Houston Community College

ARCHITECTURE, CONSTRUCTION & MANUFACTURING TECHNOLOGIES DIVISION

HEATING, AIR CONDITIONING & REFRIGERATION TECHNOLOGY DEPARTMENT

COURSE SYLLABUS

COURSE NUMBER: **Hart 1341**
COURSE TITLE: ***RESIDENTIAL AIR CONDITIONING***
CREDITS: 3 (2 lectures, 3 labs)
Course location / Times:
Course length (# of weeks):
Type of Instruction: Lecture
Contact Hours: _____hrs
Instructor Contact Information: Hoang N Do
Telephone:
Email: hoang.do@hccs.edu
Office location and hours:

COURSE DESCRIPTION

A study of components, application, and installation of mechanical Air conditioning systems including operating condition, trouble shooting, repair, and charging of a air conditioning system.

PREREQUISITE (S) / COREQUISITE: HART 1307/1301/1303/1356

Program Learning Outcomes

By studying this course, students will be able to:

- Demonstrate knowledge of basic principles of refrigeration cycle
- State the five thermal laws relating to refrigeration
- Demonstrate ability to read pressure enthalpy charts
- List the major components of mechanical refrigeration systems
- Describe the installation process of an A/C system
- Describe the basic vapor compression refrigeration cycle

Course Student Learning Outcomes (SLO)

1. Apply theory of heat transfer and knowledge of pressure/temperature relationship
2. Construct the basic vapor compression refrigeration cycle
3. Draw the major components of mechanical refrigeration systems
4. Trace the flow of refrigerant through a complete refrigeration system
5. Differentiate between the superheat and sub-cooling condition of refrigerants
6. Describe the function of a compressor, condenser, evaporator, and expansion valve

Learning Objectives Specific to SLO

1. **Apply theory of heat transfer and knowledge of pressure/temperature relationship**

    1.1 Define heat transfer and explain heat transfer

    1.2 Identify pressure differences in refrigeration systems

    1.3 Differentiate the three physical states of a matter

    1.4 Explain the difference between psia (absolute pressure) and psig (gauge pressure)

    1.5 Interpret the T/P (temperature/pressure) chart

2. **Construct the basic vapor compression refrigeration cycle**

    2.1 Define the basic operation of a refrigerator

    2.2 List refrigeration terms: sensible / latent heat/ Enthalpy/Saturation

    2.3 Recognize basic refrigeration terms and Thermodynamic laws

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

3. **Draw the major components of mechanical refrigeration systems**

    3.1 Understand theory of heat transfer

    3.2 Review knowledge of Boyle's law, Charles's law, and Dalton's law

    3.3 Interpret and convert the temperature and pressure chart

    3.4 List refrigeration terms relating to refrigeration cycle

    3.5 Illustrate the basic vapor compression refrigeration cycle

4. **Trace the flow of refrigerant through a complete refrigeration system**

    4.1 Identify two pressure conditions

    4.2 List the components in the high side and low side

    4.3 Identify accessory components of refrigeration cycle

    4.4 List temperature and pressure conditions in the compression cycle

5. **Differentiate between the superheat and sub-cooling condition of refrigerants**

    5.1 Define the saturated liquid and saturated vapor

    5.2 Calculate the superheat condition in refrigeration cycle

    5.3 Calculate the sub cooling condition in refrigeration cycle

5.4 Compare and contrast the superheat and sub cooling conditions of refrigerant

5.5 Apply the process of superheat method in charging a fixed orifice or capillary tubing System

5.6 Apply the process of sub cooling method in charging a TXV system

6. Describe the function of a compressor, condenser, evaporator, and expansion valve

6.1 Identify compressor, condenser, evaporator, and metering device

6.2 Illustrate the purpose of each major component

6.3 Comprehend the operation of each component – compressor, condenser, evaporator, Metering device

6.4 Observe the complete air conditioning system to recognize how each component Operates in mechanical refrigeration cycle

SCANS or Core Curriculum Competencies and Common Foundation Skills

Apply theory of heat transfer and knowledge of pressure/temperature relationship

Workplace Competencies [C]

C5 – Acquires and Evaluates Information

C7 – Interprets and communicate information

C15 – Understands systems

Foundation Skills [F]

F1 – Reading

F3 – Arithmetic

Construct the basic vapor compression refrigeration cycle

Workplace Competencies [C]

C5 – Acquires and Evaluates Information

Foundation Skills [F]

F1 – Reading

F3 – Arithmetic

F8 – Decision Making

F9 – Problem Solving

Draw the major components of mechanical refrigeration systems

Workplace Competencies [C]

C5 – Acquires and Evaluates Information

C7 – Interprets and communicate information

C15 – Understands systems

Foundation Skills [F]

F1 – Reading

F8 – Decision Making

Trace the flow of refrigerant through a complete refrigeration system

Workplace Competencies [C]

C5 – Acquires and Evaluates Information

C7 – Interprets and communicate information

Foundation Skills [F]

F1 – Reading

F8 – Decision Making

Differentiate between the superheat and sub-cooling condition of refrigerants

Workplace Competencies [C]

C5 – Acquires and Evaluates Information

C7 – Interprets and communicate information

Foundation Skills [F]

F1 – Reading

F3 – Arithmetic

F9 – Problem Solving

Describe the function of a compressor; condenser, evaporator, and expansion valve

Workplace Competencies [C]

C5 – Acquires and Evaluates Information

C7 – Interprets and communicate information

C15 – Understands systems

Foundation Skills [F]

F1 – Reading

F8 – Decision Making

F13 – Responsibility

F16 – Self-Management

Course Calendar Current Catalog (CAT 2011)

Instructional Methods Face to Face or Hybrid/Web Enhanced Course

Student Assignments

Apply theory of heat transfer and knowledge of pressure/temperature relationship

Textbook Reading as assigned by instructor

Chapter Review/Questions – Test your Knowledge

Weekly Quiz (online)

Construct the basic vapor compression refrigeration cycle

Class projects/Lab

Lab assignments with the use of electrical instruments

Draw the major components of mechanical refrigeration systems

Homework exercises as assigned by instructor

Weekly Quiz (online)

Written Test (One of four major online tests

Trace the flow of refrigerant through a complete refrigeration system

Class projects involved with technical applications

Lab assignments by interpreting different electrical diagrams and symbols

Differentiate between the superheat and sub-cooling condition of refrigerants

Homework exercises as assigned by instructor

Class projects/Lab

Weekly Quiz (online)

Written Test

Describe the function of a compressor; condenser, evaporator, and expansion valve

Homework exercises as assigned by instructor

Class projects/Lab

Weekly Quiz (online)

Written Test

Instructor's Requirements N/A

Program/Discipline Requirements Students are required to enroll in **LEAD 1200 -** Critical Thinking

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 by phone at 713.718.6164 - TTY 713.718.6335. Fax 713.718.1468

Course Repeater Policy:

Beginning in the Fall 2006, students who 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.

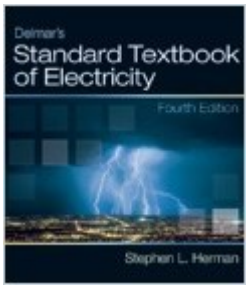
Student ID
Students are required to obtain a Student ID. For additional information, consult the ***Student Handbook***.

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 Tomczyck; Eugene Silberstein
Publisher: Delmar
Edition: 6th Edition
Publication Date: 2009
ISBN: 13- 9781428319363



By Stephen Herman
Publisher: Delmar
Edition: 004
Publication Date: 2009
ISBN: 13: 9781418065805

Tool list is available to student during the first day of class meeting or find it at HCC Learning Web - Central Campus listed by instructor name: *Hoang N Do*

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 & 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	100 pts	10 %
Quiz (10 x 30)	300	30 %
Lab (5 x 40)	200	20 %
Three major Tests		
And Final Test	400	40 %
Total possible points =	**1000 pts**	
Total Percentage =		**100%**

Grading Points

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

94% to 100%	= 4.00	A	4 points per semester hour
87% to 93%	= 3.00	B	3 points per semester hour
80% to 86%	= 2.00	C	2 points per semester hour
73% to 79%	= 1.00	D	1 points per semester hour
72% to below	= 0.0	F	0 points per semester hour
IP (In Progress)			0 points per semester hour
W (Withdrawn)			0 points per semester hour
I (Incomplete)			0 points per semester hour
AUD (Audit)			

Notes: To compute grade point average (GPA), divide the total grade points by the total number of semester hours attempted. The grades "IP', "COM" for CEU courses only, and "I" do not affect GPA.

COURSE OUTLINE, CONTENT GOALS & ACTIVITIES

COURSES OUTLINE – GOALS & ACTIVITIES

Week 1 Class orientation

- Discuss syllabi and course procedures
- Follow approved safety procedures
- Explain students how to set up the program degree plan

Week 2 Understand knowledge of basic principles of refrigeration cycle

- Understand theory of heat transfer
- Review knowledge of Boyle's law, Charles's law, and Dalton's law
- Interpret and convert the temperature and pressure chart
- Identify the first and second Law of Thermo – Dynamics
- List refrigeration terms relating to refrigeration cycle
- ***Quiz 01***
- ***Lab – 01***

Week 3 State the five thermal laws relating to refrigeration

- Trace the flow of refrigerant in refrigeration cycle
- Identify the term superheat and sub cooling condition of refrigerant
- Read and apply enthalpy charts
- ***Quiz 02***

Week 4 Understand the properties of refrigerants

- Understand the differences between CFCs, HCFCs, and HFCs
- Identify and classify common refrigerants by their numbers
- List the properties of refrigerants
- Read a pressure temperature curve
- Apply the properties of different refrigerants in different applications
- Demonstrate handling of refrigerant cylinders and identify color codes
- Follow safety procedures
- Identify the safety procedures for using refrigerant cylinders
- Review the rules of EPA in Recycle, Recover, and Reclaim
- ***Quiz 03***
- ***Lab - 02***

Week 5 Demonstrate ability to read pressure enthalpy charts

- Identify a typical pressure enthalpy diagram
- Convert gage pressure to absolute temperature
- Interpret the enthalpy chart
- Understand adiabatic compression process
- Identify compression process line

- Identify condensing process line
- Identify metering process line
- Identify evaporation process line
- Compare and contrast typical refrigeration cycle of one evaporator and condenser shown in room and refrigerated space temperature
- ***Quiz 04***

Week 6 List the major components of mechanical refrigeration systems

- Identify four major components of mechanical refrigeration cycle
- State the five thermal laws relating to refrigeration
- Explain the operation of each component of a compression system
- Trace the flow of refrigerant through a complete refrigeration system
- ***Quiz 05***

Week 7 Trace the flow of refrigerant through a complete refrigeration system

- Identify two pressure conditions
- List the components in the high side and low side
- Identify accessory components of refrigeration cycle
- List temperature and pressure conditions in the compression cycle
- ***Quiz 06***
- ***Lab - 03***

Week 8 Explain the difference between the superheat and sub-cooling condition of refrigerants

- Define the saturated liquid and saturated vapor
- Calculate the superheat condition in refrigeration cycle
- Calculate the sub cooling condition in refrigeration cycle
- Compare and contrast the superheat and sub cooling conditions of refrigerant
- Apply the process of superheat method in charging a fixed orifice or capillary tubing system
- Apply the process of sub cooling method in charging a TXV system

Mid term examination

Week 9 Explain various applications for mechanical refrigeration systems

- Understand different types of refrigeration application
- List three major refrigeration applications
- Define the purpose of each refrigeration application

- List temperature ranges of each refrigeration application
- Select compressor, condenser, evaporator, and metering device
- ***Quiz 07***
- ***Lab - 04***

Week 10 Describe the basic vapor compression refrigeration cycle

- Identify compressor, condenser, evaporator, and metering device
- Understand the purpose of each major component
- Comprehend the operation of each component – compressor, condenser, evaporator, metering device
- Observe the complete air conditioning system to recognize how each component operates in mechanical refrigeration cycle
- ***Quiz 08***
- ***Lab – 05***

Week 11 Describe the function of a compressor

- Discuss the function of a compressor
- List five basic types of compressor in use in refrigeration industry
- Classify each type of compressor in term of its application
- Compare and contrast sealed hermetic and semi hermetic compressor
- Understand internal components of each type of compressor and its construction
- Troubleshooting a compressor
- ***Quiz 09***

Week 12 Describe the function of the condenser

- Discuss the function of a condenser
- Recognize different types of condenser unit
- Define an air cooled condenser and water cooled condenser
- List an air cooled condenser
- List a water cooled condenser (tube in tube, tube and coil, tube and shell)
- Compare and contrast an air cooled and water cooled condenser
- Troubleshoot a condenser unit
- ***Lab - 06***
- ***Quiz 10***

Week 13 Describe the function of the evaporator

- Discuss the function of an evaporator
- Recognize different types of evaporator
- Understand temperature ranges of evaporator
- Comprehend the construction of an evaporator
- Compare and contrast a high temperature and low temperature evaporators
- Interpret the efficiency rating of evaporator
- Troubleshoot an evaporator

Week 14 Describe the function of the metering devices

- Discuss the function of metering device
- Identify different types of metering devices
- Explain the operation of each type of metering devices
- Comprehend the TXV valve and its operation
- Compare and contrast internal TXV and external TXV
- Learn to adjust the superheat of TXV
- Compare the various charging elements used on refrigerant controls
- Define terms related to refrigerant control operations
- Define the purpose and function of solenoid valves
- ***Quiz 11***

Week 15 Identify the basic four steps for installing central air conditioning systems

- Describe residential air conditioning systems
- Identify three methods used to install central air conditioning system
- Explain field installation, pre assembled and charged system, a completely charged evaporator, condensing unit, and tubing lines.
- Explain installation of condenser unit, evaporator, suction and liquid lines, and connection of high / low control voltage wirings
- ***Quiz 12***

Week 16 Explain procedures to start up an A/C system

- Discuss the evacuation of a system
- Define purging and explain how it is done

- Recall installation procedures: piping, leak checks, duct works, wirings, drain connections, venting, and installation codes
- Determine the method of charging a Central air conditioning system
- Evaluate the system performance according manufacturer's design specifications.
    - ***Final examination***

Instructor evaluation by using **online survey**
