I. INTRODUCTION

A. A study of components, applications, and installation of air conditioning systems with capacities of 25 tons or less.

B. Commercial Air Conditioning (HART 2341) is a required course for the completion of a two-year Associate of Applied Science degree in Heating, Air Conditioning and Refrigeration or a Certificate of Completion in Commercial Heating, Air Conditioning and Refrigeration.

C. This course is occupationally related and serves as a preparation for careers in the Heating, Air Conditioning and Refrigeration field.

D. Prerequisite(s): This course has a prerequisite or corequisite of HART 1401 and HART 1407 or consent of Department Chair.

E. Alphanumeric coding used throughout the syllabus denotes the integration of SCANS occupational competencies (C) and Foundation Skills (F).

II. LEARNING OUTCOMES

Upon successful completion of this course, Commercial Air Conditioning, the student will:

A. Apply and describe the sequence of operation for commercial air conditioning systems and their accessories. (C19, 12)

B. Demonstrate knowledge of components relative to commercial air conditioning. (C19, 12)

C. Demonstrate knowledge of system components. (C19, F12)

D. Diagnose and troubleshoot systems. (C20)

E. Describe system applications. (F2)

F. Demonstrate system installation procedures. (C20)

G. Evaluate system performance. (F1, F2, F3, F4)
III. INSTRUCTIONAL MATERIALS

A. Text: The instructional materials identified for this course are viewable through www.ctcd.edu/books

B. Audio-Visual Aids:
   1. “Chillers--Maintenance & Troubleshooting: Mechanical Components,” by Coastal Skills Training (Video)
   2. “Chillers--Maintenance & Troubleshooting: Leak Check & Electrical,” Coastal Skills Training (Video)

C. Other Instructional Materials: As selected by the instructor.

IV. COURSE REQUIREMENTS

A. Your first responsibility is scholarship. The grade you receive will be the result of your efforts both in the classroom and in the laboratory.

B. This course is designed to require a steady, continuous effort from the student. Class participation, initiative, attendance, and work efforts will be considered in grade computation.

C. Reading and study assignments will be made by the instructor. Reading of all study assignments is required, as well as specific tasks outlined by the instructor or listed on handouts, laboratory activity sheets, or in the student workbook (if used). Specific reading assignments will be assigned by the instructor or in the student workbook if used. Students are required to complete these assignments by the time specified by the instructor. Quizzes may be given on any or all reading assignments.

D. The study of a subject is not limited to the classroom, laboratory, or limits of the syllabus. Each student should seek out and study all available material available on the subject being taught. This might include use of the Internet or the library. In general, two hours of study outside the regular class period is recommended for each hour of classroom work.

E. Students are required to attend class and laboratory sessions regularly. Those who fail to do so may be dropped from the course with a grade of “FN”.

F. Students are required to be present for all examinations. See paragraph V (Examinations) for additional information.
G. Laboratory assignments will be completed on an individual basis except when limited by tools and/or materials. Projects will be subjectively graded by the instructor. When group projects are graded, all students will receive the same grade. Students assigned to a group must be present at all times when the project is being worked on. Students who are not present while a project is in progress will be given a “0” for the project. Students are required to complete all laboratory assignments by the time specified by the instructor.

V. EXAMINATIONS

A. There will be a minimum of three major examinations:

1. Three Week Exam
2. Mid Term Exam
3. Final Exam (this is a comprehensive exam)
4. Additional examinations may be given if the instructor determines it is necessary for proper evaluation of the students in the class.

B. Students must be present for all examinations. Make-up examinations will not be given. Students who know they will be absent on the day of an examination must make arrangements with the instructor prior to the absence. Students who are absent on the day of the examination due to illness or other extenuating circumstances must present to the instructor an acceptable reason for the absence on the day following the absence.

C. Students without an excused absence will be given a zero for that examination.

VI. SEMESTER GRADE COMPUTATION

A. Grade Computation:

<table>
<thead>
<tr>
<th>Component</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Three Week Exam</td>
<td>100</td>
</tr>
<tr>
<td>Mid Term Exam</td>
<td>100</td>
</tr>
<tr>
<td>Final Exam</td>
<td>250</td>
</tr>
<tr>
<td>Quizzes</td>
<td>100</td>
</tr>
<tr>
<td>Instructor Evaluations</td>
<td>150</td>
</tr>
<tr>
<td>Laboratory</td>
<td>300</td>
</tr>
<tr>
<td><strong>Total Points</strong></td>
<td><strong>1000</strong></td>
</tr>
</tbody>
</table>
B. Ratio: Points to Grade

<table>
<thead>
<tr>
<th>Points</th>
<th>Grade</th>
<th>Points Per Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>900-1000</td>
<td>A</td>
<td>4</td>
</tr>
<tr>
<td>800-899</td>
<td>B</td>
<td>3</td>
</tr>
<tr>
<td>700-799</td>
<td>C</td>
<td>2</td>
</tr>
<tr>
<td>600-699</td>
<td>D</td>
<td>1</td>
</tr>
<tr>
<td>0-599</td>
<td>F</td>
<td>0</td>
</tr>
<tr>
<td>Withdrawal</td>
<td>W</td>
<td>0</td>
</tr>
<tr>
<td>Incomplete</td>
<td>I</td>
<td>0</td>
</tr>
</tbody>
</table>

D. Students must take the final examination to receive a grade for the course.

E. Students absent on days a laboratory assignment is presented will lose the points for that laboratory assignment. This point loss may be recovered (only by students having an excused absence) by making up the assignment at a time other than regular class periods. The student must present the excuse to the instructor on the first class day after the absence and coordinate the make up time with the instructor. The project must be completed within four working days after the absence. If the make up is not completed within the allotted time the student will receive a “0” for the project.

VII. NOTES AND ADDITIONAL INSTRUCTIONS FROM COURSE INSTRUCTOR

A. Course Withdrawal: It is the student’s responsibility to officially withdraw from a course if circumstances prevent attendance. Any student who desires to, or must, officially withdraw from a course after the first scheduled class meeting must file a Central Texas College Application for Withdrawal (CTC Form 59). The withdrawal form must be signed by the student.

CTC Form 59 will be accepted at any time prior to Friday of the 12th week of classes during the 16-week fall and spring semesters. The deadline for sessions of other lengths is:

10-week session Friday of the 8th week

The specific last day to withdraw is published each semester in the Schedule Bulletin.

A student who officially withdraws will be awarded the grade of “W” provided the student’s attendance and academic performance are satisfactory at the time of official withdrawal. Students must file a withdrawal application with the College before they may be considered for withdrawal.

A student may not withdraw from a class for which the instructor has previously issued the student a grade of “F” or “FN” for nonattendance.
B. **Administrative Withdrawal:** An administrative withdrawal may be initiated when the student fails to meet College attendance requirements. The instructor will assign the appropriate grade on CTC Form 59 for submission to the registrar.

C. **Incomplete Grade:** The College catalog states, “An incomplete grade may be given in those cases where the student has completed the majority of the coursework but, because of personal illness, death in the immediate family, or military orders, the student is unable to complete the requirements for a course.” Prior approval from the instructor is required before the grade of “I” for Incomplete is recorded. A student who merely fails to show for the final examination will receive a zero for the final and an “F” for the course.

D. **Cellular Phones:** Cellular phones will be turned off while the student is in the classroom or laboratory.

E. **American’s With Disabilities Act (ADA):** Disability Support Services provides services to students who have appropriate documentation of a disability. Students requiring accommodations for class are responsible for contacting the Office of Disability Support Services (DSS) located on the central campus. This service is available to all students, regardless of location. Explore the website at [www.ctcd.edu/disability-support](http://www.ctcd.edu/disability-support) for further information. Reasonable accommodations will be given in accordance with the federal and state laws through the DSS office.

F. **Instructor Discretion:** The instructor reserves the right of final decision in course requirements.

G. **Civility:** Individuals are expected to be cognizant of what a constructive educational experience is and respectful of those participating in a learning environment. Failure to do so can result in disciplinary action up to and including expulsion.

H. Absence from the class may be unavoidable in some situations. These include illness, military/civilian job requirements, or a death in the immediate family. Documentation is required in the case of excused absences for job requirements; excuses will be on company letterhead stationary signed by the immediate supervisor stating the reason for the absence in for civilian jobs. Excuses for military personnel must be signed by the 1st Sergeant or the Company Commander. In case of illness, the individual must have a statement from the doctor treating the illness.
VIII. COURSE OUTLINE

A. Lesson One: Thermodynamics

1. **Learning Outcomes**: Upon successful completion of this lesson, the student will:

   a. Demonstrate knowledge of system components. (C19, F2)
   b. Describe system applications. (F2)
   c. Evaluate system performance. (F1, F2, F3, F4)

2. **Learning Activities**:

   a. The student will complete reading assignments as assigned (F1, F11, C5, C6).
   b. The student will study the words/terms and complete written assignments specified by the instructor (F1, F11, C5, and C6).
   c. The student will attend classroom lectures and participate in classroom discussions (F5, F6, F7, F9, F10, C1, C5, C6, and C7)
   d. The student will observe demonstrations performed by the instructor (F5, F10, C5, C6, and C14).
   e. The student will complete laboratory learning activities assigned by the instructor. See the laboratory learning activity list attached (F1 thru F17, C1, C3, C5 thru C9, C14 thru 16, and C18 thru C20).

3. **Equipment and Materials**:

   a. Hand tools
   b. Test instruments
   c. Overhead projector (as required)
   d. Other as required by the instructor

4. **Audio-Visual Aids**: (Recommended)

   a. To be selected by the instructor from those listed in Section IIID above.
   b. Others as selected by instructor.

5. **Lesson Outline**:

   a. Heat
   b. Temperature and scales
   c. BTU and specific heat
   d. Sensible and latent heat
   e. Pressure
   f. Review for three week exam
Three week exam

B. **Lesson Two: Commercial Air Conditioning Equipment**

1. **Learning Outcomes**: Upon successful completion of this lesson the student will:

   a. Demonstrate knowledge of system components. (C19, F2)
   b. Diagnose and troubleshoot systems. (C20)
   c. Describe system applications. (F2)

2. **Learning Activities**:

   a. The student will complete reading assignments as assigned (F1, F11, C5, C6).
   b. The student will study the words/terms and complete written assignments specified by the instructor (F1, F11, C5, C6).
   c. The student will attend classroom lectures and participate in classroom discussions (F5, F6, F7, F9, F10, C1, C5, C6, C7)
   d. The student will observe demonstrations performed by the instructor (F5, F10, C5, C6, C14).
   e. The student will complete laboratory learning activities assigned by the instructor. See the laboratory learning activity list attached (F1 thru F17, C1, C3, C5 thru C9, C14 thru 16, C18 thru C20).

3. **Equipment and Materials**:

   a. TV/VCR
   b. Hand tools
   c. Test instruments
   d. Overhead projector (as required)
   e. Commercial Air Conditioning System
   f. Commercial system test instruments
   g. Computer Work Station
   h. Other as required by the instructor

4. **Audio-Visual Aids**: (Recommended)

   a. To be selected by the instructor from those listed in Section IIID above.
   b. Others as selected by instructor.
5. **Lesson Outline:**

   a. Heating and cooling with air
   b. By-passed return air
   c. By-passed outdoor air
   d. The refrigeration cycle
   e. Compressors
   f. Superheated refrigerant vapor
   g. Subcooling
   h. Metering devices
   i. Condensers
   j. Air side components
   k. Chilled Water Systems
      (1) compressor
      (2) condenser
      (3) evaporators
      (4) controls
   l. Water supply
      (1) city
      (2) surface
      (3) well
   m. Cooling towers
   n. Maintenance
   o. Review for Mid Term exam
   p. Mid Term exam

C. **Lesson Three: The Air Conditioning System**

1. **Learning Outcomes:** Upon successful completion of this lesson, the student will:

   a. Demonstrate knowledge of system components. (C19, F2)
   b. Describe system applications. (F2)
   c. Demonstrate knowledge of hydronic systems. (C20)

2. **Learning Activities:**

   a. The student will complete reading assignments as assigned (F1, F11, C5, C6).
   b. The student will study the words/terms and complete written assignments specified by the instructor (F1, F11, C5, C6).
   c. The student will attend classroom lectures and participate in classroom discussions (F5, F6, F7, F9, F10, C1, C5, C6, C7).
   d. The student will observe demonstrations performed by the instructor (F5, F10, C5, C6, C14).
e. The student will complete laboratory learning activities assigned by the instructor. See the laboratory learning activity list attached (F1 thru F17, C1, C3, C5 thru C9, C14 thru 16, C18 thru C20).

3. **Equipment and Materials:**
   
a. TV/VCR  
b. Hand tools  
c. Test instruments  
d. Overhead projector (as required)  
e. Operating chiller (plant tour)  
f. Weight Charging Scale  
g. Test instruments for commercial system  
h. Laboratory assignments  
i. Other as required by the instructor

4. **Audio-Visual Aids: (Recommended)**
   
a. To be selected by the instructor from those listed in Section IIID above.  
b. Others as selected by instructor.

5. **Lesson Outline:**
   
a. Hydronic system  
b. Commercial System Start-Up  
c. Charging refrigerant by superheat  
d. Refrigerant Recovery  
e. Evacuating a System  
f. Charging Refrigerant by Weight  
g. Review for the Final Exam (This is a comprehensive exam)  
h. Final Exam