

# AIR CONDITIONING AND REFRIGERATION

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Division: Career Technical Education

## Air Conditioning and Refrigeration

Air Conditioning & Refrigeration is a cool career with many avenues for specialization within the industry. This two-year program is designed to equip you with the basic skills for industry entry-level positions in service, design, controls application, sales and more.

The Air Conditioning, Heating and Refrigeration industry provides essential technology services for the control of environments ranging from the comfort of people to the storage of essential products to the process of manufacturing goods used in everyday life.

A career in Air Conditioning and Refrigeration offers a variety of industry paths leading to greater job security and mobility of skills. With the Cypress College educational experience, you can enter this industry in areas of applied engineering, sales, estimating and design, service repair, construction, building automation and manufacturing. These industry job opportunities are rapidly expanding to accommodate the age of digital technologies interfacing with electromechanical and pneumatic technologies already in extensive use.

## Division Dean

**Rick Hodge**

**Email:** rhodge@cypresscollege.com

**Phone:** (714) 484-7231

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## Department Coordinator:

**Carlos Urquidi**

**Email:** curquidi@cypresscollege.edu

**Phone:** 714-484-7000 x48066

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## Counselors:

**Jane Jepson, Ph.D.**

**Email:** jjepson@cypresscollege.edu

**Phone:** (714) 484-7074

**Jeannie Mitsch**

**Email:** jmitsch@cypresscollege.edu

**Phone:** (714) 484-6023

**Cassie Rodriguez**

**Email:** crodriguez@cypresscollege.edu

**Phone:** (714) 808-4639

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## Division Website: Career Technical Education (<https://www.cypresscollege.edu/academics/divisions-special-programs/career-technical-education/>)

- Air Conditioning and Refrigeration Associate in Science Degree (<https://catalog.nocccd.edu/cypress-college/degrees-certificates/air-conditioning-refrigeration/air-conditioning-and-refrigeration-associate-in-science-degree/>)
- Air Conditioning and Refrigeration Certificate (<https://catalog.nocccd.edu/cypress-college/degrees-certificates/air-conditioning-refrigeration/air-conditioning-refrigeration-certificate/>)
- Air Conditioning and Refrigeration Project Management Certificate (<https://catalog.nocccd.edu/cypress-college/degrees-certificates/air-conditioning-refrigeration/air-conditioning-and-refrigeration-project-management-certificate/>)
- Air Conditioning Customer Service Certificate (<https://catalog.nocccd.edu/cypress-college/degrees-certificates/air-conditioning-refrigeration/air-conditioning-customer-service-certificate/>)
- Automated Building Controls Associate in Science Degree ([https://catalog.nocccd.edu/cypress-college/degrees-certificates/air-conditioning-refrigeration/automated\\_building\\_controls\\_associate\\_in\\_science\\_degree/](https://catalog.nocccd.edu/cypress-college/degrees-certificates/air-conditioning-refrigeration/automated_building_controls_associate_in_science_degree/))
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- Heat Pump Certificate (<https://catalog.nocccd.edu/cypress-college/degrees-certificates/air-conditioning-refrigeration/heat-pump-certificate/>)
- HVAC Automated Environmental Controls Certificate (<https://catalog.nocccd.edu/cypress-college/degrees-certificates/air-conditioning-refrigeration/hvac-automated-environmental-controls-certificate/>)
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- HVAC Codes and Estimating Certificate (<https://catalog.nocccd.edu/cypress-college/degrees-certificates/air-conditioning-refrigeration/hvac-codes-and-estimating-certificate/>)

### AC/R 036 C Refrigerant Cert Training

**1 Unit**

**Prerequisite(s):** AC/R 100 C.

Term hours: 18 lecture. This is the study preparation and safety training for the Section 608 EPA Certification Exam, A2L Refrigerants Handling and Certification and Hydrocarbon Refrigerant Handling and Certification. All Certification testing is government approved third party testing.

### AC/R 055 C Technician Customer Relations

**1 Unit**

Term hours: 18 lecture. This course provides guidelines and best practices for providing excellent field service customer relations that will enable front-line technicians and service staff in back-up and support roles to build, maintain, and increase a loyal customer base.

**AC/R 100 C Principles of Thermodynamics and Heat Transfer 3 Units**  
**Advisory:** AC/R 120 C.

Term hours: 27 lecture and 81 laboratory. This course is a basic study of the theory of thermodynamics and heat transfer as applied to mechanical vapor compression refrigeration cycle and system components. Classes include lectures with practical demonstrations and hands-on experience including laboratory projects demonstrate heat transfer theories and vapor compression mechanical system cycle components and accessories. (CSU)

**AC/R 105 C Electricity for Air Conditioning and Refrigeration I 3 Units**

Term hours: 27 lecture and 81 laboratory. This course includes the basic electrical theory, concepts and principles as applied to air conditioning and refrigeration. Schematic reading and drawing, with laboratory project applications involving circuit wiring, the measurement of electrical quantities with electrical meters and electrical safety, will be presented. (CSU)

**AC/R 106 C Electricity for Air Conditioning and Refrigeration II 3 Units**

**Prerequisite(s):** AC/R 105 C with a grade of C or better.

Term hours: 27 lecture and 81 laboratory. This course is a continuation of Electricity for Air Conditioning and Refrigeration which builds upon the principles learned and applied. Course includes single phase, three phase electric motors and ECM pressure controls, time clocks and autotransformers with a lecture and laboratory practice exercises. (CSU)

**AC/R 110 C Air Flow Design & Psychmtrcs 2 Units**

Term hours: 27 lecture and 24 laboratory. This course is an introduction into comfort cooling and air conditioning applications with a study of the behavior of air vapor mixtures as applied to the psychrometric chart and related to the design of duct systems, emphasizing duct sizing, air distribution, fans and sheet metal techniques, as it relates to indoor air quality. (CSU)

**AC/R 115 C Gas Heat Transfer Systems 3 Units**

Term hours: 27 lecture and 81 laboratory. This course is a basic study of gas heating systems for force air and boiler systems which include the principles of fuel combustion, combustion analysis, forced warmer air heat, boiler and hydronic systems. (CSU)

**AC/R 120 C Piping Prac-Tools and Safety 3 Units**

**Advisory:** AC/R 100 C Term hours: 27 lecture and 81 laboratory.

This course includes laboratory projects and demonstrations involving design and construction of system piping, including techniques of shaping, forming, soldering, welding and the tools and safe practices required to design and construct refrigerant piping systems. \$36.00 Material Fee - Payable at Registration. (CSU)

**AC/R 135 C Sustainability Design and Application (formerly Solar Energy for Heat and Cool) 2 Units**

Term hours: 27 lecture and 27 laboratory. This course includes, laboratory projects and demonstrations involving sustainable design, equipment selection and building operation. Course contents includes theory and application of passive and active solar energy systems, renewable heating energies, photo-voltaic arrays, and thermal solar heating arrays. (CSU)

**AC/R 137 C Blueprints and Dimension Analysis (formerly AC/R 037 C) 2 Units**

**Advisory:** AC/R 145 C.

Term hours: 27 lecture and 27 laboratory. This course covers the application of engineering calculations and the reading of blueprint plan sets as encountered by the air conditioning and refrigeration field technician, project manager and design engineer. Course includes practical application of numbers to the topics of problem solving, dimension conversion and mathematical verification, proportions and ratios, length measurements with field application and exercises, area calculations, duct and sheet metal calculations, and equivalent units of measurement. This course includes elements of computer-aided design. (CSU)

**AC/R 140 C Plumbing Princ and Practices 4 Units**

Term hours: 54 lecture and 54 laboratory. This course is designed to instruct the student in the application of plumbing technology as is used in commercial building systems. Students will apply the theories and skills taught in the classroom on laboratory mock-ups simulating industry standards. (CSU)

**AC/R 141 C Plumbing Fixtures 3 Units**

**Prerequisite(s):** AC/R 140 C.

Term hours: 27 lecture and 81 laboratory. This course is lecture and laboratory hands-on preparation involving the proper selection, application of sustainability and installation of basic commercial and domestic plumbing fixtures, including heat pump water heaters (CSU).

**AC/R 142 C Plumbing System Repairs 2 Units**

**Prerequisite(s):** AC/R 140 C.

Term hours: 27 lecture and 27 laboratory. This course is lecture and laboratory hands-on preparation involving field plumbing service repair diagnosis, repair techniques and proper repair solutions (CSU).

**AC/R 143 C Plumbing Irrigation 2 Units**

**Prerequisite(s):** AC/R 105 C and AC/R 140 C.

Term hours: 27 lecture and 27 laboratory. This course is lecture and laboratory hands-on study involving design, preparation and installation of field plumbing for environmental and sustainable irrigation systems (CSU).

**AC/R 205 C Commercial Air Conditioning 3 Units**

**Prerequisite(s):** AC/R 100 C and AC/R 105 C with a grade of C or better.

Term hours: 27 lecture and 81 laboratory. This is an advanced course with emphasis on the air conditioning cycle. Pipe sizing, absorption systems, centrifugal & screw chillers, cooling towers, air handlers, and chilled water pumping. (CSU)

**AC/R 210 C Commercial Refrigeration 3 Units**

**Prerequisite(s):** AC/R 100 C and AC/R 105 C with a grade of C or better.

Term hours: 27 lecture and 81 laboratory. This is an advanced course with emphasis on the refrigeration cycle. Pipe sizing, compressor sizing, H.P. requirements, single and two stage refrigeration systems and other advanced refrigeration systems will be included. (CSU)

**AC/R 215 C Codes and Commissioning (formerly Estimating for HVAC) 3 Units**

**Advisory:** AC/R 100 C and AC/R 137 C

Term hours: 27 lecture and 81 laboratory. This course is an application practice course designed to demonstrate verification methods and practices of new construction, installation of subsystems for HVAC, plumbing, electrical, building envelopes, interior systems, co-generation, utility plants, sustainable systems, lighting, controls for energy efficiency and sustainability of life cost energy usage. This course includes application of the uniform building, mechanical and electrical codes used for inspection and certification. (CSU)

**AC/R 220 C Introduction to Air Conditioning Controls (formerly A/C Controls and Energy Management)****2 Units****Advisory:** AC/R 105 C

Term hours: 27 lecture and 27 laboratory. This course is designed to instruct the students in the application of air conditioning pneumatic and Direct Digital controls as is used in commercial building systems. Students will apply the theories and skills taught in the classroom on laboratory mock-ups simulating industry standards. (CSU)

**AC/R 225 C Green Air Conditioning and Auditing****2 Units****Advisory:** AC/R 100 C and AC/R 105 C

Term hours: 27 lecture and 27 laboratory. This course is designed to instruct the student in the design, application and maintenance of highly energy efficient (GREEN) air conditioning systems. Including topics on refrigerants, carbon footprint and efficient systems for commercial applications. (CSU)

**AC/R 230 C Heat Pumps****2 Units****Prerequisite(s):** AC/R 100 C and AC/R 105 C with a grade of C or better.

Term hours: 27 lecture and 27 laboratory. This course is designed to instruct the student in the application of heat pumps for sustainability and net zero energy in commercial and non-commercial building systems. Topics include heat pump hot water heaters. Students will apply the theories and skills taught in the classroom on laboratory equipment. (CSU)

**AC/R 235 C Air Conditioning Capstone****2 Units****Advisory:** Completion of or concurrent enrollment in AC/R 137 C, AC/R 125 C, AC/R 205 C, AC/R 215 C.

Term hours: 27 lecture and 27 laboratory. This course brings together all of the elements for the design, build estimating and bid aspects of an air conditioning project application. (CSU)

**AC/R 245 C Load Calculations for Heating and Cooling (formerly AC/R 145 C)****2 Units****Prerequisite(s):** AC/R 110 C with a grade of C or better.

Term hours: 27 lecture and 27 laboratory. This is an advanced air conditioning course in which the student will learn how to calculate the heating and cooling load of a building. The student will also create a computer spreadsheet to calculate the heat and cooling load. This course will also introduce the student to industry standards computer design systems for sustainability and maximum energy efficiency, according to ASHRAE Standard 90.1. (CSU)

**AC/R 260 C Crew Leadership Fld Spvr****2 Units**

Term hours: 36 hours lecture and 18 hours laboratory. In this course, work crew leaders and field supervisors play major roles in every HVAC/R installation and construction project. This course is an overview of team building and the role of supervisor in a field environment. (CSU)

**AC/R 265 C Project Management****3 Units**

Term hours: 54 lecture and 18 laboratory. This course focuses on minor decisions that can have a major impact to the success of a HVAC/R project. It examines technical management skills, field safety, effective communications, management /leadership roles, concepts problem solving, decision-making, influence, conflict management resolution. (CSU)

**AC/R 272 C Fundamentals of Direct Current Electricity****3 Units**

Term hours: 27 Lecture and 81 Laboratory. This course builds upon electrical concepts covered in AC/R 105 C and AC/R 106 C. Topics include voltage dividers, DC voltage and current sources, simplification theorems, AC current and voltage, oscilloscope fundamentals, reactive components and reactive circuits, basic filters, ladder logic, and shop drawings. (CSU)

**AC/R 273 C Introduction to Personal Computer Hardware and Software****2 Units**

Term hours: 27 Lecture and 27 Laboratory. This course covers topics such as concepts and operation of direct digital controls such as input and output devices, programming strategies and translating sequence of operation documents for an HVAC system into an operations program for a DDC system. (CSU)

**AC/R 274 C Instrumentation for Hydronic and Air Distribution****2 Units**

Term hours: 27 Lecture and 27 Laboratory. This course covers hydronic and air distribution system fundamentals. In addition, this course covers the installation and implementation of control instrumentation. (CSU)

**AC/R 275 C System Networking****3 Units**

Term hours: 27 Lecture and 81 Laboratory. This course covers system networking for building automation. Topics include the fundamentals concepts of data transmission in various media types. The course is closely aligned with CompTia's Network+ Certification and assists students in their preparation for that credential. Topics include network fundamentals, standards, OSI model, IP protocol, network signal transmission, media, protocols, physical topologies, logical topologies, hardware, typical BAS networks, and typical BAS subnetworks. (CSU)

**AC/R 276 C Automation Hardware****2 Units**

Term hours: 27 Lecture and 27 Laboratory. This course covers the safety, application, and installation of building automation hardware and telemetry. Topics include the major types of peripheral components found in BAS systems and how to properly select and apply them in the field; standard I/O wiring, temperature devices, humidity devices, pressure devices, flow devices, life and equipment safety devices, actuators and dampers, control valves, power supply devices, transducers, relays and contactors, motor controls, enclosures, and power monitoring devices. (CSU)

**AC/R 277 C Control Logic Programming****3 Units**

Term hours: 27 Lecture and 81 Laboratory. This course in covers logic, truth tables, logical equivalences, conditionals, Boolean expressions, logic gates, digital logic circuits, number systems, object-oriented programming, data types, decision making, and programming style. (CSU)

**AC/R 278 C Building Performance and Energy Auditing****3 Units**

Term hours: 27 lecture and 81 laboratory. This course covers data analysis for energy efficiency and building performance and includes topics such as energy use basics, effects of building design on energy use, identifying effective strategies to optimize buildings systems efficiencies, correct appliance applications and benefits; terminology, understanding and identifying different types of HVAC equipment, construction basics, window design, lighting fundamentals, and photo-voltaic. (CSU)

**AC/R 279 C Building Automation Control Systems****2 Units**

Term hours: 27 lecture and 27 laboratory. This course covers common open protocols such as BACNET, Modbus and Lonworks, use of wireless protocol integration platforms such as Tridium Niagara and FieldBus, and review of whole building systems integration strategies. (CSU)

**AC/R 280 C Automation Capstone Project****2 Units**

Term hours: 27 lecture and 27 laboratory. This course includes building automation hardware application and installation, control programming, incorporating knowledge of commercial air conditioning principles. Students will design, bid, and program automation controls and devices to accomplish a predetermined control outcome. (CSU)

**AC/R 298 C Air Conditioning and Refrigeration Seminar 0.5-12 Units**

**Prerequisite(s):** May be required.

**Corequisite(s):** May be required.

**Advisory:** May be required.

Term hours: 0-12 lecture and/or 0-36 laboratory. This is a course for students who wish to increase their knowledge of air conditioning and refrigeration. Various topics will be offered. Unit credit may range from 1/2 to 12 units in any given semester. Consult the class schedule to verify credit for a particular semester. Pass/No Pass or Letter Grade Option. Fees may be required - Payable at Registration. (CSU)

At Cypress College, there are Department Program Student Learning Outcomes and Degree & Certificate Program Student Learning Outcomes.

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## **Department Program Student Learning**

### **Outcomes:**

The courses taught by this department contribute to the following ISLO/PSLOs: A-Breadth of Knowledge, Competencies, and Skills, B-Communication Skills, C-Critical Thinking, Problem Solving, and Information Competency Skills, and D-Personal, Academic, and Professional Development; specifically, the following ISLO/PSLO subcategories: A1-Career Technical Education, B1-Reading, B2-Writing, B3-Communicating, B4-Presenting, C1-Analysis, C2-Computation, C3-Research, C4-Problem Solving, C5-Technology, D1-Personal Responsibility, and D2-Global Citizenship.

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## **Degree & Certificate Program Student Learning**

### **Outcomes:**

The program student learning outcomes for each award can be found on the specific degree or certificate page.