UE19EC254: Digital Communication (4-0-0-4-4)

Course Description:

This course provides a comprehensive treatment of the physical layer aspects of practical communication systems. It covers topics from analog communication that are prerequisites for digital communication. It also covers sampling, quantization, pulse shaping and modulation techniques.

Course Objectives:

- Understand the principles of amplitude and angle modulation
- Learn the different sampling techniques
- Understand the performance of different waveform coding techniques
- Understand the idea of signal space
- Learn the different digital modulation techniques

Course Outcomes:

Students completing the course should be able to

- Analyze the different analog modulation techniques
- Analyze the different sampling techniques
- Design quantization and pulse shaping systems
- Develop detection rules for the given transmission scheme
- Analyze the different coherent and non-coherent digital modulation techniques

Pre - Requisite: NIL

Course Content:

Unit 1: Amplitude and Angle Modulation

(i) Amplitude Modulation: Double Sideband Suppressed Carrier Modulation, Generation of DSBSC Waves, Coherent detection of DSBSC Modulated Wave, Standard Amplitude Modulation, Generation of AM waves, Detection of AM waves. (ii) Angle Modulation: Canonical description of Bandpass Signals and Systems Angle Modulation, Frequency Modulation, Single tone frequency modulation, spectrum analysis of sinusoidal FM Wave, Generation of FM Waves, Demodulation of FM Waves: Balanced Frequency Discriminator,

12 Hours

Unit 2: Sampling

Sampling Theorem, Quadrature Sampling of Band Pass Signals, Practical aspects of sampling and signal recovery. Sample and Hold circuit for signal recovery, Time Division Multiplexing.

10 Hours

Unit 3: Quantization and Pulse Shaping

Pulse Code Modulation: Pulse Code Modulation, Quantization Noise and Signal to Noise ratio. Robust Quantization, Differential Pulse Code Modulation, Delta Modulation. Pulse Shaping: Discrete PAM Signals, Power spectra of Discrete PAM Signals.

12 Hours

Unit 4: Intersymbol Interference and Signal Space Representation

Inter Symbol Interference, Nyquist criterion for Distortionless Baseband Binary Transmission, Eye diagram, Gram-Schmidt Orthogonalization Procedure, Response of Bank of correlators to noisy input. Detection of known signals in Noise, Maximum-likelihood Detector.

11 Hours

Unit 5: Digital Modulation Techniques

Matched filter Receiver. Digital Modulation Schemes: Coherent Binary PSK, Coherent Binary FSK, Coherent QPSK, Differential Phase Shift Keying, Quadrature Amplitude Modulation. Power spectra and bandwidth efficiency of digital modulation schemes.

11 Hours

Text Book:

1. Simon Haykin*, "Digital Communication" John Wiley & Sons, 2010*

Reference Book:

1 Simon Haykin*, "Communication Systems" John Wiley & Sons, 4th Edition, 2001.*

UE19EC257: Digital Communication Laboratory (0-0-2-1-1)

Course Objectives:

- Impart understanding of working principles and applications of communication systems
- Introduce basic applications of modulation
- Provide basic understanding of sampling.

Course Outcomes:

Students completing the course should be able to

- Analyze and appreciate the working of communication circuits involving various modulation methods.
- Design simple circuits using QPSK, DPSK etc.
- Understand various techniques used in FSK, PSK, TDM
- Develop simple projects based on various digital modulation
- Understanding of modems, mixers, up/down converters

Pre - Requisite: Nil

Course Content:

1. Pulse Amplitude Modulation
2. DSBSC and SSB Generation
3. Amplitude Modulation and Demodulation
4. Transistor Mixer Up/Down Conversion
5. Frequency Modulation
6. Flat Top Sampling
7. Amplitude shift Keying
8. Phase Shift Keying
9. Frequency Shift Keying
10. Time Division Multiplexing
11. Open ended experiments: QPSK, DPSK, 16-QAM

Reference Books:

1. Laboratory manual prepared by Department of Electronics and Communication Engineering, PES University.