

Course Outline of Record

1. Course Code: ACR-084
2.
  - a. Long Course Title: Boiler & Hydronic Heating
  - b. Short Course Title: BOILER & HYDRO HEAT
3.
  - a. Catalog Course Description:
 

This course includes lectures and laboratory projects involving the design, assembly, and operation of hot water boilers, hot water piping distribution (hydronic), and associated controls and control valves. Included in the course content is the proper use of the related tools and safety. A lab uniform is required for this course.
  - b. Class Schedule Course Description:
 

This course covers the design, assembly, and operation of hot water boilers and hot water piping distribution (hydronic). 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 AS Degree for Employment Preparation
4. Total Units: 3.00      Total Semester Hrs: 90.00  
 Lecture Units: 2      Semester Lecture Hrs: 36.00  
 Lab Units: 1      Semester Lab Hrs: 54.00  
 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 (CCForm1-A)*

 Advisory: ESYS 004
6. Textbooks, Required Reading or Software: *(List in APA or MLA format.)*
  - a. Tomczyk, John., Silbertstein, Eugene., Whitman, Bill., Johnson, Bill. (2016). *Refrigeration And Air Conditioning Technology* (8 edition/e). Boston 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.  
 Compute using the four basic operations of addition, subtraction, multiplication, and division on the rational numbers.
    - ESYS 004 - Compute using the four basic operations of addition, subtraction, multiplication, and division on the rational numbers.
  - b.  
 Apply the order of operations to simplify expressions involving several operations.
    - ESYS 004 - Apply the order of operations to simplify expressions involving several operations.
  - c.  
 Apply the basic operations to solve application problems.
    - ESYS 004 - Apply the basic operations to solve application problems.
  - d.  
 Comprehend the concept of a fraction as a part of a whole.

- ESYS 004 - Comprehend the concept of a fraction as a part of a whole.

e.

Use the concept of ratio to determine the solution to a proportion problem.

- ESYS 004 - Use the concept of ratio to determine the solution to a proportion problem.

## 8. Course Content and Scope:

### Lecture:

- A. Boilers and Hydronic heating
  1. Fuel ignition - Burner operation
    - a. Operation of the ignition system
    - b. Derate burner capacity based of altitude
    - c. Proper fuel/air ratio for proper burner flame
    - d. Safety controls e. Pilot assemblies
    - f. Burner orifice sizing g. Sequence of Operation
  2. Hydronic Systems
    - a. Hydronic piping systems
      - i. Pipe sizing
      - ii. Piping distribution schemes
      - iii. Piping riser sizing
      - iv. Pumping, pump curves, selection
      - v. Hydronic flow balancing
    - b. Boiler Types
    - c. Pumps- alignment and lubrication
    - d. Aquastats
    - e. Water pressure regulating valves
    - f. Zone control and operation
    - g. Compression/expansion Tanks
    - h. Measuring temperatures differences.
    - i. Automatic air vent operation
    - j. Controls for multizone/multipump hydronic systems
  3. Flue gas analysis
    - a. Fuel system
    - b. Draft damper operation
    - c. Induced draft flue gas
    - d. Flue gas sampling
    - e. Flue gas chemical analysis
    - f. Stack temperatures
    - g. CO2 analysis
  4. Terminal air distribution units
    - a. VAV terminal air control
    - b. Controls for VAV boxes
    - c. Boiler temperature reset based on VAV's

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

1. Laboratory exercise demonstrating and performing the proper procedure for combustion analysis.
2. Analyzing fluid flow in rough pipes.
3. Analyzing Fluid Flow in smooth Pipes
4. Test pumps in parallel.
5. Test pumps in serial.

# ACR 084-Boiler & Hydronic Heating

6. Measure and calculate systems water flow.
7. Measure and calculate available pump head
8. Identify hydronic systems component.
9. Identify boiler safety controls.
10. Adjust Make-Up Water Systems.

## 9. Course Student Learning Outcomes:

1.  
Describe the derating process of a common gas burner.
2.  
Describe boiler safety controls.
3.  
Describe types of hydronic piping systems.
4.  
Describe the removal process of air in boiler systems.
5.  
Compare low, medium and high performing boilers systems.

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

- a. Explain the operation of the ignition system.
- b. Describe the process of verifying combustion efficiency.
- c. Calibrate burner flame for proper fuel/air ratio.
- d. Test induced draft pressure switches.
- e. Test all safety controls.
- f. Verify sequence of operation.
- g. Identify types of hydronic piping systems.
- h. Identify types of boilers.
- i. Verify alignment and lubrication of circulator.
- j. Test water pressure regulating valve (PRV).
- k. Test the zone valve operation.
- l. Demonstrate the removal of air from system.
- m. Describe the purpose of compression/expansion tank.
- n. Measure water temperature rise across the boiler.
- o. Perform efficiency test and adjust to recommended rate.

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

- a. Activity
- b. Collaborative/Team
- c. Demonstration, Repetition/Practice
- d. Discussion
- e. Laboratory
- f. Lecture
- g. Participation

# ACR 084-Boiler & Hydronic Heating

- h. Role Playing
- i. 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: 90.00

Outside Class Hours: 72.00

a. In-class Assignments

1. Read assigned text
2. Practice exams
3. Complete weekly Interactive software
4. Review assign labs
5. NATE (North American Technician Excellence) core preparation through Utility sponsored website. Student will test for core credential.
6. Student skills inventory to promote critical thinking.
7. Complete laboratory assignments.
8. Delmar Online Training Simulation
9. Online preparation for NATE core and or specialty certificate
10. Mind Tap

b. Out-of-class Assignments

1. Reading assignments
2. Complete assigned problems and questions appearing in the textbooks
3. Notebooks
4. Delmar Online Training Simulation
5. Online preparation for NATE core and or specialty certificate
6. Mind Tap

13. Methods of Evaluating Student Progress: *The student will demonstrate proficiency by:*

- Laboratory projects
- Computational/problem solving evaluations
- Presentations/student demonstration observations
- Group activity participation/observation
- True/false/multiple choice examinations
- Mid-term and final evaluations
- Student participation/contribution
- Student preparation

14. Methods of Evaluating: Additional Assessment Information:

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.

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

PO-BS Problem Solving

Recognize the importance of checking a proposed solution to verify that it satisfies the requirements of a problem.

Recognize that a solution may not be possible, given limits of time, money, or other finite resources.

Identify what isn't known, but needs to be known in order to solve a problem (depending on the problem domain, reading and/or mathematical skills are helpful).

IO - Personal and Professional Development

Self-evaluate knowledge, skills, and abilities.

# ACR 084-Boiler & Hydronic Heating

## 16. Comparable Transfer Course

University System	Campus	Course Number	Course Title	Catalog Year
-------------------	--------	---------------	--------------	--------------

## 17. Special Materials and/or Equipment Required of Students:

---

18. Materials Fees:  Required Material?

Material or Item	Cost Per Unit	Total Cost
------------------	---------------	------------

## 19. Provide Reasons for the Substantial Modifications or New Course:

Update course to include uniform costs.

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]: CCC000578629  
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

Name of Approved Program (if program-applicable): 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: 20

Third Year: 50

## 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

---

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

