Devi Ahilya University, Indore, India Institute of Engineering & Technology				**III Year B.E. (Electronics and Telecommunication Engg.)**			
Subject Code & Name	**Instructions Hours per Week**			**Credits**			
5ETRC2 DIGITAL COMMUNICATION	**L**	**T**	**P**	**L**	**T**	**P**	**Total**
	3	**1**	**2**	**3**	**1**	**1**	**5**
Duration of Theory Paper: 3 Hours							

Course Learning Objective:

The course is designed

1. To learn the advantages of digital transmission over analog transmission.
2. To understand, analyze, compare different digital encoding techniques with their applications.
3. To understand, analyze and compare different line encoding techniques with their applications.
4. To understand, analyze and compare different digital modulation techniques with their applications.
5. To understand, analyze and compare different channel encoding techniques with their applications.
6. To learn the characterises of wireless channel and its impact on various processes.

Prerequisites: Knowledge of Fourier analysis and random variables.

COURSE CONTENTS

UNIT-I

Advantages of digital transmission over analog transmission, Review of Fourier transforms, Energy Spectral Density, Power Spectral Density and their Properties. Wireless channel & its characteristics. Sampling & its types, Time and frequency domain representation of sampling. Time Division multiplexing, Digital encoding techniques: PCM, quantization (uniform and non-uniform), quantization noise, DPCM, ADPCM, DM, ADM and their comparison.

UNIT-II

Line coding techniques: Desirable characteristics of Line codes, NRZ and RZ forms of unipolar, polar & bipolar and bi-phase line codes and their waveforms, PSDs and comparison. Inter Symbol Interference, pulse shaping (Raised cosine spectrum, duo-binary signalling), Eye

Patterns. Baseband reception and probability of error, optimum filter, matched filter, correlation receivers.

UNIT-III

Band-pass modulation and demodulation techniques: BPSK, DPSK, QPSK, MPSK, BFSK, MFSK, MSK (their generation, detection, waveforms, PSDs, signal constellation diagrams, Performance of these systems in the presence of noise). Introduction to broadband modulation, Spread Spectrum and Orthogonal Frequency Division Multiplexing.

UNIT-IV

Information theory: Concept of amount of information, entropy of a communication system, source encoding such as Shannon-Fano, Huffman Codes. Information rate, channel capacity (its calculation for Binary Symmetric channel;, Binary Erasure Channel, noiseless channels and Gaussian channel), Shannon's theorem, bandwidth and S/N trade off .

UNIT-V

Channel encoding techniques: Linear Block codes (Systematic Linear Block codes, Parity check matrix, Syndrome testing), cyclic codes, Hamming codes, BCH codes, convolution codes, their encoding and decoding operation.

Course Outcome:

Students earned credits will develop ability to

CO.No.	CO	PO
CO1	Identify multiple reasons why digital transmission is better than analog transmission.	PO-1
CO2	Compare and analyze various processes such as digital encoding, line encoding, channel encoding, digital modulation etc on the basis of various performance parameters.	PO-2, PO-3
CO3	Design various processes such as pulse code modulation, linear block coder etc with given input parameters.	PO-2, PO-3
CO4	Develop simulation codes of all these processes using MATLAB.	PO-3, PO-5, PO-4
CO5	Illustrate the input & output waveforms for each block of a process such digital encoding, digital modulation etc.	PO-4, PO-2
CO6	Apply the learnt principles for practical use and upcoming communication technologies.	PO-5, PO-6, PO-9, PO 12

CO-PO Relationship

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12

CO1	3											
CO2	2	2	2									
CO3		2	3									
CO4			3	3	3							
CO5		2		3								
CO6					2	2			2			2

BOOKS RECOMMENDED:

[1]. Lathi B. P., Modern Analog and Digital Communication Systems, 4th ed., Oxford Univ. Press, 2011.
[2]. Haykin Simon Communication System, 4th ed., Wiley Publication, 2001.
[3]. Schaum's Outline Series, Analog and Digital Communication, 2nd ed., TMH, 2006.
[4]. Taub & Schilling, Principles of Communication System, 4th ed., TMH, 2013.
[5]. Dr. Bernard Sklar, Digital Communication, 4th ed. Pearson education, 2001.
[6]. Proakis & Salehi, Digital Communication, 2nd ed., McGraw Hill, 2004.

List of Practical Assignments

Assignment I

Simulation of PCM system using uniform quantizer

(1) Develop a MATLAB code for PCM system simulation.
(2) Plot the sampled signal, quantized signal and encoded signal for multiple types of input signals and for different number of encoding bits. Also provide tabular representation of various intermediate results.
(3) Plot the graph between signal to quantization noise ratio (SQNR) with respect to encoding bits for sinusoidal input.
(4) Compare the theoretical and simulated values of SQNR. Write a detailed inference on the outcome.

Assignment II

Simulation of DPCM system

Develop a MATLAB code for DPCM system simulation.

(1) Plot the sampled signal, error signal, quantized signal and encoded signal for multiple types of input signals and for different number of encoding bits. Also provide tabular representation of various intermediate results.
(2) Plot the graph between signal to quantization noise ratio (SQNR) with respect to encoding bits for sinusoidal input.
(3) Compare the SQNR for PCM & DPCM. Write a detailed inference on the received outcome.

Assignment III

Simulation of PCM system using Non-uniform quantizer

(1) Write a MATLAB code for Companding process. Draw the transfer characteristics of compression and expansion for various values of A and μ.
(2) Consider an input signal with non-uniform PDF. Apply this signal to PCM system with uniform and Non-uniform quantizers.
(3) Compare SQNR performances in both cases. Write a detailed inference on the outcome.

Assignment IV

Performance evaluation of digital communication system in presence of various digital Modulation techniques.

(1) To evaluate the BER performance of MPSK for M=2, 4, 8, 16 and their comparison study.
(2) To get the scatter plot performance of MPSK for M=2, 4, 8, 16 and their comparison study.
(3) With the help of graphs plotted, explain that MPSK is bandwidth efficient technique.

Assignment V

Performance evaluation of digital communication system in presence of various communication channels.

(1) To evaluate the performance of AWGN channel with different vales of channel noise.
(2) To evaluate the performance of fading channel.
(3) Performance comparison of different communication channels (AWGN & fading).
(4) Explain what will be the impact of a communication channel on the performance of digital Communication system.

Assignment VI

Performance enhancement of digital communication system in presence of error correcting codes.

(1) To evaluate the performance of communication system without error control codes.
(2) To evaluate the performance of communication system with error control codes.
(3) Performance comparison of communication system with & without error control codes.