COURSE OUTLINE

ELEC-237
Wireless Communication Circuits
3 Semester Hours

HOWARD COMMUNITY COLLEGE

Description

Upon completion of this course, the student will understand the fundamentals of electromagnetic wave propagation in the real world environment and how information is transmitted and received through that medium. An overview of many types of wireless communication systems will be presented. The numerous problems in selecting the method of transmission and reception will be considered, and the impact of noise, power, and impedance on system performance will be addressed. Specific circuits unique to this branch of electronics will be examined. Pre- or Co-requisite: ELEC-211 and ELEC-213. (2 hours lecture, 3 hours lab)

Overall Course Objectives

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

1. Describe the essential elements of a communication system and explain the need for modulation in communication systems.
2. Use frequency-domain representations of signals, convert simple signals between time and frequency domains, and use a table of Fourier series to find the frequency-domain representation of common waveforms.
3. Describe several types of noise and calculate noise power and voltage for thermal noise, signal-to-noise ratio, noise figure and noise temperature for single and cascaded stages.
4. Describe, draw circuits for, and analyze the most common types of radio-frequency amplifiers and oscillator circuits. (LC and crystal)
5. Describe the function of a mixer and analyze several circuits, explaining how and where they are used, and calculating output frequencies.
6. Write the time-domain equation for an AM signal, describe how the equation relates to the signal, and sketch an AM signal in both the time and frequency domains; define the modulation index, calculate it, and measure it using either an oscilloscope or a spectrum analyzer.
7. Discuss the requirements and specifications of AM transmitters, draw block diagrams for several types of transmitters, explain their operation, analyze the operations of transmitter circuits, and perform measurements on AM transmitters.
8. Describe the basic superheterodyne system, explain why it is the preferred design of most receivers, explain the requirements for each stage in a receiver, and suggest suitable types of circuits to fulfill the requirements.
9. Give several examples of transmission lines, explain what parameters of a transmission line must be considered as the frequency increases, define characteristic impedance and calculate the impedance of a coaxial or open-wire transmission line.
10. Define reflection coefficient and standing-wave ratio (calculate them in practical situations), explain the importance of impedance matching with respect to transmission lines, describe several methods of matching lines (Smith Charts) and perform the necessary calculations to achieve an impedance match using a quarter-wave transformer and a single stub.
11. Describe the nature and behavior of radio waves, explain the meaning of wave polarization (differentiate between vertical, horizontal, circular and elliptical polarization) and calculate free-space attenuation.
12. Explain the basic principles of operation of antenna systems, define antenna gain and bandwidth, sketch the approximate radiation pattern for common types of antennas and calculate the dimensions of simple practical antennas for a given frequency.

13. Given a block diagram of a sophisticated microprocessor-based electronic telephone based upon a single-chip, relate the function of each block to the features of the telephone.
14. Using a simplified block diagram of a FAX machine, explain how very high data rates are possible on voice-grade lines.
15. List ten common test instruments used in testing communications equipment and describe the basic operation of each.
16. Test common communications equipment tests on transmitters, receivers, and antennas including frequency measurements, power measurements, SWR measurements, sensitivity, and spectrum analyses.
17. Describe the basic troubleshooting procedures used for locating problems in transmitters and receivers.

Major Topics

I. Communications Systems
   - A. Elements
   - B. Time and Frequency Domains
   - C. Noise
   - D. Spectrum Analyzer

II. RF Circuits
   - A. High Frequency Effects
   - B. RF Amplifiers
   - C. RF Oscillators
   - D. Mixers

III. AM
   - A. Modulator and Demodulator
   - B. Time Domain Analysis
   - C. Frequency Domain Analysis
   - D. Bandwidth and Power

IV. AM Transmitters
   - A. Requirements and Topologies
   - B. Stages
   - C. Output Impedance Matching
   - D. AM CB
   - E. AM Transmitter Measurements

V. AM Receivers
   - A. Types and Characteristics
   - B. Circuits
   - C. Communications Receivers
   - D. CB Transceiver
   - E. Test Procedures

VI. Suppressed-Carrier AM
   - A. Generation of SC
   - B. Single-sideband Transmitters and Receivers
   - C. SB Transceiver
   - D. Test Equipment and Procedures

VII. Transmission Lines
   - A. Electrical Model
   - B. Wave Propagation on Lines
   - C. Line-Losses
   - D. Impedance Matching
   - E. Time Domain Reflectometry

VIII. Radio-Wave Propagation
   - A. Electromagnetic Waves
   - B. Free Space Propagation
   - C. Terrestrial Propagation

IX. Antennas
   - A. Simple Antennas
   - B. Directional Characteristics
   - C. Antenna Matching
   - D. Gain and Directivity
   - E. Polarization
   - F. Test Equipment

X. Cellular
   - A. Cellular Telephone and Paging
   - B. Microprocessor-Based Telephones
   - C. FAX Machines

Course Requirements

Grading/Exams: Grading procedures will be determined by the individual faculty member but will be calculated on the basis of tests, lab reports, quizzes and final exam. This course includes a comprehensive final exam.
Writing: Each week, students are expected to write a laboratory report after performing that week's assigned experiments.

Other Course Information

This course is a course in the Electronics Technology and Telecommunications Technology programs.