

### Course Outline

**COURSE:** HVAC 202      **DIVISION:** 50      **ALSO LISTED AS:**

**TERM EFFECTIVE:** Fall 2020      **CURRICULUM APPROVAL DATE:** 06/09/2020

**SHORT TITLE:** BASIC REFRIGERATION

**LONG TITLE:** Basic Refrigeration

<u>Units</u>	<u>Number of Weeks</u>	<u>Type</u>	<u>Contact Hours/Week</u>	<u>Total Contact Hours</u>
4	18	Lecture:	3	54
		Lab:	3	54
		Other:	0	0
		Total:	6	108

#### **COURSE DESCRIPTION:**

Students will study concepts of the vapor compression refrigeration system. The course includes both the theory and practice applicable to the mechanical function of air conditioning and refrigeration systems. The student will learn the major components and accessories of the sealed system including metering devices, evaporators, compressors and condensers. The practices for oxy-acetylene torch safety are emphasized along with different techniques for connecting tubing such as brazing and soldering copper refrigerant lines and the proper procedures for cutting, bending, swaging and flaring.

**PREREQUISITES:**

**COREQUISITES:**

**CREDIT STATUS:** D - Credit - Degree Applicable

**GRADING MODES**

L - Standard Letter Grade

**REPEATABILITY:** N - Course may not be repeated

**SCHEDULE TYPES:**

- 02 - Lecture and/or discussion
- 03 - Lecture/Laboratory
- 04 - Laboratory/Studio/Activity
- 04A - Laboratory - LEH 0.65
- 05 - Hybrid
- 71 - Dist. Ed Internet Simultaneous
- 72 - Dist. Ed Internet Delayed
- 73 - Dist. Ed Internet Delayed LAB
- 73A - Dist. Ed Internet LAB-LEH 0.65

**STUDENT LEARNING OUTCOMES:**

1. Demonstrate proper torch safety.

Measure of assessment: demonstration

Year assessed, or planned year of assessment: 2018

Semester: Fall

2. Evaluate, troubleshoot and repair a mechanical refrigeration system.

Measure of assessment: demonstration, exam, homework

Year assessed, or planned year of assessment: 2018

Semester: Fall

3. Select and install safety and control switches to a mechanical refrigeration system.

Measure of assessment: demonstration, exam

Year assessed, or planned year of assessment: 2018

Semester: Fall

4. Evacuate, charge and test refrigerant.

Measure of assessment: demonstration, exam

Year assessed, or planned year of assessment: 2018

Semester: Fall

**CONTENT, STUDENT PERFORMANCE OBJECTIVES, OUT-OF-CLASS ASSIGNMENTS**

Curriculum Approval Date: 06/09/2020

Lecture Content:

6 Hours

Content: Hand Tools, Equipment and Safety

Student Performance Objectives: Describe hand tools used by the air-conditioning, heating, and refrigeration technician. Describe equipment used to install and service air-conditioning, heating, and refrigeration systems. Describe equipment and tools used by residential energy auditors. Describe proper procedures for working with pressurized systems and vessels, electrical energy, heat, cold, rotating machinery, and chemicals; for moving heavy objects; and for utilizing proper ventilation.

9 Hours

Content: Principles of Heat, Measurement of Heat, Measurement of Temperature, Measurement of Pressure, Measurement of Vacuum

Student Performance Objectives: Define temperature. Make conversions between the Fahrenheit and Celsius scales. Describe molecular motion at absolute zero. Define the British thermal unit. Describe heat flow between substances of different temperatures. Explain the transfer of heat by conduction, convection, and radiation. Discuss sensible heat, latent heat, and specific heat. State atmospheric pressure at sea level and explain why it varies at different elevations. Describe two types of barometers. Explain psig and psia as they apply to pressure measurements. Define matter and density. List the three states in which matter is commonly found. State two forms of energy important to the air-conditioning (heating and cooling) and refrigeration industry.

12 Hours

Content: Brazing, Soldering, Pipe and Tube Fitting, Measurement of ACR Pipes and Tubing, Practical Use of Oxygen/Acetylene Torch, Pipe Bending, Flaring, Swaging

Student Performance Objectives: List the different types of tubing used in heating, air-conditioning, and refrigeration applications. Describe two common ways of cutting copper tubing. List procedures used for bending tubing. Discuss procedures used for soldering and brazing tubing. Describe two methods for making flared joints. State procedures for making swaged joints. Explain how a compression fitting is made. Describe procedures for preparing and threading steel pipe ends. List four types of plastic pipe and describe uses for each. Describe alternative, mechanical methods for joining pipe sections.

15 Hours

Content: Relationship between Temperature and Pressure, Mechanical Refrigeration Circuit, Compressors, Condensers, Evaporators, Metering Devices, Sight Glasses, Refrigerants, Safe Handling of Refrigerants, Types and Use of Refrigerants, Recovering and Recycling Refrigerants, Refrigeration Systems, Air Conditioning Systems, Medium Temperature Systems, Low Temperature Systems

Student Performance Objectives: Discuss applications for medium- and low-temperature refrigeration. Describe the basic refrigeration cycle. Describe the function of the evaporator or cooling coil. Explain the purpose of the compressor. Discuss the function of the condensing coil. State the purpose of the metering device. List four characteristics to consider when choosing a refrigerant for a system. Discuss different refrigerants and their applications. Describe how refrigerants can be stored or processed while refrigeration systems are being serviced.

9 Hours

Content: Controls and Safeties, Adjustment of Controls and Safety Switches, Calibration of Pressure Switches, Troubleshooting and Refrigerant Charging Procedures, Measurement of Super Heat, Measurement of Sub Cooling, Evaporator Temperature Splits, Condenser Temperature Splits

Student Performance Objectives: Describe a standing pressure test. Describe the six classes of leaks. Explain the test procedures for evaporator and condenser section leaks. Explain the test procedures for suction and liquid-line leaks. Explain the test procedures for temperature-, pressure-, and vibration-dependent leaks. Describe a deep vacuum. Describe two different types of evacuation. Describe two different types of vacuum measuring instruments. List some of the proper evacuation practices. Describe a deep-vacuum single evacuation. Describe a triple evacuation. Explain the process involved in cleaning a system after a hermetic motor burnout.

2 Hours

Final

Lab Content:

6 Hours

Content: Use of Hand Tools, Equipment and Safety

Student Performance Objectives: Practice working safely and avoiding safety hazards. Demonstrate the proper use of hand tools used by the air-conditioning, heating, and refrigeration technician. Demonstrate the proper use of equipment used to install and service air-conditioning, heating, and refrigeration systems.

9 Hours

Content: Principles of Heat, Measurement of Heat, Measurement of Temperature, Measurement of Pressure, Measurement of Vacuum

Student Performance Objectives: Identify four types of temperature scales. Identify and demonstrate the use of the two common gauges used in the air-conditioning, heating, and refrigeration industry.

12 Hours

Content: Brazing, Soldering, Pipe and Tube Fitting, Measurement of ACR Pipes and Tubing, Practical Use of Oxygen/Acetylene Torch, Pipe Bending, Flaring, Swaging

Student Performance Objectives: Perform two common ways of cutting copper tubing. Demonstrate procedures used for bending tubing. Demonstrate procedures used for soldering and brazing tubing. Perform two methods for making flared joints. Demonstrate procedures for making swaged joints. Demonstrate the procedures for preparing and threading steel pipe ends. Perform alternative, mechanical methods for joining pipe sections. Utilize safety practices when working with equipment.

15 Hours

Content: Effects of Low Air Flow, Refrigeration Plant Running Conditions, Common Refrigeration Problems, Blockages, Overcharged Systems, Undercharged Systems, Troubleshooting

Student Performance Objectives: Interpret the effects of low air flow. Appraise refrigeration plant running conditions. Identify common refrigeration problems. Perform various troubleshooting exercises.

9 Hours

Content: Troubleshooting and Refrigerant Charging Procedures, Adjustment of Metering Devices for Acceptable Super Heat and Sub Cooling Measurements,

Student Performance Objectives: Perform a standing pressure test. Demonstrate the test procedures for evaporator and condenser section leaks. Demonstrate the test procedures for suction and liquid-line leaks. Demonstrate the test procedures for temperature-, pressure-, and vibration-dependent leaks. Choose a leak detector for a particular type of leak. Choose the correct high-vacuum pump. Perform various troubleshooting exercises.

2 Hours

Final

#### **METHODS OF INSTRUCTION:**

Lecture, discussion, multi-media presentation, demonstration, guided practice.

#### **OUT OF CLASS ASSIGNMENTS:**

Required Outside Hours: 12

Assignment Description: Read corresponding information in Units 4 and 5 of textbook. Complete Review Questions at end of Units. Study for quizzes/examinations.

Required Outside Hours: 18

Assignment Description: Read corresponding information in Units 1 and 2 of textbook. Complete Review Questions at end of Units. Study for quizzes/examinations. Homework: Worksheet on conversion calculations.

Required Outside Hours: 24

Assignment Description: Read corresponding information in Units 7 and 8 of textbook. Complete Review Questions at end of Units. Study for quizzes/examinations.

Required Outside Hours: 30

Assignment Description: Out of Class Assignments: Read corresponding information in Units 3 and 9 of textbook. Complete Review Questions at end of Units. Study for quizzes/examinations. Homework: Design, build, and test a refrigeration system. Perform various troubleshooting exercises.

Required Outside Hours: 18

Assignment Description: Out of Class Assignments: Read corresponding information in Unit 8 of textbook. Complete Review Questions at end of Unit. Study for quizzes/examinations. Homework: Perform various troubleshooting exercises.

**METHODS OF EVALUATION:**

Writing assignments

Percent of total grade: 20.00 %

Homework, Lab Reports

Problem-solving assignments

Percent of total grade: 20.00 %

Lab Projects

Skill demonstrations

Percent of total grade: 20.00 %

Lab Projects/Troubleshooting

Objective examinations

Percent of total grade: 40.00 %

**REPRESENTATIVE TEXTBOOKS:**

Required Representative Textbooks

John A. Tomczyk, Eugene Silberstein, William C. Whitman, William M. Johnson. Refrigeration and Air Conditioning Technology, 8th Edition. Boston, MA: Cengage Learning,2017.

ISBN: 978-1-305-57829-6

Reading Level of Text, Grade: 12th Verified by: MS Word

Tomczyk, Silberstein, Whitman, Johnson. Lab Manual for Refrigeration and Air Conditioning Technology, 8th Edition. Boston, MA: Cengage Learning,2017.

ISBN: 978-1305578708

Reading Level of Text, Grade: 12th Verified by: MS Word

**ARTICULATION and CERTIFICATE INFORMATION**

Associate Degree:

CSU GE:

IGETC:

CSU TRANSFER:

Not Transferable

UC TRANSFER:

Not Transferable

**SUPPLEMENTAL DATA:**

Basic Skills: N

Classification: Y

Noncredit Category: Y

Cooperative Education:

Program Status: 1 Program Applicable

Special Class Status: N

CAN:

CAN Sequence:

CSU Crosswalk Course Department:

CSU Crosswalk Course Number:

Prior to College Level: Y

Non Credit Enhanced Funding: N

Funding Agency Code: Y

In-Service: N

Occupational Course: C

Maximum Hours: 6

Minimum Hours: 6

Course Control Number: CCC000587351

Sports/Physical Education Course: N

Taxonomy of Program: 094600