2024 Heating, Ventilation, Air Conditioning, and Refrigeration (HVACR)

Program CIP: 47.0201— Heating, Air Conditioning, Ventilation and Refrigeration Maintenance Technology/Technician

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Published by:

Office of Career and Technical Education
Mississippi Department of Education
Jackson, MS 39205

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The Research and Curriculum Unit (RCU), located in Starkville, as part of Mississippi State University (MSU), was established to foster educational enhancements and innovations. In keeping with the land-grant mission of MSU, the RCU is dedicated to improving the quality of life for Mississippians. The RCU enhances intellectual and professional development of Mississippi students and educators while applying knowledge and educational research to the lives of the people of the state. The RCU works within the contexts of curriculum development and revision, research, assessment, professional development, and industrial training.

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Acknowledgments

The Heating, Ventilation, Air Conditioning, and Refrigeration (HVACR) curriculum was presented to the Mississippi State Board of Education February 15, 2024. The following persons were serving on the state board at the time:

Dr. Ray Morgigno, interim state superintendent of education, executive secretary
Mr. Glen V. East, chair
Mr. Matt Miller, vice chair
Dr. Ronnie L. McGehee
Mr. Bill Jacobs
Mr. Mike Pruitt
Mrs. Mary Werner
Dr. Wendi Barrett
Mr. Charlie Frugé, student representative
Ms. Kate Riddle, student representative

The following Mississippi Department of Education (MDE) and RCU managers and specialists assisted in the development of the HVACR curriculum:

Wendy Clemons, the associate state superintendent of the MDE Office of Secondary, Professional Development, and Career Technical Education, supported the RCU and teachers throughout the development of the framework and supporting materials.
Brett Robinson, the state director of the MDE Office of Career and Technical Education (CTE), supported the RCU and teachers throughout the development of the framework and supporting materials.
Brent Bean, president, Mississippi Construction Education Foundation (MCEF) supported the RCU and teachers throughout the development of the framework and supporting materials.
Betsey Smith, the director of the RCU, supported RCU staff and teachers throughout the development of this framework and supporting materials.
Courtney McCubbins, the curriculum manager of the RCU, supported RCU staff and teachers throughout the development of this framework and supporting materials.
Jo Ann Watts, a project manager with the RCU, researched and co-authored this framework.

Special thanks are extended to the educators who contributed teaching and assessment materials that are included in the framework and supporting materials:

Austin Bond, Lee County Career and Technical Center, Tupelo
Corey Hale, Oxford High School, Oxford
Robert Lee, T.C. Randall Career and Technical Center, Belzoni
Jeremy Smith, Pascagoula College and Career Technical Institute, Pascagoula

Standards

Standards and alignment crosswalks are referenced in the appendix. Depending on the curriculum, these crosswalks should identify alignment to the standards mentioned below, as well as possible related academic topics as required in the Subject Area Testing Program in Algebra I, Biology I, English II, and U.S. History from 1877, which could be integrated into the content of the units. Mississippi's CTE HVACR is aligned to the following standards:

National Center for Construction Education and Research (NCCER) Learning Series
The NCCER developed and published a set of industry standards that are taught nationwide by contractors, associations, construction/manufacturing users, and secondary and postsecondary schools called the NCCER learning series. When developing this set of standards, the NCCER assembled a team of subject matter experts who represented manufacturing companies and schools across the nation. Each committee met several times and combined experts' knowledge and experience to finalize the set of national industry standards.

As a part of the accreditation process, all Mississippi manufacturing instructors will be required to successfully complete the Instructor Certification Training Program. This program ensures that instructors possess a deep knowledge of the content in the standards.

International Society for Technology in Education Standards (ISTE)
Reprinted with permission from *ISTE Standards for Students* (2016). All rights reserved. Permission does not constitute an endorsement by ISTE.
iste.org

College- and Career-Ready Standards
College- and career-readiness standards emphasize critical thinking, teamwork, and problem-solving skills. Students will learn the skills and abilities required by the workforce of today and the future. Mississippi adopted the Mississippi College- and Career-Readiness Standards (MCCRS) to provide a consistent, clear understanding of what students are expected to learn so teachers and parents know what they need to do to help them.
mdek12.org/oae/college-and-career-readiness-standards

Framework for 21st–Century Learning
In defining 21st–century learning, the Partnership for 21st–Century Skills has embraced key themes and skill areas that represent the essential knowledge for the 21st century: global awareness; financial, economic, business, and entrepreneurial literacy; civic literacy; health literacy; environmental literacy; learning and innovation skills; information, media, technology skills; and life and career skills. *Framework for 21st–Century Learning Definitions* (2019).
battelleforkids.org/networks/p21/frameworks-resources

Preface

Secondary CTE programs in Mississippi face many challenges resulting from sweeping educational reforms at the national and state levels. Schools and teachers are increasingly being held accountable for providing applied learning activities to every student in the classroom. This accountability is measured through increased requirements for mastery and attainment of competency as documented through both formative and summative assessments. This document provides information, tools, and solutions that will aid students, teachers, and schools in creating and implementing applied, interactive, and innovative lessons. Through best practices, alignment with national standards and certifications, community partnerships, and a hands-on, student-centered concept, educators will be able to truly engage students in meaningful and collaborative learning opportunities.

The courses in this document reflect the statutory requirements as found in Section 37-3-49, *Mississippi Code of 1972*, as amended (Section 37-3-46). In addition, this curriculum reflects guidelines imposed by federal and state mandates (Laws, 1988, Ch. 487, §14; Laws, 1991, Ch. 423, §1; Laws, 1992, Ch. 519, §4 eff. from and after July 1, 1992; Strengthening Career and Technical Education for the 21st Century Act, 2019 [Perkins V]; and Every Student Succeeds Act, 2015).

Mississippi Teacher Professional Resources

The following are resources for Mississippi teachers:

Curriculum, Assessment, Professional Learning
: Program resources can be found at the RCU's website, rcu.msstate.edu.

Learning Management System: An Online Resource
: Learning management system information can be found at the RCU's website, under Professional Learning.

Should you need additional instructions, call the RCU at 662.325.2510 or helpdesk@rcu.msstate.edu.

Executive Summary

Pathway Description
The HVACR pathway is an instructional program in the Architecture and Construction Career Cluster that prepares students for employment or continued education in heating, ventilation, and air-conditioning. The curriculum framework for this program was developed in partnership with the Mississippi Construction Education Foundation (MCEF). MCEF is the accredited sponsor of the National Center for Construction Education and Research (NCCER).

College, Career, and Certifications
NCCER Learning Series

Grade Level and Class Size Recommendations
It is recommended that students enter this program as sophomores. Exceptions to this are a district-level decision based on class size, enrollment numbers, student maturity, and CTE delivery method. This is a hands-on, lab- or shop-based course. Therefore, a maximum of 15 students is recommended per class with only one class present with the teacher at a time.

Student Prerequisites
For students to experience success in the program, the following student prerequisites are suggested:

1. C or higher in English (the previous year)
2. C or higher in high school-level math (last course taken or the instructor can specify the level of math instruction needed)
3. Instructor approval and TABE reading score (eighth grade or higher)

or

1. TABE reading and math score (eighth grade or higher)
2. Instructor approval

or

1. Instructor approval

Assessment
The latest assessment blueprint for the curriculum can be found at rcu.msstate.edu/curriculum.

Teacher Licensure
The latest teacher licensure information can be found at mdek12.org/oel/apply-for-an-educator-license.

Professional Learning
If you have specific questions about the content of any of training sessions provided, please contact the RCU at 662.325.2510 or helpdesk@rcu.msstate.edu.

Course Outlines

Option 1—Four 1-Carnegie Unit Courses

This curriculum consists of four 1-credit courses, which should be completed in the following sequence:

1. **Fundamentals of HVACR—Course Code: 993018**
2. **Applications of HVACR—Course Code: 993019**
3. **Theory of HVACR—Course Code: 993022**
4. **Advanced HVACR—Course Code: 993023**

Course Description: Fundamentals of HVACR
This course includes an introduction to the field as well as fundamentals of safety, math, and hand and power tools.

Course Description: Applications of HVACR
This course introduces blueprints, materials handling, introduction to HVACR, copper and plastic piping, soldering and brazing, basic electricity, and trade math. It gives students real-world, hands-on practice in these areas. This course should only be taken after students successfully complete Fundamentals of HVACR.

Course Description: Theory of HVACR
This course includes an in-depth study of the heating, ventilation, and air-conditioning profession, carbon steel piping practice, introduction to cooling, and introduction to heating. The course also reinforces safety related to the installation and service of HVACR applications. This course should only be taken after students successfully complete Applications of HVACR.

Course Description: Advanced HVACR
This course includes an in-depth study of the heating, ventilation, and air conditioning profession, air distribution systems, leak detection, evacuation recovery and charging, alternating current, and basic electronics. The course also reinforces safety related to the installation and service of HVACR applications. It should only be taken after students successfully complete Theory of HVACR. Scheduling and operating more than one course in the same classroom/laboratory with the same instructor is not allowed. Safety is reinforced and tested at the beginning of each course.

Fundamentals of HVACR—Course Code: 993018

Unit	Unit Title	Hours
1	Orientation	3
2	Employability Skills	8.5
3	Fundamentals of Student Organizations	4.5
4	Communication Skills	9
5	Basic Safety	36
6	Introduction to Construction Math	26
7	Hand Tools	16

8	Power Tools	16
9	Introduction to Construction Drawings	21
Total		**140**

Applications of HVACR—Course Code: 993019

Unit	Unit Title	Hours
10	Introduction to Materials Handling	20
11	Introduction to HVACR	20
12	Basic Copper and Plastic Piping	30
13	Soldering and Brazing	30
14	Basic Electricity (HVACR)	40
Total		**140**

Theory of HVACR—Course Code: 993022

Unit	Unit Title	Hours
15	Orientation and Safety	17
16	Trade Math	29
17	Basic Carbon Steel Piping Practice	44
18	Introduction to Cooling	50
Total		**140**

Advanced HVACR—Course Code: 993023

Unit	Unit Title	Hours
19	Introduction to Heating	41
20	Air Distribution Systems	36
21	Leak Detection Evacuation Recovery and Charging	32
22	Alternating Current	31
Total		**140**

Option 2—Two 2-Carnegie Unit Courses

This curriculum consists of two 2-credit courses, which should be completed in the following sequence:

1. **HVACR I—Course Code: 993020**
2. **HVACR II—Course Code: 993021**

Course Description: HVACR I
This course emphasizes heating, ventilation, and air-conditioning. Topics include employability skills, safety, construction math, construction drawings, materials handling, copper and piping, soldering and brazing, and basic electricity.

Course Description: HVACR II
This course emphasizes heating, ventilation, and air-conditioning. Topics include employability skills, safety, carbon steel piping, introduction to cooling, introduction to heating, air distribution, leak detection, evacuation recovery and charging, alternating current, and basic electronics. This course should be taken after the student has successfully completed HVACR I. Scheduling and operating more than one course in the same classroom/laboratory with the same instructor is not allowed. Safety is reinforced and tested at the beginning of each course.

HVACR I—Course Code: 993020

Unit	Unit Title	Hours
1	Orientation	3
2	Employability Skills	8.5
3	Fundamentals of Student Organizations	4.5
4	Communication Skills	9
5	Basic Safety	36
6	Introduction to Construction Math	26
7	Hand Tools	16
8	Power Tools	16
9	Introduction to Construction Drawings	21
10	Introduction to Materials Handling	20
11	Introduction to HVACR	20
12	Basic Copper and Plastic Piping	30
13	Soldering and Brazing	30
14	Basic Electricity (HVACR)	40
Total		**280**

HVACR II—Course Code: 993021

Unit	Unit Title	Hours
15	Orientation and Safety	17
16	Trade Math	29
17	Basic Carbon Steel Piping Practice	44
18	Introduction to Cooling	50
19	Introduction to Heating	41

20	Air Distribution Systems	36
21	Leak Detection, Evacuation Recovery, and Charging	32
22	Alternating Current	31
Total		**280**

Career Pathway Outlook

Overview

The Heating, Ventilation, and Air Conditioning Refrigeration (HVACR) pathway covers occupations related to systems that control the temperature and air quality in buildings, climate-controlled environments, and refrigeration systems enabling storage and transportation of goods and services. In this secondary program, students can earn the NCCER HVACR Level 1 certification, which will give students a head start on obtaining industry-recognized credentials and better prepare them for a post-secondary HVACR program. The growing number of sophisticated climate-control systems is expected to increase the demand for qualified HVACR technicians. This pathway focuses on the following: installing, cleaning, and maintaining systems; installing electrical components and wiring; inspecting and testing systems and components; using communication skills to discuss system malfunctions; repairing or replacing worn or defective parts; maintaining systems to improve performance; and keeping records of work performed. In addition to technical skills, good listening, speaking, time management, and critical thinking skills can contribute to success in this occupation. HVACR professionals work in various settings, such as in homes, schools, stores, hospitals, office buildings, or factories. Some technicians are assigned to specific job sites at the beginning of each day, and others travel to several locations to make service calls. The top four industries with the highest levels of employment for HVACR mechanics and installers are building equipment contractors (namely, plumbing, heating, and air-conditioning contractors), direct selling establishments, commercial and industrial machinery and equipment, and personal and household goods repair and maintenance. In addition, the natural gas distribution sector is among the highest-paying industries for this occupation. The U.S. Environmental Protection Agency (EPA) requires all HVACR technicians who buy, handle, or work with refrigerants to be EPA 608–certified in proper refrigerant handling. Many trade schools, unions, and employer associations offer training programs to prepare students for the EPA certification exam. Most professionals in heating, ventilation, and air conditioning receive postsecondary instruction from technical and trade schools or community colleges that offer programs in HVACR. These programs generally last six months to two years and lead to a certificate or an associate degree. Success in this field requires continuous education to stay current with the latest equipment and skills. High school students interested in becoming an HVACR technician should take CTE, math, and physics courses.

For example, careers with the highest earning potential—HVACR mechanical engineers or post-secondary teachers—require advanced degrees. An HVACR engineer is a mechanical engineer who designs ventilation, air-conditioning, and heating systems for buildings such as offices, schools, or residential spaces. HVACR engineers are usually professionals with previous expertise in plumbing and electricity, which helps them understand climate control systems. They know how air flows through different structures and can calculate heat load and loss. They collaborate with other construction specialists and follow local, state, and federal regulations and building codes.

Needs of the Future Workforce

According to the U.S. Bureau of Labor Statistics, employment of HVACR mechanics and installers is projected to grow 5% from 2021 to 2031. Also, on average, about 40,100 openings

for HVACR mechanics and installers are projected each year over this decade. Commercial and residential building construction is expected to drive employment growth. In Mississippi, the average employment growth total from 2020 to 2030, is projected to increase by 9.5% for all general occupations combined. The data given in Table 1.1 below, including the average hourly earnings, was compiled from the Mississippi Department of Employment Security in 2022.

Table 1.1: Current and Projected Occupation Report

Description	Jobs, 2020	Projected Jobs, 2030	Change (Number)	Change (Percent)	Average Hourly Earnings, 2022
Control and Valve Installers and Repairers	480	500	20	4.2%	$22.90
Cooling and Freezing Equipment Operators	190	240	50	26.3%	$17.60
General and Operations Managers	19,310	20,980	1,670	8.6%	$40.72
Heating, Air Conditioning, and Refrigeration Mechanics and Installers	2,650	2,930	280	10.6%	$20.52
Helpers—Installation, Maintenance, and Repair Workers	710	750	40	5.6%	$14.88
Installation, Maintenance, and Repair Workers, All Other	1,140	1,200	60	5.3%	$21.53
Mechanical (HVAC) Engineers	1,590	1,710	120	7.5%	$40.66
Plumbers, Pipefitters, and Steamfitters	3,050	3,300	250	8.2%	$22.80

Source: Mississippi Department of Employment Security; mdes.ms.gov (2022).

Perkins V Requirements and Academic Infusion

The HVACR curriculum meets Perkins V requirements of introducing students to and preparing them for high-skill, high-wage occupations in HVACR fields. It also offers students a program of study, including both secondary and postsecondary courses, that will further prepare them for HVACR careers. Additionally, this curriculum is integrated with academic college- and career-readiness standards. Lastly, the curriculum focuses on ongoing and meaningful professional development for teachers, as well as relationships with industry.

Transition to Postsecondary Education

The latest articulation information for secondary to postsecondary can be found at the Mississippi Community College Board website, mccb.edu.

Best Practices

Innovative Instructional Technologies

Classrooms should be equipped with tools that will teach today's digital learners through applicable and modern practices. The HVACR educator's goal should be to include teaching strategies that incorporate current technology. To make use of the latest online communication tools—wikis, blogs, podcasts, and social media platforms, for example—the classroom teacher is encouraged to use a learning management system that introduces students to education in an online environment and places more of the responsibility of learning on the student.

Differentiated Instruction

Students learn in a variety of ways, and numerous factors—students' background, emotional health, and circumstances—create unique learners. By providing various teaching and assessment strategies, students with various learning preferences can have more opportunities to succeed.

CTE Student Organizations

Teachers should investigate opportunities to sponsor a student organization. There are several here in Mississippi that can foster the types of learning expected from the HVACR curriculum. SkillsUSA is an example of a student organization with many outlets for HVACR. Student organizations provide participants and members with growth opportunities and competitive events. They also open doors to the world of HVACR careers and scholarship opportunities.

Cooperative Learning

Cooperative learning can help students understand topics when independent learning cannot. Therefore, you will see several opportunities in the HVACR curriculum for group work. To function in today's workforce, students need to be able to work collaboratively with others and solve problems without excessive conflict. The HVACR curriculum provides opportunities for students to work together and help each other complete complex tasks. There are many field experiences within the HVACR curriculum that allow and encourage collaboration with professionals currently in the HVACR field.

Work-Based Learning

Work-based learning is an extension of understanding competencies taught in the HVACR classroom. This curriculum is designed in a way that necessitates active involvement by the students in the community around them and the global environment. These real-world connections and applications link all types of students to knowledge, skills, and professional dispositions. Work-based learning should encompass ongoing and increasingly more complex involvement with local companies and HVACR industry professionals. Thus, supervised collaboration and immersion into the HVACR industry around the students are keys to students' success, knowledge, and skills development.

Professional Organizations

Association for Career and Technical Education (ACTE)
acteonline.org

National Center for Construction Education and Research (NCCER).
nccer.org

SkillsUSA
skillsusa.org

Skills USA – Mississippi
mdek12.org/CTE/SO/SkillsUSA

Using This Document

Competencies and Suggested Objectives
A competency represents a general concept or performance that students are expected to master as a requirement for satisfactorily completing a unit. Students will be expected to receive instruction on all competencies. The suggested objectives represent the enabling and supporting knowledge and performances that will indicate mastery of the competency at the course level.

Teacher Resources
All teachers should request to be added to the Canvas Teacher Resource Guide for their course. For questions or to added to the guide send a help desk ticket to the RCU by emailing helpdesk@rcu.msstate.edu.

Perkins V Quality Indicators and Enrichment Material
Some of the units may include an enrichment section at the end. This material will greatly enhance the learning experiences for students. If the HVACR program is using a national certification, work-based learning, or other measure of accountability that aligns with Perkins V as a quality indicator, this material could very well be assessed on that quality indicator. It is the responsibility of the teacher to ensure all competencies for the selected quality indicator are covered throughout the year.

Unit 1: Orientation

Competencies and Suggested Objectives
1. Describe local program and CTE center expectations, policies, and procedures. DOK1 a. Describe local program and CTE center policies and procedures, including dress code, attendance, academic requirements, discipline, shop/lab rules and regulations, and transportation regulations. b. Give a brief overview of the course. Explain to students what HVACR is, why it is important, and how it will be delivered. c. Compare and contrast local program and school policies to the expectations of employers. d. Preview course objectives, program policy, and industry standards.
2. Discuss work-based learning opportunities related to program areas. DOK1 a. Define work-based learning. b. Explore the opportunities available through the program areas below. • Work-based learning • Job shadowing • Apprenticeship programs • On-the-job training • Other opportunities

Unit 2: Employability Skills

Competencies and Suggested Objectives
1. Describe employment opportunities in the construction industry. DOK1 a. Describe employment opportunities, including potential earnings, employee benefits, job availability, working conditions, educational requirements, required technology skills, and continuing education/training. b. Discuss the guidelines for developing a proper résumé. c. Demonstrate completing job applications.
2. Examine the Mississippi Department of Employment Security (MDES) website and its applications relating to employment opportunities. DOK1 a. Perform various searches through the MDES website, such as: • Number of jobs available for a specific area of expertise • Hourly wage • Percent of jobs in the county • Percent of jobs in the state
3. Demonstrate appropriate interview skills. DOK1 a. Identify interview skills, such as speaking, dress, professionalism, and punctuality. b. Simulate a job interview.
4. Describe basic employee responsibilities and appropriate work ethic. DOK1 a. Compare and contrast employment responsibilities and expectations to local school and program policies and expectations. b. Define effective relationship skills and workplace issues, including but not limited to sexual harassment, stress, and substance abuse.

Unit 3: Fundamentals of Student Organizations

Competencies and Suggested Objectives
1. Discuss the history, mission, and purpose of student organizations, including SkillsUSA. DOK1 a. Trace the history of the program-area student organization. b. Identify the mission, purpose, and goals of the program-area student organization.
2. Explore the advantages of membership in a student organization. DOK1 a. Discuss the membership process for the program-area student organization. b. Explain the activities related to the local chapter and the state and national organizations.
3. Discuss the organization's brand resources. DOK1 a. Identify the motto, creed, and/or pledge and discuss their meanings. b. Recognize related brand resources, such as: • Emblem • Colors • Official attire • Logos • Graphic standards
4. Describe the importance of effective communication skills. DOK1 a. Demonstrate verbal and nonverbal communication skills. b. Apply appropriate speaking and listening skills to class- and work-related situations.
5. Apply leadership skills to class- and work-related situations and 21st–century skills. DOK2 a. Define leadership. b. Discuss the attributes of a leader. c. Identify the roles a leader can assume.
6. Utilize teambuilding skills in class- and work-related situations. DOK2 a. Define teambuilding. b. Discuss the attributes of a team. c. Identify the roles included in a team.
7. Discuss the various competitions offered through the program area's student organization. DOK1 a. Describe each of the competitions and the skills needed to accomplish the tasks. b. Perform the tasks needed to complete an assigned requirement for a competition.

Note: This unit will be ongoing throughout the year. Time allotted for this unit will be distributed over the entire year.

Unit 4: Communication Skills

Competencies and Suggested Objectives
1. Demonstrate the ability to follow verbal and written instructions and communicate effectively in on-the-job situations. DOK2 a. Follow basic written and verbal instructions. b. Effectively communicate in on-the-job situations using verbal, written, or electronic communication. c. Demonstrate reading and writing requirements in on-the-job situations.
2. Discuss the importance of good listening skills in on-the-job situations. DOK2 a. Apply tips for developing good listening skills.

Unit 5: Basic Safety

Competencies and Suggested Objectives
1. Describe, define, and illustrate general safety rules for working in a shop/lab and how they relate to the construction industry. DOK2 a. Describe how to avoid onsite accidents. b. Explain the relationship between housekeeping and safety. c. Explain the importance of following all safety rules and company safety policies according to Occupational Safety and Health Administration (OSHA) standards. d. Explain the importance of reporting all on-the-job injuries, accidents, and near misses. e. Explain the need for evacuation policies and the importance of following them. f. Explain causes of accidents and the impact of accident costs. g. Compare and contrast shop/lab safety rules to industry safety rules.
2. Identify and apply safety around welding operations. DOK1 a. Use proper safety practices when welding or working around welding operations. b. Use proper safety practices when welding in or near trenches and excavations. c. Explain the term "proximity work."
3. Display appropriate safety precautions to take around common jobsite hazards. DOK1 a. Explain the safety requirements for working in confined areas. b. Explain the different barriers and barricades and how they are used.
4. Demonstrate the appropriate use and care of personal protective equipment (PPE). DOK1 a. Identify commonly used PPE items. b. Understand proper use of PPE. c. Demonstrate appropriate care for PPE.
5. Explain fall protection, ladder, stair, and scaffold procedures and requirements. DOK1 a. Explain the use of proper fall protection. b. Inspect and safely work with various ladders, stairs, and scaffolds.
6. Explain the safety data sheet (SDS). DOK1 a. Explain the function of the SDS. b. Interpret the requirements of the SDS. c. Discuss hazardous material exposures.
7. Display appropriate safety procedures related to fires. DOK1 a. Explain the process by which fires start. b. Explain fire prevention of various flammable liquids. c. Explain the classes of fires and the types of extinguishers used. d. Illustrate the proper steps to follow when using a fire extinguisher. e. Demonstrate the proper techniques for putting out a fire.
8. Explain safety in and around electrical situations. DOK1 a. Explain injuries that can result when electrical contact occurs. b. Explain safety around electrical hazards. c. Explain action to take when an electrical shock occurs.

Note: Safety is to be taught as an ongoing part of the program. Students are required to complete a written safety test with 100% accuracy before entering the shop for lab simulations and projects. This test should be documented in each student's file.
Note: This unit will be ongoing throughout the year. Time allotted for this unit will be distributed over the entire year.

Unit 6: Introduction to Construction Math

Competencies and Suggested Objectives
1. Apply the four basic math skills using whole numbers, fractions, decimals, and percentages, both with and without a calculator. DOK2 a. Define basic geometric shapes used in the construction industry. b. Add, subtract, multiply, and divide whole numbers, decimals, and fractions with and without a calculator. c. Convert whole numbers to fractions and convert fractions to whole numbers. d. Convert decimals to percentages and convert percentages to decimals. e. Convert fractions to decimals. f. Convert fractions to percentages. g. Demonstrate reading a standard and metric ruler and tape measure. h. Recognize and use metric units of length, weight, volume, and temperature.

Note: This unit will be ongoing throughout the year. Time allotted for this unit will be distributed over the entire year.

Unit 7: Hand Tools

Competencies and Suggested Objectives

1. Demonstrate the use and maintenance of hand tools. DOK2
   a. Identify, visually inspect, and discuss the safe use of common hand tools including:
      - Hammers
      - Demolition tools
      - Chisels and punches
      - Screwdrivers
      - Adjustable wrenches
      - Non-adjustable wrenches
      - Sockets
      - Pliers
      - Tape measures
      - Levels
      - Squares
      - Handsaws
      - Clamps
      - Files
      - Utility knives
      - Shovels
   b. Discuss safety rules.
   c. Select and demonstrate the use of hand tools.
   d. Explain the procedures for maintenance.

Note: This unit will be ongoing throughout the year. Time allotted for this unit will be distributed over the entire year.

Unit 8: Power Tools

Competencies and Suggested Objectives

1. Demonstrate the use and maintenance of power tools. DOK2
   a. Identify, visually inspect, and discuss the safe use of common power tools, including:
      - Electric drill (corded or cordless)
      - Hammer drill
      - Impact driver
      - Circular saw
      - Jigsaw
      - Reciprocating saw
      - Portable band saw
      - Miter or cutoff saw
      - Table saw
      - Portable or bench grinder
      - Oscillating multi-tool
      - Power nailer
   b. Discuss safety rules.
   c. Select and demonstrate the use of power tools.
   d. Explain the procedures for maintenance.

Note: This unit will be ongoing throughout the year. Time allotted for this unit will be distributed over the entire year.

Unit 9: Introduction to Construction Drawings

Competencies and Suggested Objectives
1. Read, analyze, and understand basic components of a blueprint. DOK3 a. Recognize and identify terms, components, and symbols commonly used on blueprints. b. Relate information on construction drawings to actual locations on the print. c. Demonstrate the use of an engineer's and architect's scales. d. Recognize different types of drawings. e. Interpret and use drawing dimensions.

Unit 10: Introduction to Materials Handling

Competencies and Suggested Objectives
1. Safely handle and store materials. DOK1 a. Define a load. b. Establish a pre-task plan before moving a load. c. Demonstrate proper materials-handling techniques. d. Choose appropriate materials-handling equipment for the task. e. Recognize hazards and follow safety procedures required for materials handling. f. Identify and demonstrate commonly used knots.

Unit 11: Introduction to HVACR

Competencies and Suggested Objectives
1. Identify and explain heating, ventilation, air-conditioning, and refrigeration (HVACR) systems, HVACR environmental law, and job opportunities that are available in the HVACR profession. [DOK2] a. Explain the basic principles of HVACR. b. Describe the principles that guide HVACR installation and service techniques.

Unit 12: Basic Copper and Plastic Piping

Competencies and Suggested Objectives
1. Identify and discuss the tools used in the piping trade, discuss the materials and methods used in connecting piping systems, and perform copper and plastic piping tasks found in the HVACR environment. DOK2 a. Discuss and demonstrate how to use copper tubing in HVACR. b. Discuss and demonstrate how to use plastic tubing in HVACR.

Unit 13: Soldering and Brazing

Competencies and Suggested Objectives
1. Identify and utilize PPE, tools, and materials required to solder and braze copper tubing. DOK1
2. Prepare and solder/braze copper tubing systems in various industrial and HVACR applications and properly clean and install fittings. DOK2

Unit 14: Basic Electricity (HVACR)

Competencies and Suggested Objectives
1. Identify electrical safety hazards, demonstrate safety around circuits and equipment, describe basic electricity laws, interpret electrical drawings and schematics, and demonstrate wiring basic electrical circuits. DOK2 a. Describe how voltage, current, resistance, and power are mathematically related. b. Describe the difference between series and parallel circuits and calculate loads in each. c. Describe the purpose and operation of the various electrical components used in HVACR equipment.

Unit 15: Orientation and Safety

Competencies and Suggested Objectives
1. Describe local program and CTE center policies and procedures. DOK2
2. Describe employment opportunities and responsibilities of the industrial and HVACR mechanic. DOK2 a. Describe employer expectations in the workplace.
3. Explore leadership skills and personal development opportunities provided for students by student organizations, including SkillsUSA. DOK2 a. Demonstrate effective team-building and leadership skills. b. Practice appropriate work ethic.
4. Describe general safety rules for working in a shop/lab and industry. DOK2 a. Discuss safety issues and prevention associated with the HVACR shop area. b. Explain fire safety and prevention in the workplace.

Note: Safety is to be taught as an ongoing part of the program. Students are required to complete a written safety test with 100% accuracy before entering the shop for lab simulations and projects. This test should be documented in each student's file.

Unit 16: Trade Math

Competencies and Suggested Objectives
1. Identify proper math to use for problem-solving; use English and metric measurement; use powers, algebra, and geometric calculation to solve HVACR problems; and convert temperature from Fahrenheit to Celsius. DOK2 a. Demonstrate how to calculate mathematic problems found in the HVACR trade.

Unit 17: Basic Carbon Steel Piping Practice

Competencies and Suggested Objectives
1. Recognize the types and sizes of carbon steel piping and pipe fittings, and demonstrate the tools used to cut, ream, and thread carbon steel pipe in the HVACR trade. DOK2 a. Explain the uses of carbon steel pipes in the HVACR trade. b. Assemble and install carbon steel pipes and fittings.

Unit 18: Introduction to Cooling

Competencies and Suggested Objectives
1. Explain basic cooling systems, heat transfer, trade terms, refrigerants, components, controls, and proper piping of the cooling system. DOK2 a. Explain how an HVACR system removes heat from the air-conditioned area of an HVACR system. b. Identify the major components, accessories, refrigerants, and control devices available for cooling systems, and explain how each works. c. Discuss U.S. Environmental Protection Agency (EPA) standards.

Unit 19: Introduction to Heating

Competencies and Suggested Objectives
1. Explain methods of heat transfer and characteristics of combustion; identify types of fuels and furnaces and components of electric, hydronic, and gas furnaces; identify and safely use meters in gas measurement; and perform maintenance on electric and gas furnaces. DOK2 a. Explain how a heating system operates. b. Perform basic furnace preventive maintenance procedures, such as cleaning and filter replacement, with supervision.

Unit 20: Air Distribution Systems

Competencies and Suggested Objectives
1. Demonstrate the design and installation of HVACR duct systems. DOK2 a. Discuss the patterns of airflow and pressures in an HVACR duct. b. Identify types of duct systems and explain where each is used in HVACR applications. c. Describe the mechanical equipment and materials used to create air distribution systems.
2. Discuss the installation of ductwork. DOK1 a. Identify, select, and use fasteners. b. Discuss connecting rectangular, round, and spiral ductwork. c. Explain how to properly seal ductwork.

Unit 21: Leak Detection, Evacuation, Recovery, and Charging

Competencies and Suggested Objectives
1. Identify leaks in an HVACR system and perform the proper steps to repair the leak, restoring the unit to operation. DOK2 a. Describe what the Clean Air Act means to the HVACR trade. b. Define and perform a leak test on an HVACR system. c. Use nitrogen to purge a system, and charge refrigerant into a system by the methods below. • Weight • Superheat • Subcooling • Charging pressure
2. Identify and install a basic vacuum pump service operation. DOK2 a. Describe the safety procedures for using a vacuum pump. b. Install and use a vacuum pump on a system.
3. Explain the procedures for evacuation and recovery. DOK1

Unit 22: Alternating Current

Competencies and Suggested Objectives
1. Explain how single- and three-phase alternating current (AC) power is generated and transmitted for use. DOK1
2. Examine the safe operation of electrical transformers, motors, and single- and three-phase HVACR devices. DOK2 a. Explain and demonstrate the safe operation of various types of transformers. b. Describe the types of capacitors and motors found in the HVACR unit. c. State and demonstrate the safety precautions that must be followed when working with electrical equipment and testing AC components, including capacitors, transformers, and motors.

Student Competency Profile

Student's Name: _____

This record is intended to serve as a method of noting student achievement of the competencies in each unit. It can be duplicated for each student, and it can serve as a cumulative record of competencies achieved in the course.

In the blank before each competency, place the date on which the student mastered the competency.

Unit 1: Orientation		
	1.	Describe local program and CTE center expectations, policies, and procedures.
	2.	Discuss work-based learning opportunities related to program areas.
Unit 2: Employability Skills		
	1.	Describe employment opportunities in the construction industry.
	2.	Examine the Mississippi Department of Employment Security website and its applications relating to employment opportunities.
	3.	Demonstrate appropriate interview skills.
	4.	Describe basic employee responsibilities and appropriate work ethic.
Unit 3: Fundamentals of Student Organizations		
	1.	Discuss the history, mission, and purpose of student organizations, including SkillsUSA.
	2.	Explore the advantages of membership in a student organization.
	3.	Discuss the organization's brand resources.
	4.	Describe the importance of effective communication skills.
	5.	Apply leadership skills to class- and work-related situations and 21st century skills.
	6.	Utilize team-building skills in class- and work-related situations.
	7.	Discuss the various competitions offered through the program area's student organization.
Unit 4: Communication Skills		
	1.	Demonstrate the ability to follow verbal and written instructions and communicate effectively in on-the-job situations.
	2.	Discuss the importance of good listening skills in on-the-job situations.
Unit 5: Basic Safety		
	1.	Describe, define, and illustrate general safety rules for working in a shop/lab and how they relate to the construction industry.
	2.	Identify and apply safety around welding operations.
	3.	Display appropriate safety precautions to take around common jobsite hazards.

	4.	Demonstrate the appropriate use and care of personal protective equipment (PPE).
	5.	Explain fall protection, ladder, stair, and scaffold procedures and requirements.
	6.	Explain the safety data sheet (SDS).
	7.	Display appropriate safety procedures related to fires.
	8.	Explain safety in and around electrical situations.
Unit 6: Introduction to Construction Math		
	1.	Apply the four basic math skills using whole numbers, fractions, decimals, and percentages, both with and without a calculator.
Unit 7: Hand Tools		
	1.	Demonstrate the use and maintenance of hand tools.
Unit 8: Power Tools		
	1.	Demonstrate the use and maintenance of power tools.
Unit 9: Introduction to Construction Drawings		
	1.	Read, analyze, and understand basic components of a blueprint.
Unit 10: Introduction to Materials Handling		
	1.	Safely handle and store materials.
Unit 11: Introduction to HVACR		
	1.	Identify and explain heating, ventilation, air-conditioning, and refrigeration (HVACR) systems, HVACR environmental law, and job opportunities that are available in the HVACR profession.
Unit 12: Basic Copper and Plastic Piping		
	1.	Identify and discuss the tools used in the piping trade, discuss the materials and methods used in connecting piping systems, and perform copper and plastic piping tasks found in the HVACR environment.
Unit 13: Soldering and Brazing		
	1.	Identify and utilize PPE, tools, and materials required to solder and braze copper tubing.
	2.	Prepare and solder/braze copper tubing systems in various industrial and HVACR applications and properly clean and install fittings.
Unit 14: Basic Electricity (HVACR)		
	1.	Identify electrical safety hazards, demonstrate safety around circuits and equipment, describe basic electricity laws, interpret electrical drawings and schematics, and demonstrate wiring basic electrical circuits.
Unit 15: Orientation and Safety		
	1.	Describe local program and vocational/career technical center policies and procedures.
	2.	Describe employment opportunities and responsibilities of the industrial and HVACR mechanic.

	3.	Explore leadership skills and personal development opportunities provided for students by student organizations, including SkillsUSA.
	4.	Describe general safety rules for working in a shop/lab and industry.
Unit 16: Trade Math		
	1.	Identify proper math to use for problem solving; use English and metric measurement; use powers, algebra, and geometric calculation to solve for HVACR problems; and convert Fahrenheit to Celsius.
Unit 17: Basic Carbon Steel Piping Practice		
	1.	Recognize the types and sizes of carbon steel piping and pipe fittings, and demonstrate the tools used to cut, ream, and thread carbon steel pipe in the HVACR trade.
Unit 18: Introduction to Cooling		
	1.	Explain the basic cooling systems, heat transfer, trade terms, refrigerants, components, controls, and proper piping of the cooling system.
Unit 19: Introduction to Heating		
	1.	Explain methods of heat transfer and characteristics of combustion; identify types of fuels and furnaces and components of electric, hydronic, and gas furnaces; identify and safely use meters in gas measurement; and perform maintenance on electric and gas furnaces.
Unit 20: Air Distribution Systems		
	1.	Demonstrate the design and installation of HVACR duct systems.
	2.	Discuss the installation of ductwork.
Unit 21: Leak Detection, Evacuation, Recovery, and Charging		
	1.	Identify leaks in an HVACR system and perform the proper steps to repair the leak, restoring the unit to operation.
	2.	Identify/install a basic vacuum pump service operation.
	3.	Explain the procedures for evacuation and recovery.
Unit 22: Alternating Current		
	1.	Explain how single- and three-phase AC power is generated and transmitted for use.
	2.	Examine the safe operation of electrical transformers, motors, and single- and three-phase HVACR devices.

Appendix A: Industry Standards

	Units	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
CORE																							
BSM						X																	
ICM							X																
IHT								X															
IPT									X														
BLU										X													
COM					X																		
EMP			X																				
IMH											X												
HVACR - Level 1																							
INT												X											
CPP													X										
SBR														X									
BEL															X								
TMA																	X						
BAS																X							
EMP																X							
BCP																		X					
ITC																			X				
ITH																				X			
ADS																					X		
HVACR Level 2																							
LDE																							X
ALT																							X

National Center for Construction Education and Research (NCCER) Learning Series Standards for the Construction Core Technology Program

NCCER Core

1. BSM – Basic Safety (00101)
2. ICM – Introduction to Construction Math (00102)
3. IHT – Introduction to Hand Tools (00103)
4. IPT – Introduction to Power Tools (00104)
5. BLU – Introduction to Construction Drawings (00105)
6. COM – Basic Communication Skills (00107)
7. EMP – Basic Employability Skills (00108)
8. IMH – Introduction to Materials Handling (00109)

NCCER HVACR—Level 1

9. INT – Introduction to HVACR (03101-V5)
10. TMA – Trade Mathematics (03102-V5)
11. CPP – Basic Copper and Plastic Piping Practices (03103-V5)
12. SBR – Soldering and Brazing (03104-V5)
13. BCP – Basic Carbon Steel Piping Practices (03105-V5)
14. BEL – Basic Electricity (03106-V5)
15. ITC – Introduction to Cooling (03107-V5)
16. ITH – Introduction to Heating (03108-V5)
17. ADS – Air Distribution Systems (03109-V5)

NCCER HVACR—Level 2

18. LDE – Leak Detection, Evacuation, Recovery, and Charging (03205-V5)
19. ALT – Alternating Current (03206-V5)