

## EOPC3004 DIGITAL COMMUNICATION TECHNIQUES (3-0-0)

### Course Objective

The course aims to provide a clear foundation in digital communication, covering sampling, modulation, data transmission, and information theory. It helps students understand system performance in noise and apply basic error control coding to improve reliability.

### Module I(4 Hours)

Sampling Theorem and Signal Reconstruction: Sampling process, practical difficulties, aliasing and antialiasing filter. Discrete Fourier Transform (DFT). Applications of Sampling Theorem: PAM, PWM, and PPM signals.

### Module II(10 Hours)

Digital and Shift-Keying Modulation Techniques: Quantization, quantization error, non-uniform quantization, companding, encoder design, transmission bandwidth and output SNR. Differential PCM, Delta modulation (DM), adaptive delta modulation (ADM), SNR performance and comparison with PCM. Quantization noise power, output signal power, thermal noise power, output SNR of PCM with different modulation techniques, output SNR of DM. Generation, transmission, reception, spectrum and geometrical representation in signal space for BPSK, DPSK, DE-PSK, QPSK,  $\pi/4$  QPSK, M-ary PSK, BFSK, M-ary FSK, and MSK.

### Module III(6 Hours)

Principles of Digital Data Transmission: Components of a digital communication system. Line coding techniques: polar, unipolar, bipolar, and ON-OFF signaling. Pulse shaping and Nyquist criterion for zero ISI. Scrambling, regenerative repeaters, equalizers, and eye diagram analysis. Timing extraction, timing jitter. Baseband signal receivers, peak-to-RMS noise ratio, probability of error.

### Module IV(5 Hours)

Information Theory: Concept of information, average information, entropy. Shannon-Fano algorithm. Shannon's theorem on channel capacity, bandwidth-SNR trade-off. Use of orthogonal signals to attain Shannon's limit, efficiency of orthogonal signaling.

### Module V(5 Hours)

Error Control Coding: Parity check codes for error detection, Hamming distance, upper bounds on probability of error with coding. Block codes and their decoding. Algebraic codes: Hadamard code, Hamming code. Convolutional codes: code generation and Viterbi decoding.

### Course Outcomes (COs)

- CO1 Apply sampling theorem and PCM concepts for digital signal representation and transmission.
- CO2 Analyze digital and shift-keying modulation techniques (BPSK, QPSK, FSK, MSK, etc.) and evaluate their performance under noise.
- CO3 Examine digital data transmission methods including line coding, pulse shaping, matched filtering, and error probability estimation.
- CO4 Apply information theory concepts (entropy, Shannon's theorem, channel capacity) to assess communication system efficiency.
- CO5 Design and evaluate error detection and correction codes (block, convolutional, and algebraic codes) for reliable data transmission.

### Text Books

1. Taub & Schilling, Principles of Communication Systems, 2nd Edition, Tata McGraw-Hill.
2. Simon Haykin, Communication Systems, 4th Edition, Wiley.
3. Leon W. Couch II, Digital and Analog Communication Systems, 6th Edition, Pearson.
4. B.P. Lathi, Modern Digital and Analog Communication Systems, 3rd Edition, Oxford University Press.

### Supplementary Reading

1. R.P. Singh & S.D. Sapre, Communication Systems: Analog and Digital, TMH.