Florida Department of Education
Curriculum Framework

Program Title: **Heating, Ventilation, Air-Conditioning/Refrigeration (HVAC/R)**
Program Type: **Career Preparatory**
Career Cluster: **Architecture and Construction**

Career Certificate Program		
Program Number	C400400	
CIP Number	0615050110	
Grade Level	30, 31	
Program Length	1350 Hours	
Teacher Certification	Refer to the **Program Structure** section.	
CTSO	SkillsUSA	
SOC Codes (all applicable)	Please see the CIP to SOC Crosswalk located at the link below.	
CTE Program Resources	http://www.fldoe.org/academics/career-adult-edu/career-tech-edu/program-resources.stml	
Basic Skills Level	Computations (Mathematics): 10	Communications (Reading and Language Arts): 9

Purpose

The purpose of this program is to prepare students for employment or advanced training in the heating, ventilation, air-conditioning/refrigeration (HVAC/R) industry. The student should obtain EPA certification prior to leaving school in order to be employed in any job that requires work with refrigerants. This program focuses on broad, transferable skills, stresses the understanding of the heating, air-conditioning, refrigeration and ventilation industry and demonstrates elements of the industry such as planning, management, finance, technical and production skills, the underlying principles of technology, and health, safety and environmental issues.

This program offers a sequence of courses that provides coherent and rigorous content aligned with challenging academic standards and relevant technical knowledge and skills needed to prepare for further education and careers in the Architecture and Construction career cluster; provides technical skill proficiency, and includes competency-based applied learning that contributes to the academic knowledge, higher-order reasoning and problem-solving skills, work attitudes, general employability skills, technical skills, and occupation-specific skills, and knowledge of all aspects of the Architecture and Construction career cluster.

The content includes but is not limited to designing, testing and repairing heating, ventilation, air-conditioning/refrigeration (HVAC/R) systems.

Additional Information relevant to this Career and Technical Education (CTE) program is provided at the end of this document.

Program Structure

This program is a planned sequence of instruction consisting of five occupational completion points.

This program is comprised of courses which have been assigned course numbers in the SCNS (Statewide Course Numbering System) in accordance with Section 1007.24 (1), F.S. Career and Technical credit shall be awarded to the student on a transcript in accordance with Section 1001.44(3)(b), F.S.

To teach the courses listed below, instructors must hold at least one of the teacher certifications indicated for that course.

The following table illustrates the postsecondary program structure:

OCP	Course Number	Course Title	Teacher Certification	Length
A	ACR0000	Introduction to HVAC/R	AC HEAT ME @7 7G REFRG MECH 7 G	250 Hours
B	ACR0001	HVAC/R Fundamentals		250 Hours
C	ACR0012	HVAC/R Service Practices		250 Hours
D	ACR0013	HVAC/R Intermediate Service Practices		250 Hours
E	ACR0044 **OR** ACR0045	HVAC/R Advanced Service Practices (formerly 'Air-Conditioning, Refrigeration and Heating Technician')* **OR** HVAC/R Advanced Commercial and Industrial Service Practices (formerly 'Refrigeration Mechanic')*		350 Hours **OR** 350 Hours

***NOTE: Students may choose one of the following courses for the completion of OCP E: ACR0044 or ACR0045**

Common Career Technical Core – Career Ready Practices

Career Ready Practices describe the career-ready skills that educators should seek to develop in their students. These practices are not exclusive to a Career Pathway, program of study, discipline or level of education. Career Ready Practices should be taught and reinforced in all career exploration and preparation programs with increasingly higher levels of complexity and expectation as a student advances through a program of study.

1. Act as a responsible and contributing citizen and employee.

2. Apply appropriate academic and technical skills.

3. Attend to personal health and financial well-being.

4. Communicate clearly, effectively and with reason.

5. Consider the environmental, social and economic impacts of decisions.

6. Demonstrate creativity and innovation.

7. Employ valid and reliable research strategies.

8. Utilize critical thinking to make sense of problems and persevere in solving them.

9. Model integrity, ethical leadership and effective management.

10. Plan education and career path aligned to personal goals.

11. Use technology to enhance productivity.

12. Work productively in teams while using cultural/global competence.

Standards

After successfully completing this program, the student will be able to perform the following:

Introduction to HVAC/R

01.0 Demonstrate the importance of health, safety and environmental management systems in organizations and their importance to organizational performance and regulatory compliance.
02.0 Explain the importance of employability, soft skills, entrepreneurship skills and making career plans.
03.0 Identify, use and maintain the tools and tool accessories used in the heating, air-conditioning and refrigeration industry.
04.0 Demonstrate mathematics knowledge and skills.
05.0 Explain the properties of matter and heat behavior.
06.0 Describe the history and concepts of heating, air-conditioning and refrigeration.
07.0 Analyze fluids, pressures, refrigerants and related codes.
08.0 Evaluate heating, air-conditioning and refrigeration system components and accessories.
09.0 Fabricate and service the piping, tubing and fittings used in the heating, air-conditioning & refrigeration industry.
10.0 Utilize and operate mechanical refrigeration servicing and testing equipment.

HVAC/R Fundamentals

11.0 Demonstrate a practical knowledge of basic electricity and of the electrical components of heating, air-conditioning and refrigeration equipment.
12.0 Demonstrate knowledge of electrical wiring in air-conditioning and refrigeration.
13.0 Troubleshoot heating, air-conditioning and refrigeration electrical control systems and their components.
14.0 Select and test electrical generation and distribution components for commercial heating and air conditioning systems.
15.0 Maintain, test and troubleshoot electrical motors and their components for commercial heating and air-conditioning systems.

HVAC/R Service Practices

16.0 Utilize mechanical components of heating air-conditioning and refrigeration systems.
17.0 Operate solid-state electronics as used in heating, air-conditioning and refrigeration systems.
18.0 Read construction documents.
19.0 Assist in the installation of a residential heating and air-conditioning system and determine start-up procedures.
20.0 Conduct start-up and check-out procedures for mechanical heating and air-conditioning systems.
21.0 Use combustion-type heating servicing and testing equipment.
22.0 Troubleshoot combustion gas valves and regulators as used in heating, air-conditioning, refrigeration and ventilation systems.
23.0 Understand the design of heating and cooling systems.
24.0 (Optional) Explain the importance of employability, soft skills, entrepreneurship skills and making career plans.

HVAC/R Intermediate Service Practices

25.0 Select appropriate commercial compressors.
26.0 Test and adjust commercial evaporative condensers.
27.0 Maintain, test and troubleshoot commercial evaporators.

28.0 Identify basic principles of heating, air conditioning, refrigeration and ventilation piping sizing.
29.0 Maintain, troubleshoot and repair commercial heating systems.
30.0 Discuss new HVAC/R technologies.
31.0 Interpret, use and modify construction drawings and specifications.
32.0 Troubleshoot and repair commercial heating and air-conditioning systems.

HVAC/R Advanced Service Practices (option 1)
33.0 Develop an understanding of hydronic systems.
34.0 Determine the properties of air.
35.0 Use a pressure enthalpy chart to diagram refrigerant cycles.
36.0 Explain the standards for and ways to measure indoor air quality.
37.0 (Optional) Identify and understand pneumatic control systems for commercial heating and air-conditioning applications.
38.0 Develop an understanding of chilled systems.
39.0 (Optional) Maintain and repair thermal storage systems.
40.0 Understand and explain the calculation of commercial heating and air-conditioning loads.
41.0 Balance an air distribution system.
42.0 Select energy conservation equipment.
43.0 Analyze building management systems.
44.0 (Optional) Recommend alternative heating and cooling systems for various case studies.

HVAC/R Advanced Commercial and Industrial Service Practices (option 2)
45.0 Demonstrate knowledge of retail refrigeration systems.
46.0 Demonstrate knowledge of commercial and industrial refrigeration systems.
47.0 Demonstrate a working knowledge of electrical generation and distribution components for commercial heating and air conditioning systems.
48.0 Demonstrate a working knowledge of refrigeration system vibration and insulation.
49.0 Apply commercial refrigeration pipe sizing and troubleshooting procedures.
50.0 Use refrigeration systems skills in commercial applications.
51.0 Demonstrate a working knowledge of refrigerated storage systems.
52.0 Diagnose, maintain and repair ice making systems.
53.0 Use refrigeration electrical system skills in commercial applications.
54.0 Maintain and troubleshoot commercial refrigeration systems.

Florida Department of Education
Student Performance Standards

Program Title: Heating, Ventilation, Air-Conditioning/Refrigeration (HVAC/R)
Career Certificate Program Number: C400400

Course Number: ACR0000 **Occupational Completion Point: A** **Introduction to HVAC/R – 250 Hours**	
01.0	Demonstrate the importance of health, safety and environmental management systems in organizations and their importance to organizational performance and regulatory compliance. The student will be able to:
01.01	Describe personal and jobsite safety rules and regulations that maintain safe and healthy work environments.
01.02	Explain the reasons for regular safety meetings and for company safety policies.
01.03	Explain the need for employee-background checks and medical examinations.
01.04	Identify appropriate fire extinguishers and other such safety devices.
01.05	Identify and follow emergency and rescue procedures.
01.06	Identify and use safe-handling practices as they relate to hazardous and volatile fluids, compounds and gases.
01.07	Demonstrate Occupational Safety and Health Administration (OSHA) 10, Environmental Protection Agency (EPA) practices, Department of Transportation (DOT) hazardous materials safety requirements, lock-out and tag out, and electrical safety.
01.08	Obtain EPA 608 HVAC Technician, OSHA 10 or OSHA 30 Construction Industry training and, optionally, the associated certification.
01.09	Select and wear proper protective clothing and equipment.
01.10	Describe the purpose and requirements of local, state and federal heating, air-conditioning and refrigeration codes and standards as well as the manufacturer's installation instructions.
01.11	Identify and use OSHA practices when working with heating, air-conditioning and refrigeration systems and equipment.
01.12	Explain emergency procedures to follow in response to workplace accidents.
01.13	Understand a disaster and/or emergency response plan.
02.0	Explain the importance of employability, soft skills, entrepreneurship skills and making career plans. The student will be able to:
02.01	Identify and demonstrate positive work behaviors, including soft skills and entrepreneurship skills, needed to be employable.
02.02	Develop personal career plan that includes goals, objectives and strategies.

	02.03 Create and maintain a career portfolio to document knowledge, skills and experience. (Optional)
	02.04 Exhibit a professional appearance through appropriate grooming and attire.
	02.05 Evaluate and compare employment opportunities that match career goals.
	02.06 Identify and exhibit traits for retaining employment.
	02.07 Identify opportunities and research requirements for career advancement.
	02.08 Research the benefits of ongoing professional development.
	02.09 Examine licensing, certification and industry credentialing requirements.
03.0	Identify, use and maintain the tools and tool accessories used in the heating, air-conditioning and refrigeration industry. The student will be able to:
	03.01 Follow safety precautions when using hand and power tools.
	03.02 Identify and use basic hand tools and tool accessories; power tools (electric and mechanical); pipe and tube-working tools; and specialized tools of the trade.
	03.03 Apply appropriate care and maintenance procedures for tools and tool accessories, following the directions in the tool-equipment manufacturer's manual.
	03.04 Include manufacturer’s representative and tool distributors for participation in class instruction. (Optional)
04.0	Demonstrate mathematics knowledge and skills. The student will be able to:
	04.01 Demonstrate knowledge of arithmetic operations.
	04.02 Analyze and apply data and measurements to solve problems and interpret documents.
05.0	Explain the properties of matter and heat behavior. The student will be able to:
	05.01 Describe and explain freezing point, critical temperature and absolute zero.
	05.02 Explain the gas laws (Dalton, Boyle and Charles) used when dealing with air and its properties.
	05.03 Describe matter, heat and heat transfer.
	05.04 Differentiate between heat and temperature.
	05.05 Explain and distinguish among the characteristics of the three states of matter.
	05.06 Explain the relationship between temperature and humidity.

	05.07 Differentiate between latent heat and sensible heat.
06.0	Describe the history and concepts of heating, air-conditioning and refrigeration. The student will be able to:
	06.01 Explain the basic principles of heating, ventilation and air-conditioning.
	06.02 Identify the refrigeration cycle.
	06.03 Identify and explain the four major refrigeration components.
	06.04 Identify and explain the characteristics of a compression-cycle refrigerant system.
	06.05 Differentiate between air-conditioning and refrigeration.
	06.06 Differentiate between split systems, mini-splits and package systems.
07.0	Analyze fluids, pressures, refrigerants and related codes. The student will be able to:
	07.01 Identify and explain general safety issues and EPA rules and regulations regarding the handling of refrigerants.
	07.02 Define and explain pressure, fluid and temperature.
	07.03 Explain the standards for and ways to measure and calculate absolute and gauge pressures.
	07.04 Identify and explain the classifications, properties and uses of different refrigerants based on chemical composition.
	07.05 Explain how fluids react and flow in a closed versus an open environment or vessel.
	07.06 Define and identify "color-coding" of refrigerant cylinders.
	07.07 Explain the proper methods of transferring, storing and recovering refrigerants.
	07.08 Explain the effects of an improper refrigerant and contaminants in a system.
	07.09 Identify the refrigerants in common use and state the types of applications in which each is used.
	07.10 Describe how azeotropes and near-azeotropes differ from each other and from so-called pure refrigerants.
	07.11 Compare and interpret a P-T chart for pure refrigerants, azeotrope, and near-azeotrope refrigerants and explain the difference between bubble point and dew point.
	07.12 Demonstrate refrigerant leak detecting methods.
	07.13 Identify the different types of oils used in refrigeration systems and explain their relationships to the various refrigerants.
	07.14 Explain how to add and remove oil from a system.

	07.15 Describe how to test oil for acid contamination.
08.0	Evaluate heating, air-conditioning and refrigeration system components and accessories. The student will be able to:
	08.01 Explain the types, operation, use and requirements of:
	• Compressors (such as reciprocating, rotary, screw, scroll and inverter)
	• Condensers and evaporators (such as evaporative condensers, evaporative coils, shell and tube, tube within a tube and fin and tube)
	• Metering devices (such as adjusting automatic and thermostatic expansion valves, fixed orifices, stepper motor electronic expansion valve (EEV), solenoid EEV and other devices available on the local market)
	08.02 Identify the location and explain the uses of refrigerant flow accessories.
	08.03 Identify the location and explain the uses of heating, air-conditioning and refrigeration-system accessories (such as receivers, dryers/filers, solenoid valves, heat exchangers, accumulators, suction filter, oil separators, evaporator pressure-regulating valve, crankcase pressure-regulating valves, hot gas bypass valves and check valves).
09.0	Fabricate and service the piping, tubing and fittings used in the heating, air-conditioning and refrigeration industry. The student will be able to:
	09.01 Identify and explain the purpose of the piping, tubing and fittings used in the heating, air-conditioning and refrigeration industry.
	09.02 Bend tubing, using tube benders.
	09.03 Connect tubing using flared fittings, pressed fittings and compression fittings.
	09.04 Connect tubing, using a swaged-joint connection.
	09.05 Identify and use various types of torches.
	09.06 Identify, select and use appropriate brazing alloys, materials and skills.
	09.07 Explain the purposes and procedures for protecting piping materials and fabrication, such as valves, fittings and products from heat.
	09.08 Braze tubing while purging dry nitrogen.
	09.09 Silver-braze brass, steels and copper.
	09.10 Demonstrate an understanding of the procedures for installing pipe and tubing insulation.
	09.11 Explain the procedures required for installing heating, air-conditioning, refrigerant and ventilation accessories.
	09.12 Fabricate and leak-test the piping, tubing and fittings used in the heating, air-conditioning and refrigeration industry.

	09.13 Demonstrate proper safety measures when fabricating and servicing piping, tubing and fittings.
10.0	Utilize and operate mechanical refrigeration servicing and testing equipment. The student will be able to:
	10.01 Identify the effects of superheat and sub-cooling on a system.
	10.02 Identify and explain the functions of servicing and testing equipment (such as vacuum pumps, micron gauges, EPA-approved equipment, leak detectors and charging systems).
	10.03 Operate a refrigerant recovery system.
	10.04 Apply specific safety and recovery practices for refrigerants used in the industry.
	10.05 Apply specific safety practices as they relate to handling and storing cylinders and materials.
	10.06 Explain the standards for and ways to measure, test, maintain and evacuate a mechanical heating, air-conditioning and refrigeration system.
	10.07 Evacuate the refrigerant system with various vacuum methods.
	10.08 Demonstrate compliance with Environmental Protection Agency (EPA) rules and regulations and, if possible, take the EPA test.
	10.09 Charge various air-conditioning and mechanical refrigeration systems by various methods.
	10.10 Demonstrate the effects of superheat and sub-cooling on a system utilizing test equipment (such as thermometers and gages).

Course Number: ACR0001 Occupational Completion Point: B HVAC/R Fundamentals – 250 Hours	
11.0	Demonstrate a practical knowledge of basic electricity and of the electrical components of heating, air-conditioning and refrigeration equipment. The student will be able to:
	11.01 Explain the principles of electricity.
	11.02 Explain single- and three-phase power distribution.
	11.03 Define and explain watts, ohms, volts and amps.
	11.04 Identify and explain electrical measuring tools and devices.
	11.05 Explain the standards for and ways to measure watts, resistance, voltage and amperage, using appropriate instruments or devices.
12.0	Demonstrate knowledge of electrical wiring in air-conditioning and refrigeration. The student will be able to:
	12.01 Identify and explain appropriate electrical wiring symbols.

	12.02 Draw and explain a wiring schematic diagram for a control system.
	12.03 Create a wiring schematic for an air conditioner an electric furnace, a heat pump, an oil furnace (optional) and a gas furnace.
13.0	Troubleshoot heating, air-conditioning and refrigeration electrical control systems and their components. The student will be able to:
	13.01 Identify and explain the operations of electrical control systems and their components (zone damper motors, duel fuel lock out controls, outdoor thermostats/low ambient controls, defrost controls/timers and auxiliary heating controls, contactors, relays, circuit boards, motors, solenoids, and thermostats.).
	13.02 Troubleshoot protection devices, such as fuses and breakers.
	13.03 Identify, install and troubleshoot controls for heating, air-conditioning and refrigeration systems.
	13.04 Explain the operation of different types of electromechanical communicating, humidity control, and Wi-Fi and programmable operating thermostats.
	13.05 Understand the basics of how to troubleshoot operational problems for different types of electromechanical communicating, humidity control, and Wi-Fi operating thermostats.
	13.06 Understand, install and troubleshoot invertor technology.
14.0	Select and test electrical generation and distribution components for commercial heating and air conditioning systems. The student will be able to:
	14.01 Determine wire sizes and voltage drops.
	14.02 Describe the operation of various types of transformers, including 230 vs. 208 volt issues and also voltage issues from compressor time delays.
15.0	Maintain, test and troubleshoot electrical motors and their components for commercial heating and air-conditioning systems. The student will be able to:
	15.01 Explain how alternating current is developed and draw a sine wave.
	15.02 Identify and explain single-phase and three-phase wiring arrangements.
	15.03 Explain how phase shift occurs in inductors and capacitors.
	15.04 Describe the types of capacitors and their applications.
	15.05 Explain the operation of single-phase and three-phase induction motors.
	15.06 Identify and explain the operations and applications of various types of electrical motors, including electronically commutated motors (ECM) and variable speed motors, and their components as used in heating and air-conditioning systems.
	15.07 Maintain, test and troubleshoot various types of electrical motors, including ECM and variable speed motors and their components as used in heating and air-conditioning systems.
	15.08 Demonstrate the proper use of motor testing equipment.

	15.09 Demonstrate how to reverse the rotation of a motor.

Course Number: ACR0012 Occupational Completion Point: C HVAC/R Service Practices – 250 Hours	
16.0	Utilize mechanical components of heating air-conditioning and refrigeration systems. The student will be able to:
	16.01 Evaluate metering-device performance.
	16.02 Explain the methods of compression, lubrication and compressor modulation.
	16.03 Analyze the operating condition of a compressor.
	16.04 Test, troubleshoot and correct the causes of mechanical problems in a heating, air-conditioning and refrigeration system.
	16.05 Evaluate system performance.
17.0	Operate solid-state electronics as used in heating, air-conditioning and refrigeration systems. The student will be able to:
	17.01 Explain the basic principles and functions of Direct Digital Control (DDC).
	17.02 Explain basic solid-state circuits and boards.
	17.03 Identify, test and replace circuits and boards.
	17.04 Explain codes and standards and safety requirements for working with the electrical components used in heating, air conditioning and refrigeration.
18.0	Read construction documents. The student will be able to:
	18.01 Recognize and identify basic construction drawing terms, components and symbols.
	18.02 Relate information on construction drawings to actual locations on the project.
	18.03 Recognize different classifications of construction drawings.
	18.04 Interpret and use drawing dimensions.
19.0	Assist in the installation of a residential heating and air-conditioning system and determine start-up procedures. The student will be able to:
	19.01 Read and comply with dispatch orders.
	19.02 Explain codes and ordinances.

	19.03 Assist in the installation of a heating and air-conditioning system to the manufacturer's installation and operation specifications, using a practical knowledge of duct fabrication methods.
	19.04 Determine which charging method is appropriate for a given type of system in a residential air-conditioning unit and adjust superheat and/or sub-cooling.
	19.05 Determine the temperature split/ difference across the evaporator.
	19.06 Determine the temperature split/ difference across the condenser.
	19.07 Explain the electrical and mechanical operations of the basic heat pump.
	19.08 Write a service report.
	19.09 Apply good customer-relations skills.
20.0	Conduct start-up and check-out procedures for mechanical heating and air-conditioning systems. The student will be able to:
	20.01 Identify and explain the following heat-pump systems: air-to-air, water-to-air, water-to-water, air-to-ground (geothermal), open-loop and closed-loop.
	20.02 Determine the start-up and checkout procedures recommended by different manufacturers.
	20.03 Determine the temperature split/difference across the ***outdoor*** coil on a heat pump.
	20.04 Determine the temperature split/difference across the ***indoor*** coil on a heat pump.
	20.05 Apply good customer-relations skills.
21.0	Use combustion-type heating servicing and testing equipment--The student will be able to:
	21.01 Explain combustion theory and the safety precautions for using combustion-type-heating servicing and testing equipment.
	21.02 Identify and explain the various types of combustion-type heating servicing and testing equipment (such as draft gauge, U-tube manometer, sling psychrometer, millivolt meter and oil-furnace testing equipment).
	21.03 Use the servicing and testing equipment.
	21.04 Test, analyze and troubleshoot combustion-type-heating systems.
22.0	Troubleshoot combustion gas valves and regulators as used in heating, air-conditioning, refrigeration and ventilation systems. The student will be able to:
	22.01 Identify and discuss the safety and regulation issues and concerns.
	22.02 Explain the operations of various types of gas valves and regulators, such as low-voltage, line-voltage, pneumatic (optional), solenoid, gas and pressure regulators, etc.
	22.03 Identify various types of gas valves and regulators.

	22.04 Determine the application of gas valves and regulators.
	22.05 Troubleshoot gas valves and regulators.
23.0	Understand the design of heating and cooling systems. The student will be able to:
	23.01 Identify and describe the steps in the system design process.
	23.02 Use construction drawings or an actual job site to obtain information needed to complete heating and cooling load estimates.
	23.03 Identify the factors that affect heat gains and losses to a building and describe how these factors influence the design process.
	23.04 Complete a load estimate to determine the heating and/or cooling load of a building.
	23.05 State the principles that affect the selection of equipment to satisfy the calculated heating and/or cooling load.
	23.06 Select heating and/or cooling equipment using manufacturers' product data.
	23.07 Identify the various types of duct systems and explain why and where each type is used.
	23.08 Demonstrate the effect of fittings and transitions on duct system design.
	23.09 Use a friction loss chart and duct sizing table to size duct.
	23.10 Install insulation and vapor barriers used in duct systems.
	23.11 Select and install refrigerant and condensate piping following proper design principles.
	23.12 Describe airflow and pressures in a basic forced-air distribution system.
	23.13 Explain the differences between propeller and centrifugal fans and blowers.
	23.14 Identify the various types of duct systems and explain why and where each type is used.
	23.15 Demonstrate or explain the installation of metal, fiberboard and flexible duct.
	23.16 Demonstrate or explain the installation of fittings and transitions used in duct systems.
	23.17 Identify and explain the operations of electrical control systems and their components (zone damper motors).
	23.18 Demonstrate or explain the use and installation of dampers used in duct systems.
	23.19 Demonstrate or explain the use and installation of insulation and vapor barriers used in duct systems.
	23.20 Identify instruments used to make measurements in air systems and explain the use of each instrument.

	23.21 Make basic temperature, air pressure and velocity measurements in an air distribution system.
	23.22 Describe the benefits of conditioned air and indoor air quality.
	23.23 Identify various professional organizations, associations and societies and explain their purposes.
24.0	(Optional) Explain the importance of employability, soft skills, entrepreneurship skills and making career plans. The student will be able to:
	24.01 Identify and demonstrate positive work behaviors, including soft skills and entrepreneurship skills, needed to be employable.
	24.02 Develop personal career plan that includes goals, objectives and strategies.
	24.03 Create and maintain a career portfolio to document knowledge, skills and experience.
	24.04 Exhibit a professional appearance through appropriate grooming and attire.
	24.05 Evaluate and compare employment opportunities that match career goals.
	24.06 Identify and exhibit traits for retaining employment.
	24.07 Identify opportunities and research requirements for career advancement.
	24.08 Research the benefits of ongoing professional development.
	24.09 Examine licensing, certification and industry credentialing requirements.

Course Number: ACR0013 **Occupational Completion Point: D** **HVAC/R Intermediate Service Practices – 250 Hours**	
25.0	Select appropriate commercial compressors. The student will be able to:
	25.01 Compare commercial-compressor requirements with those for residential and light commercial heating and air-conditioning systems.
	25.02 Discuss appropriate commercial compressors for cooling requirements.
	25.03 Describe the mechanical operation for each type of compressor.
	25.04 Explain compressor lubrication methods.
	25.05 Explain methods used to control compressor capacity.
	25.06 Describe how compressor protection devices operate.

	25.07 Perform the common procedures used when field servicing open and semi-hermetic compressors.
26.0	Test and adjust commercial evaporative condensers. The student will be able to:
	26.01 Determine the proper air and fluid flow for commercial evaporative condensers.
	26.02 Test and adjust the airflow for proper temperature difference.
	26.03 Test and adjust the water flow for proper GPM and temperature difference.
	26.04 Check for proper water treatment.
27.0	Maintain, test and troubleshoot commercial evaporators. The student will be able to:
	27.01 Determine the operational requirements for evaporators used in commercial heating and air-conditioning applications.
	27.02 Discuss appropriate evaporators for commercial heating and air-conditioning systems
	27.03 Maintain, test and adjust commercial heating and air-conditioning accessories.
	27.04 Select the heating and air-conditioning accessories appropriate for various commercial applications.
28.0	Identify basic principles of heating, air conditioning, refrigeration and ventilation piping sizing. The student will be able to:
	28.01 Identify and explain various types of heating, air-conditioning and refrigeration piping.
	28.02 Identify basic principles of sizing various heating, air conditioning, refrigeration and ventilation for various tasks.
	28.03 Explain pressure and temperature drops.
29.0	Maintain, troubleshoot and repair commercial heating systems. The student will be able to:
	29.01 Identify the components of various commercial heating systems.
	29.02 Explain the operational principles of various commercial heating systems.
	29.03 Test and analyze heating air-distribution systems.
	29.04 Maintain, troubleshoot and repair various commercial heating systems.
30.0	Discuss new HVAC/R technologies. The student will be able to:
	30.01 Follow all HVAC/R related safety precautions.
	30.02 Describe new technologies in HVAC/R installation, including variable-speed motors, heat-pipe systems, desiccant systems, gas-driven heating systems, etc.

	30.03 Describe multi-ports and Variable Refrigerant Volume (VRV)/Variable Refrigerant Flow (VRF) systems.
	30.04 Explain how to lay out, construct and troubleshoot comfort systems.
	30.05 Test and analyze systems.
	30.06 Test and analyze heat-recovery systems and VRV/VRF.
31.0	Interpret, use and modify construction drawings and specifications. The student will be able to:
	31.01 Read mechanical plans within a set of construction drawings explain their relationship.
	31.02 Compare mechanical plans with the actual installation of duct and pipe runs, fittings and sections.
	31.03 Interpret specification documents and apply them to the plans.
	31.04 Interpret shop drawings and apply them to the plans and specifications. (Optional)
	31.05 Develop a field set of as-built drawings. (Optional)
	31.06 Identify the steps required for transferring design information to component production. (Optional)
	31.07 List and classify materials most commonly used in HVAC systems.
32.0	Troubleshoot and repair commercial heating and air-conditioning systems. The student will be able to:
	32.01 Keep a record of the installation, maintenance and repair of commercial heating and air-conditioning systems.
	32.02 Apply local, national and international codes and safety practices.
	32.03 Lay out a commercial heating and air-conditioning system.
	32.04 Lay out a typical split commercial air-conditioning system.
	32.05 Lay out a typical split commercial heating system.
	32.06 Maintain, test, analyze and repair various types of commercial heating and air-conditioning systems.
	32.07 Maintain, troubleshoot and repair water-cooled condensers.

NOTE: Students may choose one of the following courses for the completion of OCP E: ACR0044 or ACR0045

Course Number: ACR0044 Occupational Completion Point: E – Option 1 HVAC/R Advanced Service Practices – 350 Hours	
33.0	Develop an understanding of hydronic systems. The student will be able to:
33.01	Explain the terms and concepts used when working with hot-water heating systems.
33.02	Identify the major components of hot-water heating systems.
33.03	Explain the purpose of each component of hot-water heating systems.
33.04	Describe the safety precautions used when working with hot water systems.
33.05	Identify the common piping configurations used with hot water heating systems.
33.06	Explain the principles involved and describe the procedures used in balancing hydronic systems.
33.07	Select, calibrate and properly use the tools and instruments needed to balance hydronic systems.
33.08	Read the pressure across a water system circulating pump.
34.0	Determine the properties of air. The student will be able to:
34.01	Explain the principles of psychrometrics.
34.02	Identify and explain the components and uses of a psychrometric meter.
34.03	Identify indoor air quality concerns as related to psychrometrics, including mold detection, prevention and remediation.
34.04	Determine the properties of air, using a psychrometric chart.
34.05	Follow safety precautions.
34.06	Identify and explain the different types and benefits of air filtration systems, products for improving indoor air quality.
34.07	Fabricate, operate, maintain and troubleshoot air filtration systems, air handling systems and ventilation systems.
35.0	Use a pressure enthalpy chart to diagram refrigerant cycles. The student will be able to:
35.01	Identify all components of the pressure enthalpy chart.
35.02	Define enthalpy and entropy.
36.0	Explain the standards for and ways to measure indoor air quality. The student will be able to:

	36.01 Identify and explain the codes and standards regarding indoor air quality.
	36.02 Select and use indoor air quality measuring devices.
	36.03 Explain the standards for and ways to measure indoor air quality using various methods.
37.0	(Optional) Identify and understand pneumatic control systems for commercial heating and air-conditioning applications. The student will be able to:
	37.01 Identify pneumatic control systems and explain the transition to electro/pneumatic systems.
	37.02 Understand the functions of direct acting and reverse acting controls of pneumatic control systems.
38.0	Develop an understanding of chilled systems. The student will be able to:
	38.01 Explain the terms and concepts used when working with chilled-water cooling systems.
	38.02 Identify the major components of chilled-water cooling and dual-temperature water systems.
	38.03 Explain the purpose of each component of chilled-water cooling and dual-temperature water systems.
	38.04 Describe the safety precautions used when working with chilled-water systems.
	38.05 Explain the differences between reciprocating, rotary screw, scroll and centrifugal chillers.
39.0	(Optional) Maintain and repair thermal storage systems. The student will be able to:
	39.01 Apply appropriate codes, standards and safety practices.
	39.02 Describe the benefits and limitations of each type.
	39.03 Explain the operational principles of a thermal storage system.
	39.04 Identify and explain various types of thermal storage systems.
	39.05 Troubleshoot and test various types of thermal storage systems.
40.0	Understand and explain the calculation of commercial heating and air-conditioning loads. The student will be able to:
	40.01 Explain conduction as a heat-load source.
	40.02 Describe the implications of conducting and the resistance values for different types of construction materials.
	40.03 Interpret heat-transfer tables and define values U, K, C and R.
	40.04 Locate the total heat-transfer value of any surface.

	40.05 Explain infiltration and exfiltration/ventilation as a heat-load source.
	40.06 Explain a product heat-load source.
	40.07 Explain miscellaneous loads (people, motors and equipment) as heat-load sources.
	40.08 Explain the purpose of vapor barriers.
	40.09 Interpret tables of specific heat values as applied to commercial heating and air-conditioning systems.
	40.10 Understand the importance of system design and load calculation process of heating and cooling systems.
	40.11 Understand and explain the methods of installing air-movement systems.
41.0	Balance an air distribution system. The student will be able to:
	41.01 Explain the fan and pump laws.
	41.02 Use a psychrometric chart to evaluate air properties and changes in air properties.
	41.03 Explain the principles involved in the balancing of air and water distribution systems.
	41.04 Define common terms used by manufacturers when describing grilles, registers and diffusers.
	41.05 Identify and use the tools and instruments needed to balance air distribution systems.
	41.06 Change the speed of an air distribution system supply fan.
42.0	Select energy conservation equipment. The student will be able to:
	42.01 Identify and explain the operation of energy conservation equipment.
	42.02 Operate selected energy conservation equipment.
43.0	Analyze building management systems. The student will be able to:
	43.01 Identify the major components of a building management system and describe how they fit together.
	43.02 Explain a basic direct digital controller.
44.0	(Optional) Recommend alternative heating and cooling systems for various case studies. The student will be able to:
	44.01 Describe alternative technologies for heating such as in-floor, direct-fired makeup unit (DFMU), solar, air turnover, corn or wood pellet burners, waste oil/multi-fuel and fireplace inserts.
	44.02 Describe alternative technologies for heating and cooling such as ductless systems, computer rooms, chilled beams and multi-zone.

NOTE: Students may choose one of the following courses for the completion of OCP E: ACR0044 or ACR0045

Course Number: ACR0045 Occupational Completion Point: E – Option 2 HVAC/R Advanced Commercial and Industrial Service Practices – 350 Hours	
45.0	Demonstrate knowledge of retail refrigeration systems. The student will be able to:
45.01	Describe the mechanical refrigeration cycle as it applies to retail refrigeration systems.
45.02	Explain the differences in refrigerants and applications in low-, medium-, high-temperature, flammable and toxic refrigeration systems.
45.03	Identify and describe the primary refrigeration cycle components used in retail refrigeration systems.
45.04	Identify and describe the supporting components and accessories used in retail refrigeration systems.
45.05	Describe the various methods of defrost used in retail refrigeration systems.
45.06	Identify and describe the applications for the various types of retail refrigeration systems.
45.07	Describe the control system components used in retail refrigeration systems.
45.08	Explain the operating sequence of a retail refrigeration system.
45.09	Interpret wiring diagrams and troubleshooting charts to isolate malfunctions in retail refrigeration systems.
46.0	Demonstrate knowledge of commercial and industrial refrigeration systems. The student will be able to:
46.01	Identify different types of refrigerated coolers and display cases and describe each one’s common application.
46.02	Compare the basic components used in commercial/industrial refrigeration systems with those used in retail refrigeration systems.
46.03	Identify single, multiple and satellite compressor systems; describe the applications, installation considerations and advantages and disadvantages of each type.
46.04	Identify packaged condensing units and unit coolers; describe their applications, operation and installation considerations.
46.05	Identify two-stage and inverter compressors and explain their operation and applications.
46.06	Identify the various accessories used in commercial refrigeration systems and explain why each is used and where it should be installed in the system.
46.07	Identify the various refrigeration control devices and explain the purpose of each type and how it works.
47.0	Demonstrate a working knowledge of electrical generation and distribution components for commercial heating and air conditioning systems. The student will be able to:

	47.01 Calculate loads and design and lay out a commercial refrigeration system.
	47.02 Identify and explain commercial refrigeration-pressure-regulation devices, controls and components.
	47.03 Test and troubleshoot refrigerant-pressure-regulating devices, controls and components.
	47.04 Apply local and national codes and mechanical safety practices.
48.0	Demonstrate a working knowledge of refrigeration system vibration and insulation. The student will be able to:
	48.01 Describe the applications of vibration eliminators.
	48.02 Identify and select the correct insulation for commercial application.
49.0	Apply commercial refrigeration pipe sizing and troubleshooting procedures. The student will be able to:
	49.01 Determine the capacities of refrigerant lines, including the amounts they will hold, equivalent lengths of fittings and the total effective length for various pipelines.
	49.02 Identify and apply industry approved installation procedures.
	49.03 Troubleshoot refrigeration pipe sizing problems.
	• Explain the use of traps in suction line risers.
	• Explain pressure drop.
	• Calculate pressure drop in liquid line risers.
	• Size double risers, hot gas lines and liquid lines from condenser to receiver.
50.0	Use refrigeration systems skills in commercial applications. The student will be able to:
	50.01 Identify and apply the safety practices used with commercial refrigeration systems.
	50.02 Apply refrigeration-systems skills to commercial refrigeration systems.
	• Perform dehydration, evacuation and recovery procedures.
	• Interpret blueprints and mechanical drawings.
	• Service and charge a refrigeration system.
	• Test, analyze and replace compressors.
	• Retrofit alternative refrigerants and oils.

51.0	Demonstrate a working knowledge of refrigerated storage systems. The student will be able to:
	51.01 Identify and differentiate among various types of cases, such as service cases and self-service cases.
	51.02 Explain the operation of air screen freezers, glass door freezers, coffin cases and walk in coolers.
	51.03 Differentiate among medium-temperature, low-temperature and ultralow-temperature systems.
	51.04 Explain various defrost methods.
	51.05 Maintain, test and troubleshoot defrost components.
	51.06 Identify and explain the components of various refrigerated storage systems.
	51.07 Maintain, test and troubleshoot various refrigerated storage system components.
52.0	Diagnose, maintain and repair ice making systems. The student will be able to:
	52.01 Identify and explain various types and operations of ice making systems.
	52.02 Maintain, test, troubleshoot and repair various types of ice making systems, following the manufacturers' recommendations.
	52.03 Identify and explain the different types of water treatment methods and systems.
	52.04 Analyze water to identify water problems and the proper treatments.
	52.05 Install, service and repair ice machines and specialty refrigeration systems.
53.0	Use refrigeration electrical system skills in commercial applications. The student will be able to:
	53.01 Apply electrical safety practices for commercial refrigeration systems.
	53.02 Apply refrigeration electrical system skills to commercial refrigeration systems:
	• Interpret symbols of electrical components and diagrams.
	• Interpret schematics and diagrams.
	• Apply electrical theory and calculations.
	• Explain the principles of designing electrical systems.
	• Test and troubleshoot single-, three-phase, ECM, and variable speed motors.
	53.03 Test the solid state components used in commercial refrigeration systems.

	53.04 Troubleshoot and diagnose the electrical circuits used in commercial refrigeration systems.
	53.05 Test and troubleshoot the thermostatic controls used in commercial refrigeration systems.
54.0	Maintain and troubleshoot commercial refrigeration systems. The student will be able to:
	54.01 Follow appropriate safety precautions for commercial refrigeration systems.
	54.02 Identify and explain the operations of various types of commercial refrigeration systems and applications, such as single, multiplex and cascade systems.
	54.03 Maintain and troubleshoot various types of commercial refrigeration systems.

Additional Information

Laboratory Activities

Laboratory investigations that include scientific inquiry, research, measurement, problem solving, emerging technologies, tools and equipment, as well as, experimental, quality, and safety procedures are an integral part of this career and technical program/course. Laboratory investigations benefit all students by developing an understanding of the complexity and ambiguity of empirical work, as well as the skills required to manage, operate, calibrate and troubleshoot equipment/tools used to make observations. Students understand measurement error; and have the skills to aggregate, interpret, and present the resulting data. Equipment and supplies should be provided to enhance hands-on experiences for students.

Career and Technical Student Organization (CTSO)

SkillsUSA is the co-curricular career and technical student organization for providing leadership training and reinforcing specific career and technical skills. Career and Technical Student Organizations provide activities for students as an integral part of the instruction offered.

Cooperative Training – OJT

On-the-job training is appropriate but not required for this program. Whenever offered, the rules, guidelines, and requirements specified in the OJT framework apply.

Basic Skills

In Career Certificate Programs offered for 450 hours or more, in accordance with Rule 6A-10.040, F.A.C., the minimum basic skills grade levels required for postsecondary adult career and technical students to complete this program are: Computation (Mathematics) and Communications (Reading and Language Arts). These grade level numbers correspond to a grade equivalent score obtained on a state designated basic skills examination.

Adult students with disabilities, as defined in Section 1004.02, Florida Statutes, may be exempted from meeting the Basic Skills requirements (Rule 6A-10.040). Students served in exceptional student education (except gifted) as defined in s. 1003.01, F.S., may also be exempted from meeting the Basic Skills requirement. Each school district and Florida College System Institution must adopt a policy addressing procedures for exempting eligible students with disabilities from the Basic Skills requirement as permitted in Section 1004.91, F.S.

Accommodations

Federal and state legislation requires the provision of accommodations for students with disabilities to meet individual needs and ensure equal access. Postsecondary students with disabilities must self-identify, present documentation, request accommodations if needed, and develop a plan with their counselor and/or instructors. Accommodations received in postsecondary education may differ from those received in secondary education. Accommodations change the way the student is instructed. Students with disabilities may need accommodations in such areas as instructional methods and materials, assignments and assessments, time demands and schedules, learning environment, assistive technology and special communication systems. Documentation of the accommodations requested and provided should be maintained in a confidential file.

Note: postsecondary curriculum and regulated secondary programs cannot be modified.