

Heating, ventilation, air conditioning, refrigeration

**HEATING, VENTILATION, AIR
CONDITIONING, REFRIGERATION -
HVACR**

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Possible career opportunities

Upon successful completion of the Heating Ventilation Air Conditioning and Refrigeration (HVACR) program, students will have the necessary knowledge and skills for a career in residential, commercial, or industrial HVACR, including careers as Heating and Air Conditioning Mechanics and Installers and as Refrigeration Mechanics and Installers. Program content includes an introduction to the electrical and mechanical principles used in air conditioning and refrigeration, including meters, circuits, contactors, relays, thermostats, pressure switches, motors, overloads, controls, and boilers. Reading and drawing of schematic diagrams, troubleshooting, and safe electrical practices are also covered.

Program-level student learning outcomes

Program learning outcomes are subject to change. The most current list of program learning outcomes for each program is published on the DVC website at www.dvc.edu/slo.

Associate in science degree

Heating, ventilation, air conditioning, and refrigeration (HVACR)

Students completing the program will be able to...

- A. analyze the electrical parts of the refrigeration system.
- B. differentiate between many types of motor.
- C. distinguish between mechanical and electrical controls.
- D. demonstrate basic control design that have applications to the HVACR industry.
- E. identify the different types of controllers for the HVACR industry.
- F. use oral and written communication skills in the HVACR industry.

In collaboration with Plumbers-Steamfitters-Refrigeration Union Local 342 www.ua342.org, DVC currently offers three five-year apprenticeship programs: steamfitting, plumbing, and HVACR. Apprenticeship is training that is designed to prepare an individual for a career in the skilled crafts and trades. Apprentices develop technical skills, experience the sharing of assignments and see how technical tasks relate specifically with theoretical knowledge and interpretation. Apprentices earn a wage while learning. Enrollment in this program is restricted. You must be registered as an apprentice with the State of California to participate in the program and accepted into the apprenticeship program by our union partners.

While completing their HVACR apprenticeship, DVC students can earn awards at three levels of completion: a certificate of accomplishment, a certificate of achievement, and an associate in science degree. To earn an associate in science degree with a major in HVACR, students must complete 20 out of 31 core courses to meet their individual educational and career goals. In addition they must complete 18 general education units. Students must complete each course used to meet a major requirement with a "C" grade or higher and maintain an overall GPA of 2.5 or higher in the coursework required for the major.

<i>major requirements:</i>		<i>units</i>
HVACR-110	Beginning Electrical Theory	1.5
HVACR-111	Mechanical Refrigeration Theory.....	1.5
HVACR-112	Advanced Electrical Theory/Beginning Schematics.....	1.5
HVACR-113	The Refrigeration Cycle	1.5
HVACR-114	Intermediate Electrical I	1.5
HVACR-115	Intermediate Mechanical Refrigeration I.....	1.5
HVACR-116	Intermediate Electrical II	1.5
HVACR-117	Intermediate Mechanical Refrigeration II.....	1.5
HVACR-118	Electrical Troubleshooting I	1.5
HVACR-119	Electrical Troubleshooting II.....	1.5
HVACR-120	Introduction to Direct Digital Controls.....	1.5
HVACR-121	Introduction to Variable Frequency Drives	1.5
HVACR-122	Introduction to Market Refrigeration Systems ..	1.5
HVACR-123	Introduction to Pneumatic Controls.....	1.5
HVACR-124	Introduction to Boilers.....	1.5
HVACR-125	Advanced Compressor and Motor Theory.....	1.5
HVACR-126	Start Test Balance: Water Side I	1.5
HVACR-127	Start Test Balance: Air Side I	1.5
HVACR-128	Start Test Balance: Water Side II	1.5
HVACR-129	Start Test Balance: Air Side II	1.5
total minimum required units		30

Certificate of achievement

Heating ventilation air conditioning and refrigeration (HVACR)

Students completing the program will be able to...

- A. compare a number of basic principles and laws of electricity as they relate to in AC refrigeration.
- B. analyze the electrical parts of the refrigeration system.
- C. differentiate between many types of motor.
- D. distinguish between mechanical and electrical controls.
- E. demonstrate basic control design that have applications to the HVACR industry.
- F. identify the different types of controllers for the HVACR industry.

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While completing their HVACR apprenticeship, DVC students can earn awards at three levels of completion: a certificate of accomplishment, a certificate of achievement, and an associate in science degree. To earn a certificate of achievement, students must complete 14 out of 18 core courses. Students must complete each course used to meet a major requirement with a "C" grade or higher and maintain an overall GPA of 2.5 or higher in the coursework required for the certificate. The courses required for the certificate of achievement also meet some of the requirements of the major for the associate in science degree.

<i>required courses:</i>	<i>units</i>
<i>complete at least 21 units from:</i>	
HVACR-112 Advanced Electrical Theory/Beginning Schematics.....	1.5
HVACR-113 The Refrigeration Cycle	1.5
HVACR-114 Intermediate Electrical I	1.5
HVACR-115 Intermediate Mechanical Refrigeration I.....	1.5
HVACR-116 Intermediate Electrical II	1.5
HVACR-117 Intermediate Mechanical Refrigeration II.....	1.5
HVACR-118 Electrical Troubleshooting I	1.5
HVACR-119 Electrical Troubleshooting II.....	1.5
HVACR-120 Introduction to Direct Digital Controls.....	1.5
HVACR-121 Introduction to Variable Frequency Drives	1.5
HVACR-122 Introduction to Market Refrigeration Systems.....	1.5
HVACR-123 Introduction to Pneumatic Controls.....	1.5
HVACR-124 Introduction to Boilers.....	1.5
HVACR-125 Advanced Compressor and Motor Theory.....	1.5
HVACR-126 Start Test Balance: Water Side I	1.5
HVACR-127 Start Test Balance: Air Side I	1.5
HVACR-128 Start Test Balance: Water Side II	1.5
HVACR-129 Start Test Balance: Air Side II	1.5
total minimum required units	21

**Certificate of accomplishment
Heating ventilation air conditioning and refrigeration (HVACR)**

Students completing the program will be able to...

- A. identify tools and equipment, used in the industry.
- B. demonstrate general safety practices.
- C. compare a number of basic principles and laws of electricity as they relate to AC refrigeration.
- D. analyze the electrical parts of the refrigeration system.
- E. differentiate between many types of motor.
- F. distinguish between mechanical and electrical controls.

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While completing their HVACR apprenticeship, DVC students can earn awards at three levels of completion: a certificate of accomplishment, a certificate of achievement, and an associate in science degree. To earn a certificate of accomplishment, students must complete five out of seven core courses. Students must complete each course used to meet a major requirement with a "C" grade or higher and maintain an overall GPA of 2.5 or higher in the coursework required for the certificate. The courses required for the certificate of accomplishment also meet some of the requirements of the certificate of achievement and major for the associate in science degree.

<i>required courses:</i>	<i>units</i>
<i>complete at least 7.5 units from:</i>	
HVACR-110 Beginning Electrical Theory.....	1.5
HVACR-111 Mechanical Refrigeration Theory.....	1.5
HVACR-112 Advanced Electrical Theory/Beginning Schematics.....	1.5
HVACR-113 The Refrigeration Cycle.....	1.5
HVACR-114 Intermediate Electrical I.....	1.5
HVACR-115 Intermediate Mechanical Refrigeration I.....	1.5
HVACR-116 Intermediate Electrical II.....	1.5
total minimum required units	7.5

Heating, ventilation, air conditioning, refrigeration**HVACR-110 Beginning Electrical Theory**

1.5 units LR

- 18 hours lecture/36 hours laboratory per term
- Note: This program is sponsored by the International Brotherhood of Steamfitters and Plumbers and is for apprenticeship only. Course enrollment is limited to those who have been accepted by the union local responsible for the section.

This course introduces concepts of electrical principles used in air conditioning and refrigeration. Topics include meters, circuits, contactors, relays, thermostats, pressure switches, motors, overloads, circuitry and troubleshooting. This course will also cover safety as it pertains to the Heating Ventilation Air Conditioning and Refrigeration (HVACR) industry.

HVACR-111 Mechanical Refrigeration Theory

1.5 units LR

- 18 hours lecture/36 hours laboratory per term
- Note: This program is sponsored by the International Brotherhood of Steamfitters and Plumbers and is for apprenticeship only. Course enrollment is limited to those who have been accepted by the union local responsible for the section.

This course is a study in the design, assembly and operation of compression systems to include basic liquid and vapor control, metering devices, design and construction of system piping including techniques of leak detection, dehydration of systems, charging methods, recovery and troubleshooting. In addition, safety, torch techniques, cutting, fitting and brazing of various copper projects will be explored. Further, the techniques for isometric drawing and pipe symbols for soldering and brazing will be practiced.

HVACR-112 Advanced Electrical Theory/Beginning Schematics

1.5 units LR

- 18 hours lecture/36 hours laboratory per term
- Note: This program is sponsored by the International Brotherhood of Steamfitters and Plumbers and is for apprenticeship only. Course enrollment is limited to those who have been accepted by the union local responsible for the section.

This course continues to explore concepts of electrical principles used in air conditioning and refrigeration including installation of heating, cooling, and refrigeration systems; basic electric motors and their components; contactors, relays, and overloads; thermostats, pressure switches, and other electric control devices; heating control devices; and troubleshooting.

HVACR-113 The Refrigeration Cycle

1.5 units LR

- 18 hours lecture/36 hours laboratory per term
- Note: This program is sponsored by the International Brotherhood of Steamfitters and Plumbers and is for apprenticeship only. Course enrollment is limited to those who have been accepted by the union local responsible for the section.

This course covers the design, assembly and operation of compression systems to include charging, recovery, recycling and reclamation, installation, heat pumps, part load, and troubleshooting.

HVACR-114 Intermediate Electrical I

1.5 units LR

- 18 hours lecture/36 hours laboratory per term
- Note: This program is sponsored by the International Brotherhood of Steamfitters and Plumbers and is for apprenticeship only. Course enrollment is limited to those who have been accepted by the union local responsible for the section.

A sequential approach to exploring basic series and parallel circuits related to air conditioning (AC) and refrigeration. Motors, relays, contactors, thermostats, pressure switches and overloads are examined and wired. The concluding projects are basic AC and refrigeration systems. Special emphasis will be placed on electrical circuits diagnosis and troubleshooting.

HVACR-115 Intermediate Mechanical Refrigeration I

1.5 units LR

- 18 hours lecture/36 hours laboratory per term
- Note: This program is sponsored by the International Brotherhood of Steamfitters and Plumbers and is for apprenticeship only. Course enrollment is limited to those who have been accepted by the union local responsible for the section.

This course covers components and applications of refrigeration systems; electric, gas, oil, and alternative (stoves, fireplace inserts, and solar) heating; indoor air quality, comfort and psychometrics; and refrigeration applied to air conditioning.

HVACR-116 Intermediate Electrical II

1.5 units LR

- 18 hours lecture/36 hours laboratory per term
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A sequential approach to exploring basic series and parallel circuits related to air conditioning (AC) and refrigeration. Motors, relays, contactors, thermostats, pressure switches and overloads are examined and wired. The concluding projects are basic AC and Refrigeration systems. Special emphasis will be placed on electrical circuits diagnosis and troubleshooting.

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HVACR-117 Intermediate Mechanical Refrigeration II

- 1.5 units LR
- 18 hours lecture/36 hours laboratory per term
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Continues topics in heating, air conditioning, and refrigeration including gas controls, gas ignition systems, safety and operating controls, gas furnace installation practices, ventilation and combustion air, and gas furnace troubleshooting.

HVACR-118 Electrical Troubleshooting I

- 1.5 units LR
- 18 hours lecture/36 hours laboratory per term
 - Note: This program is sponsored by the International Brotherhood of Steamfitters and Plumbers and is for apprenticeship only. Course enrollment is limited to those who have been accepted by the union local responsible for the section.

This course will cover advanced electrical controls with special emphasis on troubleshooting and repair. Topics include proportional controls, economizers and variable air volume (VAV) controls. Motor starting techniques will be discussed including variable frequency drives (VFDs) with safety procedures being stressed.

HVACR-119 Electrical Troubleshooting II

- 1.5 units LR
- 18 hours lecture/36 hours laboratory per term
 - Note: This program is sponsored by the International Brotherhood of Steamfitters and Plumbers and is for apprenticeship only. Course enrollment is limited to those who have been accepted by the union local responsible for the section.

This course covers additional topics in advanced electrical controls with special emphasis on troubleshooting and repair. Covered will be proportional controls, economizers and VAV controls. Motor starting techniques will be discussed including Variable Frequency Drives with safety procedures being stressed.

HVACR-120 Introduction to Direct Digital Controls

- 1.5 units LR
- 18 hours lecture/36 hours laboratory per term
 - Note: This program is sponsored by the International Brotherhood of Steamfitters and Plumbers and is for apprenticeship only. Course enrollment is limited to those who have been accepted by the union local responsible for the section.

This course will cover direct digital controls (DDC) as they apply to the air conditioning and refrigeration industry. Topics include transmitters, sensors, power supplies and controllers. The course includes hands-on wiring testing and programming of typical components found in the industry. The student will learn techniques for troubleshooting and diagnosing hardware and software problems with DDC systems. Students will also be introduced to basic programming languages to better understand the internal operation of the system.

HVACR-121 Introduction to Variable Frequency Drives

- 1.5 units LR
- 18 hours lecture/36 hours laboratory per term
 - Note: This program is sponsored by the International Brotherhood of Steamfitters and Plumbers and is for apprenticeship only. Course enrollment is limited to those who have been accepted by the union local responsible for the section.

Introduction to variable frequency drives (VFDs), applications of use, and limited troubleshooting. Parameterization for start up, open loop, closed loop, floating point, and preset speed profiles will be covered.

HVACR-122 Introduction to Market Refrigeration Systems

- 1.5 units LR
- 18 hours lecture/36 hours laboratory per term
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This course covers the most common refrigeration equipment such as cases, defrost methods, timers, control devices, oil float systems, and heat reclaim controls. Typical market systems will be explored. Also, reading floor plans, refrigeration schedules and piping diagrams in conjunction with laying out undergrounds and overheads in a typical market will be discussed. Understanding all aspects of component operation and location including compressors, evaporators, condensers, refrigerated cases, walk-ins, heat reclaim, and connecting paraphernalia, i.e. valves, driers, etc. will be covered.

Heating, ventilation, air conditioning, refrigeration**HVACR-123 Introduction to Pneumatic Controls**

1.5 units LR

- 18 hours lecture/36 hours laboratory per term
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This course will investigate and recognize the operation of direct and reverse acting controls, air compressors, sizing of valves and dampers, thermostats, auxiliary devices, transmitters and receiver controllers. This sequential pattern is reinforced with various laboratory experiments.

HVACR-124 Introduction to Boilers

1.5 units LR

- 18 hours lecture/36 hours laboratory per term
- Note: This program is sponsored by the International Brotherhood of Steamfitters and Plumbers and is for apprenticeship only. Course enrollment is limited to those who have been accepted by the union local responsible for the section.

This course covers the components and operation of boiler systems used in hotels, apartment buildings, schools, and other large institutions. Students will be prepared for licensing examinations. A comprehensive overview of the safe and efficient operation of high pressure boilers and related equipment is also provided, including the latest combustion control technology, as well as EPA regulations and their implications.

HVACR-125 Advanced Compressor and Motor Theory

1.5 units LR

- 18 hours lecture/36 hours laboratory per term
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The course will include reciprocating compressor disassembly and assembly while developing a working knowledge of compressor function, troubleshooting, alignment, and performance. Unloaders, oils, starters and start-up procedures will be explored. Prominent Trane and Carrier compressors will be examined.

HVACR-126 Start Test Balance: Water Side I

1.5 units LR

- 18 hours lecture/36 hours laboratory per term
- Note: This program is sponsored by the International Brotherhood of Steamfitters and Plumbers and is for apprenticeship only. Course enrollment is limited to those who have been accepted by the union local responsible for the section.

This course introduces proper procedures for start, test, and balance of air conditioning systems utilizing basic principles of air and water flow will be explored. The principles of air conditioning and refrigeration will be overviewed and analyzed through the use of the Mollier Diagram and course handouts.

HVACR-127 Start Test Balance: Air Side I

1.5 units LR

- 18 hours lecture/36 hours laboratory per term
- Note: This program is sponsored by the International Brotherhood of Steamfitters and Plumbers and is for apprenticeship only. Course enrollment is limited to those who have been accepted by the union local responsible for the section.

This course provides an overview of commercial air conditioning systems currently in use today and the methods to service them. System operation, direct expansion (DX) and chiller systems, pumps, boiler controls and related systems will be covered. The use and application of heat load equations, charts and procedures as related to commercial and residential buildings is introduced.

HVACR-128 Start Test Balance: Water Side II

1.5 units LR

- 18 hours lecture/36 hours laboratory per term
- Note: This program is sponsored by the International Brotherhood of Steamfitters and Plumbers and is for apprenticeship only. Course enrollment is limited to those who have been accepted by the union local responsible for the section.

Proper procedures for start, test, and balance of air conditioning systems utilizing basic principles of air and water flow will be explored. Refrigerant pipe sizing will be explored through the use of excerpts from Trane's Refrigeration Manual and Carrier's System Design Manual. The benefits of psychrometrics on human comfort through an understanding of temperature, humidity and air movement will be examined through the use of the psychrometric diagram and course handouts. Other topics explored are fan laws, air movement, pumps, piping, air and water measurement.

HVACR-129 Start Test Balance: Air Side II

1.5 units LR

- 18 hours lecture/36 hours laboratory per term
- Note: This program is sponsored by the International Brotherhood of Steamfitters and Plumbers and is for apprenticeship only. Course enrollment is limited to those who have been accepted by the union local responsible for the section.

This course provides a continued study of commercial air conditioning systems and the methods to service them. Air distribution and heat flow are emphasized. Students will investigate air measurement and air distribution of duct design in commercial and residential buildings.