SAULT COLLEGE OF APPLIED ARTS & TECHNOLOGY

SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

Course Title: ELECTRONIC FUNDAMENTALS I

Code No.: ELN100-6

Program: ELECTRICAL/ELECTRONICS/COMPUTER ENG. TECH./TECHN'Y

Semester: ONE

Date: September, 1985

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New: _____ Revision: X

APPROVED: J.P. Drozetto
Chairperson

Date

ELECTRONIC FUNDAMENTALS I — Course Name

ELN100-6 — Course Number

PHILOSOPHY/GOALS:

This course, along with Electronic Fundamentals II (ELN101), is planned to meet the needs of the technician/technologist who is to work in the electrical/electronic field. It is intended to provide a solid background in fundamentals that is necessary for the study of the more specialized aspects of electronics. The student wiil become familiar with solid-state devices (diodes and transistors), their characteristics and applications in power supply and basic amplifier circuits. The student will be able to analyze, construct, test and troubleshoot various circuits using theoretical and practical methods.

METHOD OF ASSESSMENT (GRADING METHOD):

1. Testing in relation to the theory objectives will make up approximately 60% of the final mark and will consist of at least two major tests plus various short quizzes.

2. Testing in relation to the practical (lab) objectives will make up approximately 40% of the final mark and will consist of a power supply lab report, lab logbook reports and practical assessments which will include lab attendance, participation, performance, attitude, etc.

TEXTBOOK(S):

ELECTRONIC PRINCIPLES - 3rd Ed.; Malvino (McGraw-Hill)
Experiments for Electronic Principles - Malvino
REFERENCES:
- FUNDAMENTALS OF ELECTRONICS - 3rd Ed. Lurch (Wiley)
- GENERAL ELECTRONIC CIRCUITS - 2nd Ed.; DeFrance (Holt-Rinehart)
- FUNDAMENTALS OF ELECTRONIC DEVICES - 2nd Ed.; Tocci (Merrill)
- ELECTRONIC DEVICES AND CIRCUITS - 3rd Ed.; Boylestad/Nashelsky (Prentice-Hall)

TEXT: Electronic Principles, 3rd Ed., Malvino

BLOCK	PERIOD T-L	TOPIC DESCRIPTION	REFERENCE
I	8 - 6	Semiconductor Diodes	Chapters 1, 2

		- Introduction to Current Flow
		- Review of Basic Theorems
		- Semiconductor Theory
		- Energy Levels
		- Doping
		- PN Diode Formation
		- Diode Biasing Methods
		- Diode Circuit Analysis
		  - approximate method
		  - load lines	

II	14 - 15	DC Power Supplies	Chapters 3, 4
		- Block Diagram - Sine Wave Analysis - Power Transformers - Rectifier Circuits and Characteristics - Filter Networks - Diode Ratings - Voltage Multipliers - Zener Diode Characteristics - Zener Voltage Regulator	
III	26 - 24	Transistor (BJT) Amplifier	Chapters 5, 6, 7, 8, 9
		- NPN/PNP Transistor Characteristics - Regions of Operation - Transistor Blasing Methods - Transistor Amplifer Configurations and DC Circuit Analysis - Transistor Ratings and Specifications - CE Amplifier AC Analysis - Amplifier Troubleshooting - Cascaded Amplifiers - Input and Output Impedance - Amplifier Voltage Gain - CC and CB Amplifier Analysis	

COURSE OBJECTIVES:

At the successful completion of this course, students should meet these General Objectives:

1. Students should have obtained sufficient atomic theory to cope with the understanding of electronic devices and the fundamentals of electrical behavior.

2. Students should be familiar with the theory of operation of the following devices: -p-n diode, zener diode, junction transistor.

3. Students should be able to do DC analysis of circuits using devices in 2.

4. Students should be able to test devices in 2.

5. Students should be able to analyze DC power supply circuits.

6. Students should be able to analyze DC transistor amplifier circuits.

7. Students should be able to construct, analyze, test and troubleshoot various power supply circuits and transistor amplifier circuits using various test equipment.

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SPECIFIC OBJECTIVES FOR BLOCK 1 - ATOMIC THEORY

PART A

1. Able to sketch and describe the Bohr model for the hydrogen atom
2. Recall the 3 distinct particles that make up an atom.
3. Recall the 2 particles that make up the nucleus.
4. Recall the meaning of covalent bonding.
5. Able to define "valence electrons".
6. Able to sketch covalent bonding of silicon germanium atoms, showing valence electrons.
7. Able to sketch the energy band diagrams for a conductor, insulator and semiconductor showing conduction band, valence band and relative sizes of the forbidden band.
8. Recall the differing factors in the atomic structure of elements which determine whether the element is a conductor, insulator or semi-conductor.
9. Recall the definitions of drift current, diffusion current and concentration gradient.
10. Recall the conditions required to produce a drift current and diffusion current.
11. Recall the meaning of intrinsic and extrinsic semiconductor.
12. Recall 2 natural causes which will produce "free" electrons in an intrinsic semiconductor.
13. Able to sketch the energy band diagram of an intrinsic semiconductor at room temperature showing the formation of electron-hole pairs.
14. Recall the meaning of "recombination".
15. Recall the meaning of "doping".
16. Recall the definition of n-type, p-type, donor and acceptor impurities.
17. Recall the meanings of majority and minority carriers.
18. Able to sketch the energy-band diagrams for extrinsic semiconductors at absolute zero, room temperature and critical temperature showing the different levels and their state.

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SPECIFIC OJECTIVES FOR BLOCK 1 - P-N DIODE:

PART B

1. Recall the construction of the p-n junction and the formation of the depletion region.
2. Recall the potential barriers in silicon and germanium p-n junctions.
3. Recall the effects of forward and reverse bias on the depletion region.
4. Able to draw and recognize forward and reverse biased diode circuits.
5. Able to draw the I-V characteristics of a typical diode and label significant points and regions.
6. Recall the definitions of the following p-n diode ratings: PRV, (=PIV), VRDC, I_F(MAX), V_F, I_R.
7. Able to analyze p-n diode circuits using the approximate method.
8. Recall the standard nomenclature for voltages between terminals and current through terminals.
9. Able to plot graphs and to extract data from graphs.
10. Given a specific manual, able to extract data for particular p-n diodes.
11. Explain temperature effects on diodes.
12. Explain diode bulk resistance and diode junction capacitance.

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SPECIFIC OBJECTIVES FOR BLOCK 2 - POWER SUPPLIES:

1. Able to draw the block diagram of a typical power supply and to state the function of each block.

2. Recall the four requirements for power supplies.

3. Recall the meanings of Ripple Content and Regulation.

4. Recall the relationships between transformer turns ratio, voltage ratio and current ratio.

   a) able to perform calculations using these relationships
   b) transformer efficiency

5. Recall the meanings of step-up and step-down.

6. Recall the meaning of the term "load" as applied to power supplies.

7. Able to sketch 1/2 wave rectifier circuits.

8. Able to explain the operation of 1/2 wave rectifier circuits and to draw the appropriate waveforms.

9. Recall that the DC component of the rectified wave (1/2 wave) =

$$VDC = \frac{Emax}{\pi}$$

10. Able to sketch full-wave rectifier circuits (center-tap and bridge).

11. Able to explain the operation of full-wave rectifier circuits and draw the appropriate waveforms.

12. Recall that the DC component of the rectified wave = $VDC = \frac{2\ Emax}{\pi}$ (full wave).

13. Able to calculate DC component for given ac input and vice versa for rectifier circuits.

14. Recall the PRV rating required for the diodes in the different rectifier circuits.

15. Recall the advantages and disadvantages of H.W., F.W. and Bridge rectifiers.

16. Recall the definitions of ripple factor and percent ripple.

17. Recall the four main types of filter circuits used in power supplies.

18. Be able to draw 1/2 and full-wave rectifier circuits using simple -C filters.

19. Able to explain the effect of the capacitor filter on the output waveforms and draw these waveforms.

20. Recall the effect of capacitor filter on peak current through the diodes.

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SPECIFIC OJECTIVES FOR BLOCK 2 CONTINUED ...

21. Recall the advantages and disadvantages of the capacitor input filter.

22. Able to draw rectifier circuits using the R-C filter and explain the operation.

23. Recall the advantages and disadvantages of the R-C filter relative to the L-C filter.

24. Able to draw rectifier circuits using the π type filter and explain the operation.

25. Recall the advantages and disadvantages of the π type filter.

26. Able to draw rectifier circuits using the L-type filter and explain the operation.

27. Recall the advantages and disadvantages of the L-type filter.

28. Able to draw and explain 1/2 wave and full-wave voltage doubler circuits.

29. Able to sketch the I-V characteristic curve for a zener diode and label all significant points and regions.

30. Recall the definitions of the following zener diode ratings: VzT, IzT, IzK, IzM and PzM.

31. Recall the definitions of the voltage regulation and percentage regulation.

32. Able to calculate percent regulation.

33. Able to analyze zener voltage regulated circuits under varying input and load conditions and be able to extract zener diode data from specification sheets.

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SPECIFIC OJECTIVES FOR BLOCK : - JUNCTION TRANSISTOR:

1. Able to sketch the structure of the NPN and the PNP junction transistor and label the emitter, collector and base regions.
2. Able to sketch NPN and PNP transistors based for operation in the active, saturation or cut-off mode.
3. Recall the theory of operation of the junction transistor based in the active region.
4. Recall the relationship $I_E = I_B + I_C$.
5. Recall the definition of α_{DC}.
6. Recall the definition of I_{CBO}.
7. Able to perform calculations using 4, 5 and 6.
8. Able to draw schematic symbols of NPN and PNP transistors.
9. Recall the significance of the common base characteristic curves.
10. Able to draw common base circuits based in the active region.
11. Able to analyze common base circuits using the approximate method.
12. Recall the definition of β_{DC} (β_{DC} = LFE) (α_{DC} = hFB)
13. Recall the definition of I_{CEO}.
14. Recall the significance of commom emitter characteristic curves.
15. Able to draw common emitter circuits based in the active region.
16. Recall the relationship between α_{DC} and β_{DC}.
17. Able to analyze circuits using the load-line method.
18. Able to analyze common emitter circuits using the approximate method.
19. Able to draw collector circuits based in the active region.
20. Able to analyze common collector circuits using the approximate method
21. Able to extract data for the junction transistor from the specifications sheet or from manuals.
22. Recall the need for bias stabilization.
23. Able to analyze circuits using current feedback and voltage feedback.
24. Recall the significance of transistor maximum ratings.

Cont'd ...

SPECIFIC OJECTIVES FOR BLOCK 3 CONTINUED ...

25. Recall the effects of temperature on transistor parameters.

26. Able to construct power derating curves.

27. Able to draw circuit diagrams and perform a DC analysis (voltage and current) for the transistor configurations employing the following biasing methods:

    a) fixed bias
    b) self bias
    c) voltage divider bias

The above amplifiers will be in the common emitter or common collector configuration with or without bias stabilization.

Students should be able to calculate voltages and currents for all transistor terminals and calculate resistor values for various operating conditions using the approximate method of analysis.