Prerequisite: ELECTR 110 or equivalent

Rationale:

Prerequisite: We looked at the requirements for ELECTR 230 and determined that the expected outcomes for ELECTR 110 meet the prerequisites for the ELECTR 230 course. Thus, to follow through, we need to change the prerequisite to ELECTR 110.

Last updated: 11/99

San Bernardino Valley College

Course Outline for ELECTR 230
SEMICONDUCTOR DEVICES

I. CATALOG DESCRIPTION:
Department: Electricity/Electronics
ELECTR 230: Semiconductor Devices
3 hours lecture = 3 Units
Catalog Description: A study of semiconductor devices including the chemistry and physics of the structure of matter, the structure of the atom, and the operation of semiconductor devices based on energy level analysis.
Schedule Description: A study of semiconductor devices.
Prerequisite: ELECTR 110 or equivalent

II. NUMBER OF TIMES COURSE MAY BE TAKEN FOR CREDIT: One

III. EXPECTED OUTCOMES FOR STUDENTS:
Upon completion of the course, students will be able to:
A. Explain the chemistry and physics involved in the structure of matter.
B. Explain the operation of such semiconductor devices as: PN junction diodes, zener diodes, bipolar transistors, FET transistors, thyristors, IC's, and optoelectronic devices.
C. State the purpose of the different diodes and transistors.
D. Explore different applications of diodes and transistors.
E. State the purpose of common emitter, common collector, and common base circuit configurations.
F. Explain biasing and how it relates to the three main circuit configurations and the quiescent bias point.
G. Calculate the values necessary to bias a transistor according to need.
H. Design and construct discrete, single stage and multi-stage circuits.
I. Identify various semiconductor circuits and modify circuits to specifications.
J. Explain the operation of various class of amplifier circuits.

IV. CONTENT:
A. Semiconductor Physics
1. Electron orbits
2. Forbidden orbits
3. Energy levels
4. Crystals
5. Energy bands
6. Intrinsic conduction

7. Extrinsic conduction
8. Semiconductor devices

B. Rectifier Diodes
1. The PN junction
2. Forward bias
3. Reverse bias
4. The diode curve
5. The ideal curve
6. The second approximation
7. The third approximation
8. DC resistance of a diode
9. Temperature effects
10. Manufacturer's specifications

C. Special Diodes
1. Light-emitting diodes
2. Schottky diodes
3. Varactors
4. Zener diodes
5. Zener regulator
6. Tunnel diodes

D. Diode Applications
1. Logic gates

E. Bipolar Transistors
1. Structure
2. Forward - reverse bias
3. The common-emitter connection
4. Common-emitter curves
5. Base bias
6. Voltage-divider bias
7. Exact formula for voltage-divider bias
8. Other biasing networks
    a. Emitter-feedback bias
    b. Collector-feedback bias
    c. Emitter bias
9. PNP biasing techniques
10. Manufacturer's specifications

F. Common-Collector Approximations
1. The common-collector connection
2. Input impedance
3. Power gain
4. Source impedance
5. Output impedance

G. Common-Base Approximations
1. Common-base collector curves
2. The ideal common-base transistor
3. The common-base amplifier

H. Junction Field Effect Transistors
   1. Basic ideas
   2. Gate bias
   3. Self bias
   4. Voltage divider and source bias
   5. JFET amplifiers
   6. The JFET analog switch
   7. The voltage-variable resistance

I. MOSFETS
   1. Depletion-type MOSFET
   2. Enhancement-type MOSFET
   3. Biasing enhancement-type MOSFETs
   4. Enhancement-type MOSFET applications

J. Thyristors
   1. The ideal latch
   2. The four-layer diode
   3. The Silicon Controlled Rectifier (SCR)
   4. Variations of the SCR
   5. Bi-directional thyristors (DIAC)
   6. Unijunction transistors (UJT)
   7. UJT applications

V. METHODS OF INSTRUCTION:

Methods of instruction will vary from instructor to instructor but may include:

A. Lecture
B. Videos and transparencies and class discussion

VI. TYPICAL ASSIGNMENTS:

Typical assignments will vary from instructor to instructor but may include:

A. Use a calculator to solve biasing network problems.
B. Written homework assigned each week from the questions and problems in each chapter.

   Typical Questions:
   1. Identify various amplifier configurations.
   2. Describe the principles of amplification.

VII. EVALUATION(S):

A. Methods of evaluation will vary from instructor to instructor but may include:
   1. Quizzes
   2. End-of-chapter homework problems
   3. End-of-chapter tests
   4. Final exam

      Typical Questions:
      a. What is the common value of voltage drop across the emitter base junction?

b. Common-base circuits have the input signal applied to which transistor lead?

B. Frequency of evaluation will vary from instructor to instructor but may include:
   1. Periodic feedback based on chapter quizzes
   2. Six (6) chapter exams
   3. One (1) comprehensive final exam

VIII. TYPICAL TEXT(S):
Malvano, A. P. Semiconductor Circuit Approximations, An Introduction To Transistors And Integrated Circuits (4^{th} ed.). Glenco: New York, 1993.

IX. OTHER SUPPLIES REQUIRED OF STUDENTS:
Scientific calculator, scantron answer forms (882 or 882E)

Step 3, Form A

Content Review Form
PREREQUISITE COURSE

Target Course: ELECTR 230: Semiconductor Devices

Prerequisite Course: ELECTR 110: Direct Current Circuit Analysis

Instructions:

1. List exit competencies (skills) from Prerequisite Course. These skills are listed in the "Student Outcomes" section of the Course Outline ("upon completion of the course, the student should be able to…")
2. Indicate which of the listed exit competencies (skills) are necessary entry skills needed for success in the target course. Mark with an "X" each needed skill.
3. Indicate the degree of importance of each needed entry skill for course success, using the following rating scale:

   1=Critical 2=Very Helpful 3=Desirable

Skills Analysis

	Exit Skills in Prerequisite Course	Entry Skills Needed for Success in Target Course (Mark with an X if needed.)	Degree of Importance (Rate 1 – 3)
1.	Define and describe the basic concepts of matter, energy sources, and electrical current flow.	X	
2.	Describe the operation of resistors in series, parallel, and series/parallel direct current circuits.	X	1
3.	Recognize common symbols and define terminology used in the field of electronics.	X	1
4.	Apply proper procedures for unit conversion, scientific notation, and metric conversion.	X	1
5.	Apply calculator procedures to solve addition, fractions, powers (exponents) and radical (roots), and percentage problems.	X	2 1
6.	Apply Ohm's Law and the power formulas to series, parallel, and series/parallel circuits.	X	
7.	Apply calculator procedures to solve resistive bridge circuits.	X	1
8.	Apply the Thevenin equivalent circuit, Superposition, or Millman's theorems to solve single source or two source circuit problems.	X	2 2
9.	Apply algebraic problem solving procedures using Kirchoff's voltage and current laws.	X	
10.	Apply calculator procedures for solving voltage divider and maximum power transfer problems.	X	1
11.	Define and describe magnetism, electromagnetism, electromagnetic induction, and use the common symbols and terminology.	X	1 2