Florida Department of Education
Curriculum Framework

Program Title: **Heating, Ventilation, Air-Conditioning/Refrigeration (HVAC/R) 2**
Program Type: **Career Preparatory**
Career Cluster: **Architecture and Construction**

Career Certificate Program		
Program Number	C400420	
CIP Number	0615050112	
Grade Level	30, 31	
Program Length	600 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 two occupational completion points. The recommended sequence allows students to complete specified portions of the program for employment or to remain for advanced training. A student who completes the applicable competencies at any occupational completion point may either continue with the training program or terminate as an occupational completer.

Heating, Ventilation, Air-Conditioning/Refrigeration (HVAC/R) 1 is a core program. It is recommended that student completes Heating, Ventilation, Air-Conditioning/Refrigeration (HVAC/R) 1, or demonstrates mastery of the outcomes in that program, prior to enrollment in Heating, Ventilation, Air-Conditioning/Refrigeration (HVAC/R) 2.

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	ACR0013	HVAC/R Intermediate Service Practices	AC HEAT ME @7 G REFRG MECH 7 G	250 Hours
B	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 B: 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:

01.0 Select appropriate commercial compressors.
02.0 Test and adjust commercial evaporative condensers.
03.0 Maintain, test and troubleshoot commercial evaporators.
04.0 Identify basic principles of heating, air conditioning, refrigeration and ventilation piping sizing.
05.0 Maintain, troubleshoot and repair commercial heating systems.
06.0 Discuss new HVAC/R technologies.
07.0 Interpret, use and modify construction drawings and specifications.
08.0 Troubleshoot and repair commercial heating and air-conditioning systems.
09.0 Develop an understanding of hydronic systems.
10.0 Determine the properties of air.
11.0 Use a pressure enthalpy chart to diagram refrigerant cycles.
12.0 Explain the standards for and ways to measure indoor air quality.
13.0 (Optional) Identify and understand pneumatic control systems for commercial heating and air-conditioning applications.
14.0 Develop an understanding of chilled systems.
15.0 (Optional) Maintain and repair thermal storage systems.
16.0 Understand and explain the calculation of commercial heating and air-conditioning loads.
17.0 Balance an air distribution system.
18.0 Select energy conservation equipment.
19.0 Analyze building management systems.
20.0 (Optional) Recommend alternative heating and cooling systems for various case studies.
21.0 Demonstrate knowledge of retail refrigeration systems.
22.0 Demonstrate knowledge of commercial and industrial refrigeration systems.
23.0 Demonstrate a working knowledge of electrical generation and distribution components for commercial heating and air conditioning systems.
24.0 Demonstrate a working knowledge of refrigeration-system vibration and insulation.
25.0 Apply commercial refrigeration pipe sizing and troubleshooting procedures.
26.0 Use refrigeration systems skills in commercial applications.
27.0 Demonstrate a working knowledge of refrigerated storage systems.
28.0 Diagnose, maintain and repair ice making systems.
29.0 Use refrigeration electrical system skills in commercial applications.
30.0 Maintain and troubleshoot commercial refrigeration systems.

Florida Department of Education
Student Performance Standards

Program Title: Heating, Ventilation, Air-Conditioning/Refrigeration (HVAC/R) 2
Career Certificate Program Number: C400420

Course Number: ACR0013 **Occupational Completion Point: A** **HVAC/R Intermediate Service Practices – 250 Hours**	
01.0	Select appropriate commercial compressors. The student will be able to:
01.01	Compare commercial-compressor requirements with those for residential and light commercial heating and air-conditioning systems.
01.02	Discuss appropriate commercial compressors for cooling requirements.
01.03	Describe the mechanical operation for each type of compressor.
01.04	Explain compressor lubrication methods.
01.05	Explain methods used to control compressor capacity.
01.06	Describe how compressor protection devices operate.
01.07	Perform the common procedures used when field servicing open and semi-hermetic compressors.
02.0	Test and adjust commercial evaporative condensers. The student will be able to:
02.01	Determine the proper air and fluid flow for commercial evaporative condensers.
02.02	Test and adjust the airflow for proper temperature difference.
02.03	Test and adjust the water flow for proper GPM and temperature difference.
02.04	Check for proper water treatment.
03.0	Maintain, test and troubleshoot commercial evaporators. The student will be able to:
03.01	Determine the operational requirements for evaporators used in commercial heating and air-conditioning applications.
03.02	Discuss appropriate evaporators for commercial heating and air-conditioning systems
03.03	Maintain, test and adjust commercial heating and air-conditioning accessories.

	03.04 Select the heating and air-conditioning accessories appropriate for various commercial applications.
04.0	Identify basic principles of heating, air conditioning, refrigeration and ventilation piping sizing. The student will be able to:
	04.01 Identify and explain various types of heating, air-conditioning and refrigeration piping.
	04.02 Identify basic principles of sizing various heating, air conditioning, refrigeration and ventilation for various tasks.
	04.03 Explain pressure and temperature drops.
05.0	Maintain, troubleshoot and repair commercial heating systems. The student will be able to:
	05.01 Identify the components of various commercial heating systems.
	05.02 Explain the operational principles of various commercial heating systems.
	05.03 Test and analyze heating air-distribution systems.
	05.04 Maintain, troubleshoot and repair various commercial heating systems.
06.0	Discuss new HVAC/R technologies. The student will be able to:
	06.01 Follow all HVAC/R related safety precautions.
	06.02 Describe new technologies in HVAC/R installation, including variable-speed motors, heat-pipe systems, desiccant systems and gas-driven heating systems.
	06.03 Describe multi-ports and Variable Refrigerant Volume (VRV)/Variable Refrigerant Flow (VRF) systems.
	06.04 Explain how to lay out, construct and troubleshoot comfort systems.
	06.05 Test and analyze systems.
	06.06 Test and analyze heat-recovery systems and VRV/VRF.
07.0	Interpret, use and modify construction drawings and specifications. The student will be able to:
	07.01 Read mechanical plans within a set of construction drawings explain their relationship.
	07.02 Compare mechanical plans with the actual installation of duct and pipe runs, fittings and sections.
	07.03 Interpret specification documents and apply them to the plans.
	07.04 Interpret shop drawings and apply them to the plans and specifications. (Optional)
	07.05 Develop a field set of as-built drawings. (Optional)

	07.06 Identify the steps required for transferring design information to component production. (Optional)
	07.07 List and classify materials most commonly used in HVAC systems.
08.0	Troubleshoot and repair commercial heating and air-conditioning systems. The student will be able to:
	08.01 Keep a record of the installation, maintenance and repair of commercial heating and air-conditioning systems.
	08.02 Apply local, national and international codes and safety practices.
	08.03 Lay out a commercial heating and air-conditioning system.
	08.04 Lay out a typical split commercial air-conditioning system.
	08.05 Lay out a typical split commercial heating system.
	08.06 Maintain, test, analyze and repair various types of commercial heating and air-conditioning systems.
	08.07 Maintain, troubleshoot and repair water-cooled condensers

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

Course Number: ACR0044 Occupational Completion Point: B – Option 1 HVAC/R Advanced Service Practices – 350 Hours	
09.0	Develop an understanding of hydronic systems. The student will be able to:
	09.01 Explain the terms and concepts used when working with hot-water heating systems.
	09.02 Identify the major components of hot-water heating systems.
	09.03 Explain the purpose of each component of hot-water heating systems.
	09.04 Describe the safety precautions used when working with hot water systems.
	09.05 Identify the common piping configurations used with hot water heating systems.
	09.06 Explain the principles involved and describe the procedures used in balancing hydronic systems.
	09.07 Select, calibrate and properly use the tools and instruments needed to balance hydronic systems.
	09.08 Read the pressure across a water system circulating pump.

10.0	Determine the properties of air. The student will be able to:
	10.01 Explain the principles of psychrometrics.
	10.02 Identify and explain the components and uses of a psychrometric meter.
	10.03 Identify indoor air quality concerns as related to psychrometrics, including mold detection, prevention and remediation.
	10.04 Determine the properties of air, using a psychrometric chart.
	10.05 Follow safety precautions.
	10.06 Identify and explain the different types and benefits of air filtration systems, products for improving indoor air quality.
	10.07 Fabricate, operate, maintain and troubleshoot air filtration systems, air handling systems and ventilation systems.
11.0	Use a pressure enthalpy chart to diagram refrigerant cycles. The student will be able to:
	11.01 Identify all components of the pressure enthalpy chart.
	11.02 Define enthalpy and entropy.
12.0	Explain the standards for and ways to measure indoor air quality--The student will be able to:
	12.01 Identify and explain the codes and standards regarding indoor air quality.
	12.02 Select and use indoor air quality measuring devices.
	12.03 Explain the standards for and ways to measure indoor air quality using various methods.
13.0	(Optional) Identify and understand pneumatic control systems for commercial heating and air-conditioning applications. The student will be able to:
	13.01 Identify pneumatic control systems and explain the transition to electro/pneumatic systems.
	13.02 Understand the functions of direct acting and reverse acting controls of pneumatic control systems.
14.0	Develop an understanding of chilled systems. The student will be able to:
	14.01 Explain the terms and concepts used when working with chilled-water cooling systems.
	14.02 Identify the major components of chilled-water cooling and dual-temperature water systems.
	14.03 Explain the purpose of each component of chilled-water cooling and dual-temperature water systems.
	14.04 Describe the safety precautions used when working with chilled-water systems.

	14.05 Explain the differences between reciprocating, rotary screw, scroll and centrifugal chillers.
15.0	(Optional) Maintain and repair thermal storage systems. The student will be able to:
	15.01 Apply appropriate codes, standards and safety practices.
	15.02 Describe the benefits and limitations of each type.
	15.03 Explain the operational principles of a thermal storage system.
	15.04 Identify and explain various types of thermal storage systems.
	15.05 Troubleshoot and test various types of thermal storage systems.
16.0	Understand and explain the calculation of commercial heating and air-conditioning loads. The student will be able to:
	16.01 Explain conduction as a heat-load source.
	16.02 Describe the implications of conducting and the resistance values for different types of construction materials.
	16.03 Interpret heat-transfer tables and define values U, K, C and R.
	16.04 Locate the total heat-transfer value of any surface.
	16.05 Explain infiltration and exfiltration/ventilation as a heat-load source.
	16.06 Explain a product heat-load source.
	16.07 Explain miscellaneous loads (people, motors and equipment) as heat-load sources.
	16.08 Explain the purpose of vapor barriers.
	16.09 Interpret tables of specific heat values as applied to commercial heating and air-conditioning systems.
	16.10 Understand the importance of system design and load calculation process of heating and cooling systems.
	16.11 Understand and explain the methods of installing air-movement systems.
17.0	Balance an air distribution system. The student will be able to:
	17.01 Explain the fan and pump laws.
	17.02 Use a psychrometric chart to evaluate air properties and changes in air properties.
	17.03 Explain the principles involved in the balancing of air and water distribution systems.

	17.04 Define common terms used by manufacturers when describing grilles, registers and diffusers.
	17.05 Identify and use the tools and instruments needed to balance air distribution systems.
	17.06 Change the speed of an air distribution system supply fan.
18.0	Select energy conservation equipment. The student will be able to:
	18.01 Identify and explain the operation of energy conservation equipment.
	18.02 Operate selected energy conservation equipment.
19.0	Analyze building management systems. The student will be able to:
	19.01 Identify the major components of a building management system and describe how they fit together.
	19.02 Explain a basic direct digital controller.
20.0	(Optional) Recommend alternative heating and cooling systems for various case studies. The student will be able to:
	20.01 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.
	20.02 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 B: ACR0044 or ACR0045

Course Number: ACR0045 Occupational Completion Point: B – Option 2 HVAC/R Advanced Commercial and Industrial Service Practices – 350 Hours	
21.0	Demonstrate knowledge of retail refrigeration systems. The student will be able to:
	21.01 Describe the mechanical refrigeration cycle as it applies to retail refrigeration systems.
	21.02 Explain the differences in refrigerants and applications in low-, medium-, high-temperature, flammable and toxic refrigeration systems.
	21.03 Identify and describe the primary refrigeration cycle components used in retail refrigeration systems.
	21.04 Identify and describe the supporting components and accessories used in retail refrigeration systems.
	21.05 Describe the various methods of defrost used in retail refrigeration systems.
	21.06 Identify and describe the applications for the various types of retail refrigeration systems.

	21.07 Describe the control system components used in retail refrigeration systems.
	21.08 Explain the operating sequence of a retail refrigeration system.
	21.09 Interpret wiring diagrams and troubleshooting charts to isolate malfunctions in retail refrigeration systems.
22.0	Demonstrate knowledge of commercial and industrial refrigeration systems. The student will be able to:
	22.01 Identify different types of refrigerated coolers and display cases and describe each one's common application.
	22.02 Compare the basic components used in commercial/industrial refrigeration systems with those used in retail refrigeration systems.
	22.03 Identify single, multiple and satellite compressor systems; describe the applications, installation considerations and advantages and disadvantages of each type.
	22.04 Identify packaged condensing units and unit coolers; describe their applications, operation and installation considerations.
	22.05 Identify two-stage and inverter compressors and explain their operation and applications.
	22.06 Identify the various accessories used in commercial refrigeration systems and explain why each is used and where it should be installed in the system.
	22.07 Identify the various refrigeration control devices and explain the purpose of each type and how it works.
23.0	Demonstrate a working knowledge of electrical generation and distribution components for commercial heating and air conditioning systems. The student will be able to:
	23.01 Calculate loads and design and lay out a commercial refrigeration system.
	23.02 Identify and explain commercial refrigeration-pressure-regulation devices, controls and components.
	23.03 Test and troubleshoot refrigerant-pressure-regulating devices, controls and components.
	23.04 Apply local and national codes and mechanical safety practices.
24.0	Demonstrate a working knowledge of refrigeration-system vibration and insulation. The student will be able to:
	24.01 Describe the applications of vibration eliminators.
	24.02 Identify and select the correct insulation for commercial application.
25.0	Apply commercial refrigeration pipe sizing and troubleshooting procedures. The student will be able to:
	25.01 Determine the capacities of refrigerant lines, including the amounts they will hold, equivalent lengths of fittings and the total effective length for various pipelines.
	25.02 Identify and apply industry approved installation procedures.

	25.03 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.
26.0	Use refrigeration systems skills in commercial applications. The student will be able to:
	26.01 Identify and apply the safety practices used with commercial refrigeration systems.
	26.02 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.
27.0	Demonstrate a working knowledge of refrigerated storage systems. The student will be able to:
	27.01 Identify and differentiate among various types of cases, such as service cases and self-service cases.
	27.02 Explain the operation of air screen freezers, glass door freezers, coffin cases and walk in coolers.
	27.03 Differentiate among medium-temperature, low-temperature and ultralow-temperature systems.
	27.04 Explain various defrost methods.
	27.05 Maintain, test and troubleshoot defrost components.
	27.06 Identify and explain the components of various refrigerated storage systems.
	27.07 Maintain, test and troubleshoot various refrigerated storage system components.
28.0	Diagnose, maintain and repair ice making systems--The student will be able to:
	28.01 Identify and explain various types and operations of ice making systems.

	28.02 Maintain, test, troubleshoot and repair various types of ice making systems, following the manufacturers' recommendations.
	28.03 Identify and explain the different types of water treatment methods and systems.
	28.04 Analyze water to identify water problems and the proper treatments.
	28.05 Install, service and repair ice machines and specialty refrigeration systems.
29.0	Use refrigeration electrical system skills in commercial applications. The student will be able to:
	29.01 Apply electrical safety practices for commercial refrigeration systems.
	29.02 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- and three-phase motors and variable speed electronic commutated motors (ECM).
	29.03 Test the solid state components used in commercial refrigeration systems.
	29.04 Troubleshoot and diagnose the electrical circuits used in commercial refrigeration systems.
	29.05 Test and troubleshoot the thermostatic controls used in commercial refrigeration systems.
30.0	Maintain and troubleshoot commercial refrigeration systems. The student will be able to:
	30.01 Follow appropriate safety precautions for commercial refrigeration systems.
	30.02 Identify and explain the operations of various types of commercial refrigeration systems and applications, such as single, multiplex and cascade systems.
	30.03 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 a Career Certificate Program 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.