Eastfield College
Career Technologies’ Division
Spring 2015
HART 1407.43701
Principles of Refrigeration

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Instructor office: T155
Class Room: T101
Class Time: 5:45 pm to 10:25 pm - M-R
Class Schedule: Begins 01/20/15 Ends 02/18/15
Office Hours: 6:30 a.m.- 7:30 a.m. & 12:30 p.m.- 5:00 p.m. M - R
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This syllabus is intended as a set of guidelines for this course. Eastfield College and your instructor reserve the right to make modifications in content, schedule and requirements as necessary to promote the best education possible within prevailing conditions affecting the course.

TEXTBOOKS:
Refrigeration and Air Conditioning Technology 7th edition, Delmar Publishing
by Whitman, Johnson, Tomczyk and Silberstein. ISBN Number 978-1-111-64447-5

(This book is a requirement for this course. Many of your class assignments will come from this book Later in your studies you will be required to take the I.C.E. (Industry Competency Exam). This book is an excellent study guide for this exam.

COURSE DESCRIPTION:
An introduction to the refrigeration cycle, heat transfer theory, temperature/pressure relationship, refrigerant handling, refrigeration components, and safety.
(3 hr Lecture, 3 hr Lab., 4 Credits. Hrs.)
COURSE OBJECTIVES:
The HVAC industry is in need of trained, skilled service technicians who can accurately troubleshoot all types of cooling systems. The ability to troubleshoot an air conditioning system requires a good understanding of refrigeration basics.

The successful service technician must develop a safe and organized approach to diagnostics using appropriate instrumentation. To do this, a solid foundation of the principles of the behavior of a refrigerant in a sealed system is required.

Once this foundation of basic refrigeration has been gained, the technician is ready to advance to the study of troubleshooting, servicing and installing all types of residential and commercial air conditioning and heat pump systems.

PREREQUISITES: None

MODULES:
1. Safety
2. Introduction and Fundamentals
3. Compression Systems of Refrigeration
4. Refrigerants
5. Dehydration
6. Metering Devices
7. Compressors
8. Evaporators and Condensers

STUDENT LEARNING OUTCOMES:
The following list of course goals will be addressed in the course. These goals are directly related to the performance objectives (Addendum A). (*Designates a CRUCIAL goal)

*1. Define refrigeration terms
2. Perform sensible, latent, and total heat calculations
*3. Demonstrate temperature conversions
4. Draw refrigeration circuit
5. Identify refrigeration cycle components
6. Identify compressor components
7. Install manifold gauge assemble
*8. Demonstrate pressure conversions
*9. Perform pressure temperature conversions
10. Determine refrigerant condition
11. Measure liquid line subcooling (BASIC SKILLS F4.4)
12. Measure suction line superheat (BASIC SKILLS F4.4)
13. List refrigerant safety precautions
14. List refrigerant color code
15. Identify secondary refrigerant
16. Identify toxic refrigerants
17. Identify flammable refrigerants
18. Solve refrigerant problems
19. Perform refrigerant recovery
20. Display vacuum pump use
21. **Measure** deep vacuums
22. **Perform** system evacuation
23. **Solve** system moisture problems
24. **Compare** refrigerant charging methods
25. **Charge** refrigeration system
26. **List** thermostatic expansion valve application
27. **Identify** thermostatic expansion valve parts
28. **Describe** externally equalized expansion valve operation
29. **Describe** internally equalized expansion valve operation
30. **Describe** suction line filter purpose
31. **Describe** liquid line dryer function
32. **Describe** system clean out procedures *(BASIC SKILLS F6.4)*

**STUDENT CONTRIBUTIONS:**
Each student will spend at least 3 hours per week preparing for class. Attendance is critical in this class. Students should make every effort to be in class on time and prepared for class.

**CLASSROOM ENVIRONMENT:**
The classroom serves as a learning environment for everybody participating in this class. To facilitate academic and personal growth for everyone, you are expected to be courteous and respectful toward the instructor and other students. While I encourage an informal and friendly classroom environment that facilitates discussion and exploration, we must still accommodate one another’s differing perspectives and opinions.

Each student must adhere to the Student Code of Conduct. The Student Code of Conduct can be found in the current Eastfield College Catalogue, or on the web site.

Ringing cell phones during the class period are a distraction. Unless it is an emergency call from a family member, all other cell phone calls are to be avoided. Family members and friends should be advised not to call during class time. If a student continues to receive numerous cell phone calls during the class period, the instructor may request the cell phone be turned **OFF**.

A student that is on call by his/her company may answer cell phones in the classroom. The student will then remove himself or herself from the classroom for the conversation. All other calls are to be avoided. The instructor may amend this rule as he/she sees fit.

- There will not be **any** profanity used in the class room
- There will not be **any** texting in the class room.
- There will not be **any** cell phones or hand held computers used during tests/quizzes

Voice mail and test messages can be retrieved during the break between class lecture and lab.

**ASSIGNED SEATING:**
The instructor reserves the right to assign seating.

**The Instructor** will be the only one talking unless the student is called upon to speak. If a student does not follow this rule, he/she may be asked to leave the classroom.
CLASS ROOM FOOD AND DRINK POLICY
Food, drinks and tobacco products are prohibited in Eastfield College classrooms

However, according to Eastfield College procedures, if in a non-lab class setting, food and drink may be allowed. This is left to the instructor’s discretion.

WRITING EXPECTATIONS

ALL HOMEWORK ASSIGNMENTS MUST BE TYPEWRITTEN
In completing homework assignments, you must write out the answer to the question in a complete sentence that gives the reader both the question and the answer. No abbreviations or short words. Turning in a homework paper that does not meet these standards will result in the paper being returned to you with a comment to “Redo”.

EXAMPLE:

Question: What does the red gauge on the manifold set represent?

Our answer might be: The red gauge on the manifold set represents the high pressure side of the system.

In one sentence, this statement has given both the question and the answer.

COURSE EVALUATION:
Your final grade will be made up of the following parts:

Attendance
The class roll may be called at any time during each class session.
Students Who Are:
- Present at that point will receive ten points per day.
- Ten minutes late will receive only five points for the session.
- More than 10 min. late will not receive any points for the session.

Daily Work
(Homework, pop quizzes, and other daily work) 100 points each

Lab Work
Lab assignments. - 100 points each
(Part of the lab grade will be how well you work as a team member in the lab and selection of tools to perform the lab):

Homework assignments - 100 points each
Major Exams - 200 points each

Notebook - 200 points
(Notebook will be graded on organization and neatness)
Final Exam, 300 points (Written 150 pts. – lab 150 pts.)

NOTE:
*You must average 70% on the written final exam and lab final exam
In order to receive a passing grade in this course.*

GRADE BREAKDOWN:
100 to 90 % of total possible points = A
89 to 80 % of total possible points = B
79 to 70 % of total possible points = C
69 to 60 % of total possible points = D
Below 60 % of total possible points = F

NOTE: Should you wish to question your grade, the information contained in the instructor’s grade book and you notebook will be the final authority for establishing the final grade. Therefore, your notebook should be retained for a period of time after the class is over.

OBTAINING YOUR GRADES AT THE END OF THE SEMESTER:
Grade reports are no longer mailed. Convenient access is available online. Just use your student identification number when you log in to e-Connect Web site address: http://www.econnect.dcccd.edu/

FAMILY EDUCATIONAL RIGHTS AND PRIVACY ACT OF 1974 (FERPA)
In compliance with the Family Educational Rights and Privacy Act of 1974 (FERPA), the College may release information classified as “directory information” to the general public without the written consent of the student. Directory information includes: (1) student name, (2) student address, (3) telephone numbers, (4) date and place of birth, (5) weight and height of members of athletic teams, (6) participation in officially recognized activities and sports, (7) dates of attendance, (8) educational institution most recently attended, and (9) other similar information, including major field of student and degrees and awards received. Students may protect their directory information at any time during the academic year. If no request is filed, directory information is released upon written inquiry. No telephone inquiries are acknowledged. No transcript or academic record is released without written consent from the student, except as specified by law.

COURSE CLASS WORK
Exams: The exams will cover material from the assigned chapters in your textbook, quizzes, handouts and other assigned material. The exam can include multiple choice questions, true/false questions, fill-in-the-blank and short essay questions. There will be no make-up exam unless arrangements have been made with the instructor before the exam date! All assignments will be given a due date and will not be accepted late without a penalty.
**Final:** It is comprehensive, covering some material from the first three exams. The final can include multiple choice questions, true/false questions, fill-in-the-blank and short essay questions.

**Lab Final**  This exam will consists of parts or a combination of labs that have been used during the semester

**Quizzes:** There will be quizzes and in-class assignments throughout the semester, covering material from your textbook, lecture and handouts. These quizzes and assignments may be announced or unannounced. There will NOT be any make-up for these quizzes.

**Notebook:**  The notebook will be a binder with tabbed sections (name of the section on the tab). There will be a cover sheet at the front. The notebook will contain:

- All class work
- All class notes
- All handouts
- All tests
- All labs
- And any project papers.

The notebook will:

- Have each category tabbed
- Have a cover sheet in the notebook
- Due at the beginning of the written final exam period.
- Be considered late after the first 30 minutes of the class session. If the notebook is turned in late, there will be a penalty of 40%

The notebook may be collected at any time during the semester without notice. If the notebook is not complete up to that point, there will be a 25% deduction in the total notebook grade.

**COURSE POLICIES:**

**Attendance:** You are expected to attend EACH CLASS MEETING, and you are expected to be here on time, prepared, with your book and materials. Please consult with me whenever an absence is necessary.

- Instructors may choose to call the roll at any time during each class period
  A student not in attendance at each of these times will be counted as absent
- A student arriving in the class room more than five minutes late will not be allowed to begin an assignment that is already in progress (This includes major exams) the instructor’s time piece will be used to mark the time

If you miss a class, you are responsible to cover the missed material on your own. Have a classmate share notes with you and make sure you know about homework or other assignments due during the next class period.

Students who are receiving any form of financial aid should check with the Financial Aid Office prior to withdrawing from classes. Withdrawals may affect your eligibility to receive further aid.
and could cause you to be in a position of repayment for the current semester. Students who fail to attend or participate after the drop date are also subject to this policy.

**Preparation:** You are expected to do the reading and written assignments before you get to class.

**Daily Tests:** You must be present in class each day when a daily test or pop quiz is given. You cannot “make-up: any daily test or pop quiz.

**Major Tests:** You are expected to be here for each exam. You cannot “make-up” exams unless you have made specific arrangements with me before the scheduled exam. You MUST be present at the scheduled time for the major exams.

**Laboratory Work:** You cannot work in the lab if you do not have your required tools.
- The list of required laboratory tools will be given out in the first class meeting.
- You are expected to have all of your tools by the beginning of the second week of class.
- The laboratory work sheets are due at the end of each laboratory assignment.
- Failure to hand them in at the required time will result in a loss of the lab grade.
- You are to work with your laboratory partner, working on the assignment until both of you have completed the assignment.

**Laboratory Work Area:**
- Will be left clean. All components and test equipment will be returned to the cabinet or the tool room
- Failure to comply with the preceding rule will result in a 10% reduction from the lab grade

**SAFETY:**
A student will participate in safety training and will sign off upon completion of the training.

**Safety Glasses:** Safety glasses are required in all HVAC lab classes where the student is working on operating equipment. Your instructor is charged with enforcing this policy.

All students will be issued a pair of safety glasses at the beginning of the beginning of their first year of class. The tool room will not issue safety glasses to students after they receive their initial pair.

**Students will be removed from labs if they do not have their safety glasses.** The campus bookstore and several off campus stores have safety glasses for sale for those students who can’t keep up with theirs.

**Homework:** You are expected to turn in the written assignments on time.
- The homework is due at the beginning of the next scheduled class, and will not be accepted if it is late. Homework will be taken up at the beginning of each class. If you are absent from class, your homework is to be turned in the next scheduled class.

**E-MAILED HOMEWORK:**
Homework assignments may be e-mailed to me on or before the day they are due. They must be Microsoft Word compatible. If I cannot open the file, it will be considered not turned in.
REPEATABILITY ISSUE:
Effective for the Fall Semester 2005, the Dallas County Community Colleges will charge a higher tuition rate to students registering the third or subsequent time for a course. All third and subsequent attempts of the majority of credit and Continuing education/Workforce Training courses will result in higher tuition to be charged. Developmental Studies and some other courses will not be charged a higher tuition rate. Third attempts include courses taken at any of the Dallas County community Colleges since the Fall 2002 semester. For complete information and updates, go to http://www.dcccd.edu/ThirdCourseAttempt/.

STOP BEFORE YOU DROP
For Students who enrolled in college level courses for the first time in the fall of 2007, Texas Education Code 51.907 limits the number of courses a student may drop.

You may drop no more than 6 courses during your entire undergraduate career unless the drop qualifies s an exception. Your campus counseling/advising center will give you more information on the allowable exceptions.

Remember that once you have accumulated 6 non-exempt drops, you cannot drop any other courses with a “W”, therefore please excise caution when dropping courses in any Texas public institution of higher learning, including all seven of the Dallas County Community colleges.

For more information, you may access: https://www1.dcccd.edu.coursedrops

DCCCD WITHDRAWAL POLICY:
If you are unable to complete this course, it is your responsibility to withdraw formally. Each course has a specific drop date. For this class, the withdraw request must be received in the Registrar’s Office by drop date found on fee receipt. Failure to do so will result in your receiving a performance grade, usually an “F”. If you drop a class or withdraw from the college before the official drop/withdrawal deadline, you will receive a “W” (withdrawal) in each class dropped.

For complete information on the drop requirements, policies and procedures, refer to the current online college catalogue at www.dcccd.edu at the following link.
https://www.dcccd.edu/catalog/ss/oep/dw.cfm?use nav=acad info&loc=econ

Students who are receiving any form of financial aid should check with the Financial Aid Office prior to withdrawing from classes. Withdrawals may affect your eligibility to receive further aid and could cause you to be in a position of repayment for the current semester. Students who fail to attend or participate after the drop date are also subject to this policy.

SIX COURSE DROP RULE:
As a result of passage of Senate Bill 1231 during the 80th Texas Legislature, Section 51.907 was added to the Texas education Code. This statute applies to students who enroll in a Texas public institution of higher education for the first time in fall of 2007 or later. Based on this law, DCCCD or any other Texas public institution of higher education may not permit students to drop more than six courses during their entire undergraduate career. All college level courses dropped after the official drop and add period are included in the six course limit, including
courses dropped at another Texas public institution of higher education, unless the reason qualifies as an exception.

**STUDENT E-MAIL:**
Legal privacy issues prevent your instructor from discussing your work or your grades on commercial e-mail accounts. If you wish to send your papers as attachments to an e-mail (and the instructor permits it), or if you have a question about your grade, you must open a student e-mail account. The account is free. You may set it up by going to www.econnect.dcccd.edu and click on Student Services, Online services, and Student NetMail. All students receiving financial aid must open a student NetMail account.

**INCOMPLETES:**
An incomplete grade of “I” may be given when an unforeseen emergency prevents you from completing the work in a course. The “I” must be converted to a performance grade (A-F) within 90 days after the first day in the subsequent regular semester. If the work is not completed after 90 days, the “I” is converted to a performance grade, usually an “F”.

**PRINTING ON CAMPUS:**
Printing in the Computer Lab (L-108), Library, and Learning Assistance Center will cost 5 cents a page. Students must bring a $1.00, $5.00, $10.00, or $20.00 bill to the lab to create an account. Accounts must be created before attempting to print. No change is made in the lab. Once the money is in the bill acceptor, it cannot be retrieved. Cash refunds are not possible. Accounts stay active as long as the account has value.

**EMERGENCY & INCLEMENT WEATHER PROCEDURE:**
In case of emergency or inclement weather conditions, Eastfield students should listen to KEOM-FM Radio station (88.5) as the primary media source. In partnership with the Mesquite Independent school District, Eastfield College Administration will notify KEOM immediately after a decision is made to cancel classes on any given day of inclement weather or for emergency purposes. Students may also monitor other local radio and television stations. The earliest an announcement may be broadcast on KEOM Radio is 6 a.m. Students may also refer to the Eastfield College web page www.eastfieldcollege.com for the Inclement Weather announcement under the Features area of the front page. The announcement will be posted immediately following the decision to close the college.

**SEXUAL HARRASSMENT:**
Eastfield College has a zero tolerance policy on sexual harassment. All students shall report complaints of sexual harassment informally to the college Human Resources Director or formally to the Vice Chancellor of Educational Affairs

**ACADEMIC HONESTY:**
Scholastic dishonesty is a violation of the Code of Student Conduct. Scholastic dishonesty includes, but if not limited to, cheating on a test, plagiarism, and collusion.

As a college student, you are considered a responsible adult. Your enrollment indicates acceptance of the DCCCD Code of Student Conduct. Published in the DCCD Catalog at http://www1.dcccd.edu/cat0506/ss/code.cfm Internet at http://dcccd.edu.
Academic dishonesty includes, but is not limited to, cheating on tests, plagiarism and collusion.

**Cheating** includes copying from another student’s test or homework paper, using materials not authorized, collaborating with or seeking from another student during a test, knowingly using, buying selling, stealing, or soliciting the contents of an unadministered test, and substituting for another person to take a test.

**Plagiarism** is the appropriating, buying, receiving as a gift, or obtaining by any means another persons work and the unacknowledged submission or incorporation of it in one’s own written work.

**Collusion** is the unauthorized collaboration with another person in preparing written work for the fulfillment of course requirements. Academic dishonesty is a serious offense in college. You can be given a failing grade on an assignment or test, can be failed for the class, or you can even be suspended from college.

**FINANCIAL AID STUDENTS:**
If you are receiving Financial Aid grants or loans, you must begin attendance in all class. Do not drop or stop attending any class without contacting the financial Aid Office. Changes in your enrollment level and failing grades may require that you repay financial aid funds. Failure to contact the instructor will result in your name being submitted to the Financial Aid Office as a “non-attendee”. All students receiving financial aid must open an e-mail account through NetMail. See direction in the syllabus for opening an e-mail account.

**ABSENCE FOR OBSERVATION OF HOLY DAYS:**
Absences for observance of a religious holy day are excused if arrangements have been made with the instructor prior to the holiday. A student whose absence is excused to observe a religious holiday is allowed to contract with the instructor to take a make-up examination or complete an assignment which must be turned in within three class days of the agreement.

**AMERICANS WITH DISABILITIES ACT COMPLIANCE:**
It is the policy of Eastfield College to provide reasonable accommodations for qualified individuals who are student with disabilities. This college will adhere to all Federal, State and Local laws, regulations and guidelines with respect to providing reasonable accommodations as required to afford equal educational opportunity. It is the student's responsibility to contact Eastfield College Disability Services Office in C237. Call 972-860-8348, or email efcdos.dcccd.edu. For more information, go to, http://www.eastfieldcollege.edu/SSI/DSO/index.html

**HAZARDOUS MATERIAL:**
You have the right to know that you may be working with, or in the presence of Hazardous Materials. A list of specific materials is posted on the “Green” Safety Bulletin Boards. Material safety Data sheets are available from the tool room. Students will be trained on the safe handling of these materials. The student will be required to sign off on this training.

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TENTATIVE ASSIGNMENTS

1. Introduction – Read before class Unit 4 in the RACT textbook
   Answer Review Questions at the end of the unit.

2. Safety test

3. Read before class Units 1 in RACT textbook. “Heat and Pressure”
   Read Refrigeration Theory #7 & # 8 in GNICE
   Answer questions # 1 thru # 5, # 13 thru # 21, and # 30 thru #33 on pages # 143
   and # 144 in GNICE

4. Read before class Unit 2 in RACT textbook. “Matter and Energy”
   Answer review Question1 thru 28 at the end of the unit.

5. Continue Unit 2. Matter and Energy

6. Read before class Unit 3 in RACT textbook. “Refrigeration and Refrigerants”
   Answer review questions 1 thru 28,30,31,at the end of the unit.

7. Read all of the Appion “G5 Twin” (Handout)

8. Read before class Unit 8 in RACT textbook. “System Evacuation”
   Answer questions 1-12 on pages 167 & 168 in GNICE.

9. Exam

10. Read before class Unit 10 in RACT textbook. “System Charging”
    Answer questions 1 thru 11 on pages 168 and 169 in GNICE.
    Continue Unit 10

11. Read before class Unit 24 in RACT textbook. “Expansion Devices”
    Answer questions # 1 thru #13 on pages 155 and 156 in GNICE.

12. Read before class Unit 21 in RACT textbook. “Evaporators and the Refrigeration System”
    Answer review questions 1 thru 14 at the end of unit
13. Read before class Unit 22 in RACT textbook. “Condensers”
   Answer review questions 1 thru 15 at the end of unit

14. Read before class Unit 23 in RACT textbook. “Compressors”
   Answer review questions 1 thru 18 at the end of unit

15. Read before class Unit 9 in RACT textbook. “Recovery, Recycle and Reclaim”
   Answer review questions #1 thru #13 on pages 162 and 163 in GNICE

16. Written Final
   Lab Final

** These assignments are tentative. The instructor reserves the right to make adjustments at any time during the semester. Pay close attention in class for possible assignment changes.
Eastfield College
Air Conditioning and Refrigeration

Tool and Instruments list

GENERAL TOOLS:

Safety glasses
Tool box or pouch

BASIC ELECTRIC METER:

Any multimeter that will measure: Volts, Amps, Ohms, Temperature and Capacitance.

Examples of this meter:
Fluke 116/322 HVAC Comb. Kit

REFRIGERANT TOOLS:

Compound manifold gauge set with check valve hoses and one 90° low loss fitting
Refrigerant valve core tool (ratchet with adapter)
Compound manifold gauge set with check valve hoses and one 90° low loss fitting for use with 410a refrigerant only.

HAND TOOLS:

8 in. and 12 in. adjustable open-end wrenches
Allen wrench set
Refrigeration ratchet wrench & adapter
6 " combination pliers
Wire cutter pliers
Six in one screwdriver
Fireplace lighter
Insulated test/jumper leads with alligator clips
Ball Peen Hammer
Leather and Latex or vinyl disposable gloves

POWER TOOLS

Cordless drill (with fully charged battery) and socket bits (1/4\textsuperscript{th}, 5/16\textsuperscript{th}, 3/8\textsuperscript{th}, and 7/16\textsuperscript{th})