COURSE OUTLINE

ELEC-238
Wireless Communication Systems
3 Semester Hours

HOWARD COMMUNITY COLLEGE

Description

Upon completion of this course, the student will have an understanding of the principles of the major wireless communication systems in use throughout the world today. The course will focus on understanding and troubleshooting equipment common to these systems and will investigate concepts unique to wireless communication systems such as cellular, microwave, and satellites. A section on electromagnetic compatibility, RF interference, and spectrum analysis will be particularly valuable in understanding how systems interact. Prerequisite: ELEC-237. (2 hours lecture, 3 hours lab)

Overall Course Objectives

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

1. Draw an FM waveform, analyze the frequency spectrum using Bessel functions and perform measurements on FM signals using a spectrum analyzer.
2. Calculate BW, side frequencies, deviation, modulation index, carrier and sideband voltage and power levels, and S/N for simple situations.
3. Analyze the operation of both direct and indirect frequency modulators, and compare the following types of FM detectors: discriminator, ratio detector, PLL, and quadrature.
4. Explain the purpose of frequency conversion (up-conversion and down-conversion) and calculate a receiver's sensitivity and dynamic range given NF and BW.
5. Draw block diagrams for several types of frequency synthesizer, explain their operation, calculate output frequencies and interpret specifications.
6. Explain the purpose and operation of spread-spectrum techniques (frequency hopping and direct sequence) and provide common application examples.
7. Calculate the characteristic impedance of free-space, free-space attenuation, power density, electric and magnetic field intensity for waves propagating in free-space, and polarization.
8. Calculate the cutoff frequency, phase and group velocity, guide wavelength, characteristic impedance, and attenuation for the dominant mode in a rectangular waveguide.
9. List the types of antennas used in satellite communications (include dishes and horns), calculate antenna gain, ERP, BW, beamwidth and polarization, and name the frequency bands utilized and the range of frequencies for each band (up-link and down-link).
10. Explain the theory of satellite communications system power requirements, calculate the link budget, calculate propagation delay and path loss for communication links involving geostationary communication satellites, and describe the applications for which satellites are suitable.
11. Explain the operation of the three major types of optical fibers, compare their performance, perform calculations involving critical angle, numerical aperture and bandwidth-distance product, and state the requirements for good splice or connection.
12. List the components incorporated in the fiber link, prepare a loss budget for a fiber-optic system, compute a system budget to meet minimum power requirements and describe the need for and operation of repeaters.
13. Compare analog and digital communication techniques, discuss the appropriate use of each, and identify which forms of modulation are analog types and which are digital types.
14. Calculate information capacity of a channel, minimum sampling rate for a signal, BER, and PCM system parameters
15. Define: FSK; PSK; BPSK; QPSK; 8PSK; 16PSK; QAM; 8QAM; 16QAM; BER; TDM; FDM; PCM; PAM; and PDM.

16. Explain how the 902 Mhz to 928 Mhz frequency range of PCS (Personal Communications Service) with spread spectrum (frequency hopping or direct sequence) for telephones share the same frequency band with little or no interference.
17. Describe the DSP (Digital Signal Processing) digital data compression techniques are used to shorten facsimile (FAX) transmission by a factor of 10 or more.
18. List the sequence of operations that occur when a person initiates a cellular telephone call in the AMPS (Advanced Mobile Phone Service) developed by the Bell Telephone Company division of AT&T.
19. Explain the concept of frequency reuse in a cellular telephone system.
20. Define ISDN and explain how its operation replaces local analog loop with digital transmission using the installed base of twisted-pair cable used for analog local loops.

Major Topics

I. FM Transmission
   - A. Angle Modulation
   - B. FM Analysis
   - C. PLL FM Transmitter

II. FM Reception
   - A. RF Amplifiers
   - B. Limiters and Discriminators
   - C. PLL

III. Communication Techniques
   - A. Frequency Conversion
   - B. Receiver Noise, Sensitivity, Dynamic Range
   - C. Frequency Synthesis
   - D. Spread Spectrum

IV. Microwaves and Satellites
   - A. Antennas, Tubes and Cavity Resonators
   - B. Solid-State Devices
   - C. Micro Integrated Circuit \Waveguiding
   - D. Communications Satellites
     - (1) Orbits, Types, Frequency Management
     - (2) Earth Terminal (Transmitter and Receiver)
     - (3) Transponder
     - (4) Received Power and Link Budget

VI. Fiber Optics
   - A. Optical Fibers
   - B. Light Sources and Detectors
   - C. Fiber Connections
   - D. Systems and Fiber Optic LANs

VII. Digital and Data Communications
   - A. Digital vs. Analog
   - B. Digitizing
   - C. PCM and Delta Modulation
   - D. Information Theory and Coding
   - E. BER vs. Noise
   - F. Transmission of Digital Data via Analog Carriers
   - G. TDM and FDM

VIII. Cellular
   - A. PCS and AMPS
   - B. DSP and FAX
   - C. ISDN

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.