ETC132
SEMICONDUCTORS I
5 Credit Hours

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Revision Date: January 2001
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CAREER & TECHNICAL EDUCATION
Alan C. Foster, Associate Dean
ETT246 INSTALLATION AND REPAIR OF MICROCOMPUTERS

I. CATALOG DESCRIPTION

Prerequisite: Basic computer literacy skills strongly recommended
3 Credit Hours

Installation and Repair of Microcomputers covers configuration, diagnosis, and repair of microcomputers and microcomputer peripheral devices. Software installation and upgrading are included. Both hardware and software troubleshooting techniques are covered. This course fulfills the computer literacy graduation requirement for degree-seeking students. (F,S)

II. COURSE GENERAL OBJECTIVES

A. Identify basic terms, concepts, and functions of system modules, including how each module should work during normal operation.
   a. Identify basic procedures for adding and removing field replaceable modules
   b. Identify available IRQs, DMA channels, and I/O addresses with procedures for configuring them for device installation

2. Identify common peripheral ports, associated cables and their connectors
3. Identify proper procedures for installing and configuring IDE/EIDE devices
4. Identify proper procedures for installing and configuring SCSI devices
5. Identify proper procedures for installing and configuring peripheral devices
6. Identify proper procedures for upgrading BIOS
7. Identify hardware methods for system optimization and when to use them
8. Identify common symptoms and problems associated with each module and how to troubleshoot and isolate the problem
9. Identify basic troubleshooting procedures and good practices for eliciting problem symptoms from customers
10. Identify the purpose of various types of preventive maintenance products and procedures and when to use/perform them.
11. Identify procedures and devices for protecting against environmental hazards
12. Identify the potential hazards and proper safety procedures relating to lasers and high voltage equipment
13. Identify items that require special disposal procedures relating that comply with environmental guidelines
14. Identify ESD (Electrostatic Discharge) precautions and procedures, including the use of ESD protection devices
15. Distinguish between the popular CPU chips in terms of their basic characteristics
16. Identify the categories of RAM terminology, their locations, and physical characteristics
17. Identify the most popular type of motherboards, their components, and their architecture
18. Identify the purpose of CMOS, what it contains and how to change its basic parameters
19. Identify basic concepts, printer operations, printer components, and field replaceable units in primary printer types
20. Identify care and service techniques and common problems with primary printer types
21. Identify the types of printer connections and configurations
23. Identify the unique components of portable systems and their unique problems
24. Identify basic networking concepts, including how a network works
25. Identify procedures for swapping and configuring network interface cards
26. Identify ramifications of repairs on the network
27. Differentiate effective from ineffective behaviors as these contribute to the maintenance or achievement of customer satisfaction.

Course Objectives (DOS Windows objectives)

A. Identify the operating system=s functions, structure, and major system files.
B. Identify ways to navigate the operating system and how to get to needed technical Information.
C. Identify basic concepts and procedures for creating and managing files and directories in DOS/Windows.
D. Identify the procedures for basic disk management.
E. Differentiate between types of memory.
F. Identify typical memory conflict problems and how to optimize memory use.
G. Identify the procedures for installing DOS, Windows 3.x, Windows 95, and bringing the software to a basic operational level.
H. Identify steps to perform an operating system upgrade.
I. Identify the basic system boot sequences and alternative ways to boot the system software, including steps to create an emergency boot disk with utilities installed.
J. Identify procedures for loading /adding device drivers and the necessary software for certain devices
K. Identify the procedures for changing options, configuring, and using the Windows printing subsystem.
L. Identify the procedures for installing and launching typical Windows and non- Windows applications.
M. Recognize and interpret the meaning of common error codes and startup messages, from the boot sequence and identify steps to correct the problem.
N. Recognize Windows-specific printing problems and identify the procedures for correcting them.
O. Recognize common problems and determine how to resolve them.
P. Recognize concepts relating to viruses and virus types-their danger, their symptoms, sources, of viruses, how they infect, how to protect against them and how to identify/remove them.
Q. Identify the Networking capabilities for DOS and Windows including procedures for connecting to the network.
R. Identify concepts and capabilities relating to the Internet and basic procedures for setting up a system for Internet access.

III. COURSE OUTLINE

A. Diode Theory
B. Diode Circuits
C. Special Purpose Diodes
D. Bipolar Transistors
E. Bipolar Transistor Biasing Circuits
F. Common Emitter Amplifier
G. Common Collector Amplifier (Emitter Follower)
H. Common Base Amplifier
I. Class A Power Amplifiers
J. Class B Power Amplifiers
K. Class C Power Amplifiers

IV. UNIT OBJECTIVES

A. Diode Theory

1. State the definition for:
   a. intrinsic semiconductor
   b. extrinsic semiconductor
   c. hole
   d. recombination
   e. barrier potential
   f. breakdown voltage
   g. bulk resistance
   h. region
   i. forward bias
   j. knee voltage
   k. reverse bias
   l. avalanche

2. State the valence of the impurity added to produce:
   a. N-type semiconductor
   b. P type semiconductor

3. State the majority and minority current carriers for:
   a. N-type semiconductor
   b. P type semiconductor

4. Draw and label the schematic symbol for a PN junction diode

5. State the requirements to forward and reverse bias of a PN junction diode

6. Describe the volt/ampere characteristics of a PN junction diode

7. State the forward voltage drop (V_F) for a:
   a. germanium PN junction diode
   b. silicon PN junction diode

8. Describe the relationship between temperature and reverse current (I_R)

9. Describe the diode in terms of the:
   a. first approximation (ideal)
   b. second approximation (forward voltage drop)
   c. third approximation (forward voltage drop plus bulk resistance)

B. Diode Circuits

1. Schematically draw and describe the principal theory of operation of the:
   a. half-wave rectifier
   b. conventional full-wave rectifier
   c. bridge rectifier
   d. center-tapped bridge or complementary full-wave rectifier

2. State the relationship between peak input (secondary) voltage and the unfiltered dc average output for the:
   a. half-wave rectifier
   b. conventional full-wave rectifier
   c. bridge rectifier
4. Describe the principal theory of operation of the capacitive input filter
5. Given capacitance, ripple frequency and load current, calculate the rms ripple at the output of a capacitive input filter
6. Describe the principal theory of operation of the RC \( \text{TT} \)-section filter
7. Describe the principal theory of the LC \( \text{TT} \)-section filter
8. Describe the technique for reducing surge current
9. State the PIV requirements for the diodes used (assuming a capacitive input filter) in terms of peak input (secondary) voltage for the:
   a. half-wave rectifier
   b. conventional full-wave rectifier
   c. bridge rectifier
10. State the relationship between the dc average output voltage, percentage of ripple, and ripple frequency for the capacitive input filter
11. State the relationship between the dc average output voltage, percentage of ripple, and capacitance for a capacitive input filter
12. State the relationship between the dc average output voltage, percentage of ripple, and load current for a capacitive input filter
13. Given the dc average output voltage and the RMS ripple voltage, calculate the percentage of ripple at the output of a power supply
14. State the relationship between the peak input and the dc average output of a voltage multiplier
15. Schematically draw the voltage multiplier:
   a. doubler
   b. tripler
   c. quadrupler
16. Schematically draw and describe the principal theory of operation of the positive and negative diode limiter
   a. series
   b. shunt
17. Schematically draw and describe the principal theory of operation of the positive and negative clamper

C. Special Purpose Diodes

1. Describe the volt/ampere characteristics of the zener diode
2. Draw and label the schematic symbol for the zener diode
3. Given zener voltage and zener power dissipation rating, calculate the maximum value of zener current
4. Describe the principal theory of operation of the shunt zener regulator
5. Given the power supply and load specifications, determine the value of series current limiting resistor and zener diode specifications for a shunt zener regulator
6. Given no-load and full-load voltage, calculate the percentage of load regulation of a power supply
7. Given the change in input and output voltage, calculate the percentage of line regulation of a power supply
8. Demonstrate the in-circuit procedures for testing a zener diode
9. Draw and label the schematic symbol for the LED
10. State the normal bias requirements for the LED
11. Draw and label the schematic symbol for the photo diode
12. State the relationship between reverse current and radiant energy striking the photo diode
13. State the definition of the term diode reverse recovery time
14. Describe the forward and reverse characteristics of the PIN diode
15. Draw and label the schematic symbol for the Schottky diode
16. State the principal advantage of the Schottky diode over the conventional rectifying diode
17. State the relationship between junction capacitance and diode bias
18. Draw and label the schematic symbol for the varactor diode
19. Draw and label the schematic symbol for the tunnel diode
20. Describe the volt/ampere characteristics of the tunnel diode
21. Describe the volt/ampere characteristics of the constant-current diode
D. Bipolar Transistors

1. Describe the formation for:
   a. NPN bipolar transistor
   b. PNP bipolar transistor

2. Draw and label the schematic symbol for:
   a. NPN bipolar transistor
   b. PNP bipolar transistor

3. Describe the bias requirements for linear operation of the:
   a. NPN bipolar transistor
   b. PNP bipolar transistor

4. State the direction of electron flow in the external circuit for a biased for linear application:
   a. NPN bipolar transistor
   b. PNP bipolar transistor

5. State the definition for dc beta

6. State the definition for dc alpha

7. State dc beta in terms of dc alpha

8. State the dc alpha in terms of dc beta

9. State the relationships described by the collector family of curves

10. State the definition of the term cutoff

11. State the definition of the term saturation

12. Calculate the limits of the dc load line

13. State the relationship between emitter-to-base voltage and collector current
    within the limits of cutoff and saturation

14. State the relationship between collector-to-base voltage and collector current

15. State the general relationship between dc beta and temperature

16. Calculate transistor power dissipation

17. State the definition of the term derating factor with respect to a transistor's maximum power dissipation rating

18. State and apply the standard subscript notation for:
    a. emitter supply voltage
    b. collector supply voltage
    c. base supply voltage
    d. emitter-to-base voltage
    e. collector-to-emitter voltage
    f. collector-to-base voltage
    g. emitter current
    h. collector current
    i. base current
    j. collector-to-emitter breakdown voltage
    k. emitter-to-base breakdown voltage
    l. collector current with an open base
    m. collector current with an open emitter
    n. collector power dissipation

19. Determine the dc conditions for base bias

20. Determine the dc conditions for emitter bias

21. Demonstrate the procedures for testing a bipolar transistor with an ohmeter
A. Bipolar Transistor Biasing Circuits

1. Determine the limits of the dc load line and the Q point of operation for:
   a. base (fixed) bias
      1. without emitter feedback
      2. with emitter feedback
   b. collector feedback bias
      1. without emitter feedback
      2. with emitter feedback
   c. voltage divider bias
   d. emitter bias
      1. Single supply
      2. Dual supply

2. Calculate the input resistance at the base of a transistor

3. Apply Thevenin’s theorem to the analysis of the stability of voltage divider bias

4. State the relationship between Icbo and temperature

5. Describe the effect of Icbo on the Q point of operation

6. Describe the relative dependence of the Q point of operation on the dc beta of the transistor for the various bias techniques

7. Analyze the various dc bias circuits for the effects of open and shorted components

E. Common Emitter Amplifier

1. Describe the common emitter amplifier in terms of its input and output

2. State the definition of the term ac beta

3. Given dc emitter current, determine the approximate value of the ac resistance of the emitter diode

4. Determine the voltage gain of a common emitter amplifier

5. Determine the current gain of a common emitter amplifier

6. Determine the power gain of a common emitter amplifier

7. Determine the input-base resistance of a common emitter amplifier

8. Determine the input resistance of a common emitter amplifier

9. Determine the output resistance of a common emitter amplifier

10. State the phase relationship between base voltage and collector voltage

11. Describe the principal theory of operation of the coupling capacitor

12. Describe the principal theory of operation of the emitter bypass capacitor

13. State the effect on linearity and voltage gain by aswamping out® the ac resistance of the emitter diode

14. State the advantage of h parameters over linear approximations

15. State the four h parameters

16. Demonstrate a basic understanding of the application of h parameters to the analysis of a common emitter amplifier

17. Determine the voltage gain of cascaded stages

18. State the definition of the term negative or degenerative feedback

19. Evidence an understanding of dc and ac analysis for fault isolation in a common emitter amplifier
F. Common Collector Amplifier (Emitter Follower)

1. Describe the common collector amplifier in terms of its input and output
2. State the phase relationship between base voltage and emitter voltage
3. Determine the voltage gain of a common collector amplifier
4. State the current gain of a common collector amplifier
5. Determine the power gain of a common collector amplifier
6. Determine the input-base resistance of a common collector amplifier
7. Determine the input resistance of a common collector amplifier
8. Determine the output resistance of a common collector amplifier
9. Describe the principal theory of operation of the Darlington pair
10. Evidence an understanding of dc and ac analysis for fault isolation for a common collector amplifier

G. Common Base Amplifier

1. Describe the common base amplifier in terms of its input and output
2. State the phase relationship between emitter voltage and collector voltage
3. Determine the voltage gain of a common base amplifier
4. State the current gain of a common base amplifier
5. Determine the power gain of a common base amplifier
6. Determine the input resistance of a common base amplifier
7. Determine the output resistance of a common base amplifier
8. Evidence an understanding of dc and ac analysis for fault isolation for a common base amplifier

I. Class A Power Amplifiers

1. State the definition for class A
2. State the optimum Q point for class A
3. Calculate quiescent collector power dissipation
4. State the maximum ac load power for class A in terms of quiescent transistor collector power dissipation
5. Determine the large signal voltage gain for a common emitter amplifier
6. Determine the maximum symmetrical limits at the output of a resistively loaded common emitter amplifier
7. Determine the maximum symmetrical limits at the output of a common emitter amplifier with an impedance or transformer coupled load
8. Calculate the efficiency of a class A amplifier
9. Evidence an understanding of dc and ac analysis for fault isolation for a class A power amplifier

J. Class B Power Amplifiers

1. State the definition for class B
2. Determine the quiescent conditions for a class B complementary push-pull amplifier using voltage divider bias
3. Determine the quiescent conditions for a class B complementary push-pull amplifier using diode bias or current mirror bias
4. State the cause of crossover distortion in a class B amplifier
5. Describe the technique for reducing crossover distortion
6. Determine the saturation collector current for a class B amplifier
7. State the worse-case relationship between quiescent transistor power dissipation and maximum load power for class B power amplifiers
8. Calculate voltage gain and maximum load power for class B push-pull common emitter and emitter follower amplifiers
9. Calculate the efficiency of a class B push-pull power amplifier
10. State the input driving requirements for complementary and non-complementary class B push-pull power amplifiers
11. State the relative advantage of diode bias stabilization over thermistor bias stabilization
12. State the purpose of a heat sink
13. Evidence an understanding of dc and ac analysis for fault isolation for a class B push-pull power amplifier

K. Class C Power Amplifiers

1. State the definition for Class C
2. Describe the principal theory of operation of base-leak bias (clamper bias) for class C operation
3. State the relationship between the discharge time constant of the base-leak capacitor and the period of the lowest input frequency
4. State the advantage of base-leak bias (clamper-bias) for class C operation over a fixed bias scheme
5. Describe the principal theory of operation of a fundamental tuned class C amplifier
6. Calculate the maximum output power of a tuned class C amplifier
7. Calculate the efficiency of tuned class C amplifier
8. Describe the efficiency of class C relative to class A and class B
9. Describe the principal theory of operation of a frequency multiplier
10. Evidence an understanding of dc and ac analysis for fault isolation for a class C amplifier

V. METHODS OF INSTRUCTION

A. Lecture
B. Textbook Exercises
C. Demonstration
D. Laboratory
E. Computer Based Circuit Simulation
F. Group Participation

VI. REQUIRED TEXTBOOK(S)


VII. REQUIRED MATERIALS

Electronic Calculator (scientific)
Needle-nose pliers
Wire Cutters (flush cutting)

VIII. SUPPLEMENTAL REFERENCES

None

IX. METHODS OF EVALUATION

A. Quizzes
B. Unit Examinations
C. Student Participation
D. Laboratory Performance
E. Homework Assignments

Distribution of Final Grade:

60% - Theory
30% - Laboratory Performance
10% - Instructor evaluation of observed traits and characteristics

A - 90 to 100%
B - 80 to 89%
C - 70 to 79%
D - 65 to 69%
F - Below 65%

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