licensing, trade regulations, and safety protocols, applying these concepts to ensure compliance and safe operation in HVAC systems.

Course: Fundamentals of Cooling

Length: Semester

Standards

- 9.3.12.AC-CST.5: Apply practices and procedures required to maintain jobsite safety.
- 9.3.12.AC-MO.4: Determine worksite conditions to plan for equipment installation.
- 9.3.12.EL-ENG.1: Use engineering systems and manufacturing processes to solve engineering problems.
- 9.3.12.EL-ENG.4: Demonstrate the operation of electrical/electronic systems.
- 9.3.12.EL-MA.2: Operate and maintain electrical tools and equipment.
- 9.3.12.EL-MA.3: Use troubleshooting techniques to identify and repair electrical and electronic systems.
- 9.4.12.IML.6: Use troubleshooting procedures to solve technology problems.
- 9.4.12.CT.1: Identify and define authentic problems and significant questions for investigation.
- 9.4.12.TL.2: Create and publish information about products, using technology tools.

Essential Question(s)

- How does the mechanical refrigeration cycle function, and what are the primary components that make it work?



- What are the common causes of compressor failures in HVAC systems, and how can they be identified and prevented?
- How do different types of refrigerant compressors affect performance and reliability in HVAC systems?
- What are the key EPA regulations and handling requirements for refrigerants, and why is environmental compliance important for HVAC technicians?
- How do metering devices, such as thermal expansion valves, regulate refrigerant flow, and what factors are considered when selecting and installing these components in HVAC systems?

Content

- Understand the principles of the mechanical refrigeration cycle and how it functions in HVAC systems.
- Identify the primary components of a refrigeration system, including compressors, condensers, evaporators, and metering devices.
- Explain the role and operation of refrigerant compressors in the cooling process.
- Recognize common compressor failures and the factors that contribute to these issues.
- Differentiate between the types of compressors used in the HVAC industry and their specific applications.
- Understand the properties and handling requirements of refrigerant oils used in modern HVAC systems.
- Learn the EPA regulations for refrigerant handling and service to ensure environmentally sound practices.
- Understand how refrigerants are circulated within an HVAC system and the function of the refrigerant circuit.
- Identify the components of the metering system, including thermal expansion valves, and understand their purpose in controlling refrigerant flow.
- Describe the process for selecting and installing thermal expansion valves in HVAC systems.
- Troubleshoot cooling systems to diagnose issues related to the refrigeration cycle and compressor operation.
- Explain the role of the distributor in refrigerant systems and how it interacts with other components.
- Understand the importance of proper refrigerant recovery, recycling, and disposal techniques.
- Learn the guidelines for maintaining refrigerant compressors to ensure optimal performance and longevity.
- Interpret performance data for refrigerant compressors to assess system reliability and identify potential problems.

Skills



- Safely operate and troubleshoot refrigerant compressors used in HVAC systems.
- Identify and replace faulty components within the refrigeration cycle, such as compressors and metering devices.
- Properly handle and service refrigerants in compliance with EPA regulations.
- Diagnose and repair common compressor failures using industry-standard tools and techniques.
- Measure and assess refrigerant levels in HVAC systems to ensure optimal cooling performance.
- Install and calibrate thermal expansion valves in refrigeration systems.
- Use diagnostic tools to evaluate the performance of the mechanical refrigeration cycle.
- Perform maintenance tasks on refrigerant compressors to prevent system failures.
- Recover, recycle, and dispose of refrigerants in an environmentally sound manner.
- Select appropriate refrigerant oils and apply them correctly in HVAC systems.
- Troubleshoot and repair issues within the refrigerant circuit, ensuring efficient cooling operation.
- Interpret HVAC schematics and diagrams to accurately service cooling systems.
- Utilize tools such as multimeters and pressure gauges to test refrigerant circuit components.
- Analyze system performance data to identify potential compressor issues before failure.
- Apply EPA requirements for refrigerant handling to minimize environmental impact while servicing HVAC systems.

Assessments

- Compressor Troubleshooting and Repair Assessment
 - Students will diagnose and repair a malfunctioning compressor in a simulated HVAC system. They will follow proper safety protocols, identify the issue, and demonstrate the correct repair or replacement of the faulty component, ensuring the system operates correctly afterward.
 - Refrigerant Handling and Compliance Assessment
 - Students will complete a practical assessment where they demonstrate proper refrigerant handling techniques, including recovery, recycling, and disposal, in compliance with EPA regulations. They will also be tested on their ability to follow environmentally sound practices during HVAC servicing.
-



Course: Fundamentals of Heating:

Length: Semester

Standards

- 9.3.12.AC-CST.5: Apply practices and procedures required to maintain jobsite safety.
- 9.3.12.AC-MO.4: Determine worksite conditions to plan for equipment installation.
- 9.3.12.EL-MA.2: Operate and maintain electrical tools and equipment.
- 9.3.12.EL-MA.3: Use troubleshooting techniques to identify and repair electrical and electronic systems.
- 9.3.12.EL-ENG.3: Troubleshoot electrical/electronic systems to resolve operating problems.
- 9.3.12.EL-ENG.1: Use engineering systems and manufacturing processes to solve engineering problems.
- 9.2.12.CAP.3: Investigate how continuing education, training, certifications, and licensure can enhance career advancement.
- 9.4.12.IML.6: Use troubleshooting procedures to solve technology problems.

Essential Question(s)

- How do gas forced air systems operate, and what are the key components that make them effective in residential heating?
- What are the fundamental differences between gas-fired and oil-fired heating systems, and how do these differences impact system performance and maintenance?
- What are the key steps in troubleshooting common issues with gas-fired furnaces and boilers?
- How does combustion work in heating systems, and why is it critical to ensure safe and efficient operation?
- What are the primary safety considerations when working with residential heating systems, particularly gas and oil-fired systems?

Content



- Understand the basic principles of heat transfer and how they apply to residential heating systems.
- Identify the key components of gas forced air systems and their roles in heating.
- Understand how combustion occurs in heating systems and the importance of proper combustion for safety and efficiency.
- Recognize the differences between gas-fired and oil-fired heating systems in terms of operation, efficiency, and maintenance requirements.
- Understand the construction and operation of gas-fired furnaces and boilers.
- Learn the functions of key components in oil-fired heating systems, including burners, heat exchangers, and fuel delivery systems.
- Understand the safety mechanisms integrated into heating systems, such as limit switches, flame sensors, and pressure switches.
- Explain the process of ignition and flame propagation in gas heating systems.
- Understand the various fuel types used in residential heating systems and their impact on performance and efficiency.
- Identify common problems in gas-fired heating systems and their causes, including ignition failure, airflow issues, and combustion problems.
- Understand the role of thermostats and controls in regulating heating system operation.
- Learn how to read and interpret schematics and wiring diagrams for gas and oil heating systems.
- Understand the environmental impact of different heating systems and the importance of energy-efficient heating practices.
- Recognize the importance of regular maintenance to ensure the safe and efficient operation of residential heating systems.
- Understand basic troubleshooting techniques for both gas and oil-fired heating systems, including diagnosing common component failures.

Skills

- Safely operate and troubleshoot gas-fired furnaces and boilers.
- Identify and replace faulty components in residential heating systems, such as burners, igniters, and heat exchangers.



- Properly adjust and set thermostats to regulate heating systems.
- Diagnose common problems in gas and oil-fired heating systems, such as ignition failure and airflow issues.
- Perform routine maintenance on gas and oil-fired heating systems to ensure optimal performance.
- Read and interpret schematics and wiring diagrams for gas and oil-fired heating systems.
- Use diagnostic tools to evaluate the performance of heating systems and detect operational issues.
- Perform combustion analysis to ensure proper fuel mixture and efficient system operation.
- Replace or repair faulty ignition systems in gas furnaces.
- Install and set up residential heating systems, ensuring compliance with safety regulations.
- Adjust fuel and air ratios to optimize combustion efficiency in oil-fired systems.
- Test and calibrate safety controls, such as limit switches and flame sensors, to prevent system malfunctions.
- Perform a complete inspection of gas-fired and oil-fired heating systems to identify potential safety hazards.
- Recover and recycle heating system fluids and oils following industry standards and regulations.
- Follow proper procedures for venting and exhaust systems to ensure safe operation and compliance with local codes.

Assessments

- Troubleshooting and Repair Practical Assessment
 - Students will diagnose and repair a malfunctioning gas or oil-fired heating system in a hands-on lab environment. They will be evaluated on their ability to identify the problem, follow safety protocols, and perform the necessary repairs to restore system operation.
 - Combustion Efficiency and Safety Assessment
 - Students will conduct a combustion analysis on a heating system, adjusting fuel and air ratios for optimal efficiency. They will also test and calibrate safety controls such as flame sensors and limit switches, ensuring the system operates safely and efficiently.
-



Course: EPA 608 Certification - Core and Type I

Length: Semester

Standards

- 9.3.12.AC-CST.5: Apply practices and procedures required to maintain jobsite safety.
- 9.3.12.EL-MA.3: Use troubleshooting techniques to identify and repair electrical and electronic systems.
- 9.3.12.EM-S.4: Demonstrate the safe use of tools and equipment used in the environmental service industry.
- 9.3.12.EL-ENG.4: Demonstrate the operation of electrical/electronic systems.
- 9.3.12.EL-MA.2: Operate and maintain electrical tools and equipment.
- 9.4.12.IML.6: Use troubleshooting procedures to solve technology problems.
- 9.2.12.CAP.3: Investigate how continuing education, training, certifications, and licensure can enhance career advancement.
- 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem-solving.
- 9.1.12.CR.1: Plan, organize, and assign work within a group to meet project deadlines.

Essential Question(s)

- What are the environmental and safety risks associated with handling refrigerants, and how can they be mitigated?
- Why is the EPA Section 608 certification required for HVAC technicians, and what regulations must be followed when servicing appliances?
- What are the fundamental principles covered in the Core certification, and how do they apply to everyday HVAC work?
- How do the refrigerant handling requirements differ when working with small appliances like refrigerators and air conditioners in Type I certification?
- What are the specific procedures for safely recovering, recycling, and disposing of refrigerants from small appliances to comply with EPA regulations?

Content



- Understand the purpose and importance of the EPA Section 608 certification for HVAC technicians.
- Explain the environmental impact of refrigerants and their role in ozone depletion.
- Understand the different types of refrigerants, their properties, and their classifications.
- Identify the health and safety risks associated with refrigerants and proper handling techniques.
- Understand the regulations surrounding the recovery, recycling, and disposal of refrigerants.
- Learn the penalties for violating EPA regulations regarding refrigerant handling.
- Understand the purpose and process of the Core certification, covering basic HVAC safety and environmental hazards.
- Recognize the specific appliances covered under Type I certification, including small appliances like refrigerators and window air conditioners.
- Understand the legal requirements for servicing, repairing, and disposing of appliances containing controlled refrigerants.
- Identify the equipment required for the recovery of refrigerants from small appliances.
- Understand the process for recovering refrigerants from systems without leaks versus systems with suspected leaks.
- Explain how to properly use and maintain recovery equipment to comply with EPA standards.
- Learn the recordkeeping and reporting requirements mandated by the EPA for refrigerant handling.
- Understand the process for leak detection in small appliances and the appropriate response.
- Explain the legal procedures for purchasing and transporting refrigerants under EPA regulations.

Skills

- Safely recover refrigerants from small appliances in compliance with EPA regulations.
- Properly identify refrigerant types and classify them according to environmental impact and safety guidelines.
- Operate recovery and recycling equipment for refrigerants from domestic appliances like refrigerators and air conditioners.
- Detect and diagnose refrigerant leaks in small appliances and take appropriate corrective actions.
- Follow EPA protocols for the safe disposal of refrigerants to prevent environmental contamination.
- Complete EPA-mandated documentation for refrigerant recovery, recycling, and disposal.



- Adhere to the legal requirements for purchasing and transporting refrigerants.
- Perform safe refrigerant handling techniques to minimize exposure and environmental risk.
- Identify and select appropriate personal protective equipment (PPE) when handling refrigerants.
- Calibrate and maintain refrigerant recovery equipment to ensure proper operation.
- Follow procedures for safely opening systems or containers holding controlled refrigerants.
- Identify and replace faulty components in small appliances that contribute to refrigerant leaks.
- Safely transport and store refrigerants to prevent leaks or contamination.
- Pass the EPA 608 Core and Type I certification exams by demonstrating knowledge of relevant regulations and safe practices.
- Demonstrate proper procedures for recycling and reclaiming refrigerants during appliance servicing.

Assessments

- EPA 608 Certification
 - Core
 - Type I

Course: Employability and Customer Communication

Length: Semester

Standards

- 9.3.12.TD.3: Demonstrate how to interpret and clearly communicate written, verbal, and visual information in an industrial trades environment.
- 9.3.12.BM-HR.2: Access, evaluate, and disseminate information for human resources management decision-making.
- 9.3.12.BM-MGT.2: Access, evaluate, and use information to improve customer relations.



- 9.3.12.BM-HR.4: Plan, monitor, and manage day-to-day business activities to foster a customer-service-oriented work environment.
- 9.4.12.CT.3: Collaborate with individuals inside and outside the organization to solve problems.
- 9.1.12.CR.3: Collaborate with peers to complete tasks and solve problems.
- 9.3.12.BM-MGT.3: Apply ethics and customer service skills to achieve business objectives.
- 9.2.12.CAP.3: Investigate how continuing education, training, certifications, and licensure can enhance career advancement.
- 9.4.12.TL.2: Create and publish information about products using technology tools.

Essential Question(s)

- What strategies can HVAC technicians use to effectively search for and secure employment in the industry?
- How can problem-solving skills enhance a technician's ability to succeed in the HVAC field?
- Why are first impressions important when interacting with customers, and how can technicians ensure a positive customer experience?
- What are the key communication skills needed to convey technical information clearly and professionally in the HVAC industry?
- How can building strong customer relationships impact long-term success in the HVAC trade?

Content

- Understand the process of searching for and applying to positions within the HVAC industry.
- Recognize the importance of developing a professional resume and cover letter tailored to the HVAC trade.
- Understand the role of networking and building professional connections in finding job opportunities.
- Learn how to identify and solve common problems encountered in the workplace to enhance job performance.
- Understand the importance of customer satisfaction in building a successful HVAC career.
- Recognize the impact of a strong first impression when interacting with customers.



- Understand the fundamentals of effective verbal and non-verbal communication in customer interactions.
- Learn how to manage difficult customer situations and resolve conflicts professionally.
- Understand the importance of active listening when addressing customer concerns.
- Recognize the role of time management and reliability in fostering positive customer relationships.
- Understand the basic principles of business ethics and professionalism in the HVAC industry.
- Learn the importance of clear and concise communication when explaining HVAC issues or solutions to customers.
- Understand how to use digital tools, such as email and scheduling apps, to communicate effectively with customers and employers.
- Learn how to follow up with customers after service to maintain relationships and encourage repeat business.
- Understand how to balance technical skills with interpersonal skills to create a well-rounded professional profile in the HVAC trade.

Skills

- Create a professional resume and cover letter specific to the HVAC industry.
- Conduct a job search and apply for positions within the HVAC trade.
- Demonstrate effective problem-solving skills when faced with challenges in the workplace.
- Make a positive first impression during customer interactions, using both verbal and non-verbal communication.
- Handle difficult customer situations with professionalism and calm resolution.
- Communicate technical HVAC issues and solutions clearly and concisely to non-technical customers.
- Practice active listening to fully understand customer concerns and provide accurate solutions.
- Use time management techniques to ensure timely service and customer satisfaction.
- Develop professional networking strategies to expand career opportunities in the HVAC industry.
- Demonstrate professionalism and ethical behavior in customer and employer relationships.
- Use digital tools, such as email and scheduling software, to manage customer communications effectively.
- Resolve customer complaints in a way that maintains a positive relationship and encourages repeat business.
- Follow up with customers after service to gather feedback and build long-term relationships.
- Work collaboratively with team members and supervisors to enhance job performance.



- Balance technical expertise with interpersonal skills to build a strong professional reputation in the HVAC field.

Assessments

- Customer Interaction Role-Play Assessment
 - Students will participate in a role-play scenario where they interact with a "customer" to diagnose an HVAC issue. They will be assessed on their ability to make a positive first impression, communicate technical information clearly, listen actively to customer concerns, and resolve the issue professionally.
- Job Application and Interview Simulation
 - Students will complete a mock job application, including a professional resume and cover letter. They will also participate in a simulated job interview, where they will be assessed on their ability to articulate their skills, experiences, and problem-solving abilities relevant to the HVAC trade.

Course: Heat Pumps, Hydronics, and Oil Heat Fundamentals

Length: Semester

Standards

- 9.3.12.AC-CST.5: Apply practices and procedures required to maintain jobsite safety.
- 9.3.12.EL-MA.3: Use troubleshooting techniques to identify and repair electrical and electronic systems.
- 9.3.12.AC-MO.3: Apply construction skills when installing and maintaining mechanical systems in a building.
- 9.3.12.EL-ENG.4: Demonstrate the operation of electrical/electronic systems.
- 9.3.12.EM-S.4: Demonstrate the safe use of tools and equipment used in the environmental service industry.
- 9.3.12.EM-S.3: Apply proper safety procedures, including lockout/tagout, in working with mechanical, electrical, and chemical systems.
- 9.2.12.CAP.3: Investigate how continuing education, training, certifications, and licensure can enhance career advancement.



- 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem-solving.

Essential Question(s)

- How do heat pumps operate, and what role do electric resistance heating elements play in their function?
- What are the key components and operation principles of hydronic heating systems, and how do they differ from other heating methods?
- What are the common troubleshooting techniques for oil-fired heating systems, and how can technicians identify and repair common issues?
- How are hydrocarbons (HCs) and hydrofluoro-olefins (HFOs) changing the landscape of refrigerants, and what safety standards must be followed when working with these materials?
- What are the environmental and efficiency benefits of alternative heating systems like hydronics and heat pumps in residential applications?

Content

- Understand the basic operation and principles of heat pumps in residential heating systems.
- Learn the function and importance of electric resistance heating elements as supplemental heat in heat pump systems.
- Understand the components and operation of hydronic heating systems, including pumps, valves, and heat exchangers.
- Identify the various types of fluids used in hydronic systems and their specific applications.
- Understand how heat transfer occurs in hydronic systems and the role of thermal conductivity in efficient heating.
- Learn the construction, operation, and components of oil-fired heating systems.
- Understand the common causes of malfunctions in oil-fired heating systems and how to troubleshoot them.
- Identify key safety practices when working with oil-fired heating systems, including proper fuel handling and ventilation.



- Learn the properties and environmental impact of hydrocarbons (HCs) and hydrofluoro-olefins (HFOs) as refrigerants.
- Understand the regulations and safety standards related to handling HCs and HFOs in HVAC systems.
- Learn the advantages and disadvantages of using HCs and HFOs compared to traditional refrigerants.
- Understand the environmental benefits of alternative heating systems, such as heat pumps and hydronic systems.
- Learn the different types of pumps and instruments used in hydronic heating systems and their specific roles.
- Understand the process for selecting, installing, and maintaining heat pumps and hydronic systems.
- Learn about emerging technologies in alternative heating systems and the impact of evolving refrigerants like HFOs on HVAC practices.

Skills

- Install and configure heat pump systems for residential applications.
- Troubleshoot and repair common issues with heat pump systems, including problems with electric resistance heating elements.
- Safely handle and maintain the fluids used in hydronic heating systems.
- Install and service hydronic heating system components, such as pumps, valves, and heat exchangers.
- Perform routine maintenance on oil-fired heating systems to ensure safe and efficient operation.
- Troubleshoot and repair common problems in oil-fired heating systems, such as fuel supply and ignition issues.
- Safely handle and store heating oil in compliance with industry safety standards.
- Conduct proper leak detection and repair in oil-fired heating systems.
- Safely handle, store, and use hydrocarbon (HC) and hydrofluoro-olefin (HFO) refrigerants in HVAC systems.
- Follow safety protocols and regulations when servicing systems that use HCs and HFOs as refrigerants.
- Conduct a combustion analysis of oil-fired heating systems to ensure proper fuel efficiency.
- Size and select the appropriate pumps and instruments for hydronic heating systems based on system requirements.
- Read and interpret schematics and diagrams for heat pump, hydronic, and oil-fired heating systems.
- Perform efficiency tests on heat pumps and hydronic systems to ensure optimal operation.



- Implement environmentally sound practices in the installation and servicing of HVAC systems using alternative refrigerants like HCs and HFOs.

Assessments

- Heat Pump Installation and Troubleshooting Assessment
 - Students will be tasked with installing a residential heat pump system, including configuring electric resistance heating elements. They will troubleshoot a simulated issue with the system and perform necessary repairs, demonstrating their understanding of proper installation and diagnostic techniques.
- Hydronic System and Oil Furnace Practical Assessment
 - Students will perform a hands-on assessment where they install, service, and troubleshoot a hydronic heating system and an oil-fired furnace. They will be evaluated on their ability to safely handle fluids, repair common system malfunctions, and follow safety protocols related to oil systems and refrigerants like HCs and HFOs.

Course: EPA 608 Certification - Type II and Type III

Length: Semester

Standards

- 9.3.12.EM-S.4: Demonstrate the safe use of tools and equipment used in the environmental service industry.
- 9.3.12.EL-MA.3: Use troubleshooting techniques to identify and repair electrical and electronic systems.
- 9.3.12.AC-CST.5: Apply practices and procedures required to maintain jobsite safety.
- 9.3.12.EM-S.3: Apply proper safety procedures, including lockout/tagout, in working with mechanical, electrical, and chemical systems.
- 9.3.12.EM-S.5: Identify the impact of government, industry, and organizational policies and regulations on environmental services.
- 9.3.12.AC-MO.4: Operate and maintain mechanical systems in construction projects.



- 9.2.12.CAP.3: Investigate how continuing education, training, certifications, and licensure can enhance career advancement.
- 9.3.12.EL-ENG.4: Demonstrate the operation of electrical/electronic systems.
- 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem-solving.

Essential Question(s)

- What are the key differences between high-pressure and low-pressure refrigerants, and how do they affect the servicing of HVAC systems?
- Why is it essential for HVAC technicians to obtain Type II and Type III certifications when working with different refrigerant systems?
- What safety protocols and EPA regulations must be followed when handling and disposing of high-pressure and low-pressure refrigerants?
- How do the recovery, recycling, and disposal processes differ for equipment using high-pressure versus low-pressure refrigerants?
- What are the common challenges technicians face when servicing chillers and high-pressure systems, and how can these be effectively addressed while ensuring compliance with EPA standards?

Content

- Understand the EPA regulations governing the handling, recovery, and disposal of high-pressure and low-pressure refrigerants.
- Learn the environmental impact of refrigerants and the importance of following EPA guidelines to minimize ozone depletion.
- Understand the differences between high-pressure refrigerants (Type II) and low-pressure refrigerants (Type III).
- Recognize the types of equipment that use high-pressure refrigerants, such as residential air conditioners and supermarket refrigeration systems.
- Understand the operation and servicing requirements of low-pressure refrigerant systems, including chillers.



- Learn the proper procedures for recovering and recycling refrigerants from high-pressure and low-pressure systems.
- Understand the safety precautions necessary when working with pressurized refrigerant systems.
- Learn the components of high-pressure HVAC systems and how to properly maintain and repair them.
- Understand the unique challenges associated with servicing chillers and low-pressure systems.
- Learn the correct techniques for leak detection and repair in both high-pressure and low-pressure systems.
- Understand the legal requirements for disposing of refrigerants and refrigerant-containing equipment.
- Learn how to safely open systems containing high-pressure and low-pressure refrigerants for servicing or repairs.
- Understand the role of certification in ensuring compliance with EPA refrigerant regulations.
- Learn the proper use and maintenance of recovery and recycling equipment for both high-pressure and low-pressure systems.
- Understand the testing process for EPA Type II and Type III certifications, including the types of questions and topics covered.

Skills

- Safely recover and recycle high-pressure refrigerants from residential and commercial HVAC systems.
- Properly service and maintain low-pressure refrigerant systems, such as chillers.
- Use appropriate equipment to detect and repair leaks in high-pressure and low-pressure refrigerant systems.
- Apply EPA regulations when handling, storing, and disposing of refrigerants.
- Operate recovery and recycling equipment in compliance with EPA standards for both high-pressure and low-pressure systems.
- Follow safety protocols when opening systems containing controlled refrigerants for servicing.
- Identify and categorize refrigerants used in various high-pressure and low-pressure systems.
- Properly dispose of equipment containing high-pressure or low-pressure refrigerants in an environmentally sound manner.
- Troubleshoot and repair components of high-pressure refrigerant systems, such as compressors and condensers.
- Diagnose and repair problems in low-pressure systems, such as leaks and refrigerant loss.



- Perform maintenance on chiller systems, ensuring safe and efficient operation.
- Prepare for and pass the EPA Type II and Type III certification exams.
- Record and document refrigerant recovery, recycling, and disposal in accordance with EPA requirements.
- Recognize and address common issues in supermarket refrigeration and process refrigeration systems.
- Ensure compliance with all legal and safety standards when servicing or disposing of refrigerant systems.

Assessments

- EPA 608 Certification
 - Type II
 - Type III

Course: Air Distribution and Duct Systems Fundamentals

Length: Semester

Standards

- 9.3.12.AC-CST.5: Apply practices and procedures required to maintain jobsite safety.
- 9.3.12.AC-MO.4: Operate and maintain mechanical systems in construction projects.
- 9.3.12.EL-MA.3: Use troubleshooting techniques to identify and repair electrical and mechanical systems.
- 9.3.12.EM-S.4: Demonstrate the safe use of tools and equipment used in the environmental service industry.
- 9.3.12.EM-S.3: Apply proper safety procedures, including lockout/tagout, in working with mechanical, electrical, and chemical systems.
- 9.3.12.EL-ENG.4: Demonstrate the operation of electrical/electronic systems.
- 9.3.12.EL-MA.2: Operate and maintain electrical tools and equipment.
- 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem-solving.



Essential Question(s)

- How do air movement principles influence the design and efficiency of air distribution systems in HVAC?
- What are the key components of a sheet metal duct system, and how do they contribute to airflow and system durability?
- How does proper maintenance of HVAC components, such as lubrication and belt installation, impact system performance?
- Why is indoor air quality (IAQ) important in HVAC systems, and how can ductwork influence air quality?
- What are the best practices for sealing and insulating duct systems to prevent heat loss or gain and improve overall system efficiency?

Content

- Understand the basic principles of air movement and their application in air distribution system design.
- Learn how to identify and use key components of air distribution systems, including dampers, registers, and diffusers.
- Understand the purpose and function of various air measurement devices used in HVAC systems.
- Learn to interpret charts and data related to air distribution and system performance.
- Understand the design and construction principles of sheet metal duct systems and their advantages in HVAC applications.
- Learn how to properly seal and insulate duct systems to prevent heat loss or gain.
- Understand the importance of low resistance airflow in duct design to improve system efficiency.
- Learn the impact of improperly sealed ductwork on overall HVAC system performance.
- Understand how to conduct basic maintenance activities, including lubrication of HVAC components and belt installation.
- Learn the procedures for performing maintenance inspections on gas furnaces, cooling, and heat pump systems.
- Understand the relationship between air distribution and indoor air quality (IAQ) in residential and commercial settings.
- Learn how to assess and improve indoor air quality through proper air distribution and duct design.



- Understand the different methods of assembling sheet metal duct systems, including connections and fasteners.
- Learn the safety protocols required when working with sheet metal and HVAC systems.
- Understand how to evaluate and improve system performance through regular maintenance and proper ductwork installation.

Skills

- Design and install air distribution systems that maximize airflow efficiency.
- Measure and interpret air flow using air measurement devices and charts.
- Assemble and install sheet metal duct systems, ensuring proper airflow and durability.
- Properly seal and insulate duct systems to prevent heat loss or gain.
- Perform routine maintenance tasks, including lubricating HVAC components and installing belts.
- Conduct maintenance inspections on gas furnaces, cooling systems, and heat pumps.
- Identify and address common issues that affect air distribution efficiency in HVAC systems.
- Use safety procedures when working with sheet metal and HVAC components.
- Diagnose and resolve problems related to poor indoor air quality (IAQ) in HVAC systems.
- Apply best practices for sealing ductwork to minimize air leaks and energy loss.
- Troubleshoot issues related to improper duct installation or damage.
- Perform calculations to ensure balanced air distribution in HVAC systems.
- Select appropriate components for air distribution systems based on design needs.
- Identify signs of ductwork wear or damage and perform repairs as needed.
- Evaluate the effectiveness of air distribution systems through testing and performance analysis.

Assessments

- Air Distribution System Design and Installation Assessment
 - Students will design and install a basic air distribution system, including the proper selection and installation of ductwork, dampers, registers, and diffusers. They will be evaluated on the system's airflow efficiency, sealing, and insulation practices, ensuring minimal heat loss or gain.
-



- Maintenance and Inspection Practical Assessment
 - Students will perform a full maintenance inspection on an HVAC system, including lubrication of components, belt installation, and an assessment of a gas furnace or heat pump. They will be assessed on their ability to follow proper procedures and identify potential issues affecting system performance.

Course: System Sizing, Stainless Steel Tubing, and Green HVAC Practices

Length: Semester

Standards

- 9.3.12.AC-CST.5: Apply practices and procedures required to maintain jobsite safety.
- 9.3.12.AC-MO.4: Operate and maintain mechanical systems in construction projects.
- 9.3.12.EL-MA.3: Use troubleshooting techniques to identify and repair electrical and mechanical systems.
- 9.3.12.EM-S.4: Demonstrate the safe use of tools and equipment used in the environmental service industry.
- 9.3.12.EM-S.5: Identify the impact of government, industry, and organizational policies and regulations on environmental services.
- 9.3.12.EL-MA.2: Operate and maintain electrical tools and equipment.
- 9.3.12.AC-CST.8: Demonstrate the implementation of sustainable practices in the construction industry.
- 9.2.12.CAP.3: Investigate how continuing education, training, certifications, and licensure can enhance career advancement.

Essential Question(s)

- How does the use of Manual J and D impact the proper sizing of HVAC systems for efficiency and performance?
- What are the best practices for installing and maintaining corrugated stainless steel tubing in HVAC applications?



- How does routine maintenance, such as lubrication and belt installation, contribute to the longevity and efficiency of HVAC systems?
- What are the key principles of Green HVAC certification, and how do they promote energy conservation in the industry?
- How can HVAC professionals integrate green technologies into system design and installation to reduce environmental impact?

Content

- Understand the purpose and application of Manual J and Manual D for accurately sizing HVAC systems.
- Learn the principles behind system sizing and its importance for energy efficiency and comfort.
- Understand the use and installation of corrugated stainless steel tubing (CSST) in HVAC systems.
- Learn the best practices for safely handling and installing CSST to prevent leaks and ensure system integrity.
- Understand the role of HVAC maintenance in system performance, including lubrication and belt installation.
- Learn the proper procedures for performing routine maintenance on HVAC components.
- Understand the key concepts of Green HVAC certification and its role in promoting energy efficiency.
- Learn about the environmental and economic benefits of implementing green technologies in HVAC systems.
- Understand the principles of energy conservation and how they apply to heating and cooling systems.
- Learn how to evaluate the energy efficiency of HVAC systems and identify areas for improvement.
- Understand the impact of system sizing on energy use, operating costs, and customer satisfaction.
- Learn how to integrate green HVAC technologies into system design and installation.
- Understand the importance of reducing the carbon footprint in HVAC system operations.
- Learn how to properly size HVAC systems for residential and commercial applications using industry-standard methods.
- Understand the safety standards and codes related to the installation and maintenance of CSST and other HVAC components.

Skills



- Accurately size HVAC systems using Manual J and Manual D calculations for residential and commercial applications.
- Install and properly secure corrugated stainless steel tubing (CSST) in HVAC systems following best practices.
- Perform routine HVAC maintenance tasks, including lubrication and belt installation, to ensure efficient system operation.
- Apply energy conservation principles to design and install HVAC systems that reduce environmental impact.
- Inspect and maintain HVAC systems to improve energy efficiency and prolong system life.
- Identify opportunities to integrate green technologies into HVAC systems to enhance sustainability.
- Follow safety protocols for handling and installing CSST to prevent leaks and ensure proper functionality.
- Troubleshoot and repair issues in HVAC systems related to improper sizing or maintenance.
- Evaluate the energy efficiency of existing HVAC systems and recommend improvements.
- Use diagnostic tools to assess the performance of HVAC components and ensure optimal operation.
- Apply green HVAC certification knowledge to assess and reduce the carbon footprint of HVAC systems.
- Select appropriate HVAC components and materials based on system sizing and energy efficiency requirements.
- Perform detailed inspections of HVAC systems to ensure compliance with green HVAC standards.
- Implement best practices for reducing energy consumption in heating and cooling systems.
- Interpret technical diagrams and manuals to install, maintain, and troubleshoot HVAC systems.

Assessments

- HVAC System Sizing and Installation Assessment
 - Students will be tasked with performing a system sizing calculation using Manual J and D for a residential or commercial building. They will then demonstrate proper installation techniques for HVAC components, including corrugated stainless steel tubing (CSST), ensuring compliance with safety and industry standards.
 - Green HVAC and Maintenance Practical Assessment
 - Students will conduct a maintenance inspection on an HVAC system, including lubrication and belt installation. They will also assess the system for energy efficiency and recommend green technology improvements, demonstrating their understanding of green HVAC principles and energy conservation.
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Course: Residential Split System/ Gas Furnace Proficiency

Length: Semester

Standards

- 9.3.12.AC-CST.5: Apply practices and procedures required to maintain jobsite safety.
- 9.3.12.AC-MO.4: Operate and maintain mechanical systems in construction projects.
- 9.3.12.EL-MA.3: Use troubleshooting techniques to identify and repair electrical and mechanical systems.
- 9.3.12.EL-MA.2: Operate and maintain electrical tools and equipment.
- 9.3.12.EM-S.4: Demonstrate the safe use of tools and equipment used in the environmental service industry.
- 9.3.12.EM-S.3: Apply proper safety procedures, including lockout/tagout, in working with mechanical, electrical, and chemical systems.
- 9.2.12.CAP.3: Investigate how continuing education, training, certifications, and licensure can enhance career advancement.
- 9.3.12.EL-ENG.4: Demonstrate the operation of electrical/electronic systems.

Essential Question(s)

- What are the key steps involved in properly installing residential split systems and gas furnaces?
- How can HVAC technicians effectively troubleshoot common issues in residential split systems and gas furnaces?
- What methods and tools are used to test the efficiency of a gas furnace and a residential split system?
- How does system efficiency impact energy consumption and overall performance in residential HVAC systems?
- What advanced troubleshooting techniques can be used to identify and resolve efficiency problems in gas furnaces and split systems?



Content

- Understand the components and function of residential split systems and gas furnaces.
- Learn the installation procedures for residential split systems, including refrigerant lines, electrical connections, and indoor/outdoor units.
- Understand the proper installation process for gas furnaces, including venting, ductwork, and gas line connections.
- Learn the safety protocols for handling and installing gas furnaces and refrigerant systems.
- Understand the principles of combustion and how they apply to gas furnace operation.
- Learn how to troubleshoot common issues in residential split systems, including refrigerant leaks, airflow problems, and electrical faults.
- Understand the methods for diagnosing and repairing gas furnace malfunctions, such as ignition failures and thermostat issues.
- Learn how to measure and evaluate system airflow and refrigerant charge to ensure proper system operation.
- Understand the importance of regular maintenance for optimizing system performance and longevity.
- Learn the key factors affecting the energy efficiency of residential split systems and gas furnaces.
- Understand the importance of proper system sizing and its effect on performance and efficiency.
- Learn how to test the efficiency of a gas furnace and residential split system using industry-standard tools.
- Understand the environmental impact of inefficient systems and the benefits of improving HVAC efficiency.
- Learn advanced techniques for troubleshooting and improving the efficiency of HVAC systems.
- Understand how to analyze system performance data to identify opportunities for improving efficiency and reducing energy consumption.

Skills

- Install residential split systems, including refrigerant lines, electrical components, and both indoor and outdoor units.
- Properly install gas furnaces, ensuring correct venting, ductwork, and gas line connections.
- Troubleshoot and repair common issues in residential split systems, such as refrigerant leaks, electrical malfunctions, and airflow problems.



- Diagnose and resolve problems in gas furnaces, including ignition failures, thermostat malfunctions, and combustion issues.
- Safely handle and install HVAC components, following proper safety protocols for refrigerants and gas furnaces.
- Measure system airflow and refrigerant charge to ensure optimal performance in residential split systems.
- Test and adjust gas pressure and airflow in gas furnaces to ensure efficient and safe operation.
- Use diagnostic tools to measure and evaluate the efficiency of residential split systems and gas furnaces.
- Perform routine maintenance tasks, such as cleaning coils, changing filters, and inspecting heat exchangers.
- Apply advanced troubleshooting techniques to improve system efficiency and resolve complex HVAC issues.
- Test for proper operation of electrical components, including capacitors, relays, and motors in HVAC systems.
- Identify and correct system imbalances, such as improper airflow or refrigerant charge, to optimize system performance.
- Analyze efficiency test results and recommend adjustments or repairs to improve system performance.
- Perform a complete system efficiency evaluation on both split systems and gas furnaces using industry-standard methods.
- Interpret and follow technical diagrams, schematics, and manufacturer specifications during installation and troubleshooting tasks.

Assessments

- Installation and Troubleshooting Practical Assessment
 - Students will be tasked with installing a residential split system and gas furnace in a lab setting. They will demonstrate proper installation techniques, troubleshoot simulated issues, and ensure the systems are operating efficiently. Students will be assessed on accuracy, safety practices, and their ability to resolve common HVAC problems.
 - System Efficiency Testing Assessment
 - Students will perform an efficiency test on both a residential split system and a gas furnace using diagnostic tools. They will measure refrigerant charge, airflow, and combustion efficiency, and then analyze the data to make recommendations for improving system performance. Assessment will focus on their ability to accurately test and interpret results.
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Course: Codes and Ordinances

Length: Semester

Standards

- 9.3.12.AC-CST.5: Apply practices and procedures required to maintain jobsite safety.
- 9.3.12.AC-CST.8: Demonstrate the implementation of sustainable practices in the construction industry.
- 9.3.12.AC-MO.4: Operate and maintain mechanical systems in construction projects.
- 9.3.12.EL-ENG.4: Demonstrate the operation of electrical/electronic systems.
- 9.3.12.EM-S.5: Identify the impact of government, industry, and organizational policies and regulations on environmental services.
- 9.3.12.EM-S.3: Apply proper safety procedures, including lockout/tagout, in working with mechanical, electrical, and chemical systems.
- 9.4.12.CT.1: Identify and define authentic problems and significant questions for investigation.
- 9.2.12.CAP.3: Investigate how continuing education, training, certifications, and licensure can enhance career advancement.

Essential Question(s)

- How do local, state, and national codes impact the design, installation, and maintenance of HVAC systems?
- What are the key building and safety codes that HVAC technicians must follow to ensure compliance and safe system operation?
- How do zoning laws affect the installation and placement of HVAC systems in residential and commercial buildings?
- What role do energy efficiency standards and environmental regulations play in the development and maintenance of HVAC systems?



- How can HVAC technicians interpret and apply codes and ordinances to ensure compliance in real-world installations and maintenance tasks?

Content

- Understand the purpose and importance of local, state, and national codes governing HVAC systems.
- Learn how to interpret building codes and safety regulations for HVAC installations.
- Understand the key elements of zoning laws that affect the placement and operation of HVAC systems.
- Learn about energy efficiency standards and their impact on HVAC system design and performance.
- Understand the environmental regulations that apply to HVAC systems, particularly concerning refrigerants and emissions.
- Learn how to apply the National Electrical Code (NEC) to HVAC installations.
- Understand the role of OSHA (Occupational Safety and Health Administration) standards in maintaining a safe working environment during HVAC installations and repairs.
- Learn the significance of ASHRAE (American Society of Heating, Refrigerating, and Air-Conditioning Engineers) standards in the HVAC industry.
- Understand the process for obtaining permits and inspections for HVAC system installations and modifications.
- Learn how to ensure compliance with fire safety codes when installing HVAC systems.
- Understand the importance of ventilation codes and indoor air quality (IAQ) regulations.
- Learn the legal requirements for energy-efficient HVAC systems, such as those outlined in LEED (Leadership in Energy and Environmental Design) certifications.
- Understand how building codes differ between residential and commercial HVAC installations.
- Learn how to interpret and apply mechanical codes related to ductwork, piping, and ventilation.
- Understand the consequences of non-compliance with HVAC codes and ordinances, including fines and legal liability.

Skills

- Interpret and apply local, state, and national HVAC codes to ensure compliance in installations.



- Analyze building codes to determine HVAC system requirements for residential and commercial applications.
- Apply zoning laws to correctly install HVAC systems in compliance with local regulations.
- Ensure HVAC systems meet energy efficiency standards during design and installation.
- Follow environmental regulations regarding refrigerants and emissions when installing or servicing HVAC systems.
- Apply the National Electrical Code (NEC) to safely wire HVAC equipment.
- Ensure compliance with OSHA safety standards while performing HVAC installations or repairs.
- Implement ASHRAE standards when designing and installing HVAC systems.
- Obtain and process permits for HVAC installations, ensuring all paperwork complies with legal requirements.
- Inspect HVAC systems to ensure they meet fire safety codes and regulations.
- Verify that ventilation systems comply with indoor air quality (IAQ) standards and related codes.
- Perform energy audits to confirm HVAC systems meet energy efficiency and LEED requirements.
- Distinguish between residential and commercial HVAC codes and apply them appropriately.
- Interpret mechanical codes to properly size and install ductwork, piping, and ventilation systems.
- Identify and rectify non-compliance issues in existing HVAC systems to avoid legal and safety penalties.

Assessments

- Code Interpretation and Application Assessment
 - Students will be given various scenarios involving HVAC installations in residential and commercial settings. They will be required to interpret the relevant local, state, and national codes and ordinances and apply them to ensure compliance. Students will be assessed on their ability to accurately analyze and implement the appropriate codes in each scenario.
 - Permit and Inspection Simulation Assessment
 - Students will complete a simulation where they must obtain the necessary permits for an HVAC installation and prepare the system for inspection. They will be evaluated on their understanding of the permit process, adherence to relevant codes, and their ability to ensure the system meets legal and safety requirements during the inspection.
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Resources

→ Course Resources

- ◆ NCCER- Core Curriculum: Introductory Craft Skills - Pearson Fifth edition ,2015.
- ◆ NCCER- Heating,Ventilating and Air Conditioning- Level 1 - Pearson Fourth edition ,2013.

- ◆ NCCER- Heating,Ventilating and Air Conditioning- Level 2 - Pearson Fourth edition ,2013.
- ◆ NCCER- Heating,Ventilating and Air Conditioning- Level 3 - Pearson Fourth edition ,2013.
- ◆ NCCER- Basic Math for the Construction Trades- Pearson Fifth edition ,2015.
- ◆ Mainstream Engineering EPA 608, HC/HFO, IAQ, Maintenance, Green Systems
- ◆ CareerSafe Online, <https://campus.careersafeonline.com/> - OSHA 10-Hour Construction Industry