Heating, Ventilation, Air-Conditioning/Refrigeration (HVAC/R)

MASTER PLAN OF INSTRUCTION
2020 - 2021

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MISSION

The mission of Fort Myers Technical College is to provide high quality career and technical training, in order to prepare students for current and emerging industries, delivered by a professional and caring staff in a positive learning environment.

Lack of English language skills will not be a barrier to admission and participation. The district may assess each student's ability to benefit from specific programs through placement tests and counseling, and, if necessary, will provide services or referrals to better prepare students for successful participation.

FMTC
FORT MYERS TECHNICAL COLLEGE

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Heating, Ventilation, Air-Conditioning/Refrigeration (HVAC/R)

INTRODUCTION

The Heating, Ventilation, Air-Conditioning/Refrigeration (HVAC/R) program is 1,350 hours of instruction training individuals to attain an entry-level status in the HVAC/R industry. The program covers a broad range of instruction that may be found in the program outline of this Master Plan of Instruction. An appropriate amount of time is spent in each area to thoroughly cover needed instructional material as well as to gain manipulative skills.

The program utilizes both theory and practical application of material to help the students gain needed knowledge and skills. Due to the increasing complexity of systems on today's HVAC/R equipment, it is even more important to know why a procedure is done as well as how it is done. Understanding how a system functions, therefore, has an important role to play in this program of study.

Each student must successfully complete written test material on theory and related topics as well as successfully demonstrate the practical application of this information in the laboratory environment.

Prerequisites for this program should include a background in the sciences such as chemistry and physics on a very basic level, math in general with an emphasis on basic geometry, algebra and measuring. Computer skills are essential for navigating the Internet, accessing computerized simulators, and interfacing with learning management systems.

PROGRAM MISSION

The mission of the Heating, Ventilation, Air-Conditioning/Refrigeration (HVAC/R) program is to prepare students for employment in the HVAC mechanic or installer positions in the HVAC/R field. It is also designed to assist those students who wish to update present skills and cross-train in other HVAC/R areas. The program focuses on student and industry needs. Training is constantly updated by the instructor and program advisory committee to keep current with technological changes.

PROGRAM PHILOSOPHY

We believe that competent workers in the high-performance workplace need:

1. Skills in communications, mathematics, science, critical thinking, teamwork, and effective work habits.
2. Training in emerging concepts and technologies.
3. Relevant work-based learning experience.

We will provide a caring atmosphere that promotes a high degree of student-faculty interaction that fosters development of business and industry partnerships.

PROGRAM CONTENTS

- Fundamentals
- HVAC/R Science
- Refrigeration Systems and Components
- Refrigeration Practices
- HVAC/R Electrical Systems and Components
- Air Conditioning Systems
- Heating Systems
- Heat Pumps

- System Design, Sizing and Layout
- Commercial Environmental Systems
- Commercial Refrigeration Systems
- Installation, Maintenance, Service and Troubleshooting

ESSENTIAL TRAINING TASKS

Physical Requirements

- Maintain a high degree of manual dexterity
- Stoop
- Kneel
- Lift at least 50 pounds and walk with it
- Use voice, hearing, and sight effectively to perform jobs in the HVAC/R field
- Crouch or bend
- High degree of finger dexterity
- Crawl
- Differentiate colors
- Use depth perception
- Work in an atmosphere of loud noise
- Work in an atmosphere of changes in temperature
- Perform repetitive tasks
- Measure accurately
- Work without close, direct supervision
- Work on multiple tasks and priorities
- Perform and complete tasks of relative complexity

Cognitive Requirements

- Handle confrontation and frustration and assist in problem resolution
- Interpret a variety of instructions furnished in written, oral, and diagrammatic form
- Collaborate with others
- Cope with high levels of stress
- Perform mathematical computations at a level of tenth grade or higher
- Make fast decisions under pressure
- Cope with anger, fear, and hostility of others in a calm manner
- Demonstrate a high degree of patience
- Read and understand computers and related equipment
- Work in close or crowded areas
- Communicate effectively with customers, fellow students, and instructional staff

ACCOMMODATIONS

Federal and state legislation requires the provision of accommodations for students with disabilities as identified on the secondary student's IEP or 504 plan or post-secondary student's accommodations plan to meet individual needs to ensure equal access. Post-secondary students with disabilities must self-identify, present documentation, required accommodations if needed, and develop a plan with their post-secondary service provider. Accommodations received in post-secondary 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 services provided are maintained in a confidential file.

TUITION

Tuition is charged for adult students at a reasonable rate that may vary slightly from year to year and is due prior to the first day of each semester. Current fee information is available from Student Services. Tuition is waived for eligible high school dual-enrolled students. Failure to pay all fees due at the time class begins will result in the student not being able to attend class and/or clinical.

CLASS SCHEDULE

Daytime certificated classes meet Monday through Friday from 8:00 A.M. until 2:30 P.M. This amounts to 30 hours of classroom instruction per week. Lunch breaks are 30 minutes in length.

ATTENDANCE POLICY

In an effort to develop appropriate employability skills, FMTC students are expected to attend all class sessions. As is expected in the workplace, when it is necessary to be absent due to illness or emergency situations, all students are to notify the instructor on or before the date of absence. The student attendance policy for each post-secondary program is consistent with industry standards.

Campus attendance is kept via a computerized system. It is the responsibility of the student to **log in** and **out** in order to receive credit for class time. This allows the school to keep accurate attendance records for the actual number of hours and minutes attended.

All adult students are expected to be in attendance at least 90% of their scheduled hours during each semester. Adult students failing to maintain the 90% attendance standard may not be permitted to continue in their program and may be required to sit out one full semester, unless administration approves to waive the 90% standard based on special circumstances.

Absences

A student who is absent for 6 consecutive class sessions, without prior approval and without contact with the instructor, will be withdrawn from enrollment in his/her program. A student withdrawn for absenteeism must petition administration to return. Students exhibiting a pattern of consecutive absences of 4 days may be subject to dismissal as determined by a School Intervention Team. School Intervention Team meetings will be held as necessary to attempt to alleviate issues resulting in excessive absences and to counsel the student of possible alternatives and consequences.

Students, who are late for class, including returning late from lunch, must clock in. Students who leave school early must notify their instructor and clock out. This time out of class is recorded as time absent and is counted against the required 90% attendance. Excessive tardies or early departures will be reported to the Security Specialist and will result in a meeting with the School Intervention Team.

Adult students who know they will be out of school for an extended period of time (4 days or longer) may apply for a Leave of Absence from their program. A Leave of Absence will be granted only once during a twelve month period. STUDENTS WHO EXERCISE A LEAVE OF ABSENCE MAY HAVE TO EXTEND THEIR TIME IN THEIR PROGRAM AND PAY ADDITIONAL FEES.

Leaving Campus During School Hours

Students should notify their instructor when leaving campus early. This is for the safety of students, to accurately track time, and to allow the instructor to best utilize instructional resources.

PLAN OF INSTRUCTIONAL PRACTICES

Teaching Methods

HVAC/R theory is taught using a hybrid of face-to-face instruction and interaction with the text material and instructor as well as computerized delivery of text, audio-visual material, and assessments. Teaching aids utilizing digital presentations, DVDs, etc. are used to a great extent throughout all instruction. Practical shop experiences are designed to enhance and reinforce the theories involved as well as to develop

manipulative skill and good work and safety practices. Wall charts, specification charts, and other reference materials are on constant display throughout the classroom and laboratory.

A great deal of equipment must be utilized for "hands-on" skill requirements. Test equipment such as multi-meters, amp meters, gauges, recovery machines are used so that the students will acquire rapport in working with such equipment and will have a basis for future troubleshooting requirements.

Materials are reviewed and updated periodically to keep them as current and as relevant as possible.

Safety
A basic outline of safety standards and practices is covered the first week of class along with a continuous implementation of safety principles.

Evaluation
Class performance, quizzes, tests, attendance, portfolio assessments, completion of project assignments, decision-making, work habits, achievement of entry-level competencies, and other methods are used for evaluation. See "Grading Procedures."

Work-Based Activities
Work-based learning activities play an integral part of the curriculum of FMTC's career-technical training programs. These activities are planned with two objectives in mind. First, the activity provides students with the opportunity to develop and apply 'real world' experience using the knowledge and skills attained in the program. Second, the activity provides the instructor with objective input from potential employers or customers of program graduates. Each work-based activity has a written instructional plan outlining objectives, experiences, competencies, and evaluation required during the activity.

Work-based activities are program specific and may include:

- Unpaid in-school shop activities to provide customer service opportunities under the direct supervision of the program instructor.
- Unpaid job shadowing experiences that may include in-school or off campus employer-based experiences under the supervision of a qualified employer representative who is working closely with the program instructor.
- Paid or unpaid cooperative training experiences conducted at the employer's work location under the supervision of a qualified employer representative and under the direction of the program instructor.

Cooperative Education
Cooperative training is available for students and coordinated by the instructor and career specialist. Cooperative training if for students who have shown competence in program training that indicates readiness for placement in an on-the-job program. High school students participating in the cooperative job placement program must be in the 12th grade. To be eligible for a cooperative education experience, students must have completed one-half of the required program hours and requirements.

Student may be returned to the program for additional training if they do not function satisfactorily on the job or when the cooperative agreement is terminated at the request of the student, parent, employer, or program instructor. Veterans will be accepted into the program in accordance with the Department of Veterans Affairs approved program.

Additional information regarding cooperative opportunities may be obtained from the program instructor or career specialist.

Job Shadowing
Job shadowing experiences, or volunteer experiences, are available to students as part of their program training. These experiences are designed to give the student actual hands-on experience doing a variety of

related tasks. Length and type of experiences will vary. The program instructor determines appropriateness of the experience. Additional information regarding job-shadowing experiences may be obtained from the program instructor or career specialist.

GRADING PROCEDURE

Teacher Grading Procedure:

Employability	30%
Attendance	20%
MyHVACLab (theory)	20%
Labs (hands-on)	20%
E-learning	10%

Degree of Competency:
Ratings are industrial performance standards. They are confirmed by the instructor who observes and evaluates performance as he/she would in the role of an employer or supervisor.

Grading:
Career MAP Completion
3 – Skilled – can work independently with no supervision
2 – Moderately Skilled – can perform job completely with limited supervision
1 – Limited Skill – requires instruction and close supervision
0 – No Exposure – no experience or knowledge in this area

The grading scale for the program is as follows:

A	90-100%
B	80-89%
C	70-79%
D	60-60%
F	0-59%

Fort Myers Technical College is a post-secondary institute designed to provide trained individuals to industry. The approved post-secondary program grading requirements must be met if the student is to receive a certificate.

Program Progress
Students are required to complete the program of training within the hours allotted by the State of Florida for completion. Progress must be at a rate that will allow completion of the program with the number of membership hours stated in the Curriculum Frameworks.

Failure to progress at this rate will require the student to meet with the program instructor, career specialist, and an administrator in order to identify an appropriate completion point or to assist the student in selecting a more appropriate training program.

Work Habits
Effective work habits are the cornerstone to successful employment. Students are expected to demonstrate productive work habits during all phases of enrollment. Instructors will work with students who need assistance in this area to improve the overall possibility for successful employment.

Attendance: Attends class, arrives/leaves on time; begins and ends work as expected.
Character: Displays loyalty, honesty, trustworthiness, dependability, reliability, initiative, self-discipline, and self-responsibility; displays a high level of effort and commitment to performing and completing work.
Teamwork: Respects the right of others; respects confidentiality; is cooperative; is assertive; displays a customer service attitude; seeks opportunities for continuous learning; demonstrates mannerly behavior; encourages and facilitates cooperation, pride, trust, and group identity; fosters commitment and team spirit.

Appearance: Displays appropriate dress, grooming, hygiene, and etiquette; wears full regulation uniform.
Attitude: Displays a willingness to cooperate and accept constructive criticism; sets realistic expectations; approaches assignments with interest.
Productivity: Is prepared for class by reading assignments and completing homework; contributes to class discussions; and involvement in lab activities (in other words, no sleeping or daydreaming). Follows safety practices; conserves and maintains equipment and supplies; keeps work area neat and clean; follows directions and procedures; makes up assignments and tests punctually; notifies proper authorities of situations presenting potential safety hazards; does not use or knowingly permits others to use tools and equipment improperly; stays on task and utilizes time constructively.
Organization: Manifests skill in prioritizing and management of time and stress; demonstrates flexibility in adapting to changes.
Communication: Communicates accurate information to others in a professional and courteous manner; displays appropriate nonverbal (eye contact, body language) and oral (listening, telephone etiquette, grammar) skills; asks pertinent questions; listens attentively to others, notifies instructor in advance of absences or tardies.

SATISFACTORY ACADEMIC PROGRESS

In order to receive and continue to receive financial assistance of any type, a student must maintain satisfactory academic progress. The Financial Aid Advisor will require a progress report to be completed by the student's instructor and submitted to the Financial Aid Office prior to each disbursement.

Students are considered to be making Satisfactory Academic Progress (SAP) if they successfully complete their scheduled clock hours, achieve a specific cumulative grade evaluation or grade point average (GPA), and do not exceed the maximum time limits to complete their course of study. Each Student Academic Progress will be checked at 450 clock hours and prior to subsequent disbursements for students enrolled in programs one academic year or greater. Progress will be checked at the half-way point for programs less than one academic year. No SAP is required prior to the first disbursement.

REQUIREMENTS FOR A CERTIFICATE

All competencies specified in the State of Florida Curriculum Frameworks for this program must be successfully completed. Students must complete all courses in the program with a minimum 75% average in each course, and work habits.

Proficiency in the competency standards listed in the Master Plan of Instruction must be demonstrated.

Students must meet minimum T.A.B.E. skill requirements (or qualify for an exemption) prior to graduation.

In addition to the requirements above, the recommendation of the instructor for certification includes: consideration of personal appearance, employability skills, a willingness to learn and to work, punctuality, cooperative attitude, and appropriate work habits.

Students will attempt Industry Certifications in all of the following areas throughout the HVAC/R program: EPA Section 608 Refrigerant Usage, NATE Industry Competency Exams (ICE) in Residential Heating and Air Conditioning, Light Commercial Heating and Air Conditioning, and Commercial Refrigeration.

STUDENT DRESS CODE

Students who attend the Air-Conditioning, Refrigeration, & Heating Technology program shall dress in a manner appropriate for the job in which they are receiving training, including any special protective gear and professional uniforms. All clothing must be neither distracting nor offensive and be clean, neat, modest, in good repair, and appropriately sized.

Administration has the final authority for determining whether or not a student's apparel conforms to the dress code. When it is determined that it does not, students will be required to change into clothing which will conform to this code or leave campus. Students may return to campus when they have changed into appropriate clothing.

Program designated uniform: khaki shirts (tucked into pants at waist), work pants or jeans, and work shoes or boots (Leather uppers and non-conductive soles and heels. Canvas uppers on shoes are not acceptable.).

JOB DESCRIPTIONS

OCP A Introduction to HVAC/R (250 Hours)
A student completing this occupational completion point could possibly find employment as an HVACR helper with introductory knowledge of electrical components and their function.

OCP B HVAC/R Fundamentals (250 Hours)
A student completing this occupational completion point could possibly find employment as an HVACR mechanic's assistant with introductory knowledge of system components and their function, refrigerants and their applications, and be EPA Certified for Proper Refrigerant Usage.

OCP C HVAC/R Service Practices (250 Hours)
A student completing this occupational completion point could possibly find employment as an HVACR Mechanic with introductory knowledge of system and piping design, start-up and shut-down procedures, and duct sizing.

OCP D HVAC/R Intermediate Service Practices (250 Hours)
A student completing this occupational completion point could possibly find employment as an HVACR Mechanic with advanced knowledge of system and piping design, start-up and shut-down procedures, and duct sizing.

OCP E HVAC/R Advanced Service Practices / OR / HVAC/R Advanced Commercial and Industrial Service Practices (350 Hours)
A student completing this occupational completion point should find employment as an HVACR entry-level maintenance technician, service technician, or commercial refrigeration service technician.

TEXTBOOKS

For the most recent book list for the Heating, Ventilation, Air-Conditioning/Refrigeration program, visit FMTC's online bookstore – www.fmtcshop.com .

REQUIRED MATERIALS

- Safety glasses
- Tool box or tool bag with lock
- 1 set of nut drivers
- 1 set of flat blade (slotted) screwdrivers
- 1 set of Phillips screwdrivers
- 1 electrical multi-meter, minimum CAT III 600 volt rating (digital meter is preferred)
- 1 clamp-on ammeter, minimum CAT III 600 volt rating
- Refrigeration service valve ratchet wrench (Ritchie brand is preferred)
- 1 pair 6 inch needle nose pliers (with side cutters)
- 1 6-inch adjustable wrench (crescent wrench)
- 1 10-inch adjustable wrench (crescent wrench)
- 1 set of hex wrenches (Allen keys)
- 1 refrigeration manifold (suitable for use with R-410A) with hoses equipped with low loss fittings
- 1 pair tongue and groove pliers (channel locks)

- 1 stake-on crimping tool (for solderless electrical terminals)
- 1 hammer
- 1 tubing cutter (1/4” to 1 1/8”)
- 1 pair 8.5” heavy duty lineman’s pliers (Klein’s)
- 1 graduated swaging tool
- 1 measuring tape (25’-1 inch wide)
- Smart phone or tablet is recommended

PROGRAM OBJECTIVES

See the attached Florida State Department of Education Curriculum Frameworks for program objectives and competencies.

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
Standard Length	1350 Hours
Teacher Certification	Refer to the **Program Structure** section.
CTSO	SkillsUSA
SOC Codes (all applicable)	49-9021 - Heating, Air Conditioning, and Refrigeration Mechanics and Installers
CTE Program Resources	http://www.fldoe.org/academics/career-adult-edu/career-tech-edu/program-resources.stml
Basic Skills Level	Mathematics: 10 Language: 9 Reading: 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	SOC Code
A	ACR0000	Introduction to HVAC/R	AC HEAT ME @7 7G REFRG MECH 7 G	250 Hours	49-9021
B	ACR0001	HVAC/R Fundamentals		250 Hours	49-9021
C	ACR0012	HVAC/R Service Practices		250 Hours	49-9021
D	ACR0013	HVAC/R Intermediate Service Practices		250 Hours	49-9021
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	49-9021

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 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 and entrepreneurship skills.
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 Read construction documents.
06.0 Explain the properties of matter and heat behavior.
07.0 Describe the history and concepts of heating, air-conditioning and refrigeration.
08.0 Demonstrate a practical knowledge of basic electricity & of the electrical components of heating, air-conditioning & refrigeration equipment.
09.0 Demonstrate knowledge of electrical wiring in air-conditioning and refrigeration.
10.0 Troubleshoot heating, air-conditioning and refrigeration electrical control systems and their components.
11.0 Select and test electrical generation and distribution components for commercial heating and air conditioning systems.
12.0 Analyze fluids, pressures, refrigerants and related codes.
13.0 Evaluate heating, air-conditioning and refrigeration system components and accessories.
14.0 Fabricate and service the piping, tubing and fittings used in the heating, air-conditioning and refrigeration industry.
15.0 Maintain, test and troubleshoot electrical motors and their components for commercial heating and air-conditioning systems.
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 Utilize and operate mechanical refrigeration servicing and testing equipment.
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 Make career plans.
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 technologies.
31.0 Interpret, use and modify construction drawings and specifications.
32.0 Troubleshoot and repair commercial heating and air-conditioning systems.
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.
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.