Maryland CTE Programs of Study

HVACR II (2025)

GENERAL REQUIREMENTS. This course is recommended for students in Grades 11-12. 1

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INTRODUCTION 2

A Career and Technical Education (CTE) instruction provides content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and succeed in current or emerging professions. 2.A

B The Construction Career Cluster prepares students for careers in designing, planning, and building sustainable infrastructure. This field includes architects, engineers, construction managers, and skilled trades professionals. 2.B

C The HVACR Program of Study prepares students for a career in the HVACR trade through a comprehensive three-course sequence. Students learn to safely install, maintain, and repair heating, ventilation, air conditioning, and refrigeration systems. They master workplace safety protocols, tool usage, and trade mathematics before progressing to electrical system fundamentals and circuit analysis. Students develop hands-on skills in pipe fitting, soldering, brazing, and ductwork installation. The program advances to complex system components including compressors, heat pumps, and air quality equipment. Students learn to perform maintenance, troubleshoot systems, manage refrigerants safely, and provide professional customer service. Upon completion, they can diagnose problems, conduct repairs, and maintain HVACR systems according to industry standards. 2.C

D HVACR II focuses on advanced system components, maintenance procedures, and customer service skills. Students learn AC electrical theory through hands-on work with transformers, capacitors, and induction motors. The course covers critical components like compressors, metering devices, and refrigerant systems, including installation and troubleshooting. Students perform maintenance tasks such as belt drive adjustments, gasket replacement, and system inspections. They gain practical experience in heat pump servicing, indoor air quality management, and venting system installation. Additionally, students develop professional customer service skills and learn environmentally safe refrigerant handling procedures. Through hands-on activities, they master tasks like leak detection, system evacuation, and equipment charging. 2.D

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E **Students will participate in at least two Career-Connected Education and Work-Based Learning experiences in this course, which might include informational interviews or job shadowing relevant to the program of study.** 2.E

F **Students are encouraged to participate in extended learning experiences through aligned Career and Technical Student Organizations (CTSOs). CTSOs are a cocurricular requirement in the Carl D. Perkins Act, and alignment to CTSO activities is an expectation for CTE programs in the state of Maryland.** 2.F

KNOWLEDGE AND SKILLS 3

A **The student demonstrates the necessary skills for career development, maintenance of employability, and successful completion of course outcomes. The student is expected to:** 3.A

1. Identify and demonstrate positive work behaviors that enhance employability and job advancement, such as regular attendance, promptness, proper attire, maintenance of a clean and safe work environment, and pride in work. 3.A.1
2. Demonstrate positive personal qualities such as flexibility, open-mindedness, initiative, active listening, and a willingness to learn. 3.A.2
3. Employ effective reading, writing, and technical documentation skills. 3.A.3
4. Solve problems using critical thinking techniques and structured troubleshooting methodologies. 3.A.4
5. Demonstrate leadership skills and collaborate effectively as a team member. 3.A.5
6. Implement safety procedures, including proper handling of hardware and following OSHA guidelines. 3.A.6
7. Exhibit an understanding of legal and ethical responsibilities in the construction field, following applicable laws and best practices for safety. 3.A.7
8. Demonstrate time-management skills and the ability to prioritize tasks in a technical setting. 3.A.8

B **The student identifies various career pathways in the HVACR field. The student is expected to:** 3.B

1. Develop a career plan that includes the necessary education, certifications, job skills, and experience for specific roles in the HVACR field. 3.B.1
2. Create a professional resume and portfolio that reflect skills, projects, certifications, and recommendations. 3.B.2
3. Demonstrate effective interview skills for roles in the HVACR field. 3.B.3

C **The student identifies the issues associated with HVACR hazards found on a jobsite. The student is expected to:** 3.C

1. Demonstrate safe working procedures in a construction environment. 3.C.1
2. Explain the purpose of the Occupational Safety and Health Administration (OSHA) and how it promotes safety on the job. 3.C.2
3. Identify HVACR hazards and how to avoid or minimize them in the workplace. 3.C.3

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4 Explain safety issues concerning lockout and tagout procedures, personal protection using assured grounding and isolation programs, confined space entry, respiratory protection, and fall protection. 3.C.4

D The student integrates core academic skills into HVACR construction practices. The student is expected to: 3.D

1 Demonstrate the use of clear communication techniques, both written and verbal, that are consistent with industry standards. 3.D.1

2 Apply mathematical concepts such as the 3-4-5 ratio method for squaring corners and calculate various types of pipe offsets, including parallel and rolling offsets at different angles (11¼, 22½, 45, 60, and 72 degrees). Students will practice advanced geometric calculations, trigonometric principles for determining offset constants, and more complex grade and elevation calculations. Students perform detailed material takeoffs and apply mathematical principles to commercial HVACR applications. 3.D.2

3 Use scientific principles including electrical theory including voltage, current, resistance, and power calculations as applied to water heaters and electronic HVACR controls. The students will review thermodynamics in relation to water heater operation and heat transfer through piping systems. Students learn about the chemical properties and behavior of different fuel gases and oils, principles of combustion, and the science behind backflow prevention. The course includes advanced concepts in hydraulics and pneumatics for pressure testing and system design, as well as the scientific principles behind firestopping and insulation. 3.D.3

E The student analyzes principles of customer service in HVACR. The student is expected to: 3.E

1 Establish positive first impressions with customers. 3.E.1

2 Apply effective communication techniques during service calls. 3.E.2

3 Manage different types of customer interactions professionally. 3.E.3

F The student conducts HVACR maintenance requirements. The student is expected to: 3.F

1 Apply maintenance procedures for various HVACR systems. 3.F.1

2 Diagnose and evaluate common material/component failure. 3.F.2

3 Install gaskets, seals, and belt drives according to specifications. 3.F.3

4 Conduct system and equipment inspections according to maintenance schedules. 3.F.4

G The student conducts basic analysis of HVACR site installation. The student is expected to: 3.G

1 Evaluate appropriate locations for installing HVACR equipment considering structural requirements, space limitations, and accessibility. 3.G.1

2 Compare various installation sites including indoor utility rooms, attics, basements, concrete slabs, and rooftops based on specific application requirements. 3.G.2

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3 Evaluate site-specific safety considerations including equipment isolation, fire safety, and emergency access. 3.G.3

4 Understand residential and commercial site requirements with respect to equipment size, load calculations, and building codes. 3.G.4

5 Examine existing site conditions to identify potential installation obstacles or modifications required for successful equipment placement. 3.G.5

H The student evaluates alternating current principles. The student is expected to: 3.H

1 Analyze transformer and power distribution systems. 3.H.1

2 Comprehend advanced wiring schematics. 3.H.2

3 Demonstrate troubleshooting procedures according to manufacturer specifications. 3.H.3

4 Test AC circuits and components using appropriate instruments. 3.H.4

5 Demonstrate the ability to wire a functional control circuit with required safety protocols. 3.H.5

6 Evaluate induction motor operation and electrical safety practices. 3.H.6

I The student evaluates compressor system operations. The student is expected to: 3.I

1 Explain operating principles of HVACR compressors. 3.I.1

2 Understand installation and service procedures. 3.I.2

3 Diagnose common compressor issues. 3.I.3

4 Evaluate system operations and their impact on compressor operations. 3.I.4

J The student evaluates metering device applications. The student is expected to: 3.J

1 Install (mock-up as appropriate) fixed and adjustable expansion devices. 3.J.1

2 Explain the use and operation of electronic expansion valves. 3.J.2

3 Analyze operating principles of metering components. 3.J.3

4 Adjust devices according to manufacturer specifications. 3.J.4

K The student analyzes refrigerant and oil properties. The student is expected to: 3.K

1 Explain how refrigerant theory is applied to refrigerant systems. 3.K.1

2 Identify characteristics of pure and blended refrigerants. 3.K.2

3 Select appropriate lubricating oils for refrigeration systems. 3.K.3

4 Conduct leak detection tests specific to their application. 3.K.4

5 Apply proper handling and safety procedures. 3.K.5

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L **The student evaluates refrigerant handling procedures. The student is expected to:** 3.L

1. Perform safe evacuation, recovery, and charging procedures of pressurized systems. 3.L.1
2. Apply environmentally safe handling methods. 3.L.2

M **The student analyzes heat pump system operations. The student is expected to:** 3.M

1. Analyze reverse cycle heating principles. 3.M.1
2. Install and maintain heat pump systems. 3.M.2
3. Troubleshoot heat pump control circuits. 3.M.3

N **The student evaluates indoor air quality factors. The student is expected to:** 3.N

1. Evaluate factors affecting indoor air quality. 3.N.1
2. Perform air quality surveys using appropriate equipment. 3.N.2
3. Evaluate impact of humidity on indoor air quality and electrostatic environmental concerns. 3.N.3
4. Implement air quality control measures. 3.N.4

O **The student evaluates venting system requirements. The student is expected to:** 3.O

1. Apply principles of fossil fuel furnace venting. 3.O.1
2. Select appropriate vent systems for gas heating equipment. 3.O.2
3. Install (mock-up as appropriate) venting systems according to specifications. 3.O.3