

Course Outline of Record

1. Course Code: ACR-076
2.
  - a. Long Course Title: Facilities Maintenance - Chillers
  - b. Short Course Title: FAC MAINT/CHILLERS
3.
  - a. Catalog Course Description:  
Presents current industry practices in maintaining chilled water, hot water, steam, cooling towers, pumps and energy management for central station systems. A lab uniform is required for this course.
  - b. Class Schedule Course Description:  
Chilled water, cooling tower and boiler maintenance. A lab uniform is required for this course.
  - c. Semester Cycle (if applicable): N/A
  - d. Name of Approved Program(s):
    - AIR CONDITIONING AND REFRIGERATION Certificate of Achievement
    - AIR CONDITIONING AND REFRIGERATION AS Degree for Employment Preparation
4. Total Units: 3.00      Total Semester Hrs: 72.00  
 Lecture Units: 2.5      Semester Lecture Hrs: 45.00  
 Lab Units: 0.5      Semester Lab Hrs: 27.00  
 Class Size Maximum: 27      Allow Audit: No  
 Repeatability No Repeats Allowed  
 Justification 0
5. Prerequisite or Corequisite Courses or Advisories:  
*Course with requisite(s) and/or advisory is required to complete Content Review Matrix (CCForm I-A)*  
 Advisory: ACR 060 or  
 Advisory: ACR 060 Concurrent enrollment
6. Textbooks, Required Reading or Software: (List in APA or MLA format.)
  - a. John Tomczyk; Eugene Silberstein, B.A., M.S., BEAP, CMHE; Bill Whitman; Bill Johnson (2017).  
Refrigeration Air Conditioning Technology (8th/e). Boston, MA 02210 Cengage Learning. ISBN:  
9781305578296  
 College Level: Yes  
 Flesch-Kincaid reading level: 11.1
7. Entrance Skills: *Before entering the course students must be able:*
  - a. History, overview of refrigeration and air conditioning industry, career opportunities, and field entry level requirements.
    - ACR 060 - Explain the operation of the mechanical refrigeration cycle.
    - ACR 060 - Use tools, equipment and materials to perform silver brazing operations on copper, steel and brass refrigeration lines and fittings.
    - ACR 060 - Demonstrate an understanding of the two aspects of comfort air conditioning.
  - b. Heat, heat transfer and measurement of heat.
    - ACR 060 - Explain the operation of the mechanical refrigeration cycle.
    - ACR 060 - Demonstrate an understanding of the two aspects of comfort air conditioning.
  - c. Pressure, pressure systems and measurement.
    - ACR 060 - Identify the chemical make-up of the refrigerant gasses and their place on the temperature scale.
  - d. Pressure/temperature relationship of refrigerants.
    - ACR 060 - Identify the chemical make-up of the refrigerant gasses and their place on the temperature scale.
  - e. Mechanical refrigeration cycle.
    - ACR 060 - Explain the operation of the mechanical refrigeration cycle.

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### f. Operation, refrigerant state changes, heat flow, pressure division and refrigerant flow.

- ACR 060 - Explain the operation of the mechanical refrigeration cycle.
- ACR 060 - Identify the chemical make-up of the refrigerant gasses and their place on the temperature scale.

### g. Components including compressors, evaporators, condensers, metering devices and refrigerants.

- ACR 060 - Identify and explain the operation, purpose and construction of the major components found in the mechanical refrigeration cycle.

### h. Accessory devices and components.

- ACR 060 - Identify and explain the operation, purpose and construction of the major components found in the mechanical refrigeration cycle.

### i. Types of air conditioning systems.

- ACR 060 - Identify and explain the operation, purpose and construction of the major components found in the mechanical refrigeration cycle.
- ACR 060 - Demonstrate an understanding of the two aspects of comfort air conditioning.

### j. Refrigerant systems.

- ACR 060 - Explain the operation of the mechanical refrigeration cycle.
- ACR 060 - Identify and explain the operation, purpose and construction of the major components found in the mechanical refrigeration cycle.

### k. Service procedures and safe use of tools and instruments.

- ACR 060 - Use tools, equipment and materials to perform silver brazing operations on copper, steel and brass refrigeration lines and fittings.

### l. Pressure estimating and performance testing.

- ACR 060 - Explain the operation of the mechanical refrigeration cycle.

### m. Silver brazing techniques for copper steel, and brass refrigerant lines and fittings.

- ACR 060 - Use tools, equipment and materials to perform silver brazing operations on copper, steel and brass refrigeration lines and fittings.

## 8. Course Content and Scope:

### Lecture:

- High pressure chillers and safety
- Low pressure chillers and safety
- Types of chiller compressors
- Dx and flooded evaporators
- Cooling towers and safety
- Purge systems
- Refrigerant recovery
- Energy management systems
- High and low pressure boilers and safety
- Piping systems-production and distribution
- Air handlers, vav controls, hot deck-cold deck
- Variable frequency drives, pumps, valves and safety
- Central station maintenance

### Lab: *(if the "Lab Hours" is greater than zero this is required)*

- Tour campus and community central station systems
- Computer simulations
- Computer energy management programs
- Identify and describe function of central station systems
- Observe central station maintenance
- Observe chiller-boiler start-up and shut-down
- Rounds and readings

## 9. Course Student Learning Outcomes:

- Describe central station equipment safe and efficient operation.

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2. Monitor central station equipment for proper and safe operation.

3.

Describe the steps to perform routine maintenance on central station systems.

10. Course Objectives: *Upon completion of this course, students will be able to:*

- a. Describe how chilled water systems operate
- b. Describe how boilers operate
- c. Describe how cooling towers operate
- d. Describe how water is used to move heat
- e. Monitor system operation via computers
- f. Describe safety and use of PPE in a central station
- g. Describe refrigerant use and safety

11. Methods of Instruction: *(Integration: Elements should validate parallel course outline elements)*

- a. Collaborative/Team
- b. Demonstration, Repetition/Practice
- c. Discussion
- d. Laboratory
- e. Lecture
- f. Observation
- g. Participation
- h. Technology-based instruction

12. Assignments: *(List samples of specific activities/assignments students are expected to complete both in and outside of class.)*

In Class Hours: 72.00

Outside Class Hours: 90.00

a. Out-of-class Assignments

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|--|
| <ol style="list-style-type: none"><li>1. Periodic reading assignments</li><li>2. Online research</li><li>3. Computer exercises</li></ol> |
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b. In-class Assignments

- |   |
|---|
| <ol style="list-style-type: none"><li>1. Computer simulations</li><li>2. Rounds and readings</li><li>3. Tour campus facilities</li><li>4. NATE Preparation online</li></ol> |
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13. Methods of Evaluating Student Progress: *The student will demonstrate proficiency by:*

- Written homework  
Blackboard
- Laboratory projects
- True/false/multiple choice examinations
- Mid-term and final evaluations
- Student participation/contribution

14. Methods of Evaluating: Additional Assessment Information:

Completion of energy management projects Completion of lab and computer projects

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15. Need/Purpose/Rationale -- *All courses must meet one or more CCC missions.*

PO - Career and Technical Education

Fulfill the requirements for an entry- level position in their field.

Apply critical thinking skills to execute daily duties in their area of employment.

Apply critical thinking skills to research, evaluate, analyze, and synthesize information.

Display the skills and aptitude necessary to pass certification exams in their field.

Exhibit effective written, oral communication and interpersonal skills.

IO - Critical Thinking and Communication

Apply principles of logic to problem solve and reason with a fair and open mind.

Summarize, analyze, and interpret oral and written texts, with the ability to identify assumptions and differentiate fact from opinion.

16. Comparable Transfer Course

University System	Campus	Course Number	Course Title	Catalog Year
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17. Special Materials and/or Equipment Required of Students:

- |   |
|---|
| <ol style="list-style-type: none"> <li>1. Personal Protective Equipment</li> <li>2. safety glasses</li> <li>3. ANSI Z87.1</li> <li>4. hard hat</li> <li>5. Z89.1-2003</li> <li>6. hearing protection</li> <li>7. ANSI S12.6-1997</li> </ol> |
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18. Materials Fees:  Required Material?

Material or Item	Cost Per Unit	Total Cost
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19. Provide Reasons for the Substantial Modifications or New Course:

Update to include uniform information.

20. a. Cross-Listed Course (*Enter Course Code*): *N/A*  
 b. Replacement Course (*Enter original Course Code*): *N/A*

21. Grading Method (*choose one*): Letter Grade Only

22. MIS Course Data Elements

- a. Course Control Number [CB00]: CCC000513168
- b. T.O.P. Code [CB03]: 94600.00 - Environmental Control Tec
- c. Credit Status [CB04]: D - Credit - Degree Applicable
- d. Course Transfer Status [CB05]: C = Non-Transferable
- e. Basic Skills Status [CB08]: 2N = Not basic skills course
- f. Vocational Status [CB09]: Clearly Occupational
- g. Course Classification [CB11]: Y - Credit Course
- h. Special Class Status [CB13]: N - Not Special
- i. Course CAN Code [CB14]: *N/A*
- j. Course Prior to College Level [CB21]: Y = Not Applicable
- k. Course Noncredit Category [CB22]: Y - Not Applicable
  - l. Funding Agency Category [CB23]: Y = Not Applicable
- m. Program Status [CB24]: 1 = Program Applicable

## ACR 076-Facilities Maintenance - Chillers

Name of Approved Program (if program-applicable): AIR CONDITIONING AND REFRIGERATION, AIR CONDITIONING AND REFRIGERATION

*Attach listings of Degree and/or Certificate Programs showing this course as a required or a restricted elective.)*

23. Enrollment - Estimate Enrollment

First Year: 25

Third Year: 27

24. Resources - Faculty - Discipline and Other Qualifications:

a. Sufficient Faculty Resources: Yes

b. If No, list number of FTE needed to offer this course: *N/A*

25. Additional Equipment and/or Supplies Needed and Source of Funding.

N/A

26. Additional Construction or Modification of Existing Classroom Space Needed. (*Explain:*)

N/A

27. FOR NEW OR SUBSTANTIALLY MODIFIED COURSES

Library and/or Learning Resources Present in the Collection are Sufficient to Meet the Need of the Students Enrolled in the Course: Yes

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28. Originator Ramiro Galicia Origination Date 05/05/17