

APPE3004 DIGITAL COMMUNICATION (3-0-0)

Course Objectives:

This course provides a comprehensive understanding of digital communication systems, covering sampling, quantization, line coding, and modulation techniques (BPSK, QPSK, MSK). Students will analyze signal representation, evaluate receiver performance in AWGN channels, and explore information theory concepts like entropy and source coding. Emphasis is placed on error control coding (block, cyclic, convolutional codes) to enhance system reliability.

Module-I: (06 Hours)

Fundamentals of Digital Communication: Nyquist Sampling Theorem, Pulse Code Modulation, Delta Modulation, Adaptive delta Modulation, Base band digital communication, Line encoder, Unipolar RZ and NRZ, Polar RZ and NRZ, Bipolar NRZ (alternate Mark Inversion), Manchester, Difference between source coding and encoding.

Module-II: (06 Hours)

Signal Space and AWGN Channel: Signal space representation: Orthogonal expansion of signal, Gram Schmidt procedure.

Digital transmission over AWGN channel: Matched filter, maximum likelihood (ML) and maximum a posteriori receiver, power spectral density, Probability of error.

Module-III: (06 Hours)

Bandwidth-Limited Channel and Passband Modulation: Modulation for bandwidth limited channel: Inter symbol Interference, Equalization technique, error performance in bandwidth constraint channel.

Passband digital transmission carrier modulation: BPSK, QPSK, MSK, BFSK, MFSK, CPFSK, MSK, GMSK, carrier phase modulation.

Module-IV: (06 Hours)

Uncertainty, information, entropy, information rate, discrete memory less channel, loss less channel, Deterministic channel, Shannon Hartley law, Source coding, Shannon fanon coding, Huffman encoding.

Module-V: (06 Hours)

Introduction to Error Control Coding, Linear Block code, Hamming code. Cyclic code, convolution code, optimal decoding of convolution code.

Course Outcome:

Upon completion of the course, the students will be able to:

- CO1: Understand and apply the principles of sampling, quantization, and line coding in digital communication systems.
- CO2: Analyze signal representation using orthogonal basis functions and evaluate receiver performance over AWGN channels.
- CO3: Describe and compare various digital modulation schemes and their performance under bandwidth and noise constraints.
- CO4: Explain the concepts of information theory, compute entropy, and apply basic source coding algorithms.
- CO5: Design and evaluate error control coding techniques such as block codes, cyclic codes, and convolutional codes.

Text Books:

1. Sanjay Sharma, Communication Systems, Katson Books, 4th Edition, 2007
2. B.P. Lathi and Zhi Ding, Modern Analog and Digital Communication Systems, Oxford University Press, 4th Edition, 2011
3. Simon Haykin, Digital Communications Systems, Wiley, 5th Edition, 2009
4. John G. Proakis and Masoud Salehi, Digital Communication, McGraw-Hill, Latest Edition

Supplementary Reading:

1. Herbert Taub, Donald L. Schilling, and Goutam Saha, Principles of Communication Systems, Tata McGraw-Hill, 3rd Edition, 2008
2. Shu Lin and Daniel J. Costello, Error Control Coding: Fundamentals and Applications, Pearson Education, Latest Edition