

Houston Community College

CAREER AND TECHNOLOGY EDUCATION HEATING, VENTILATION AND AIR CONDITIONING

COURSE SYLLABUS

COURSE NUMBER: Hart 1307

COURSE TITLE: Basic Refrigeration Principles

CREDITS: # (2 lectures, 3 labs)

PREREQUISITE/COREQUISITE:

INSTRUCTOR: Issac Bolston

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
10. List several types of electric motors
11. Demonstrate service procedures required for several types of motors
12. Use various electrical testing instruments to check motor windings, shorts and grounds

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.
7. Given different types of Ac motors, the student will use various electrical testing instruments to check motor windings, shorts and grounds. Performance will be satisfactory when the student can accurately sketch and identify the motor windings by passing 90% of accuracy on the practice.

COURSE POLICIES

Program/Discipline Requirement: If applicable:

Student is required to bring to class all necessary tools, and dress according to lab safety requirements. Student must bring textbooks, notebooks and other required supplies.

Access Student Service Policies on the Web site:

<http://hccs.edu/student-rights>

HCC Policy Statement: ADA Academic Honesty Student attendance 3-peater Withdrawal deadline:

EGSL3—Evaluation for Greater Learning Student Survey System

At Houston Community College, professors believe that thoughtful student feedback is necessary to improve teaching and learning. During a designated time near the end of the term, you will be ask to answer a short on line survey of research-based questions related to instructions. The anonymous results of the survey will be made available to your professors and department chairs for continual improvement of instruction. Look for the survey as part of the term.

Distance Education and/or Continuing Education Policies

Access DE Policies on their Web site:

[http://de.hccs.edu/media/houston-community-college/distance-education/student-services/2015-HCC-DE-Student-Handbook-\(Revised-1715\).pdf](http://de.hccs.edu/media/houston-community-college/distance-education/student-services/2015-HCC-DE-Student-Handbook-(Revised-1715).pdf)

Access CE Policies on their Web site:

<http://www.hccs.edu/continuing-education/students/financialaid/continuing-education/>

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 John A. Tomczyk, Eugene Silberstein, William C. Whitman, William M. Johnson

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HVAC Level 1 Trainee Guide NCCER 4TH Edition

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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	200	20%
Quiz (5 x 50)	250	25%
Lab (5 x 50)	250	25%
Midterm Examination	150	15%
Final Examination	150	15%
Total Possible Points	1000	-
Total Percentage	-	100%

Grading Points

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

90% - 100%	4.00	A
80% - 89%	3.00	B
75% - 80%	2.00	C
70% - 74%	1.00	D
69% - below	0.00	F

EGLS3 -- Evaluation for Greater Learning Student Survey System

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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

Identify compound gages

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

Recognize four major components and auxiliary components.

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

Understand the operation of mechanical refrigeration system

Quiz

Lab

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

(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 five thermal laws relating to refrigeration cycle
- Trace the flow of refrigerant through a complete refrigeration system

Quiz

Lab

Week 3

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

- Discuss safety
- 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
- Use and care of the recovery equipment
- Use and care of the vacuum pump
- Read a pressure and temperature curve
- Apply refrigeration cycle analysis technique
- Sketch a complete refrigeration cycle
- Demonstrate ability to read pressure-enthalpy diagrams
- Demonstrate handling of refrigerant cylinders and safety procedures
- Follow approved safety procedures for using refrigerant cylinders

Quiz

Lab

Week 4

(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
- 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

(Reading Assignment: HART 1307 Unit 41, Learning Web)

- Select the correct instruments for checking an air conditioning unit with a mechanical problem.
- Read pressure and temperature at specific location of a cycle
- Interpret recorded readings by using temperature and pressure chart
- Calculate the correct operating suction pressures for both standard- and high-efficiency air-conditioning equipment under various conditions.
- Calculate the standard operating discharge pressures at various ambient conditions.
- Record a full load current , head pressure, suction pressure from an A/C system

Mid term examination

Week 5

(Reading Assignment: HART 1307 Unit 7, Learning Web)

- List the types of tubing used in HVAC/R applications
- Discuss the procedures for soldering and brazing
- Describe the process of cutting copper tubing
- Describe the process of bending tubing
- Explain how to flare and swage copper tubing
- Explain the process of threading steel pipe
- Describe various types of plastic pipe
- Demonstrate soldering and brazing techniques
- Understand the difference between soldering and brazing techniques

(Reading Assignment: HART 1307 Unit 36, Learning Web)

- Describe the operation of various refrigeration components
- Understand how evaporator works
- 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
- Observe the evaporator operating under normal and loaded conditions
- Take pressure and temperature to determine superheat of the refrigerant

Quiz

Lab

Week 6

(Reading Assignment: HART 1307 Unit 36, Learning Web)

- 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
- Explain the function of the compressor Discuss the concept of compression ratio Describe four different methods of compression
- Describe the component parts of reciprocating compressors

(Reading Assignment: HART 1307 Unit 36, Learning Web)

- 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
- 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

Lab

Week 7

(Reading Assignment: HART 1307 Unit 36, Learning Web)

- Understand the purpose and operation of refrigerant control devices
- Identify the main types of refrigerant controls
- Understand how each refrigerant control functions
- Describe the characteristics of each expansion device
- Compare and contrast the application of different refrigerant controls
- Evaluate how the system operates
- Convert pressure to saturation temperature by using the T/P chart
- Measure and calculate the superheat and sub-cooling temperature of vapor /liquid refrigerant
- 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.

Quiz**Lab****Week 8**

- 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 installation instructions from a manual
- Review the maintenance and troubleshooting of mechanical components

Final examination

THE END