CENTRAL TEXAS COLLEGE
SYLLABUS FOR HART 2431
ADVANCED ELECTRICITY

SEMESTER CREDIT HOURS: 4

INSTRUCTOR: ________________
OFFICE HOURS: ________________

I. INTRODUCTION

A. Advanced electrical instruction and skill building in installation and servicing of air conditioning and refrigeration equipment including detailed instruction in motors and power distribution, motor controls, and application of solid devices.

B. Advanced Electricity (HART 2431) is a required course for the completion of a Level II Certificate of Completion or a two-year Associate of Applied Science degree in Heating, Air Conditioning and Refrigeration or a Level I Certificate of Completion in Residential Heating Air Conditioning and Refrigeration.

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

D. Prerequisite(s): This course has a prerequisite of HART 1401 (Electrical Principles) and HART 1403 (A/C Control 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. OVERALL OR GENERAL OBJECTIVES OF THE COURSE

Upon successful completion of this course, Advanced Electricity, the student will:

A. Apply the principles and theory of power distribution. (F1, C19)
B. Describe the theory and operation of electric motors. (F2, F6)
C. Identify solid state devices and describe their operation. (F1, F2)
D. Troubleshoot electric motors. (C18, C20)
E. Draw and read electrical schematics. (F2)
F. Perform troubleshooting using computer simulations. (C20)
G. Rewire a complete system. (C19)

06/12/2012
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: As selected by the instructor.

E. Other Instructional Materials: As selected by the instructor.
   1. Transparencies, instructor made.

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 must present to the instructor a Dr. note 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>Special Quizzes</td>
<td>100</td>
</tr>
<tr>
<td>Computer Exam</td>
<td>50</td>
</tr>
<tr>
<td>Laboratory</td>
<td>300</td>
</tr>
<tr>
<td>Total Points</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. Attendance and Grading

Attendance is mandatory. IAW with the CTC catalog, a student will be administratively withdrawn during a 16 week semester when the student's absences total five.

If a student is absent from class due to a doctor's appointment or illness, the absence will be excused if the student presents a note from the doctor stating the time and date of the appointment or medical condition at the next scheduled day of class.

The doors to the classroom will be locked at the beginning of class. Please do try to enter when the doors are locked. You will be allowed to enter the class when the class goes on break. If you miss a quiz or a practical due to being late, you will not be allowed to take the quiz or practical. For every three days that you are late, you will be counted as absent from class. This is due to funding from the state.

A total of ten quizzes will be given during the semester. If the student is not present or arrives after the quiz has been administered to the class, then the student will receive a grade of zero (0) for that quiz. If the student was absent, then the student has the option to take the quiz when the student presents to the instructor a note from their doctor stating the medical condition.

Labs are to be turned in on time. Labs that are turned in late will be penalized five points if the lab is turned in one class day late, 10 points if turned in two class days late and 15 points if turned in three class days late. If the student was absent, then the student has the option to make up that lab when the student presents to the instructor a note from their doctor stating the medical condition.

There will be a minimum of three exams this semester. It is the student's responsibility to take each exam. If a student misses an examination, then a grade of zero (0) will be posted for that examination. If a student is absent during the examination due to a doctor's appointment or illness, the absence will be excused if the student presents a note from the doctor stating the time and date of the appointment or medical condition at the next scheduled day of class, at that time the student will then be able to make up the examination.
Registration for the next semester begins on ________________________________.

In order to register for your next classes you are required to bring a copy of you transcripts printed from Webadvisor showing your GPA to Helen. In addition you are required to bring a copy of your degree plan.

If you are using FA, please view the link regarding FAQ.

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
- **12-week session**: Friday of the 12th week

The equivalent date (75% of the semester) will be used for sessions of other lengths. 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 students 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 and Beepers:** Cellular phones and beepers 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. For more than one day of illness, the individual must have a statement from the doctor treating the illness.
A. Lesson One: Basic Electricity

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

   a. Apply the principles and theory of power distribution. (F1, C19)
   b. Identify solid state devices and describe their operation. (F1, F2)
   c. Draw and read electrical schematics. (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 C16, C18 thru C20)

3. **Equipment and Material:**

   a. Control circuit components
   b. Hand tools and electrical test equipment
   c. Overhead projectors
   d. TV/VCR (as required)
   e. Other as selected by the instructor

4. **Audio Visual Aids:**

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

5. **Lesson Outline:**

   a. Introduce the course
      (1) State the school and departmental policies
      (2) Disseminate handouts
      (3) Have students annotate rosters and policy statement
   b. Explain the electrical schematic legend
c. Review standard symbols
d. Explain magnets and electromagnetism
e. Solenoids
f. Transformers
g. Relays
h. Contactors
i. Motor starting relays
   (1) potential relays
   (2) current relays
j. Indoor fan relay - gas furnace
k. Indoor fan relay - electric furnace
l. Fan center
m. Impedance or lock-out relay
n. Time delay relay
o. Thermostat
   (1) heat and cool wall mount
   (2) gas filled pressure operated
   (3) bimodal operator
   (4) solid state
p. Pressure controls
   (1) low pressure control
   (2) high pressure control
   (3) oil pressure control
q. Commercial defrost controls
r. Resistance in series
s. Resistance in parallel
t. Ohms law review
u. Capacitors
   (1) dry
   (2) oil filled
v. Electrical test equipment
   (1) multimeter
   (2) Ohm meter
   (3) ammeter
w. Laboratory
   (1) open switch voltmeter
   (2) open switch Ohmmeter
   (3) LRA ammeter
   (4) RLA ammeter
   (5) compressor terminal identification
   (6) Testing Capacitors
x. Review for Three Week Exam
y. Three Week Exam

B. Lesson Two: Electrical Schematic Diagrams
1. **Learning Outcomes:** Upon successful completion of this lesson the student will:
   a. Apply the principles and theory of power distribution. (F1, C19)
   b. Draw and read electrical schematics. (F2)
   c. Rewire a complete system. (C19)

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 C16, C18 thru C20)

3. **Equipment and Material:**
   a. Air Conditioning systems
   b. Hand tools and electrical test equipment
   c. Overhead projectors
   d. TV/VCR (as required)
   e. Other as selected by the instructor

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

5. **Lesson Outline:**
   a. Schematic wiring diagram, air conditioner compressor circuit
   b. Laboratory, air conditioner compressor circuit
   c. Schematic wiring diagram, gas fired forced furnace with automatic air conditioning
   d. Laboratory, gas fired forced furnace with automatic air conditioning
   e. Laboratory, substitute gas fired forced furnace with automatic air conditioning
   f. Schematic wiring diagram for a dual compressor supermarket
refrigeration system.

g. Analyze and troubleshoot each sub-circuit in the schematic for the dual compressor supermarket refrigeration schematic

h. Schematic wiring diagram, package air conditioner air cooled condenser

i. Laboratory, air conditioner with air cooled condenser

j. Schematic wiring diagram, electric forced air furnace

k. Laboratory, electric forced air furnace

l. Schematic wiring diagram, electric forced air furnace with air conditioning

m. Laboratory, electric forced air furnace with air conditioning

n. Review for Mid Term Exam

o. Mid Term Exam
C. **Lesson Three: Manufacture Schematic and Troubleshooting Solutions**

1. **Learning Outcomes:** Upon successful completion of this lesson the student will:
   a. Apply the principles and theory of power distribution. (F1, C19)
   b. Describe the theory and operation of electric motors. (F2, F6)
   c. Identify solid state devices and describe their operation. (F1, F2)
   d. Troubleshoot electric motors. (C18, C20)
   e. Draw and read electrical schematics. (F2)
   f. Perform troubleshooting using computer simulations. (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 C16, C18 thru C20)

3. **Equipment and Material:**
   a. Air Conditioning and Refrigeration equipment
   b. Hand tools and electrical test equipment
   c. Overhead projectors
   d. TV/VCR (as required)
   e. Other as selected by the instructor

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

5. **Lesson Outline:**
   a. The wiring diagram
   b. Troubleshooting the electrical circuit
   c. Troubleshoot and repair a minimum of ten computer-simulated problems in the supermarket refrigeration system
   d. Draw a schematic diagram for a window air conditioner
e. Draw a schematic diagram for an electric furnace
f. Draw a schematic diagram for a gas furnace
g. Draw a schematic diagram for a commercial refrigeration defrost system
h. Wire and test a commercial refrigeration defrost system
i. Draw a schematic diagram for a commercial refrigeration condensing unit
j. Wire and test a commercial refrigeration condensing unit
k. Review for the Final Exam (This is a comprehensive exam)
l. Final exam