CENTRAL TEXAS COLLEGE
SYLLABUS FOR HART 1403
AIR CONDITIONING CONTROL PRINCIPLES
Semester Hours Credit: 4

INSTRUCTOR: ________________
OFFICE HOURS: ________________

I. INTRODUCTION

A. A basic study of electrical, pressure, and temperature controls including motor starting devices, operating relays, and troubleshooting safety controls and devices. Emphasis on use of wiring diagrams to analyze high and low voltage circuits. A review of Ohm’s law as applied to A/C controls and circuits.

B. Air Conditioning Control Principles (HART 1403) 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 of HART 1401, Electrical 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, Air Conditioning Control Principles, the student will:

A. The student will test, repair, and/or replace motor starting and protection devices (C1, C3, C4, C5, C6, C7, C14, C15, C16, C18, C19, C20, F1 through F6, and F8 through F17).

B. Test, repair, and/or replace electrical components (C1, C3, C4, C5, C6, C7, C14, C15, C16, C18, C19, C20, F1 through F6, and F8 through F17).

C. Read, draw, and interpret high and low voltage control circuits (C1, C3, C4, C5, C6, C7, C14, C15, C16, C18, C19, C20, F1 through F6, and F8 through F17).

D. Diagnose, test, disassemble and reassemble electric motors (C1, C3, C4, C5, C6, C7, C14, C15, C16, C18, C19, C20, F1 through F6, and F8 through F17).
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: (Recommended)
   1. “Miswire is Murder”, Copeland #2001 (video)
   2. “Single-phase AC Motors, Bergwall #812 (4 videos)
   3. Others as 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 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 (Comprehensive)
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 COMPUTATIONS

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>Hands on Performance Tests</td>
<td>150</td>
</tr>
<tr>
<td>Laboratory</td>
<td>300</td>
</tr>
<tr>
<td><strong>Total Points</strong></td>
<td>1000</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>

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 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 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

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 for civilian jobs.
VIII. COURSE OUTLINE

A. Lesson One: Basic Electricity and introduction to controls

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

   a. State the difference between alternating current and direct current (C5, C7, F6, and F10).
   b. Describe the controls in a series circuit, a parallel circuit and a series parallel circuit (C5, C7 C15, F6, and F10).
   c. Define magnetism and magnetic induction (C5, C7, F6, and F10).
   d. Explain the operations of a generator and a basic electric motor (C5, C7, F6, and F10).
   e. Explain the electrical power, both single and three phase and their differences, and the three main properties of the power circuit (C5, C7, F6, F10).
   f. Explain the basic transformer principals (C5, C7, F6, F10).
   g. Read, draw and interpret high and low voltage circuits (C3 through C7, C14 through C20, F1 through F6 and F8 through F17).
   h. Use test equipment (C18, C19, C20).
   i. Test, repair and/or replace electrical components (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, and 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, 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 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. Electrical test instruments
   e. Automatic control devices
5. **Audio-Visual Aids: (Recommended)**
   
a. As selected by the instructor.

5. **Lesson Outline:**
   
a. Introduce the course
b. Disseminate the:
   (1) syllabus
   (2) handouts
c. Have students annotate the:
   (1) class roster
   (2) departmental policy statement
d. Basic electricity
e. Electrical measuring instruments
f. Wire sizes and circuit protection devices
g. Generator operations
h. Transformer operations
i. Troubleshooting evaluation
j. Review for three week exam.
k. Three week exam

A. **Lesson Two: Digital Controls**

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

   a. Describe the different digital controls (C5, C7, F6, and F10).
   b. Describe the function and operation of digital controls (C5, C7, F6, and F10).
   c. Explain methods of troubleshooting (C5, C7, F6, and F10).

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, 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 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. Various types of equipment
e. Electrical test instruments
f. Hand tools
g. Digital multimeters
h. High efficiency A/C system
i. Thermometers
j. Commercial refrigeration system semi-hermetic compressor
k. Commercial refrigeration system
l. Others as selected by the instructor

4. Audio Visual Aids: (Recommended)

a. As selected by the instructor

5. Lesson Outline:

a. Controls
b. Digital Controls
c. Compressor Unloading/ unloader
d. System efficiency
e. Motor starting controls
f. Heater controls
g. Refrigerant control devices

A. Lesson Three: Controls and troubleshooting

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

a. Explain the use of wiring diagrams (C5, C7, F6, and F10).
b. Describe the control circuit (C5, C7, F6, and F10).
c. Explain how to test various controls (C5, C7, F6, and F10).
d. Describe air conditioning control devices (C5, C7, F6, and F10).
e. Test, repair and/or replace motor starting and protection devices (C18, C19, and C20).
f. Install central circuit wiring (C18, C19, and C20).
g. Install heat and cool thermostats (C18, C19, and C20).
h. Install starter relays (C18, C19, and 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, and 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, 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 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. Electric test equipment
   e. Hand tools
   f. Air conditioning and refrigeration systems
   g. Electric furnace
   h. Gas furnace
   i. Commercial Refrigeration System with Potential Relay
   j. Commercial Refrigeration System with Current Relay
   k. Limit control
   l. Combination fan and limit control
   m. Other as required by the instructor

4. Audio Visual Aids: (Recommended)
   a. As selected by the instructor.
   b. Others as selected by the instructor.

5. Lesson Outline:
   a. Wiring diagrams
   b. Fundamentals of controls
   c. Air conditioning controls
   d. Thermostat construction
e. Range and differential adjustments
f. Motor safety controls
g. Motor starting relays
h. Defrost controls
i. Sequencers
j. Fan and limit controls
k. Review for the Final Exam (This is a comprehensive exam)
l. Final Exam