COURSE OUTLINE

ELEC-117

Linear Electronics

4 Credits

HOWARD COMMUNITY COLLEGE

Description

In this course, the student will learn the characteristics of electronic devices such as diodes, transistors, and operational amplifiers, and their behavior in various electronic circuits. Specifically, applications of the following devices will be studied: rectifier diodes, zener diodes, bipolar junction transistors (BJT), field-effect transistors (FET). Also, various applications of the operational amplifier will be studied. Prerequisite: ELEC-107. (3 hours lecture, 3 hours lab)

Overall Course Objectives

Upon completion of this course, the student will be able to:

1. Describe how a pn junction (semiconductor diode) is formed, discuss its characteristics and explain how it works with respect to forward and reverse bias.
2. Explain how various rectifier circuits (half-wave, center-tapped full-wave, and full-wave bridge) function, and calculate the average output voltage and peak inverse voltage for each rectifier type.
3. Describe how a capacitor filter smoothes out a rectified voltage, and explain how the value of the filter capacitor determines the amount of ripple voltage.
4. Explain the zener diode characteristic curve, discuss various zener characteristics and parameters, and use a zener diode for voltage regulation (line regulation and load regulation).
5. Describe the basic construction of a bipolar junction transistor (BJT), identify npn and pnp transistors, define the transistor currents and their relationship, and interpret the characteristic curves of a transistor.
6. Explain how a transistor is biased for use as an amplifier and how the transistor produces gain in amplifier circuits.
7. Identify various transistor packaging configurations and terminals.
8. Define linear operation in relation to transistor characteristic curves and loadline, and analyze the bias of a transistor that operates as a linear amplifier.
9. Analyze a transistor amplifier using r parameters in the CE, CC and CB configuration, and explain (calculate) voltage gain, input resistance, and output resistance of an amplifier.
10. Show how voltage gain is increased by connecting amplifiers in cascade.
11. Distinguish between large-signal and small-signal operation.
12. Measure the frequency response of an amplifier.
13. Analyze circuits using junction field-effect transistors (JFET).
14. Describe the basic Op-Amp characteristics.
15. Discuss Op-Amp modes and their parameters.
16. Explain negative feedback in Op-Amp circuits.
17. Analyze the non-inverting, voltage-follower and inverting Op-Amp configurations, and describe their impedances.
18. Discuss Op-Amp compensation.
19. Analyze open loop and closed-loop responses of an Op-Amp.
20. Analyze the operation of several basic comparator circuits.
21. Analyze the operation of integrators and differentiators.

Major Topics:

I. Introduction to Semiconductors
- A. N-type and P-type semiconductors
- B. The Diode: biasing, voltage-current characteristics
- C. Diode Applications: rectifiers, limiting and clamping circuits

II. Special Purpose Diodes
- A. Zener diodes
- B. Varactor diodes
- C. Optical diodes

III. Bipolar Junction Transistors (BJT)
- A. BJT characteristics and parameters
- B. Transistor packages and identification
- C. Transistor bias circuits

IV. BJT Amplifiers
- A. Transistor AC Equivalent Circuits
- B. Common-emitter, common-collector, and common-base amplifiers
- C. Multistage amplifiers

V. Field-Effect Transistors (FET)
- A. The JFET – Characteristics and parameters
- B. JFET Biasing
- C. The MOSFET – Characteristics and parameters
- D. MOSFET biasing

VI. FET Amplifiers
- A. Common-source amplifier
- B. Common-drain amplifier
- C. Common-gate amplifier

VII. Power Amplifiers
- A. Class A amplifiers
- B. Class B and Class AB push-pull amplifiers
- C. Class C amplifiers

VIII. Amplifier Frequency Response
- A. Basic concepts – The decibel
- B. Low-frequency amplifier response
- C. High-frequency amplifier response
- D. Total amplifier frequency response
- E. Measurements

IX. Operational Amplifiers
- A. Op-Amp input modes and parameters
- B. Negative feedback
- C. Bias current and offset voltage compensation
- D. Open-loop response and closed-loop response

X. Basic Op-Amp Amplifications
- A. Comparators
- B. Summing amplifiers
- C. Integrators and differentiators

Course Requirements

Grading/exams: Grading procedures will be determined by the individual faculty member, but will be based on classroom exercises, lab experiments, homework assignments, quizzes, unit tests, and final exam.

Writing: Specific writing assignments will be determined by the individual faculty member.

Other Course Information

This course is required in the Photonics Technology, Electronics Technology, Telecommunications Technology, and Biomedical Technology Programs.