

Air Conditioning, Refrigeration, and Environmental Control Technology

Description

The Air Conditioning, Refrigeration, and Environmental Control Technology program offers a comprehensive program in refrigeration, air conditioning and heating, including solar energy and ventilation, dealing with the technology of controlled environments for structures, enclosures and processes from water fountains to large central air conditioning systems. Alternative energy systems such as solar and wind systems are explored.

Program Emphasis

The program has a series of complementary certificates which, with the appropriate general education and graduation requirements, lead to an Associate in Science degree. The program offers Certificates in Basic Refrigeration and Control Systems; Air Conditioning, Heating, and Advanced Refrigeration; Heating, Ventilation, and Air Conditioning, Refrigeration Systems Design; Stationary Engineering Hospital and General Maintenance Technology; and an Associate Degree in Air Conditioning, Refrigeration, and Environmental Control Technology. *E.P.A. Examination preparation is included in AIRE 100 and AIRE 103 courses. The college program is an authorized E.P.A. testing center. Exams are offered a number of times during the year.*

Faculty	Office	Telephone
Thomas Davies	A-107D	619-388-3425
David Fierro	A-107E	619-388-3731

Career Options

Air conditioning and refrigeration contractor, dispatcher, manufacturer's service representative, sales engineer, service engineer, service manager, and service technician.

Academic Programs

The certificates of performance and achievement and associate degree require completion of the courses

Certificate of Performance: Basic Refrigeration and Control Systems*

Courses:	Units
AIRE 100, Thermal and Refrigeration Theory.....	4
AIRE 103, Thermal/Refrigeration Lab.....	2
AIRE 124, Control Systems Theory.....	3
AIRE 125, Control Systems Lab.....	2
Total Units = 11	

*This is a department award in recognition of information on the transcript and does not imply that a graduation requirement has been met.

Certificate of Achievement: Air Conditioning, Refrigeration, and Environmental Control Technology Air Conditioning, Heating, and Advanced Refrigeration

Courses Required for the Major:	Units
AIRE 100, Thermal and Refrigeration Theory.....	4
AIRE 103, Thermal and Refrigeration Lab	2
AIRE 122, Construction Drawings and Estimating	3
AIRE 123, Construction Drawings & Estimating Lab... ..	1
AIRE 124, Control Systems Theory.....	3
AIRE 125, Control Systems Lab.....	2
AIRE 126, Fluid Flow Dynamics.....	3
AIRE 127, Fluid Flow Dynamics Lab.....	2
AIRE 132, Advanced Refrigeration Theory.....	3
AIRE 133, Advanced Refrigeration Lab.....	2
AIRE 134, Heating, Solar & Alternative Energy Systems Theory.....	4
AIRE 135, Heating, Solar & Alternative Energy Systems Laboratory	2
Total Units = 31	

Certificate of Achievement: Air Conditioning, Refrigeration, and Environmental Control Technology

Heating, Ventilation, and Air Conditioning, Refrigeration Systems Design

Courses Required for the Major:	Units
AIRE 100, Thermal and Refrigeration Theory.....	4
AIRE 103, Thermal and Refrigeration Lab	2
AIRE 122, Construction Drawings & Estimating	3
AIRE 123, Construction Drawings & Estimating Lab... ..	1

AIRE 124, Control Systems Theory	3
AIRE 125, Control Systems Lab.....	2
AIRE 126, Fluid Flow Dynamics.....	3
AIRE 127, Fluid Flow Dynamics Lab.....	2
AIRE 138, HVAC/Refrigeration Systems Design	3
AIRE 139, HVAC/Refrigeration Systems Design Lab ...	2
Total Units = 25	

Certificate of Achievement: Air Conditioning, Refrigeration, and Environmental Control Technology Stationary Engineering Hospital and General Maintenance Technician

Courses Required for the Major:	Units
AIRE 100, Thermal and Refrigeration Theory.....	4
AIRE 103, Thermal and Refrigeration Lab	2
AIRE 122, Construction Drawings and Estimating	3
AIRE 123, Construction Drawings & Estimating Lab ..	1
AIRE 124, Control Systems Theory	3
AIRE 125, Control Systems Lab.....	2
AIRE 126, Fluid Flow Dynamics.....	3
AIRE 127, Fluid Flow Dynamics Lab.....	2
AIRE 134, Heating, Solar & Alternative Energy Systems Theory.....	4
AIRE 135, Heating, Solar & Alternative Energy Systems Laboratory	2
BLDC 260, Building Codes and Zoning (Mesa only) ...	3
BUSE 150, Human Relations in Business	3
Total Units = 32	

Associate in Science Degree: Air Conditioning, Refrigeration, and Environmental Control Technology

Courses Required for the Major:	Units
Certificate of Achievement, Air Conditioning, Heating and Advanced Refrigeration	31
AIRE 138, HVAC/Refrigeration Systems Design	3
AIRE 139, HVAC/Refrigeration Systems Design Lab ...	2
Total Units = 36	

Additional general education and graduation requirements for the associate degree are listed in the catalog. **The associate degree requires a minimum of 60 units.**

Recommended electives: Air Conditioning, Refrigeration and Environmental Control Technology 198, 270, 290, 296.

Courses

Air Conditioning, Refrigeration, and Environmental Control Technology (AIRE)

100 Thermal and Refrigeration Theory 4 hours lecture, 4 units Grade Only

Advisory: Completion of or concurrent enrollment in Air Conditioning, Refrigeration, and Environmental Control Technology 103 with a grade of "C" or better, or equivalent.

Limitation on Enrollment: This course is not open to students with credit for Environmental Control Technology 100.

This course is a study of conceptual elementary thermodynamics, including molecular theory of temperature, pressure and heat. Emphasis is placed on the refrigeration cycle, cycle components, their thermal performance and applications. Course content includes an introduction to the refrigeration and solar industry, its history, publications, organizations and employment opportunities. Associate Degree Credit & transfer to CSU and/or private colleges and universities.

103 Thermal/Refrigeration Lab 6 hours lab, 2 units Grade Only

Advisory: Completion of or concurrent enrollment in Air Conditioning, Refrigeration, and Environmental Control Technology 100 with a grade of "C" or better, or equivalent.

Limitation on Enrollment: This course is not open to students with previous credit for Environmental Control Technology 103.

This course is a hands-on, project-oriented study of the tooling, materials, methods and equipment used in Heating, Ventilation and Air Conditioning (HVAC) and refrigeration. Emphasis is placed on projects related to heat transfer and saturation, system evacuation, charging, leak testing and use of precision instruments. (FT) Associate Degree Credit & transfer to CSU and/or private colleges and universities.

112 Comfort Heating Systems Theory 4 hours lecture, 4 units Grade Only

Corequisite: Air Conditioning, Refrigeration, and Environmental Control Technology 113 with a grade of "C" or better, or equivalent.

Limitation on Enrollment: This course is not open to students with previous credit for Air Conditioning, Refrigeration, and Environmental Control Technology 134.

This course engages in the study, identification, and understanding of the safe operation of comfort heating equipment and systems. Instruction includes the use of combustion analyzers to evaluate the combustion process of various fuels, their heat output, analysis of bi-products, equipment capacity and combustion efficiency. The course includes discussions on equipment design, installation and maintenance in common types of comfort heating systems, including forced-air fuel-fired furnaces, boilers, heatpumps and airhandlers, hydronic heating and integrated conventional and alternative energy systems. This course is intended for students pursuing certificates or an associate degree in Air Conditioning, Refrigeration and Environmental Control Technology. (FT) Associate Degree Credit & transfer to CSU and/or private colleges and universities.

113 Comfort Heating Systems Lab 6 hours lab, 2 units Grade Only

Corequisite: Air Conditioning, Refrigeration, and Environmental Control Technology 112 with a grade of "C" or better, or equivalent.

Limitation on Enrollment: This course is not open to students with previous credit for Air Conditioning, Refrigeration, and Environmental Control Technology 135.

This course involves a series of demonstrations and lab projects to provide identification, knowledge and understanding of the safe operation of comfort heating equipment and systems. Readings from combustion analyzers are used to evaluate the combustion process of various fuels, their heat output, analysis of bi-products, equipment capacity and combustion efficiency. The course includes design, maintenance training and practice on common types of comfort heating systems, including forced-air gas-fired and oil-fired furnaces, boilers, furnaces, heatpump fancoils, hydronic heating and integrated conventional and alternative energy systems. This course is intended for students pursuing certificates or an associate degree in Air Conditioning, Refrigeration and Environmental Control Technology. (FT) Associate Degree Credit & transfer to CSU and/or private colleges and universities.

122 Construction Drawings and Estimating
3 hours lecture, 3 units
Grade Only

Corequisite: Air Conditioning, Refrigeration, And Environmental Control Technology 123 with a grade of "C" or better, or equivalent.

Advisory: Mathematics 35 with a grade of "C" or better, or equivalent or Assessment Skill Level M30.

This course is a study of the generation, reading and interpretation of construction drawings from initial concepts to actual building construction. Emphasis is placed on how the Heating, Ventilation and Air Conditioning (HVAC) systems are integrated into the structure by architects, engineers and ultimately the construction contractors and subcontractors. Course content includes architectural, mechanical, electrical and plumbing drawings, and also covers job planning, sources and use of pricing guidelines, municipal, county, state and federal codes, energy codes and standards, specifications and computer software programs used in the development of construction drawings and used for construction estimating. This course is intended for students pursuing certificates or an associate degree in Air Conditioning, Refrigeration and Environmental Control Technology. (FT) Associate Degree Credit & transfer to CSU and/or private colleges and universities.

123 Construction Drawings and Estimating Lab
3 hours lab, 1 unit
Grade Only

Corequisite: Air Conditioning, Refrigeration, And Environmental Control Technology 122 with a grade of "C" or better, or equivalent.

Advisory: Mathematics 35 with a grade of "C" or better, or equivalent or Assessment Skill Level M30.

This laboratory course provides practice in the reading of construction drawings and plans for structures and building components. Students use pricing guides for Heating, Ventilating and Air Conditioning (HVAC), computer-aided drafting software, engineering and architectural scales, and elementary sketching and drawing techniques to complete laboratory projects. This course is intended for students pursuing certificates or an associate degree in Air Conditioning, Refrigeration and Environmental Control Technology. Associate Degree Credit & transfer to CSU and/or private colleges and universities.

124 Control Systems Theory
3 hours lecture, 3 units
Grade Only

Corequisite: Completion of or concurrent enrollment in Air Conditioning, Refrigeration, and Environment Control Technology 125 with a grade of "C" or better, or equivalent.

Limitation on Enrollment: This course is not open to students with credit for Environmental Control Technology 124.

This course is a study of electricity as it relates to the prime movers and controls for Heating, Ventilation and Air Conditioning (HVAC) and refrigeration. Emphasis is placed on the theory, construction and application of the elementary refrigeration system, electrical control and circuits, compressor relays and other electromechanical controls. Associate Degree Credit & transfer to CSU and/or private colleges and universities.

125 Control Systems Lab
6 hours lab, 2 units
Grade Only

Limitation on Enrollment: This course is not open to students with credit for Environmental Control Technology 125.

Survey of electrical instrumentation and hardware used in the field of "HVAC" and refrigeration and accessories. Projects designed to develop ability to sketch, test, and fabricate complete basic electrical control systems for refrigeration and elementary air conditioning units. Includes logic and schematic circuits and their construction. Associate Degree Credit & transfer to CSU and/or private colleges and universities.

126 Fluid Flow Dynamics
3 hours lecture, 3 units
Grade Only

Corequisite: Completion of or concurrent enrollment in Air Conditioning, Refrigeration, and Environment Control Technology 127 with a grade of "C" or better, or equivalent.

Limitation on Enrollment: This course is not open to students with credit for Environmental Control Technology 126.

Fundamental laws governing air flow in ducting systems; fans, system curves, fan curves, common methods of air distribution; friction losses in ducts; use of system calculators; laws of hydronics; pipe sizing, pump sizing; pressure losses in hydronic systems; air psychrometries; water treatment and air filtration fundamentals. Associate Degree Credit & transfer to CSU and/or private colleges and universities.

127 Fluid Flow Dynamics Lab**6 hours lab, 2 units
Grade Only**

Corequisite: Air Conditioning, Refrigeration, and Environment Control Technology 126.

Limitation on Enrollment: This course is not open to students with credit for Environmental Control Technology 127.

This laboratory course provides practice in fluid measuring methods and instrumentation. Emphasis is placed on working with instruments such as pitot tube devices and velometers to illustrate the interaction of fluid systems curves. Course content also includes air psychometries, air and hydronic system balancing and measurement of sound. Associate Degree Credit & transfer to CSU and/or private colleges and universities.

132 Advanced Refrigeration Theory**3 hours lecture, 3 units
Grade Only**

Limitation on Enrollment: This course is not open to students with credit for Environmental Control Technology 132.

A comprehensive analysis of refrigeration systems involving Molier diagrams and system balance in terms of heat and equipment. Standard multi-stage, low temperature, and cascade systems are included. Complex mechanical system controls studied. Fluid velocities and correct piping methods, lubrication systems and lubricants, refrigerant performance, centrifugal, screw and absorption systems are included. Associate Degree Credit & transfer to CSU and/or private colleges and universities.

133 Advanced Refrigeration Lab**6 hours lab, 2 units
Grade Only**

Limitation on Enrollment: This course is not open to students with credit for Environmental Control Technology 133.

A rigorous series of projects on the functioning of normal and abnormal refrigeration systems designed to equip students with the ability to solve difficult mechanical problems. Preparation of Molier diagrams for refrigeration systems and heat pumps, adjustment and installation of various systems, specific control devices such as back pressure regulators, head pressure controls, etc. Associate Degree Credit & transfer to CSU and/or private colleges and universities.

138 HVAC/Refrigeration System Design**3 hours lecture, 3 units
Grade Only**

Limitation on Enrollment: This course is not open to students with credit for Environmental Control Technology 138.

An intensive course on the theory of design for heating, refrigeration, air conditioning, and solar energy systems. Includes building envelope heat load calculations, equipment selection criteria, system selection and optimization. Energy conservation techniques in design and hydronic system design applications are included. Associate Degree Credit & transfer to CSU and/or private colleges and universities.

139 HVAC/Refrigeration System Design Lab**6 hours lab, 2 units
Grade Only**

Limitation on Enrollment: This course is not open to students with credit for Environmental Control Technology 139.

Applied design techniques for the development of complete "HVAC" refrigeration and solar designs in an occupationally similar environment. A series of design projects includes applied heat load estimation; applied psychometries; system and equipment selection criteria; and use of design manuals, tables, and manufacturers catalogs. Applied energy conservation techniques are included. Associate Degree Credit & transfer to CSU and/or private colleges and universities.

144 Direct Digital Controls Theory**4 hours lecture, 4 units
Grade Only**

Corequisite: Air Conditioning, Refrigeration, and Environmental Control Technology 145 with a grade of "C" or better, or equivalent.

Advisory: Computer Business Technology 161 and 180, each with a grade of "C" or better, or equivalent. This course is a study of Direct Digital Control (DDC) theory: rationale, DDC system design, DDC system sensors, DDC controllers and advanced heating, ventilation and air conditioning (HVAC) controls, network architecture, Internet protocol (IP) addressing and interoperation, open and non-proprietary systems, American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) BACnet, and the LonWorks platform. The course examines BACnet DDC hybrid control strategies using various analog and binary system actuators. Specific emphasis is placed on developing student skills using networks that are built into the AIRE Program DDC lab equipment and utilized throughout the world, including the SDCCD campuses and buildings. This course is intended for students

pursuing certificates or an associate degree in Air Conditioning, Refrigeration and Environmental Control Technology. (FT) Associate Degree Credit & transfer to CSU and/or private colleges and universities.

145 Direct Digital Controls Lab

**6 hours lab, 2 units
Grade Only**

Corequisite: Air Conditioning, Refrigeration, and Environmental Control Technology 144 with a grade of "C" or better, or equivalent.

Advisory: Computer Business Technology 161 and 180, each with a grade of "C" or better, or equivalent. This course applies Direct Digital Control (DDC) theory to laboratory projects: system design, American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) BACnet DDC controller selection and integration with heating, ventilation and air conditioning (HVAC) system components, BACnet network architecture, development of graphical views and hierarchical database tree, logical BACnet program development, and construction of DDC system operator machine interface graphics. Course projects include the development of a facility graphical view and control hierarchy tree, setup of a control logic diagram using blocks, symbols and wires, and construction of an operator graphical interface. Laboratory training simulations are compared to actual DDC HVAC control strategies used by the San Diego Community College District's BACnet DDC system, and throughout the world. This course is intended for students pursuing certificates or an associate degree in Air Conditioning, Refrigeration and Environmental Control Technology. (FT) Associate Degree Credit & transfer to CSU and/or private colleges and universities.

198 Computer Applications in Air Conditioning, Refrigeration, Environmental Control Technology

**2 hours lecture, 3 hours lab, 3 units
Grade Only**

Limitation on Enrollment: This course is not open to students with credit for Environmental Control Technology 198.

Presentation of computer applications in Air Conditioning, Refrigeration, Environmental Control Technology as required for employment in local business and industry. Instruction will be on a specific software and hardware as currently used in Air Conditioning, Refrigeration, Environmental Control. Specific software and hardware will be announced for each course section, each semester. (FT) Associate Degree Credit only and not Transferable.

270 Work Experience in Air Conditioning, Refrigeration, Environmental Control Technology

**Hours by Arrangement (One unit of credit is earned for each 75 hours of paid employment or 60 hours of volunteer work.), 1-4 units
Grade Only**

Limitation on Enrollment: Must obtain an Add Code from Work Experience Coordinator for registration. A program of on-the-job learning experiences for students employed in a job related to their major or their educational goals. The combined maximum credit for all work experience courses from all disciplines may not exceed 16 units. Associate Degree Credit & transfer to CSU and/or private colleges and universities.

290 Independent Study in Air Conditioning, Refrigeration, Environmental Control Technology

**Hours by Arrangement, 1-3 units
Grade Only**

Limitation on Enrollment: Must obtain an Add Code from instructor for registration. This course is not open to students with credit for Environmental Control Technology 290.

For students who wish to study special problems. This course may be taken four times with different content for a maximum of six units. Associate Degree Credit & transfer to CSU and/or private colleges and universities.

This discipline may offer specialized instruction in one or more of the following areas: Supervised Tutoring (044), Experimental Topics (265), Independent Study (290), Individualized Instruction (296), Service Learning (277), or Work Experience (270). Detailed course descriptions are listed on page page 108. Please refer to the class schedule and/or see the dean or department chair for availability.