SAN DIEGO COMMUNITY COLLEGE DISTRICT
CONTINUING EDUCATION
COURSE OUTLINE

**SECTION I**

SUBJECT AREA AND COURSE NUMBER

ELRN 451

COURSE TITLE

ELECTRONIC TECHNICIAN I

TYPE COURSE

NON FEE VOCATIONAL

CATALOG COURSE DESCRIPTION

This is an open-entry/exit course that is designed to teach skills required for entry-level employment as an electronic technician. Students will learn the fundamentals of electricity, DC and AC circuit theory, electronic devices and basic communications electronics. Instruction includes the operation of test instruments, basic programming for testing, problem solving and safety practices and procedures. Instruction will take place in a simulated workplace enabling students to gain the necessary workplace skills. (FT)

LECTURE/LABORATORY HOURS

450

ADVISORY

Basic computer knowledge and internet search skills.

RECOMMENDED SKILL LEVEL

An eighth grade reading and math level and ability to communicate effectively in the English language.

INSTITUTIONAL STUDENT LEARNING OUTCOMES

1. Social Responsibility
   SDCE students demonstrate interpersonal skills by leaning and working cooperatively in a diverse environment.
2. Effective Communication
   SDCE students demonstrate effective communication skills.

INSTITUTIONAL STUDENT LEARNING OUTCOMES (CONTINUED)

3. Critical Thinking
   SDCE students critically process information, make decisions, and solve problems independently or cooperatively.
4. Personal and Professional Development
   SDCE students pursue short term and life-long learning goals, mastering necessary skills and using resource management and self advocacy skills to cope with changing situations in their lives.

COURSE GOALS

1. Introduce the principles and practices of electrical theory, direct current and alternating current circuits and computer technology that the electronic technician will use in the electronic component fabrication industry today.
2. Provide the student with instruction and practical experience necessary to safely perform electronic component identification and basic troubleshooting.
3. Introduce electronic testing and troubleshooting techniques and practices using computerized equipment to assist in identification and repair of electronic components to identified acceptable standards.
4. Enhance the student's workplace skills including soft skills, math, communications, business ethics, etc., necessary to succeed in the electronics industry.

COURSE OBJECTIVES

1. Demonstrate safety requirements and practices utilized in the electronics industry.
2. Understand and utilize the terminology of electronic components and test equipment when communicating with instructors, staff and students.
3. Identify DC and AC circuits, and components in an electronic assembly.
4. Set up computerized test equipment, troubleshoot and safely operate electronic testing equipment found in industry to industry acceptable standards.

**SECTION II**

COURSE CONTENT AND SCOPE

MODULE I – ORIENTATION & SAFETY 10 hrs

1. Orientation
   1.1. Course Syllabus
   1.2. Program
   1.3. Facilities
2. Industry Trends
   2.1. Management

COURSE CONTENT AND SCOPE (CONTINUED)

- 2.2. Finances
- 2.3. Labor issues

3. Safety Orientation
   - 3.1. Facilities
     - 3.1.1. Safety equipment
     - 3.1.2. Types
   - 3.2. Common types of injuries
     - 3.2.1. Electrical burns
     - 3.2.2. Chemical hazards
   - 3.3. Tool safety
     - 3.3.1. Hand tools
     - 3.3.2. Electrical tools
   - 3.4. Fire safety
     - 3.4.1. Escape procedures
     - 3.4.2. Overloading
   - 3.5. Equipment safety
     - 3.5.1. Grounding
     - 3.5.2. High voltage
   - 3.6. Right to Know
   - 3.7. Material Safety Data Sheets (MSDS)

MODULE II – DC 55 hrs

1. Basic Concepts of Electricity
   - 1.1. Static electricity
   - 1.2. Conductors, insulators, and electron flow
   - 1.3. Electric circuits
   - 1.4. Voltage and current
   - 1.5. Resistance
   - 1.6. Voltage and current in a practical circuit
   - 1.7. Conventional versus electron flow
2. OHM's Law
   - 2.1. How voltage, current, and resistance relate
   - 2.2. An analogy for Ohm's Law
   - 2.3. Power in electric circuits
   - 2.4. Calculating electric power
   - 2.5. Resistors
   - 2.6. Nonlinear conduction
   - 2.7. Circuit wiring
   - 2.8. Polarity of voltage drops
   - 2.9. Computer simulation of electric circuits
3. Electrical Safety
   - 3.1. The importance of electrical safety
   - 3.2. Physiological effects of electricity
   - 3.3. Shock current path

COURSE CONTENT AND SCOPE (CONTINUED)

- 3.4. Safe practices
- 3.5. Emergency response
- 3.6. Common sources of hazard
- 3.7. Safe circuit design
- 3.8. Safe meter usage

4. Scientific Notation And Metric Prefixes
   - 4.1. Scientific notation
   - 4.2. Arithmetic with scientific notation
   - 4.3. Metric notation
   - 4.4. Metric prefix conversions
   - 4.5. Hand calculator use
   - 4.6. Scientific notation in SPICE
5. Series And Parallel Circuits
   - 5.1. What are "series" and "parallel" circuits?
   - 5.2. Simple series circuits
   - 5.3. Simple parallel circuits
   - 5.4. Conductance
   - 5.5. Power calculations
   - 5.6. Correct use of Ohm's Law
   - 5.7. Component failure analysis
   - 5.8. Building simple resistor circuits
6. Divider Circuits And Kirchhoff's Laws
   - 6.1. Voltage divider circuits
   - 6.2. Kirchhoff's Voltage Law (KVL)
   - 6.3. Current divider circuits
   - 6.4. Kirchhoff's Current Law (KCL)
7. Series-Parallel Combination Circuits
   - 7.1. What is a series-parallel circuit?
   - 7.2. Analysis technique
   - 7.3. Re-drawing complex schematics
   - 7.4. Component failure analysis
   - 7.5. Building series-parallel resistor circuits
8. DC Network Analysis
   - 8.1. What is network analysis?
   - 8.2. Branch current method
   - 8.3. Mesh current method
   - 8.4. Node voltage method
   - 8.5. Introduction to network theorems
   - 8.6. Superposition Theorem
   - 8.7. Thevenin's Theorem
   - 8.8. Norton's Theorem
   - 8.9. Thevenin - Norton equivalencies
   - 8.10. Maximum Power Transfer Theorem
   - 8.11. -Y and Y- conversions

COURSE CONTENT AND SCOPE (CONTINUED)

9. Physics Of Conductors And Insulators
   - 9.1. Introduction
   - 9.2. Conductor size
   - 9.3. Conductor ampacity
   - 9.4. Fuses
   - 9.5. Specific resistance
   - 9.6. Temperature coefficient of resistance
   - 9.7. Superconductivity
   - 9.8. Insulator breakdown voltage
10. Capacitors
   - 10.1. Electric fields and capacitance
   - 10.2. Capacitors and calculus
   - 10.3. Factors affecting capacitance
   - 10.4. Series and parallel capacitors
   - 10.5. Practical considerations
11. Inductors
   - 11.1. Magnetic fields and inductance
   - 11.2. Inductors and calculus
   - 11.3. Factors affecting inductance
   - 11.4. Series and parallel inductors
   - 11.5. Practical considerations
12. Rc And L/R Time Constants
   - 12.1. Electrical transients
   - 12.2. Capacitor transient response
   - 12.3. Inductor transient response
   - 12.4. Voltage and current calculations
   - 12.5. Complex voltage and current calculations
   - 12.6. Complex circuits
   - 12.7. Solving for unknown time

MODULE III – AC 115 hrs

1. Basic Ac Theory
   - 1.1. What is alternating current (AC)?
   - 1.2. AC waveforms
   - 1.3. Measurements of AC magnitude
   - 1.4. Simple AC circuit calculations
   - 1.5. AC phase
   - 1.6. Principles of radio
2. Complex Numbers
   - 2.1. Introduction
   - 2.2. Vectors and AC waveforms
   - 2.3. Simple vector addition
   - 2.4. Complex vector addition

COURSE CONTENT AND SCOPE (CONTINUED)

- 2.5. Polar and rectangular notation
- 2.6. Complex number arithmetic
- 2.7. More on AC "polarity"
- 2.8. Some examples with AC circuits

3. Reactance And Impedance - Inductive
   - 3.1. AC resistor circuits
   - 3.2. AC inductor circuits
   - 3.3. Series resistor-inductor circuits
   - 3.4. Parallel resistor-inductor circuits
4. Reactance And Impedance - Capacitive
   - 4.1. AC resistor circuits
   - 4.2. AC capacitor circuits
   - 4.3. Series resistor-capacitor circuits
   - 4.4. Parallel resistor-capacitor circuits
5. Reactance And Impedance - R, L, and C
   - 5.1. Review of R, X, and Z
   - 5.2. Series R, L, and C
   - 5.3. Parallel R, L, and C
   - 5.4. Series-parallel R, L, and C
   - 5.5. Susceptance and Admittance
6. Resonance
   - 6.1. An electric pendulum
   - 6.2. Simple parallel (tank circuit) resonance
   - 6.3. Simple series resonance
   - 6.4. Applications of resonance
   - 6.5. Resonance in series-parallel circuits
   - 6.6. Q and bandwidth of a resonant circuit
7. Mixed-Frequency Ac Signals
   - 7.1. Introduction
   - 7.2. Square wave signals
   - 7.3. Other waveshapes
   - 7.4. Circuit effects
8. Filters
   - 8.1. What is a filter?
   - 8.2. Low-pass filters
   - 8.3. High-pass filters
   - 8.4. Band-pass filters
   - 8.5. Band-stop filters
   - 8.6. Resonant filters
9. Transformers
   - 9.1. Mutual inductance and basic operation
   - 9.2. Step-up and step-down transformers
   - 9.3. Electrical isolation
   - 9.4. Phasing

COURSE CONTENT AND SCOPE (CONTINUED)

- 9.5. Winding configurations
- 9.6. Voltage regulation

10. Polyphase Ac Circuits
    - 10.1. Single-phase power systems
    - 10.2. Three-phase power systems
    - 10.3. Phase rotation
    - 10.4. Polyphase motor design
    - 10.5. Three-phase Y and Delta configurations
    - 10.6. Three-phase transformer circuits
    - 10.7. Harmonics in polyphase power systems
    - 10.8. Harmonic phase sequences
11. Power Factor
    - 11.1. Power in resistive and reactive AC circuits
    - 11.2. True, Reactive, and Apparent power
    - 11.3. Calculating power factor
    - 11.4. Practical power factor correction
12. AC Metering Circuits
    - 12.1. AC voltmeters and ammeters
    - 12.2. Frequency and phase measurement
    - 12.3. Power measurement
    - 12.4. Power quality measurement
    - 12.5. AC bridge circuits
    - 12.6. AC instrumentation transducers

MODULE IV – ELECTRONICS 150 hrs

1. Amplifiers And Active Devices
    - 1.1. From electric to electronic
    - 1.2. Active versus passive devices
    - 1.3. Amplifiers
    - 1.4. Amplifier gain
    - 1.5. Decibels
    - 1.6. Absolute dB scales
    - 1.7. Attenuators
2. Solid-State Device Theory
    - 2.1. Introduction
    - 2.2. Quantum physics
    - 2.3. Valence and Crystal structure
    - 2.4. Band theory of solids
    - 2.5. Electrons and ``holes''
    - 2.6. The P-N junction
    - 2.7. Junction diodes
    - 2.8. Bipolar junction transistors

COURSE CONTENT AND SCOPE (CONTINUED)

- 2.9. Junction field-effect transistors
- 2.10. Insulated-gate field-effect transistors (MOSFET)
- 2.11. Semiconductor manufacturing techniques
- 2.12. Superconducting devices
- 2.13. Quantum devices
- 2.14. Semiconductor devices in SPICE

3. Diodes And Rectifiers
   - 3.1. Introduction
   - 3.2. Meter check of a diode
   - 3.3. Diode ratings
   - 3.4. Rectifier circuits
   - 3.5. Peak detector
   - 3.6. Clipper circuits
   - 3.7. Clamper circuits
   - 3.8. Voltage multipliers
   - 3.9. Inductor commutating circuits
   - 3.10. Diode switching circuits
   - 3.11. Zener diodes
   - 3.12. Special-purpose diodes
   - 3.13. Other diode technologies
4. Bipolar Junction Transistors
   - 4.1. Introduction
   - 4.2. The transistor as a switch
   - 4.3. Meter check of a transistor
   - 4.4. Active mode operation
   - 4.5. The common-emitter amplifier
   - 4.6. The common-collector amplifier
   - 4.7. The common-base amplifier
   - 4.8. The cascode amplifier
   - 4.9. Biasing techniques
   - 4.10. Biasing calculations
   - 4.11. Input and output coupling
   - 4.12. Amplifier impedances
   - 4.13. Current mirrors
5. Junction Field-Effect Transistors
   - 5.1. Introduction
   - 5.2. The transistor as a switch
   - 5.3. Meter check of a transistor
   - 5.4. Active-mode operation
   - 5.5. The common-source amplifier
   - 5.6. The common-drain amplifier
   - 5.7. The common-gate amplifier
   - 5.8. Depletion-type
   - 5.9. Enhancement-type

COURSE CONTENT AND SCOPE (CONTINUED)

5.10. Biasing techniques
6. Operational Amplifiers
   6.1. Introduction
   6.2. Single-ended and differential amplifiers
   6.3. The "operational" amplifier
   6.4. Negative feedback
   6.5. Divided feedback
   6.6. An analogy for divided feedback
   6.7. Voltage-to-current signal conversion
   6.8. Averager and summer circuits
   6.9. Building a differential amplifier
   6.10. The instrumentation amplifier
   6.11. Differentiator and integrator circuits
   6.12. Positive feedback
   6.13. Practical considerations
   6.14. Operational amplifier models
7. Practical Analog Semiconductor Circuits
   7.1. ElectroStatic Discharge
   7.2. Power supply circuits
   7.3. Amplifier circuits
   7.4. Oscillator circuits
   7.5. Phase-locked loops
   7.6. Computational circuits
   7.7. Measurement circuits
   7.8. Control circuits

MODULE V – COMPUTER TECHNOLOGY 120 hrs

1. Computer & Interface as a Test Instrument
   1.1. Introduction
   1.2. Inside and outside PC
   1.3. Keyboard, LCD display
   1.4. Serial Interface RS232, SESI, USB, IEEE 1394
   1.5. CPU, memories
   1.6. Hardware installations
   1.7. Printers
2. Using Windows as a Test Instrument
   2.1. Windows and PC
   2.2. Working with files
   2.3. Creating folders, subfolders
   2.4. Copying, moving, deleting files
3. Networks for Electronic Testing
4. Programming Test Instruments
   4.1. Local Area Networks ( LANs)

COURSE CONTENT AND SCOPE (CONTINUED)

4.2. Working on the network
4.3. Sharing files
4.4. Sharing printers
4.5. Finding computers on the network
4.6. Programming in C++
4.7. Basic internet & Email understanding
4.8. Searching on the internet

APPROPRIATE READINGS

Students may be given reading assignments from the course text book, informational handouts, related trade magazines and internet articles.

WRITING ASSIGNMENTS

Typical writing assignments will include: completing assigned reports, providing written answers to assigned questions, performing arithmetic calculations as assigned and completing shop and/or job orders.

APPROPRIATE ASSIGNMENTS THAT DEMONSTRATE CRITICAL THINKING

Students will perform analysis and evaluation of reading and/or classroom materials and utilize this analysis in classroom discussions, writing assignments, and in performing laboratory activities. Students must select and use appropriate methods and materials needed to complete laboratory assignments.

OUTSIDE ASSIGNMENTS

Students are expected to spend a minimum of one hour per day outside of the class in practice and preparation for each day in class. Appropriate assignments may include, but are not limited to: appropriate internet research, readings, preparing research reports, preparing appropriate writing assignments and studying as needed to perform successfully in class.

EVALUATION

A student's grade will be based on multiple measures of performance related to the course objectives. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability. Multiple measures may include, but are not limited to the following: quizzes, lab projects, classroom participation, and attendance.

Upon successful completion of the course a Certificate of Course Completion will be issued.

Upon successful completion of this course and Electronic Technician II a Certificate of Program Completion will be issued.

METHOD OF INSTRUCTION

Methods of instruction will include, but are not limited to; lectures, demonstrations, laboratory, audio-visual presentations and computer assisted instruction. Classroom lectures, demonstration, laboratory, computer assisted instruction, computer assisted in simulation analog and digital labs, computer assisted in semi-automatic testing and troubleshooting. Group and individual instructions, field trips, guess speakers, job shadowing and internships/externships may also be utilized.

This course, or sections of this course, may be offered through distance education.

TEXT AND SUPPLIES

*Circuit Analysis Theories and Practice* (2003), Robbins & Miller, Current Edition, Delmar
*Basic Electronics* (2010), Grob, Current Edition, McGraw-Hill
*Grob's Basic Electronics* (2006), Mitchel E. Schultz, Current Edition, McGraw-Hill
*Digital Fundamentals* (2005), Floyd, Current Edition, Prentice Hall
*Electronic Communication Systems* (1996), David L. Heiserman, Current Edition, McGraw-Hill
*Principal of Electronic Communication Systems* (2007), Frenzel, Current Edition, McGraw-Hill

PREPARED BY: Hoai Pham / Bill Borinski DATE March 5, 2012

REVISED BY Tai Hong / Andrei Lucas DATE May 6, 2020

Instructors must meet all requirements stated in Policy 3100 (Student Rights, Responsibilities and Administration Due Process) and the attendance Policy set forth in the Continuing Education Catalog

References

San Diego Community College District Policy 3100
California Community College, Title 5, Section 55002
Continuing Education Catalog