MARICOPA COMMUNITY COLLEGES

Solid-State Devices and Circuits I

Course: **ELE121**	Lecture **4** Credit(s) **3** Period(s) **3** Load
	Laboratory **0** Credit(s) **3** Period(s) **2** Load
First Term: **2004 Fall**	Course Type: **Occupational**
Final Term: **Current**	Load Formula: **S**

Description: Theory of operation of semiconductor diodes and transistors. Bipolar junction transistor biasing and load-line analysis. Alternating Current (AC) equivalent circuits applied to small signal amplifiers. Characteristics of large signal and power amplifiers

Requisites: Prerequisites: A grade of C or better in ELE111.

MCCCD Official Course Competencies

1. Define the following electronic terms: intrinsic semiconductor, n-type material, p-type material, doping, covalent bonding, pentavalent atoms and trivalent atoms. (I)
2. Describe the operation of both a forward and reverse-biased diode. (II)
3. Analyze small and large-signal diode circuits. (III, IV)
4. Describe the functions of the base, emitter and collector of a bipolar transistor, and how they are biased. (V)
5. Identify and describe the various forms of transistor biasing and how an operating point is selected. (VI)
6. Solve for all DC voltages, and current in the three basic transistor amplifiers configurations (Common Emitter (CE), Common Base (CB), and Common Collector (CC). (VII, VIII)
7. Calculate input and output impedances and voltage gain for a given configuration, using the AC model of the three basic transistor amplifier configurations. (VII, VIII)
8. Explain the concept of the transconductance and its effect on the Field Effect Transistor amplifier gain. (IX)
9. Describe the operation of common-source, common-drain, and common-gate amplifier and draw schematic diagrams for each. (IX)
10. Apply the scientific method in inquire and deduction relating the laws, theories and axioms of solid-state devices to specific laboratory experiments. (I-XI)
11. Explain the concept of differential versus common-mode signals. (X)
12. Analyze a differential amplifier, computer gain, input impedance and common-mode rejection ratio (CMRR). (X)
13. Explain the concept of open-loop vs closed loop responses of an amplifier and relate to amplifier stability. (XI)
14. Calculate voltage gains, input and output impedance and bandwidths for inverting and non-inverting operational amplifier (OP-AMP) circuits. (XII)

MCCCD Official Course Outline

I. Introduction
   A. Semiconductor theory
   B. Conduction in crystals
   C. Doping
II. Diode Theory
   A. The unbiased diode
   B. Forward bias
   C. Reverse bias
   D. Diode approximations
III. Diode Circuits
   A. The half-wave rectifier
   B. The full-wave rectifier
   C. The bridge rectifier
   D. The limiter
   E. The DC clamper
IV. Special-Purpose Diodes
   A. Zener diodes
   B. Optoelectronic devices
   C. The Scottky diode
   D. Varactor diodes
V. Bipolar Transistors
   A. Basic concepts
   B. Forward-reverse bias
   C. The CE connection
   D. Transistor characteristics
   E. DC load lines
   F. The transistor current source
VI. Transistor Biasing Circuits
   A. Base bias
   B. Emitter-feedback bias
   C. Collector-feedback bias
   D. Voltage-divider bias
VII. CE Amplifiers
   A. Coupling and bypass capacitors
   B. Superposition theorem for amplifiers
   C. AC resistance of the emitter diode
   D. The AC model of a CE stage
   E. The swamped stages
   F. Cascaded stages
VIII. CC and CB Amplifiers
   A. The CC amplifier
   B. The AC model of an emitter follower
   C. The common-base amplifier

IX. Field Effect Transistor Amplifiers
  A. Transconductance
  B. The CS amplifier
  C. The CD amplifier
  D. The CG amplifier
  E. Other applications
X. OP-AMP Theory
  A. The differential amplifier
  B. DC analysis of a differential amplifier
  C. AC analysis of a differential amplifier
  D. The operational amplifier
  E. OP-AMP characteristics
XI. Frequency Response and Stability
  A. Basic concepts
  B. Open-loop response
  C. Closed-loop response
  D. Stability considerations
XII. Linear OP-AMP Circuits
  A. Negative feedback
  B. Non-inverting voltage amplifiers
  C. The inverting voltage amplifier
  D. The summing amplifier

Last MCCCD Governing Board Approval Date: **11/25/2003**