EL CAMINO COLLEGE

COURSE OUTLINE OF RECORD

I. Course Information

Course Acronym:* ECHT

Course Number:* 22

Descriptive Title:* Basic Electronic Fabrication

Division: Industry and Technology

Department:* Electronics and Computer Hardware Technology

Course Disciplines: Electronics

Catalog Description:* This course focuses on the materials and the processes used for fabricating electronic systems. The process includes designing, assembling, testing, and documenting a basic electronic fabrication project. Topics covered will include safety, component identification, schematic diagrams, assembly pictorials, soldering (both printed wire boards and terminals), inspection, sheet metal fabrication, hand-tool use, cabling, wire wrapping, printed circuit board construction and repair, Continuous Improvement Techniques (CIT), and Electrostatic Discharge (ESD) awareness. Mass production will be stressed for practical experience in all areas.

Conditions of Enrollment:

Prerequisite:

Co-requisite:

Recommended Preparation: Electronics and Computer Hardware Technology 11 or equivalent

Enrollment Limitation:

Course Length: Full Term

Hours Lecture (per week): 2

Hours Laboratory (per week): 4

Outside Study Hours:* 4

Total Course Hours:* 108

Course Units:* 3

Grading Method: Letter Grade only

Credit Status: Credit, degree applicable

Transfer CSU: Yes

Effective Date: 3/3/1990

Transfer UC: No

Effective Date:

General Education:
ECC

Term:

Other:

CSU GE:

Term:

Other:

IGETC:

Term:

Other:

II. Outcomes and Objectives

A. Student Learning Outcomes (SLOs) (The course student learning outcomes are listed below.)
SLO revisions are completed via the SLO Change Form available on the College Curriculum Committee website.

Student Learning Outcomes:

SLO #1 Tools &Test Equipment
Upon successful completion of this course, students will be able to identify and safely operate/manipulate various types of electronic hand tools and test equipment.

SLO #2 Experimental Data and Analysis Reporting
The students will be able to incorporate experimental data and analysis reporting protocols, using either "paper" or "paperless" environments, similar to data reporting and analysis used by many Electronics Manufacturers and Service Organizations.

SLO #3 Low Voltage Power Supply
Upon successful completion of this course, students will be able to produce a functional low voltage, direct current (DC) power supply project sample that meets predetermined specifications and which could be potentially mass produced.

B. Course Objectives (The major learning objective for in this course are listed below.)

Course Objectives:

1. Distinguish quality requirements and process techniques involved in soldering: terminals, circuit board assemblies, and removal of components from soldered assemblies.
2. Create mechanical drawings of chassis using perspectives, orthographic projections, and wiring diagrams.
3. Reproduce methods utilized in modern printed circuit board construction.
4. Create systematic construction steps for the fabrication process.
5. Identify schematic symbols and reference designators used in various schematic diagrams.
6. Duplicate quality requirements for rework of printed circuit assemblies.
7. Utilize word processing, spreadsheets, and basic computer assisted drafting program in developing a planner's guide, using a pre-established protocol.
8. Identify hazards and hazardous materials involved in manufacturing electronic circuitry.
9. Differentiate between an assembly drawing and schematic diagram.
10. Reproduce conforming methods for fabricating splices and acceptable wire terminations.
11. Relate hardware requirements and develop a Bill of Materials (BOM) for the assigned project.
12. Define quality fabrication assurance techniques involved for continuous improvement as defined for the assigned project.

III. Outline of Subject Matter

(Topics should be detailed enough to enable an instructor to determine the major areas that should be covered to ensure consistency from instructor to instructor and semester to semester.)
Example:

I. Main Topic (3 hours, lecture)
- **A. Sub topics**
- **B. Sub topics**
  - **1. Super sub topic**
  - **2. Super sub topic**

Major Topics:

I. ELECTRONIC FABRICATION OVERVIEW AND SAFETY (4.5 hours, lecture)

1. Introduction of schematic symbols
2. Component identification, hand-tool use, basic soldering techniques (soldering and de-soldering)

II. SCHEMATIC - CIRCUIT DESIGN (9 hours, lab)

1. Safety test and hand tool practicum
2. Schematic/circuit design laboratory

III. ETCHING PROCESS AND SAFETY (4 hours, lecture)

1. Printed circuit board preparation
2. Pad bonding
3. Resist
4. Etching
5. Neutralization and disposal of spent enhanced and plating techniques

IV. SOLDERING TECHNIQUES FOR PRINTED CIRCUIT BOARDS (PCB's) (12 hours, lab)

1. Types of solder
2. Types of fluxes
3. Component installation on PCB's
4. Component removal on PCB's
5. Renewing surfaces on PCB's

V. SCHEMATIC AND PICTORIAL DRAWINGS (6 hours, lecture)

1. Basic circuit layout techniques
2. Routing of all traces
3. Space allotment concerns, reverse engineering and continuous improvement techniques
4. Introduction to basic computerized design tools

VI. INTRODUCTION TO CIRCUIT BOARD LAYOUT (8.5 hours, lecture)

1. Direct transfer, Kodak Photo Resist (KPR), silk screening
2. Printed circuit board layout
3. Single side, doubles side and multi-layer printed circuit boards

VII. PCB LAYOUT TECHNIQUES (11 hours, lab)

1. Samples
2. Standards
3. Island Fabrication
4. Component choice for PCB Assembly
5. Radial
6. Axial
7. Contact, thermal printing for PCB substrates

VIII. CHASSIS LAYOUT (4 hours, lecture)

1. Metal forming
2. Drilling
3. hearing and finishes

IX. CHASSIS/PACKAGING FABRICATION (16 hours, lab)

1. Industrial materials: drill types, galvanized steel, cold rolled steel, aluminum sheet stock, thermoset and thermoplastics
2. Basic layout: Layout lines, folding, drilling, breaking sharp edges
3. Chassis finishes and details
4. Product testing and evaluation

X. DOCUMENTATION REQUIREMENTS (5 hours, lecture)

1. Assembly drawings
2. Schematic
3. Parts lists
4. Evaluation tools
5. Test protocols
6. Wire diagrams and assembly procedures

XI. INTRODUCTION TO COMPUTER ASSISTED CIRCUIT DESIGN (12 hours, lab)

1. Circuit to pictorial design lab using circuit board design software
2. Schematic design using circuit board design software
3. Technical drawing import tools, used design tools used to develop PCB masks

XII. TEST AND MEASUREMENT TECHNIQUES (4 hours, lecture)

1. Loading
2. Power dissipation
3. Methods for reporting data for mass production - student defense

mass production - student defense of project design

XIII. FINAL BUILD LAB (12 hours, lab)

1. Load testing
2. Documenting results for improvement
3. Practicum on:
    1. Soldering
    2. Wiring
    3. Metal fabrication sample
    4. Plastic fabrication sample

Total Lecture Hours: 36

Total Laboratory Hours: 72

Total Hours: 108

IV. Primary Method of Evaluation and Sample Assignments

A. Primary Method of Evaluation (choose one):

1) Substantial writing assignments

2) Problem solving demonstrations (computational or non-computational)

3) Skills demonstrations

Primary Method of Evaluation: 3) Skills demonstration

B. Typical Assignment Using Primary Method of Evaluation

Typical Assignment Using Primary Method of Evaluation: Given a schematic drawing and performance objectives, develop a Planners Guide, similar to what is used by many industrial organizations to mass produce a product. Planners Guide will include printed circuit board design, Bill of Materials, chassis fabrication, soldering, wiring, safety, reliability and cost effectiveness. Submit Planners Guide to the instructor.

C. College-level Critical Thinking Assignments

Critical Thinking Assignment 1: Given component footprint specifications, successfully place all the required components on a printed circuit card that measures 4 inches by 2 inches, to form a functional predetermined circuit. Submit circuit board to the instructor.

Critical Thinking

Critical Thinking Assignment 2: Given a schematic, electronic symbolization, transfer the information from the schematic to a pictorial drawing. Submit drawing to the instructor.

D. Other Typical Assessment and Evaluation Methods

Examples: **Class Performance, Objective Exam, Clinical Evaluation, Oral Exams, Completion, Other Exams, Embedded Questions, Performance Exams, Essay Exams, Presentation, Fieldwork, Quizzes, Homework Problems, Reading Reports, Journal kept throughout course, Term or Other Papers, Laboratory Reports, True/False, Matching Items, Written Homework, Multiple Choice, Other (specify)**

Other Evaluation Methods:
Performance Exams
Laboratory Reports
Class Performance

V. Instructional Methods

Examples: **Lecture, Group Activities, Lab, Role play/simulation, Discussion, Guest Speakers, Multimedia presentations, Field trips, Demonstration, Other (specify)**

Instructional Methods:
Demonstration
Guest Speakers
Laboratory
Lecture
Multimedia Presentations
Simulation

If other:

Note: In compliance with Board Policies 1600 and 3410, Title 5 California Code of Regulations, the Rehabilitation Act of 1973, and Sections 504 and 508 of the Americans with Disabilities Act, instruction delivery shall provide access, full inclusion, and effective communication for students with disabilities.

VI. Work Outside of Class

Work Outside of Class:* Journal (done on a continuing basis throughout the semester)

Required reading

Skill practice

If Other:

VII. Texts and Materials

A. Up-to-date Representative Textbooks: Please use the following format(s):

Printed Text - Author, Title, Edition, Publisher, Year.
Digital Text (OER Text) - Author (last name first). Title. Edition or Version (if beyond 1st). Publisher, Publication year or Revision date. URL. License.
Sample: *Dillon, Dave. Blueprint for Success in College and Career. Version 1.3. Rebus Community, 2018. press.rebus.community/blueprint2/. Licensed under CC BY 4.0.*

If you wish to list a text that is more than 5 years old, please annotate it as a "discipline standard".

Multiple textbooks may be listed.

Up-To-Date Representative Textbooks:	Ronald Reis. ELECTRONIC PROJECT DESIGN AND FABRICATION. 6th ed. Prentice Hall, 2009. (Discipline Standard)

B. Alternative Textbooks: Please use the following format(s): if applicable

Printed Text - Author, Title, Edition, Publisher, Year.

Digital Text (OER Text) - Author (last name first). Title. Edition or Version (if beyond 1st). Publisher, Publication year or Revision date. URL. License.

Sample: *Dillon, Dave. Blueprint for Success in College and Career. Version 1.3. Rebus Community, 2018. press.rebus.community/blueprint2/. Licensed under CC BY 4.0.*

If you wish to list a text that is more than 5 years old, please annotate it as a "discipline standard".

Multiple textbooks may be listed.

Alternative Textbooks:	

C. Required Supplementary Readings

Required Supplementary Readings:	

D. Other Required Materials

Other Required Materials:	Purchase components and hardware for required project

VIII. Conditions of Enrollment

A. Requisites (Course Prerequisites and Corequisites) Skills needed without which a student would be highly unlikely to succeed.

Requisite:	
Category:	

Requisite course(s): List both prerequisites and corequisites in this box.

Requisite and Matching skill(s):Bold the requisite skill. List the corresponding course objective under each skill(s).

B. Requisite Skills: (Non-Course Prerequisite and Corequisites) Skills needed without which a student would be highly unlikely to succeed.

Requisite Skill:

Requisite Skill and Matching Skill(s): Bold the requisite skill(s). If applicable

C. Recommended Preparations (Course) (Skills with which a student's ability to succeed will be strongly enhanced.)

Requisite course: Electronics and Computer Hardware Technology 11

Requisite and Matching skill(s):Bold the requisite skill. List the corresponding course objective under each skill(s).

Understand color coding of components.

ECHT 11 - Differentiate color codes and component symbols to build a circuit.

Knowledge of electronic parts and identification.

ECHT 11 - Connect meters to circuits, select proper meter ranges and obtain accurate measurements.

Ability to build simple Direct Alternating (DC) circuits.

ECHT 11 - Apply fundamental circuit theories, Alternating Current (AC) and Direct Current (DC) to compute component values and voltages, resistances, currents, and power in various circuit configurations.

Understand the basics of Ohms Law.

ECHT 11 - Apply fundamental circuit theories, Alternating Current (AC) and Direct Current (DC) to compute component values and voltages, resistances, currents, and power in various circuit configurations.

Ability to use multimeters.

ECHT 11 - Demonstrate the use of various types of test equipment, including Digital Multimeter (DMM), signal generators, power supplies, and oscilloscope to make various circuit measurements.

D. Recommended Preparation (Non-Course) (Skills with which a student's ability to succeed will be strongly enhanced.)

Requisite Skill: or equivalent

Requisite Skill and Matching skill(s): Bold the requisite skill. List the corresponding course objective under each skill(s). If applicable

This course involves the student in the practical aspects of electronic fabrication from proposal preparation to printed circuit board assembly and tests. It is highly recommended that students in this course have prior experience and/or knowledge in basic electricity and electronics to include electronic schematics, parts lists, soldering techniques, and basic electronic parts identification.

E. Enrollment Limitations

Enrollment Limitations and Category:

Enrollment Limitations Impact:

Course Created by: Steve Cocca **Date:** 09/01/1989

Original Board Approval Date: 03/03/1990

Last Reviewed and/or Revised by: Arnulfo Runas **Date:** 05/06/2023

Last Board Approval Date: 11/20/2023 effective FALL 2024