

# HEATING, AIR CONDITIONING AND REFRIGERATION TECHNOLOGY

## COURSE SYLLABUS

**COURSE NUMBER:** Hart 1307

**COURSE TITLE:** Basic Refrigeration Principles

**CREDITS:** # (2 lectures, 3 labs)

**PREREQUISITE/COREQUISITE:** HART 1303

**INSTRUCTOR:** C. Pleasant

### COURSE DESCRIPTION

Air conditioning, temperature scales, pressure gauge, thermodynamics of refrigeration, four major components.

### END OF COURSE OUTCOMES

By studying this course, students will be able to:

1. Compare temperature scales and convert from one temperature to another
2. Apply the proper use of hand tools, equipment, and safety practice
3. Demonstrate the ability to use basic hand tools and instruments
4. Analyze refrigeration Cycle
5. Describe the basic refrigeration cycle and the function of four major components
6. Apply the proper use of different refrigerants and their application in a system
7. Define basic refrigeration term
8. Demonstrate the proper operation of soldering and brazing techniques
9. Practice refrigeration techniques and safety

### STUDENT LEARNING OUTCOMES

1. Given a reading assignment along with lectures, the student will compare and convert Fahrenheit, Celsius, Kelvin, and Rankine temperature scales. Performance will be satisfactory; the student can use temperature conversion formula from one temperature to another by passing 80 % on the quiz assignment.
2. Given a reading assignment along with lectures, the student will differentiate sensible heat, specific heat, latent heat, and apply the use of BTU formula. Performance will be satisfactory When the student can use the heat formula (BTU) to calculate the enthalpy of a substance by passing 80 % on the quiz assignments
3. Given a lab assignment along with lectures, the student will demonstrate the use of hand tools, instruments and the use of **vacuum pump with compound gage**. Performance will be satisfactory. When the student can operate the proper tools for servicing equipment by passing 80 % of accuracy on the practice.
4. Given the basic mechanical refrigeration system, the student will identify the four major components and explain the operation of individual components. Performance will be satisfactory. When the student can sketch a cycle, and summarize the flow of refrigerant by passing 90 % of accuracy on the practice.

5. Given the basic mechanical refrigeration system, the student will analyze the refrigeration cycle with the understandings of superheat and sub-cooling condition of refrigerant substance. Performance will be satisfactory when the student can calculate the superheat and sub-cooling of refrigerant during the operation and recognize the safety of operating refrigerant equipment by passing 90 %of accuracy on the practice.
6. Given a piece of copper tubing and fittings, the student will perform brazing technique with copper tubing using both low – high temperature soldering/brazing. Performance will be satisfactory when the student can practice the technique of soldering and brazing and recognize the safety of operating equipment by passing 100 % of accuracy on the practice.

## **COURSE POLICIES**

### **Attendance**

Students are expected to attend classes regularly, and to be on time for every class period. Students can be dropped from a class due to excessive absences. Excessive tardiness may be considered absences. Students are responsible for subjects, assignments, and projects covered during their absences. Consult the Student Handbook for more details or visit <http://www.hccs.edu/hccs/current-students>.

### **Academic Honesty**

Scholastic dishonesty is treated with the utmost seriousness by the instructor and the College. Academic dishonesty includes, but it is not limited to the willful attempt to misrepresent one's work, cheat, plagiarize, or impede other students' scholastic progress. Consult the Student Handbook for more details.

### **Students with Disabilities**

The Disability Support Services Office (DSSO) assists students with physical, learning, or emotional disabilities in developing independence and self-reliance. Students with Disabilities are urged to contact the DSSO at least 30 to 60 days prior to the first day of class. The goal is to ensure that students with disabilities get off to a good start and have the support necessary for them to succeed. The DSSO are committed to compliance with the Americans with Disabilities Act (ADA) and Rehabilitation Act of 1973 (section 504). Student can contact DSSO by phone at 713.718.6164 - TTY 713.718.6335. Fax 713.718.1468

### **Course Repeater Policy:**

Beginning in the fall 2006, students repeat a course for a third or more times will face significant tuition/fee increases at HCC and other Texas public colleges and universities. Please ask your instructor and/or counselor about opportunities for tutoring/other assistance prior to considering course withdrawal or if you are not receiving passing grades.

### **Cell Phones**

All cell phones must be muted, set to vibrate, or turned off during class. Cell phone activity during class is deemed disruptive to the academic process and will not be tolerated. If you need to make or receive an Emergency Call, please leave the classroom.

## **Calculators**

If the course allows the use of a calculator during class, lab projects, and exams, the student is responsible to bring his/her calculator. Cell phones are not calculators, and are not allowed to be used for that purpose during class, tests, or exams.

## **Student ID**

Students are required to obtain a Student ID. For additional information, consult the Student Handbook.

## **Parking Rules and Regulations**

Students are required to follow HCC's regulations regarding parking and permits. For additional information, visit <http://www.hccs.edu/hccs/about-hcc/police/parking/parking-rules-and-regulations>

## **Books, Tools and Supplies**

Students are required to purchase and bring to class the required textbooks, tools, notebooks, supplies, and writing instruments as required by the instructor.



By Bill Whitman; Bill Johnson; John Tomczyk; Eugene Silberstein

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Tool list is available to student during the first day of class meeting.

## **Dress Code**

Dress code must be appropriate for the class. Students must dress in a way that clothing and accessories do not compromise their safety, and the safety of others. Proper foot wear is required in all laboratories. Absolutely no sandals or other footwear that exposes the feet will be allowed.

## **Classroom and Laboratory Conduct**

Proper behavior is expected in all classes and laboratories. Foul language and horseplay are not allowed. Making or receiving cell phone calls during class are not allowed. Sleeping in class is not allowed.

## **Course Withdrawal**

It is the responsibility of the student to officially withdraw from a course before the official withdrawal deadline. A student who does not withdraw from a course by the deadline will receive an "F" as the

final grade. Also note that under Section 51.907 of the Texas Education Code, an institution of higher education may not allow a student to drop more than six courses.

### **Student Evaluation Policies/Grading Scales**

|                       |      |      |
|-----------------------|------|------|
| Class Participation   | 180  | 18%  |
| Quiz (8 x 40)         | 320  | 32%  |
| Lab (5 x 40)          | 200  | 20%  |
| Midterm               |      |      |
| Examination           | 150  | 15%  |
| Final Examination     | 150  | 15%  |
| <br>                  |      |      |
| Total Possible Points | 1000 | -    |
| <br>                  |      |      |
| Total Percentage      | -    | 100% |

### **Grading Points**

The percentage of total points that students achieve is converted to a letter grade as follows:

|             |      |   |
|-------------|------|---|
| 94% - 100%  | 4.00 | A |
| 87% - 93%   | 3.00 | B |
| 80% - 86%   | 2.00 | C |
| 73% - 79%   | 1.00 | D |
| 72% - below | 0.00 | F |

### **COURSE OBJECTIVES AND GOALS**

Upon completion of this course, the student will be able to:

- Apply the basic physical, chemical, and engineering principles related to refrigeration
- Compare temperature scales and convert from one temperature to another
- Discuss the proper use of hand tools, equipment, and safety practice
- Demonstrate the ability to use basic hand tools and instruments
- Analyze refrigeration Cycle
- Describe the basic refrigeration cycle and the function of four major components
- Discuss the proper use of different refrigerants and their application in a system
- Define basic refrigeration term
- Understand refrigeration principles
- Demonstrate the proper operation of soldering and brazing techniques
- Practice refrigeration techniques and safety
- Demonstrate adaptability by collaborating and planning a project with others

## **COURSE OUTLINE, CONTENT GOALS AND ACTIVITIES**

### **Week 1** (*Reading Assignment: HART 1307 Unit 1, Learning Web*)

Discuss syllabus, school policies, syllabus requirements and assignments

Course description and Learning Outcomes

Required Textbooks and Tools

Class attendance and grading scales

Discuss the early development of refrigeration

History and Fundamentals of Refrigeration

### **Week 2** (*Reading Assignment: HART 1307 Unit 2, Learning Web*)

Apply principles of heat transfer, and temperature/pressure relationship

Understand the basic physical, chemical, thermodynamic laws

The principles of heat transfer - How the heat moves?

Practice the conversion of temperature scales

Differentiate the gauge pressure (psig) and Absolute pressure (psia)

Identify sensible heat, latent heat, specific heat, and practice conversions

Calculate the enthalpy of water at a variety of temperature

Understand the Boyle's, Charles', Dalton's laws, and Perfect Gas equation

Use the Perfect gas equation to calculate pressure, volume, mass, and temperature

Quiz 01

### **Week 3** (*Reading Assignment: HART 1307 Unit 3, Learning Web*)

Recognize basic refrigeration terms and Thermodynamic laws

Understand physical laws which apply to refrigeration

Explain the operation of a simple ice refrigerator

Define the BTU - Use the Btu formula to calculate the total heat

Identify the basic mechanical refrigeration systems

Read and understand the five thermal laws relating to refrigeration

Observe the compression cycle and trace the flow of refrigerant

Record the reading on the Refrigeration Cycle trainer

State the five thermal laws relating to refrigeration

Name the basic mechanical refrigeration systems

Identify four major refrigeration components

Understand the operation of mechanical refrigeration system

Identify the five thermal laws relating to refrigeration cycle

Use the refrigeration cycle trainer to record the temperature, pressure, temp of refrigerant

Trace the flow of refrigerant through a complete refrigeration system

Quiz 02

Lab – 01

### **Week 4**

Explain the compression cycle and the operation of each component in a cycle

Discuss the compression cycle and the operation of each component in a cycle

Describe the operation of various components: evaporator, condenser, compressor, expansion devices

Sketch a complete refrigeration cycle

Recognize four major components and auxiliary components.

Label characteristics of each components  
Trace the flow of refrigerant through a complete refrigeration system  
Sketch a complete refrigeration cycle  
List components and auxiliary components  
Recognize the condition of refrigerant throughout the cycle  
Read pressure and temperature at specific location of a cycle  
Interpret a recorded readings by using temperature and pressure chart  
Quiz 03

**Week 5** (*Reading Assignment: HART 1307 Unit 9, Learning Web*)

Discuss properties of different refrigerants and their application in a system  
Understand the differences between CFCs, HCFCs, and HFCs  
Identify and classify common refrigerants by their numbers  
Understand the properties of refrigerants  
Read a pressure and temperature curve  
Demonstrate ability to read pressure-enthalpy diagrams  
Demonstrate handling of refrigerant cylinders and safety procedures  
Follow approved safety procedures for using refrigerant cylinders  
Quiz 04  
Lab – 02

**Week 6** (*Reading Assignment: HART 1307 Unit 5, Unit6, Learning Web*)

Explain how to use various hand tools and instruments and safety rules  
Identify a tool list - Categorize a tool list  
List the various types of tool used in HVAC field  
Select the proper tools for servicing and maintaining A/C equipments  
Cut and swage a piece of copper tubing - connect tubing with flare fittings  
Calibrate compound pressure gage and Temperature reading instruments  
Use and care of the vacuum pump and compound gages  
Define various types of service valves  
Follow approved safety procedures when working with pressurized vessels  
Demonstrate adaptability by collaborating and planning a project with others

**Mid term examination**

**Week 7**

Demonstrate soldering and brazing techniques  
Understand the difference between soldering and brazing techniques  
Lab - 03

**Week 8**

Analyze Refrigeration cycle  
Draw an actual refrigeration cycle with all major components  
List all components  
Identify refrigeration terms: saturated, superheat, sub-cooled, and de-superheat.  
Record pressure and temperature from a operating refrigeration cycle

Use T/P chart to convert pressure to corresponding saturated temperature  
Measure the superheat and sub-cooled refrigerant  
Determine how the unit performs or need adjustments

Quiz 05

Lab - 04

### **Week 9**

Describe the operation of various refrigeration components  
Observe the evaporator operating under normal and loaded conditions  
Take pressure and temperature to determine superheat of the refrigerant  
Observe the air cooled condenser operating under normal and loaded conditions  
Take pressure and temperature to determine condensing temperature of the refrigerant  
Calculate the temperature difference of sub-cooled liquid refrigerant and condensing refrigerant  
Quiz 06

### **Week 10**

Understand how evaporator work s  
Understand the function of the evaporator in a refrigeration system  
Evaluate the evaporator performance in terms of suction pressure, temperature, starving evaporator, and the superheat of refrigerant  
Understand how condenser works  
Understand the function of the condenser in a refrigeration system  
Evaluate the condenser performance in terms of discharge pressure, condensing temperature, temperature difference between ambient air and condensing refrigerant, and the superheat of discharge vapor  
Use the thermometer and a gage manifold to record all readings for calculation  
Understand how compressor works  
Name four different types of compressors  
Describe how compressors operate  
Identify the internal parts of compressor  
Evaluate the performance of a hermetic compressor  
Illustrate the tear-down of semi-hermetic compressor  
Demonstrate techniques of removing compressor from a refrigeration system  
Quiz 07  
Lab - 05

### **Week 10**

Understand the purpose and operation of refrigerant control devices  
Identify the six main types of refrigerant controls  
Understand how each refrigerant control functions  
Describe the characteristics of each expansion device  
Define terms related to refrigerant control operations  
Compare and contrast the application of different refrigerant controls  
Evaluate the operation of TXV in terms of internal and external pressure equalizers  
Quiz 08

**Week 11**

Apply refrigeration cycle analysis technique

Sketch a complete refrigeration cycle

Record a full load current , head pressure, suction pressure from an A/C system

Convert pressure to saturation temperature by using the T/P chart

Measure and calculate the superheat and sub-cooling temperature of vapor /liquid refrigerant

Evaluate how the system operates

Measure temperature difference across the evaporator and condenser

Understand actual parameters of a full operating A/C system

Compare and Contrast actual and required operating parameters in an A/C system.

**Week 12**

Demonstrate ability to collect technical data from manuals and equipments by using Internet resources

Identify a variety of Internet resources for equipment and parts selection

Collect service technical manuals for a specific model and manufacturer

Review the troubleshooting suggestions from a manual

**Final examination**

THE END