I. INTRODUCTION

A. A study of electronic circuit fabrication techniques including printed circuit boards, wire wrapping, bread boarding, and various soldering techniques.

B. This course serves as a required or elective course on various degree plans. Curriculum plans for degrees and certificates, are listed in the current Central Texas College Catalog.

C. The delivery method of this course may be traditional lecture/lab, blended lecture/lab.

D. Prerequisites: None.

II. LEARNING OUTCOMES

Upon successful completion of this course, Electronic Fabrication, the student will be able to:

A. Apply electronic circuit fabrication techniques to industry standards. (C1, C5, C8, C11, C15, C18, C19, C20, F1, F2, F3, F5, F9, F10, F16)

B. Document step-by-step procedures. (C5, C6, C8, C15, F1, F2, F8)

C. Create schematic/wiring diagrams (C1, C6, C8, C15, C19, F1, F2, F8, F9, F16)

D. Apply circuit description. (C5, C6, F1, F2)

E. Identify the tools required to produce a printed circuit board. (C5, C7, C15, C18, C19, F8, F9, F16)

F. Produce soldering connections. (C5, C15, C16, C18, C19, C20, F1, F8)

III. INSTRUCTIONAL MATERIALS

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

A. Attend both lecture and lab or in the case of online delivery, be actively engaged in Blackboard and maintain constant progress.

B. Be prepared to participate in discussion, team projects/assignments and take unannounced assessments relating to the lecture materials.

C. Complete all exams/assessments.

D. Submit all assignments on time.

V. ASSESSMENTS

A. Student content mastery will be evaluated in the following areas:
   - Written exams
   - Hands-on project assignments

B. Scheduled and unscheduled assessments will be given at the discretion of the instructor.

C. Exams/assessments may be composed of both subjective and objective questions plus computer output.

D. A student must take all exams/assessments. No make-up exams/assessments will be given. Both online and on campus students who know in advance that they will be absent due to school sponsored trips, military duty or orders, or any other valid reason, must arrange to take an early exam/assessment. Unexpected absences due to illness or other extenuating circumstances will require the student to see the instructor about make-up work in lieu of the missed exam/assessment.

E. Students with unexcused absences will be given a zero for each missed assignment.

VI. SEMESTER GRADE COMPUTATIONS

<table>
<thead>
<tr>
<th>Course Requirements</th>
<th>Points</th>
<th>Points</th>
<th>Grade</th>
<th>Quality Points</th>
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<tr>
<td>Soldering Principles Exam</td>
<td>100</td>
<td>900-1000</td>
<td>A-Superior</td>
<td>4</td>
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<tr>
<td>Component ID Exam</td>
<td>100</td>
<td>800-899</td>
<td>B-Above Average</td>
<td>3</td>
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<tr>
<td>Hands-on Projects</td>
<td>800</td>
<td>700-799</td>
<td>C-Average</td>
<td>2</td>
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<tr>
<td></td>
<td></td>
<td>600-699</td>
<td>D – Passing but Unsatisfactory</td>
<td>1</td>
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</table>
VII. NOTES AND ADDITIONAL INSTRUCTIONS FROM THE 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 student must sign the withdrawal form.

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
- 8-week session: Friday of the 6th week
- 5-week session: Friday of the 4th 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.

For non-GoArmyEd active military students, the effective date of withdrawal is the filing date with the Education Center. For all other students, the effective date of withdrawal is the date that the withdrawal application is received by the Central Texas College representative.

Students who used financial aid, military tuition assistance, VA benefits, or other non-personal funds may be required to repay tuition and fees to the funding agency. For specific repayment requirements, contact the Office of Student Financial Aid or Veterans Services Office before withdrawing. Military tuition assistance students should visit their military Education Center or Navy College Office.

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 a grade of “F,” “FI,” “FN,” “IP,” or “XN.”

B. **Instructor Initiated Withdrawals:** Faculty are authorized to withdraw students who are not making satisfactory course progress to include failure to meet College attendance requirements as outlined in the section of the Catalog entitled “Satisfactory Progress Standards.” The instructor will assign the appropriate grade on CTC Form 59 for submission to the registrar.
Students enrolled in distance learning courses are expected to maintain constant progress throughout the course. Failure to do so may result in the student being administratively withdrawn by the instructor.

Students who have not attended class by the 12th class day of a 16-week course or the 6th class day of an 8-week term may be administratively withdrawn by the instructor with a grade of "W." Students may be administratively withdrawn from any class when their absences reach a total equal to 12.5% of the class hours for the course; and in the opinion of the instructor, the student cannot satisfactorily complete the course. An example: Students attending a 48-hour class during an 8-week period normally meet 180 minutes each session for 16 sessions. Those students accumulating two (2) unexcused absences are subject to Administrative Withdrawal since the total unexcused absences equal 12.5% of class hours for the course. Those students attending a 48 hour class during a 16-week period normally meet 90 minutes each session for 32 sessions. Those students accumulating four (4) unexcused absences are subject to Administrative Withdrawal since the total unexcused absences equals 12.5% of class hours for the course. In a distance learning course the last date of attendance is the last activity by the student in the course.

C. **Administrative Withdrawal:** A student may be administratively withdrawn by a designated member of the administrative staff of the College when the student has been placed on Academic Suspension or Disciplinary Suspension; the student has an outstanding financial obligation owed to the college; or the student registered for a course without the required prerequisite or departmental permission.

The College is under no obligation to refund tuition and fees, or other costs associated with an administrative or instructor initiated withdrawal.

D. **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 “IP” for Incomplete is recorded.

E. **Cell Phones and Pagers:** Students will silence cell phones and mobile devices while in the classroom or lab.

F. **Americans with Disabilities Act (ADA):** Disability Support Services provide 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. Review 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.

G. Instructor Discretion: The instructor reserves the right of final decision in course requirements and may make changes to the course outline and/or assignments as needed.

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

I. Degree Progression: Students who receive a grade of “D” are advised not to enroll in the next course for which this course was a prerequisite.

J. Failing Grade: The grade of “F” or “FN” will be given for academic failure, non-attendance or scholastic dishonesty.

K. Scholastic Honesty: All students are expected to maintain the highest standards of scholastic honesty in the preparation of all course work and during examinations. The college policy on scholastic honesty, including definitions on plagiarism, collusion, and cheating can be found at the following URL: http://online.ctcd.edu/plagiarism.cfm
VIII. COURSE OUTLINE

A. Lesson One: Wiring Connections and Splices

1. Learning Objectives: Upon successful completion of this unit the student will be able to:
   a. Make various terminal and splice connections using various sizes of solid and stranded wire. (C18, C19)
   b. Assemble cables using various connectors and plugs used in electronic applications. (C18, C19)
   c. Properly strip insulation from all types and styles of electrical cables and wire. (C18, C19, F8)

2. Learning Activities:
   a. Read the assigned chapter.
   b. Observe the demonstration on splicing.
   c. Perform the lab exercise as outlined in the unit handout.

3. Unit Outline: Follow the sequence of Lesson Objectives.

B. Lesson Two: Soldering and the Soldering Process

1. Learning Objectives: Upon successful completion of this unit, the student will be able to:
   a. Emphasize the importance of quality soldering techniques and practices. (C18, C19, F8)
   b. Explain the basic composition of solder alloys and the ways in which solder interacts with metal. (C18, C19, F8)
   c. Describe the role of flux in removing oxides and promoting good solder bonding, and the recommended varieties to use in quality electronic circuit soldering. (C18, C19, F8)
   d. Provide information on various types of soldering irons and tips: their selection and use plus factors affecting heat flow. (C3, C18, C19, F8)
   e. Illustrate wetting action, thermal mass, thermal linkage, heat rate recognition and acceptable and unacceptable solder joints.
   f. Introduce the concept of Work Piece Indicator as it relates to the soldering process.
   g. Identify the basic components of a conductive soldering iron.

2. Learning Activities:
   a. Watch the demonstration of soldering performed by the instructor. (C5, F5)
   b. Complete the soldering exercise as outlined by the instructor. (C3, C18, C19, F8)
c. Perform evaluation exercise to an acceptable standard in the assigned way and time. (C3, C18, C19, F8)

3. **Unit Outline**: Follow the sequence of Lesson Objectives.

**C. Lesson Three: Soldering to Connectors**

1. **Learning Objectives**: Upon successful completion of this unit, the student will be able to:
   a. Present the proper methods for preparing Cup, Hook, Bifurcated, and Turret Terminals for soldering. (C18)
   b. Illustrate the correct procedures for wire cutting to the proper length so that an appropriate insulation is provided. (C3, C18, C19, F8)
   c. Explain the use of solder pre-forms. (F8)
   d. Demonstrate the correct procedures for soldering wire leads to Cup, Hook, Bifurcated, and Turret Terminals using either a standard soldering iron or a resistance soldering tweezers. (C3, C18, C19, F8)
   e. Outline quality control criteria and requirements meeting preferred specifications. (C3, C18, C19, F8)

2. **Learning Activities**
   a. Review the chapter on Cup, Hook, Bifurcated, and Turret Terminals.
   b. Observe the demonstration on soldering Cup, Hook, Bifurcated, and Turret Terminals.
   c. Perform the lab exercise as outlined in the unit handout.

3. **Unit Outline**: Follow the sequence of Lesson Objectives.

**D. Lesson Four: Constructing RF Cable Terminations**

1. **Learning Objectives**: Upon successful completion of this unit, the student will be able to:
   a. Describe a radio frequency cables construction and how constant impedance is maintained along its length. (C5, F10)
   b. Understand the standards for construction of a BNC termination on a RF cable. (C15, F1)
   c. Explain the steps necessary to install a BNC termination. (C15)
   d. Test a BNC cable for shorts, opens, and proper termination and correct any errors. (C16, C19, C20, F1, F9)

2. **Learning Activities**
   a. Read the text on RF connectors in the book.
   b. Watch the demonstration on installing a BNC connector on a RF cable.
c. Build a RF cable with BNC terminations on both ends in accordance with the text and instructions supplied by manufacturers.

3. **Unit Outline:** Follow the sequence of Lesson Objectives.

E. **Lesson Five: Board Fabrication**

1. **Learning Objectives:** Upon successful completion of this unit the student will be able to:
   a. Describe the tools and processes of circuit board etching
   b. Properly expose a photosensitive PC board using correct film pattern.
   c. Properly develop the PC board after exposure.
   d. Etch the PC board using the bench top spray etcher.
   e. Drill holes for component mounting.
   f. Mount components in accordance with drawings provided.
   g. Solder components in place with damage to either components or PC board.

2. **Learning Activities:**
   a. Review handout on Assembly Project. (C5, C6)
   b. Observe the demonstration on Assembly Project. (C5, C6)
   c. Perform the lab exercise as outlined in the unit handout. (C3, C18, C19, F8)

3. **Unit Outline:** Follow the sequence of Lesson Objectives.

F. **Lesson Six: Soldering/Desoldering Through-Hole Components and DIPS**

1. **Learning Objectives:** Upon successful completion of this unit, the student will be able to:
   a. Emphasize the importance of removing oxides from replacement component leads and the circuit board land surfaces. (F10)
   b. Describe component lead forming practices. (C5)
   c. Present the various types of lead terminations for mounting axial lead components. (C3, C18, C19, F8)
   d. Demonstrate and explain the correct soldering procedures for fully-clinched, straight-through and semi-clinched connections. (C3, C18, C19, F8)
   e. Identify acceptable/unacceptable quality control, control criteria, and standards for ensuring high-reliability solder connections. (C3, C18, C19, F8)
f. Demonstrate and explain correct procedures for mounting and soldering Dual-In-Line Packs (DIPS) onto double-sided boards with plated-through holes. (C3, C18, C19, F8)
g. Illustrate and explain the physical process involved when making solder applications to double-sided PCBs. (C10)

2. Learning Activities:
a. Review chapter on soldering and removing through-hole components.
b. Observe the demonstration on soldering and removing through-hole components.
c. Perform the lab exercise as outlined in the unit handout.

3. Unit Outline: Follow the sequence of Lesson Objectives.

G. Lesson Seven: Trace Board Repairs.

1. Learning Objectives: Upon successful completion of this unit the student will be able to:
a. Perform a Surface Wire Jumper repair.
b. Perform a Through-Board Jumper repair.
c. Repair lifted or missing terminals.
d. Repair a burned or missing section of circuit board.
e. Remove eyelets, rivets, and terminals.

2. Learning Activities:
a. Review the chapter on track, pad, and board repairs. (C3, C5, C6, C18, C19, F8)
b. Observe the demonstration on track, pad, and board repairs. (C3, C5, C6, C18, C19, F8)
c. Perform the lab exercise as outlined in the unit handout. (C3, C5, C6, C18, C19, F8)

3. Unit Outline: Follow the sequence of Lesson Objectives.

H. Lesson Nine: Soldering/Desoldering Surface Mount Components

1. Learning Objectives: Upon successful completion of this unit, the student will be able to:
a. Describe quality control criteria and standards for acceptable and unacceptable solder connections. (C19)
b. Emphasize the importance of removing oxides from replacement component leads and the circuit board land surfaces. (F10)

2. Learning Activities:
a. Review chapter on surface mount components
b. Observe the demonstration on installation and removal of surface mounted resistors and capacitors.
c. Correctly install and remove surface mount resistors and capacitors.
d. Observe the demo on the installation and removal of small outline integrated circuits.
e. Correctly install and remove small outline integrated circuits.

3. **Unit Outline:** Follow the sequence of Lesson Objectives.

I. **Lesson Nine: Component Electronic Symbols and Identification**

1. **Learning Objectives:** Upon successful completion of this unit, the student will be able to:
   a. Describe components and their basic function (C5)
   b. Identify symbols for electronic components. (C3, C18, C19, F8)
   c. Explain component layouts given a circuit schematic. (C15, F1, F2)

2. **Learning Activities:**
   a. Review the handout on electronic symbols and components.
   b. Observe the demonstration on reading schematic layouts.
   c. Watch the PowerPoint presentation on electronic components.

3. **Unit Outline:** Follow the sequence of Lesson Objectives.