I. **INTRODUCTION**

A. A study of components, applications and installation of mechanical air conditioning systems including operating conditions, troubleshooting, repair and charging of air conditioning systems.

B. Residential Air Conditioning (HART 1341) 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 Residential or 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 1407, Refrigeration Principles 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 the successful completion of this course, Residential Air Conditioning, the student will:

A. Demonstrate systems applications (C15, F1, F2).

B. Define psychometrics and use the psychometric chart (C5, C7, F6, F10).

C. Implement and demonstrate industry accepted refrigerant charging procedures. C18,C20).

D. State the function of the mechanical refrigeration system (F7, C7, C15).

E. Demonstrate air conditioning system installation procedures (C18, C19, C20).
F. Demonstrate component and part diagnostics and replacement (C18, C19, C20).

G. State the operation characteristics of the residential split system (F6, F10, C7, C15).

H. Describe the air distribution system and measure air movement (F6, F10, C7, C15).

I. State the functions of the controls used on an air conditioning system (F6, F10, C7, C15).

J. Demonstrate mechanical troubleshooting skills (C5, C15, C18, C19, C20, F9).

K. Construct a fiberglass duct (C18, F9, F10).

III. INSTRUCTIONAL MATERIALS

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

B Supplementary Reading: As assigned by the instructor.

C. References: As selected by the instructor.

D. Audio-Visual Aids: Currently none recommended. May be selected by the instructor.

E. 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
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”. It is the policy of Central Texas College to withdraw a student who has five absences during a 16 week semester or three absences during a 10 week semester.

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. Exam #1
2. Exam #2
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 must present to the instructor a note from their doctor stating the 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 COMPUTATIONS

A. Grade Computation:

Exam #1 100 points
Exam #2 100 points
Final Exam 250 points
Quizzes 100 points
Exit Exam 50 points
Computer testing 100 points
Total Points 1000 points

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>

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

D. 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 makeup time with the instructor or the lab assistant. The lab exercise must be completed within two working days after the absence. If the makeup is not completed within the allotted time the student will receive a “0” for the project.

VII. NOTES AND ADDITIONAL INSTRUCTIONS FROM THE 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: Cell phones will be turned off while the student is in the classroom or laboratory. Blue tooth devices or ear buds will not be worn while in the classroom.

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 or a death in the immediate family. In case of illness the individual must have a statement from the doctor treating the illness.

VIII. COURSE OUTLINE

A. Lesson One: Mechanical Systems

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

   a. Measure superheat (C5, C7, C15, C18, C19, C20, F1, F2, F3, F9, F12).
   b. Define psychometrics and use the psychometric chart (C5, C7, F6, F10).
   c. Describe the function of the components of a residential split air conditioning system (C5, C7, C15, F6, F10).
   d. Construct and interpret a pressure-enthalpy diagram (C5, C15, C18, C19, C20, F1, F2, F3, F4, F9, F12).
   e. Perform basic air pressure measurements (C5, C15, C18, C19, C20, F1, F2, F3, F4, F9, F12).

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 9, C14 thru 16, C18 thru 20).
3. **Equipment and Materials:**

   a. Handouts (as required by the instructor)
   b. TV/VCR or overhead projector (as required)
   c. Safety equipment
   d. Diagnostic tools, measuring tools and test equipment (as required)
   e. Service equipment
   f. Hand tools
   g. Refrigerants
   h. Residential split system air conditioning unit
   i. Other as required by the instructor

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

   a. None currently selected.
   b. Others as selected by the instructor.

5. **Lesson Outline:**

   a. Introduce the course
   b. Annotate class roster
   c. An introduction to air conditioning
      (1) Early developments
      (2) Industry manpower needs
      (3) Occupational opportunities
      (4) Trade association
   d. Air conditioning benefits
      (1) Comfort zone
      (2) Air movement
      (3) Medical consideration
      (4) Dehumidification
   e. Explain psychometrics
      (1) The study of air and its properties
      (2) Weight of air
      (3) Calculate the weight of air in a room
      (4) Humidity
      (5) Superheated gases in air
      (6) Dry-bulb and wet-bulb temperatures
      (7) Dew point
   f. Introduce the psychometric chart
   g. Conduct psychometric chart exercises
   h. Conduct exercise using the sling psychrometer
   i. Explain the basic theory of refrigeration
   j. Construct a pressure-enthalpy diagram
   k. Explain the functions of the evaporator
(1) Construction
(2) A coil
(3) Slant or Slab coil
(4) M coil
(5) Coil circuits

1. Explain the functions of the compressor
   (1) Purpose
   (2) Types
       (a) reciprocating
       (b) rotary
       (c) welded hermetic
       (d) bolted (serviceable) hermetic
       (e) scroll

m. Explain the functions of the condenser
   (1) Construction
   (2) Types
       (a) side discharge
       (b) top discharge

n. Explain the different designs of condensing unit
o. Explain high efficiency condensers
p. Define the components of the air distribution system
q. System pressures
r. Air measuring instruments for duct systems
s. Types of fans
t. Air measurements
u. Pressure-temperature chart
   (1) Diagnosing system pressures
       (a) Suction pressure
       (b) Condensing pressure
   (2) Interpreting the pressure temperature chart
v. Review for exam #1.
w. Exam #1

B. Lesson Two: Testing and Servicing the System

1. Learning Outcomes: Upon the successful completion of this lesson the student will:
   a. Calculate heat transfer (F1, F2, F3, F9, C5, C7, C15, C18, C19, C20).
   b. Replace fans and motors (C18, C19, C20).
   c. Recover refrigerant (C18, C19, C20).
   d. Perform system pump down and evacuation operations (C18, C19, 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 9, C14 thru 16, C18 thru 20).

3. Equipment and Materials:
   a. Handouts (as required by the instructor)
   b. TV/VCR or overhead projector (as required)
   c. Safety equipment
   d. Diagnostic tools, measuring tools and test equipment (as required)
   e. Service equipment
   f. Hand tools
   g. Refrigerants
   h. Residential split system air conditioning unit
   i. Ducting materials
   j. Air conditioning air distribution system
   k. Other as required by the instructor

4. Audio Visual Aids: (Recommended)
   a. None currently selected
   b. Others as selected by the instructor

5. Lesson Outline:
   a. Residential split air conditioning system
   b. Evaporator section
   c. Condensing unit
   d. Active and passive recovery
   e. Pump down exercise
   f. Perform a triple vacuum (evacuation)
   g. Service valves
   h. Equipment start-up
   i. Leak detection
   j. Review for exam #2
   k. Exam #2
C. **Lesson Three: Changing Major Components**

1. **Learning Outcomes:** Upon the successful completion of this lesson the student will:
   a. Demonstrate brazing and silver soldering skills (C18, C19, C20).
   b. Demonstrate system recovery procedures (C18, C19, C20).
   c. Demonstrate system pump down procedures (C18, C19, C20).
   d. Remove and replace the evaporator (C18, C19, C20).
   e. Remove and replace the compressor (C18, C19, C20).
   f. Charge the system (C18, C19, C20).
   g. Test for noncondensables (C18, C19, C20).
   h. Identify mechanical malfunctions (C18, C19, C20).
   i. Determine correct unit operating pressures (C18, C19, 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 9, C14 thru 16, C18 thru 20).

3. **Equipment and Materials:**
   a. Handouts (as required by the instructor)
   b. TV/VCR or overhead projector (as required)
   c. Safety equipment
   d. Diagnostic tools, measuring tools and test equipment (as required)
   e. Service equipment
   f. Hand tools
   g. Refrigerants
   h. Residential split system air conditioning unit
   i. Ducting materials
   j. Air conditioning air distribution system
   k. Brazing equipment
   l. Copper cutting and flaring tools
   m. Other as required by the instructor
4. **Audio Visual Aids:** (Recommended)

   a. None currently selected.
   b. Others as selected by the instructor.

5. **Lesson Outline:**

   a. Cutting and bending copper.
   b. Flare and swag copper.
   c. Review of brazing techniques.
   d. Joining copper.
   e. Construct a complex copper circuit.
   f. Demonstrate system pump down.
   g. Remove and replace the evaporator
   h. Perform a system leak test
   i. Perform a system evacuation
   j. Demonstrate a refrigerant recovery
   k. Remove and replace the compressor
   l. Charge the system
   m. Test the system for noncondensable gasses
   n. Explain temperature and pressure measurements
   o. Do exercise on measuring temperature and pressure
   p. Do exercise on superheat measurements
   q. Do exercise on low refrigerant charge
   r. Do exercise on overcharge of refrigerant
   s. Do exercise on dirty condenser coil
   t. Do exercise on dirty evaporator coil
   u. Explain the start-up procedure for a mechanical refrigeration system
   v. Explain the use of pressures to troubleshoot the mechanical system
   w. Review for the Final Exam (This is a comprehensive exam)
   x. Final Exam