SCHEME OF COURSE WORK

Course Details:

Course Title	: DIGITAL COMMUNICATIONS		
Course Code	: 13EC1114	L T P C	4 0 0 3
Program	: B.Tech.		
Specialization	: ELECTRONICS AND COMMUNICATION ENGINEERING		
Semester	: V		
Prerequisites	: Communication system basics		
Courses to which it is a prerequisite	: Data Communications		

Course Outcomes (COs):

1	Comprehend Pulse Code Modulation and Delta Modulation.
2	Explain the Modulation and Demodulation methods of the Digital Modulation.
3	Evaluate the Error performance of Digital Modulation schemes.
4	Comprehend the efficiency of Source Coding Techniques.
5	Comprehend error detection and correction codes.

Course Outcome versus **Program Outcomes:**

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO-1	S	S	M	M	S							M
CO-2	S	S	S	S	S							S
CO-3	S	S	S	S	M							M
CO-4	S	S	S	S	S		M					M
CO-5	S	S	S	S	S						M	S

S - Strongly correlated, *M - Moderately* correlated, *Blank - No correlation*

Assessment Methods:	Assignment / Quiz / Seminar / Case Study / Mid-Test / End Exam

Teaching-Learning and Evaluation

WEEK	TOPIC / CONTENTS	Course Outcomes	Sample questions	Teaching-Learning Strategy	Assessment Method & Schedule
1	Introduction to Digital Communications. **PULSE DIGITAL MODULATION**: Elements of digital communication systems, Advantages of digital communication systems, Elements of PCM, Sampling.	**CO-1**	1. List out the advantages of Digital Communication over Analog Communication. 2. A PCM system uses a uniform quantizer followed by a υ bit encoder. Show that rms signal to quantization noise ratio is approximately given by $(1.8+6\upsilon)$dB 1. 3. Derive the expression for Quantization error in PCM.	Lecture/ Problem solving	Assignment I/Quiz-I/Mid-I
2	Quantization & Coding, Quantization error, Companding in PCM, systems, Differential PCM systems (DPCM).	**CO-1**	1. A signal x(t) is uniformly distributed in the range ± xmax. Calculate maximum signal to noise ratio for this signal. 2. Draw the Characteristics of Compander and write input and output relation for A-Law and μ-Law.	Lecture/ Problem solving	Assignment I/Quiz-I/Mid-I
3	**DELTA MODULATION**: Delta modulation, adaptive delta modulation, comparison of PCM and DM systems, Noise in PCM and DM systems.	**CO-1**	**1.** Consider a sine wave of frequency f_m and amplitude A_m applied to a delta modulator of step size Δ. Show that the slope overload distortion will occur if $A_m > \frac{\Delta}{2\pi f_m T_s}$ *where* T_s *is the sampling period* **2.** List out the differences between DM, ADM, PCM and DPCM.	Lecture/ Problem solving	Assignment I/Quiz-I/Mid-I
4	**DIGITAL CARRIER MODULATION TECHNIQUES**: Introduction, ASK, FSK, PSK	**CO-2**	1. Explain the modulation and demodulation techniques of ASK with necessary block diagrams. 2. Explain the modulation and demodulation techniques of FSK with necessary block diagrams. **3.** 3. Compare the performance of ASK, FSK and PSK.	Lecture/ Problem solving	Assignment I/Quiz-I/Mid-I

5	DPSK, QPSK, M-ary PSK, ASK, FSK, Similarity of BFSK and BPSK.	**CO-2**	1. Explain with the help of block diagram, the modulation and demodulation of DPSK signal schemes. 2. Compare the performance of DPSK with that of PSK.	Lecture/ Problem solving	Assignment I/Quiz-I/Mid-I
6	**DIGITAL DATA TRANSMISSION**: Base band signal receiver, Probability of error, The optimum filter, Matched filter	**CO-3**	1. Explain the operation of baseband signal receiver. 2. Derive the probability of error for Optimum Filter.	Lecture/ Problem solving	Assignment I/Quiz-I/Mid-I
7	Probability of error using matched filter, Coherent and Non-coherent detection of FSK	**CO-3**	1. Derive the probability of error for Matched Filter. 2. Explain the coherent and Non-Coherent detection of FSK.	Lecture/ Problem solving	Assignment I/Quiz-I/Mid-I
8	Calculation of error probability of ASK, BPSK, BFSK,QPSK	**CO-3**	1. Derive the probability of error for ASK. 2. Derive the probability of error for BPSK. 3. Derive the probability of error for BFSK. 4. Derive the probability of error for QPSK.	Lecture/ Problem solving	Assignment I/Quiz-I/Mid-I
9	**Mid-Test 1**				
10	**INFORMATION THEORY**: Discrete messages, Concept of amount of information and its properties, Average information.	**CO-4**	1. A three level signal has three characters s_1, s_2, and s_3 with probabilities $p_1= p_2$, and $p_3 =1/2$. Find the entropy of the source. 2. A source generates one of the five possible messages during each message interval. The probabilities of these messages are $P_1=1/2$, $P_2=1/16$, $P_3=1/8$, $P_4=1/4$ and $P_5=1/16$. Find the information content of each message.	Lecture/ Problem solving	Assignment I/Quiz-I/Mid-I

11	Entropy and its properties, Information rate, Mutual information and its properties.	**CO-4**	1. A message source generates eight message symbols $m_1, m_2, \ldots m_8$ with probabilities 0.25, 0.03, 0.19, 0.16, 0.11, 0.14, 0.08, 0.04 respectively. Give the Huffman code for these symbols and determine the entropy of the source and the average number of bits per symbol. 2. A binary source is emitting an independent sequence of 0's and 1's with probabilities P and 1-P, respectively. Plot the entropy of this source versus P($0<P<1$) 3. Prove that H(X, Y) = H(X) + H(YJX) .	Lecture/ Problem solving	Assignment I/Quiz-I/Mid-I
12	**SOURCE CODING**: Introduction Advantages Shannon's theorem Shanon-Fano coding	**CO-4**	1. An information source produces 8 different symbols with probabilities ½, ¼, 1/8, 1/16, 1/32, 1/64, 1/128, and 1/256 respectively. These symbols are encoded as 000,001,010,011,100,110, and 111 respectively. i. What is the amount of information per symbol? ii. What are the probabilities of occurring for P(0) and P(1)? iii. What is the efficiency of the code so obtained? iv. Give an efficient code with the help of the method of Shannon. v. What is the efficiency of the code after Shannon Fano code applied?	Lecture/ Problem solving	Assignment I/Quiz-I/Mid-I

13	Huffman coding, Efficiency calculations, Channel capacity of discrete and analog Channels	**CO-4**	1. For the following construct Huffman code and determine coding efficiency and redundancy. $P(m_1)=0.30$, $P(m_2)=0.25$, $P(m_3)=0.15$, $P(m_4)=0.12$, $P(m_5)=0.10$, $P(m_6)=0.08$, 2. A transmission channel has a bandwidth of 4 kHz and signal to noise power ratio is 31. i. How much should the bandwidth be in order to have the same channel capacity if S/N ratio is reduced to 15? ii. What will be the signal power required of the bandwidth is reduced to 3 kHz for the source channel capacity.	Lecture/ Problem solving	Assignment I/Quiz-I/Mid-I
14	Capacity of a Gaussian channel, Bandwidth –S/N trade off. **LINEAR BLOCK CODES**: Introduction, Matrix description of Linear Block codes, Error detection and error Correction capabilities of Linear block codes .	**CO-4**	1. A Gaussian channel has a bandwidth of 4 kHz and a two sideband noise power spectral density $\eta/2$ of 10^{-14} watts/Hz. The signal power at the receiver has to be maintained at a level less than or equal to 1/10 of a milliwatt. Calculate the capacity of the channel. 2. For the given generator matrix determine the possible code vectors i. $G = \begin{bmatrix} 1 & 0 & 0 & 0 & 1 & 1 \\ 0 & 1 & 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 1 & 1 & 0 \end{bmatrix}$ 3. Mention the error correction and error detection capabilities of Linear Block Codes.	Lecture/ Problem solving	Assignment I/Quiz-I/Mid-I
15	Hamming codes, Binary cyclic codes, Algebraic structure, Encoding and Syndrome	**CO-4**	1. For a (6,3) systematic linear block code the three parity check bits C_4, C_5, C_6 are formed from the following $c_4 = d_1 \oplus d_3$, $c_5 = d_1 \oplus d_2 \oplus$	Lecture/ Problem solving	Assignment I/Quiz-I/Mid-I

	calculation, BCH Codes.		d_3 *and* $c_6 = d_1 \oplus d_2$ Write down the generator matrix Construct all possible code words Find the location of error for R=010111 2. Explain the significance of syndrome calculation.		
16	**CONVOLUTION CODES**: Introduction, Encoding of convolution codes, Time domain approach, Graphical approach	**CO-5**	1. Explain the difference between Linear Block Codes and Convolution Codes. 2. Explain in detail about Time domain and Graphical approach for encoding of Convolution Codes.	Lecture/ Problem solving	Assignment I/Quiz-I/Mid-I
17	State, Tree, trellis diagram, decoding using Viterbi algorithm.	**CO-5**	1. Explain in detail about Convolution Codes. 2. Explain Viterbi algorithm with an example.	Lecture/ Problem solving	Assignment I/Quiz-I/Mid-I
18	**Mid-Test 2**				
19/20	**END EXAM**				

Course Co-ordinator Module Co-ordinator