JEFFERSON COLLEGE
COURSE SYLLABUS

HRA216
RESIDENTIAL AIR CONDITIONING SYSTEMS
5 Credit Hours

Prepared by
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Revised by
William Kaune
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HRA216  RESIDENTIAL AIR CONDITIONING SYSTEMS

I.  CATALOGUE DESCRIPTION

A.  Prerequisite: HRA101 Electricity for HVAC, HRA105 Principles of Refrigeration, EPA Certification (acquired on own or through HRA125 Refrigeration and Air Conditioning Mechanical Systems class), and Reading Proficiency

B.  5 Semester Credit Hours

C.  Residential Air Conditioning Systems covers the theory, installation, diagnosis, and service of residential air conditioning systems, including heat pumps (F,S)

II.  EXPECTED LEARNING OUTCOMES / ASSESSMENT MEASURE

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Assessment</th>
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<tbody>
<tr>
<td>Students will diagnose heating and cooling unit sizes for residential equipment</td>
<td>In-class exam as well as homework and/or quizzes, and/or in-class projects</td>
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<tr>
<td>Students will diagnose room cooling units for proper electrical operation</td>
<td>In-class exam as well as homework and/or quizzes, and/or in-class projects</td>
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<td>Students will master calculations for ductwork sizes for residential heating and cooling equipment</td>
<td>In-class exam as well as homework and/or quizzes, and/or in-class projects</td>
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<td>Students will practice installing residential ductwork and solve air movement problems</td>
<td>In-class exam as well as homework and/or quizzes, and/or in-class projects</td>
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<td>Students will comprehend electrical wiring and perform electric wiring on cooling units</td>
<td>In-class exam as well as homework and/or quizzes, and/or in-class projects</td>
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<td>Students will develop skills in control wiring and will install control wiring on cooling units</td>
<td>In-class exam as well as homework and/or quizzes, and/or in-class projects</td>
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<tr>
<td>Students will become proficient and troubleshoot electric wiring and control wiring on air source heat pumps</td>
<td>In-class exam as well as homework and/or quizzes, and/or in-class projects</td>
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<tr>
<td>Students will become proficient and troubleshoot electric wiring and control wiring on geothermal heat pumps</td>
<td>In-class exam as well as homework and/or quizzes, and/or in-class projects</td>
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<tr>
<td>Students will be able to practice troubleshooting components of air source heat pumps and geothermal heat pumps</td>
<td>In-class exam as well as homework and/or quizzes, and/or in-class projects</td>
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III. OUTLINE OF TOPICS

A. Unit 37 Air Distribution and Balance
   1. Conditioning Equipment
   2. Correct Air Quantity
   3. The Forced-Air System
   4. The Blower
   5. System Pressures
   6. Air-Measuring Instruments for Duct systems
   7. Types of Fans
   8. Types of Fan Drives
   9. The Supply Duct system
  10. The Plenum System
  11. The Extended Plenum System
  12. The Reducing Plenum System
  13. The Perimeter Loop System
  14. Duct System Standards
  15. Duct Materials
  16. Galvanized-Steel Duct
  17. Fiberglass Duct
  18. Spiral Metal Duct
  19. Flexible Duct
  20. Combination Duct Systems
  21. Duct Air Movement
  22. Balancing Dampers
  23. Zoning
  25. Zoning with a Multispeed Compressor and Variable-Speed Blower
  26. Adding Zoning to an Existing system
  27. Duct Insulation
  28. Blending the Conditioned Air with Room Air
  29. The Return Air Duct System
  30. Sizing duct for Moving Air
  31. Measuring Air Movement for Balancing
  32. The Air Friction Chart
  33. Practical Troubleshooting Techniques
  34. Residential Duct system Problems
  35. Commercial Duct Systems

B. Unit 38 Installation
   1. Introduction to Equipment Installation
   2. Square and Rectangular Duct
   3. Round Metal Duct Systems
   4. Insulation for Metal Duct
5. Ductboard Systems
6. Flexible Duct
7. Electrical Installation
8. Installing the Refrigeration System
9. Installing Split-System Air Conditioners
10. The Split-system Condensing Unit
11. Installing Refrigerant Piping
12. Equipment Start-Up

C. Unit 39 Controls
1. Controls for Air Conditioning
2. Prime Movers – Compressors and Fans
3. Low-Voltage Controls
4. Some History of Residential Central Air Conditioning
5. Economics of Equipment Design
6. Operating Controls for Older Air-Cooled systems
7. Safety Controls for Older Air-Cooled Systems
8. Operating Controls for Modern Equipment
9. Safety Controls for Modern Equipment
10. The Working Control Package
11. Electronic Controls and Air-Conditioning Equipment

D. Unit 42 Electric, Gas, and Oil Heat with Electric Air Conditioning
1. Comfort All Year
2. Five Processes for Conditioning Air
3. Add-On Air Conditioning
4. Insulation for Existing Ductwork
5. Evaluation of an Existing Duct System
6. Cooling Versus Heating Air Quantity
7. Control Wiring for Cooling and Heating
8. Two Low-Voltage Power Supplies
9. Phasing Two Low-Voltage Transformers
10. Adding a Fan Relay
11. New All-Weather Systems
12. All-Weather Split Systems
13. Package or Self-Contained All-Weather Systems
14. Wiring the All-Weather System
15. Servicing the All-Weather System

E. Unit 43 Air Source Heat Pumps
1. Reverse-Cycle Refrigeration
2. Heat Sources for Winter
3. The Four-Way Reversing Valve
4. The Air-to-Air Heat Pump
5. Refrigerant Line Identification
6. Metering Devices
7. Thermostatic Expansion Valves
8. The Capillary Tub
9. Combinations of Metering Devices
10. Electronic Expansion Valves
11. Orifice Metering Devices
12. Liquid-Line Accessories
14. Auxiliary Heat
15. Balance Point
16. Coefficient of Performance
17. Split System Air-to-Air Heat Pump
18. The Indoor Unit
19. Air Temperature of the Conditioned Air
20. The Outdoor Unit Installation
21. Package Air-to-Air Heat Pumps
22. Controls for the Air-to-Air Heat Pump
23. The Defrost Cycle
24. Indoor Fan Motor Control
25. Auxiliary Heat
26. Servicing the Air-to-Air Heat Pump
27. Troubleshooting the Electrical System
28. Troubleshooting Mechanical Problems
29. Troubleshooting the Four-Way Valve
30. Troubleshooting the Compressor
31. Checking the Charge
32. Special Applications for Heat Pumps
33. Heat Pump Using Scroll Compressor
34. Heat Pump Systems with Variable-Speed Motors
35. Service Technician Calls

F. Unit 44 Geothermal Heat Pumps
1. Reverse-Cycle Refrigeration
2. Geothermal Heat Pump Classifications
3. Open-Loop Systems
4. Water Quality
5. Closed-Loop Systems
6. Ground-Loop Configurations and Flows
7. System Materials and Heat Exchange Fluids
8. Geothermal Wells and Water Sources
9. Water-to-Water Heat Pumps
10. Troubleshooting
12. Service Technician Calls

IV. METHOD(S) OF INSTRUCTION
A. Classroom Lecture
B. Lab Demonstrations
C. Specialty Lectures by Industry Personnel

V. REQUIRED TEXTBOOK(S)

VI. REQUIRED MATERIALS
HRA Tool Kit - estimated cost - $420 (purchased through the HRA Department)

VII. SUPPLEMENTAL REFERENCES: None

VIII. METHOD OF EVALUATION
A. Theory Tests, Quizzes, Homework 45%
B. Shop/Lab 45%
C. Instructor Evaluation, Attendance 10%

IX. ADA AA STATEMENT
Any student requiring special accommodations should inform the instructor and the Coordinator of Disability Support Services (Library phone 636-481-3169).

X. ACADEMIC HONESTY STATEMENT
All students are responsible for complying with campus policies as stated in the Student Handbook (see College website, http://www.jeffco.edu).
XI. ATTENDANCE STATEMENT

Regular and punctual attendance is expected of all students. Any one of these four options may result in the student being removed from the class and an administrative withdrawal being processed: (1) Student fails to begin class; (2) Student ceases participation for at least two consecutive weeks; (3) Student misses 15 percent or more of the coursework; and/or (4) Student misses 15 percent or more of the course as defined by the instructor. Students earn their financial aid by regularly attending and actively participating in their coursework. If a student does not actively participate, he/she may have to return financial aid funds. Consult the College Catalog or a Student Financial Services representative for more details.

XII. OUTSIDE OF CLASS ACADEMICALLY RELATED ACTIVITIES

The U.S. Department of Education mandates that students be made aware of expectations regarding coursework to be completed outside the classroom. Students are expected to spend substantial time outside of class meetings engaging in academically related activities such as reading, studying, and completing assignments. Specifically, time spent on academically related activities outside of class combined with time spent in class meetings is expected to be a minimum of 37.5 hours over the duration of the term for each credit hour.