Title: Communication Systems

Code Number: EE3102

Credit Hours: 3 (3+1)

Prerequisites: EE2201 Signals and Systems

Semester: 5th

Course Objectives

The course will enable students to:

1. Analyze various signal properties including bandwidth, spectral density, and distortion to assess their impact on communication channels.
2. Apply principles of modulation techniques and understand their generation and demodulation processes.
3. Outline key concepts in digital communication systems and digital modulation techniques and evaluate their performance in the presence of noise.
4. Conduct experiments for modulation and demodulation techniques, evaluate signal distortion, and measure signal-to-noise ratio using real communication hardware.
5. Execute communication systems, including signal modulation, demodulation, noise analysis, and performance evaluation of digital communication techniques utilizing MATLAB/Simulink.

Contents

Unit 1: Analysis and transmission of signals:

1. Channel Bandwidth and rate of communication
2. Signal energy and Energy Spectral Density
3. Signal Power and Power Spectral Density
4. Signal Distortion over communication channel

Unit 2: Amplitude modulations and demodulations:

1. Baseband and carrier communications,
2. Double Sideband (DSB)
3. Single Sideband (SSB)
4. Vestigial Sideband (VSB)
5. Superheterodyne AM Receiver
6. Carrier Acquisition, Television

Unit 3: Angle modulation and demodulation:

1. Instantaneous frequency,
2. Bandwidth of FM/PM,
3. Generation of FM/PM,
4. Demodulation of FM/PM

Unit 4: Principles of Digital Communications:

1. Sampling and Quantization,
2. Sampling theorem and aliasing
3. Pulse Amplitude Modulation, Pulse Position and Pulse width Modulation
4. Quantization Noise, Signal to Quantization Noise Ratio
5. Pulse code Modulation
6. Delta Modulation

7. Frequency Shift Keying, Phase Shift Keying
8. ASK, PSK, DPSK, QAM

Unit 5: Noise Analysis

1. Noise: Sources. Spectral Density and Probability Density
2. Noise: Mathematical representation
3. Signal to Noise Ratio
4. Noise in AM, FM, and PM systems Pulse Modulation
5. Evaluation of Error Probability for different Digital Modulated Signals over Noisy Channel
6. Elements of Information Theory and coding techniques. Shannon's Theorem.
7. Exchange of S/N and Bandwidth

Lab Work Outline:

In this lab, students will delve into both hardware and software aspects of communication systems. Hardware experiments include modulation and demodulation techniques, frequency spectrum analysis, and performance evaluation of various communication channels. Software tasks involve using tools like Matlab/Simulink for simulating digital and analog communication systems, designing filters, conducting bit error rate (BER) analysis, and generating signal constellations. The lab integrates hardware and software for real-time communication system implementation and advanced signal processing techniques, providing a comprehensive hands-on learning experience.

Teaching-Learning Strategies:

The pedagogical approach to this course relies on face-to-face teaching in a university classroom environment. The lectures are delivered using multimedia support and on white board. Students are engaged and encouraged to solve real world problems using computer-aided tools.

Assignments/Types and Number with calendar:

A minimum of four assignments to be submitted before the written exams for each term.

Assessment and Examinations:

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Sessional Assessment	25%	It is continuous assessment. It includes classroom participation, attendance, assignments and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Recommended Books:

1. B.P. Lathi and Zhi Ding, “Modern Digital and Analog Communication Systems” 4th Edition, Oxford University Press, (2010).
2. Simon Haykin, “Communication Systems” 4th Edition, Wiley (2006).
3. John G. Proakis and Masoud Salehi, “Communication Systems Engineering” Prentice Hall, (2002).
4. John G. Proakis, Masoud Salchi, Fundamentals of Communication Systems", Second Edition, Prentice Hall, 2013
5. John G. Proakis, Masoud Salehi, "Digital Communications", Fifth Edition, McGraw Hill, 2008,