Model Question Paper

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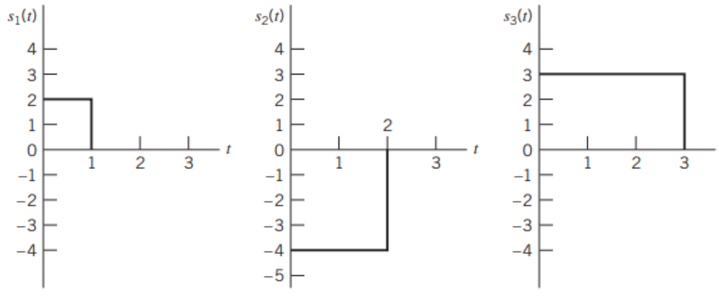
5^{th} Semester B.E. Degree Examination

Digital Communication

TIME: 03 Hours **Max. Marks: 100**

Note: Answer any **FIVE** full questions, choosing at least **ONE** question from each **MODULE**.

		Module -1	**Bloom's Taxonomy Level**	**COs**	**Marks**
Q.01	a	Define Hilbert transform. List the properties of the Hilbert transform.	L2	CO1	6
	b	Define pre-envelope and complex envelope of a real valued signal. Determine the pre-envelope and complex envelope of the RF pulse defined by $x(t) = A\ rect(t/T)\cos(2\pi f_c t)$	L2	CO1	6
	c	Explain the geometric representation of signals. Show that the energy of the signal is equal to squared length of the vector representing it.	L2	CO1	8
		OR			
Q.02	a	Express Bandpass signal s(t) in canonical form and polar form. Also express the relationship between Cartesian and Polar Representations of Band-Pass Signal	L2	CO1	6
	b	Using the Gram-Schmidt orthogonalization procedure, find a set of orthonormal basic functions to represent the three signals $s_1(t)$,$s_2(t)$ and $s_3(t)$ shown in figure. Also express each of these signals in terms of the set of basis functions. 	L2	CO1	6
	c	With neat diagram and expressions, explain the a. Correlation receiver b. Matched filter Receiver.	L2	CO1	8
		Module-2			
Q. 03	a	Define binary phase shift keying. Draw the transmitter and receiver block diagram and derive the probability of error or BER of the Coherent BPSK.	L2	CO2	8
	b	Binary data are transmitted over a microwave link at the rate of 10^6 bps and power spectral density of noise at the receiver input is 10^{-10} W/Hz. Find the average carrier power required to maintain an average probability of error $P_e \leq 10^{-4}$ for i)BPSK ii)DPSK {Ref: $Q(3.72) \leq 10^{-4}$}	L2	CO2	4

	c	Describe the QPSK signal with its signal space characterization. With a neat block diagram explain the generation and detection of QPSK signals	L2	CO2	8
OR					
Q.04	a	Define binary phase shift keying. Draw the transmitter and receiver block diagram and derive the probability of error or BER of the Coherent BPSK.	L2	CO2	8
	b	Binary data are transmitted over a microwave link at the rate of 10^6 bps and power spectral density of noise at the receiver input is 10^{-10} W/Hz. Find the average carrier power required to maintain an average probability of error $P_e \leq 10^{-4}$ for i)BPSK ii)DPSK {Ref: $Q(3.72) \leq 10^{-4}$}	L2	CO2	4
	c	Describe the QPSK signal with its signal space characterization. With a neat block diagram explain the generation and detection of QPSK signals	L2	CO2	8
Module-3					
Q. 05	a	Define the following terms with respect to information theory (i) Entrophy (ii) Self information (iii) Rate of Information (iv) Source efficiency (v)Channel Capacity	L2	CO3	5
	b	A zero memory has a source alphabet S = {S_1, S_2, S_3} with P = {1/2, 1/4, 1/4}. Construct second order source and compute its entropy. Verify that $H(S^2) = 2.H(S)$	L2	CO3	7
	c	Figure shows the Binary symmetric channel. Find H(X), H(Y), H(Y/X), H(X/Y),H(X,Y) and I(X,Y). Also find the rate of information transmission in bits/sec. Given P(X1) = 0.6 and P(X2) = 0.4 and rs = 1000symbols/sec	L2	CO3	8
OR					
Q. 06	a	A DMS emits symbols from the source alphabet S = {S_1,S_2,S_3,S_4,S_5,S_6,S_7} with P = { 0.25, 0.25, 0.125, 0.125, 0.125, 0.0625, 0.0625}. Compute: (i) H(S) (ii) $H(S)_{max}$ (iii) Information rate R if r_s = 5 symbols/sec.	L2	CO3	6
	b	State the following along with relevant equations: (a) Source coding theorem (b) Channel Coding theorm (c) Information Capacity Law	L2	CO3	6
	c	A Source has an alphabet S = {s1, s2, s3, s4, s5, s6} with statistics P ={1/3, 1/8, 1/4,1/8, 1/12, 1/12}. Construct a Huffman code by placing the composite symbol "as high as possible" and compute the efficiency.	L2	CO3	8
Module-4					
Q. 07	a	For a(6,3) linear block code, the check bits are related to the message bits as per the equations given below : C4 = d1+d2, C5 = d1+d2+d3, C6 = d2+d3 i) Obtain G and H matrix ii) Find all the possible code words. iii) Find the minimum distance of the code. iv) If the received code is [110101], detect and correct the error.	L3	CO4	10
	b	The generator polynomial of a (7,4) cyclic code is g(x) = 1+x+x2. Obtain the code polynomial in systematic form for the input sequences [1001] and [1011]. Draw the encoder circuit for the same. If the received vector is 1110101, draw the syndrome calculation circuit. Find the syndrome by listing the states of the registers.	L3	CO5	10

OR					
Q. 08	a	Design a linear block code with minimum distance dmin = 3 and message length of 4 bits.	L3	CO4	4
	b	For a systematic (7,4) linear block code, the parity matrix is given by $P = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 1 \end{bmatrix}$ (i) Find all the possible code words (ii) Find the error detecting and error correcting capabilities of the code.	L3	CO4	6
	c	A generator polynomial for a (15,7)cyclic code is $g(x) = 1+x^4 +x^6 +x^7+ x^8$. Find the code vector for the message $D(x) = x^2+x^3+x^4$. Also find the syndrome of the received polynomial $r(x) = 1+x+x^3+ x^6+ x^8+ x^9+ x^{11}+ x^{14}$ and draw the syndrome calculation circuit.	L3	CO5	10
Module-5					
Q. 09	a	For the convolution encoder with a code rate r=1/3, constraint length v=3 and the impulse responses g(1) = {1,1,0}, g(2) = {1, 0,1} and g(2) = {1, 1,1}. (i) Draw the convolutional encoder diagram (ii) Draw the State diagram (iii) Trace the path through the state diagram that corresponds to the message sequence m = {1 1 1 0 1}	L3	CO5	12
	b	Write the step by step procedure for decoding of convolution codes using Viterbi algorithm	L3	CO5	8
OR					
Q. 10	a	For the convolution encoder with a code rate r=1/2, constraint length K=4 and the impulse responses g(1) = {1,1,1,1} and g(2) = {1, 1,0,1}, find the code C for the message m = {1 0 1 11} and draw the convolutional encoder diagram.	L3	CO5	10
	b	For the convolution encoder with a code rate r=1/2, constraint length K=3 and the impulse responses g(1) = {1,1,1} and g(2) = {1, 0,1}, Apply the Viterbi algorithm for the received sequence 1000100000.. and compute the decoded sequence.	L3	CO5	10