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CBCS SCHEME

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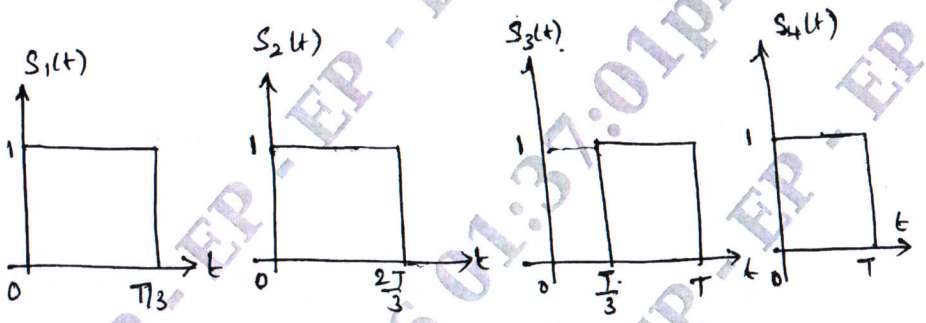
BEC503

Fifth Semester B.E./B.Tech. Degree Examination, June/July 2026
Digital Communication

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	Discuss the application of Hilbert Transform. Show that a signal g(t) and its Hilbert transform $\hat{g}(t)$ are orthogonal over the entire time interval $(-\infty,+\infty)$	07	L2	CO1
	b.	Define pre-envelope of a real valued signal. Given a bandpass signal S(t), sketch the amplitude spectra of a signal S(t), pre-envelope $S_l(t)$ and complex envelope $\tilde{S}(t)$.	07	L2	CO1
	c.	With neat diagram discuss the synthesizer and analyser of generating and reconstruction of signal.	06	L3	CO1
		OR			
Q.2	a.	Consider the signal $S_1(t)$, $S_2(t)$ and $S_3(t)$ as given in Fig.Q2(a).  Fig.Q2(a) Evaluate an orthogonal basis for these set of signals using Gram-Schmidt orthogonalization. Also plot graph. Express each signals interms of basis functions.	15	L3	CO1
	b.	Suppose $S_1(t)$, $S_2(t)$ and $S_3(t)$ are represented with reference to two orthogonal basis functions as given $S_1(t) = 3\phi_1(t)$; $S_2(t) = -2\phi_1(t) + 3\phi_2(t)$; $S_3(t) = -3\phi_1(t) - 3\phi_2(t)$ then construct the corresponding signal constellation diagram.	05	L3	CO2
		Module – 2			
Q.3	a.	With a block diagram, discuss coherent QPSK transmitter and receiver.	06	L3	CO2
	b.	Describe the signal space representation for BPSK modulation. Obtain the expression for average probability of symbol error for BPSK using coherent detection.	10	L3	CO2
	c.	Compute the constellation of QAM for M = 16 and draw the signal space diagram.	04	L2	CO2

OR

Q.4	**a.**	A binary data stream is encoded using DPSK. Determine the encoded and decoded output for the sequence 1 1 0 1 0 0 0 1 1	**04**	**L2**	**CO2**
	b.	Illustrate the generation and detection of DPSK signal with neat diagram.	**10**	**L2**	**CO2**
	c.	Define Bandwidth Efficiency. Tabulate and comment on the bandwidth efficiency of M-ary PSK signals for different values of M.	**06**	**L2**	**CO2**

Module – 3

Q.5	**a.**	Outline the mutual information of the channel. Mention its properties and also define Channel Capacity.	**08**	**L2**	**CO3**
	b.	The output of an information source contains 160 symbols 128 of which occur with a probability of 1/256 and remaining with a probability of 1/64 each. Calculate the average information rate of the source if the source emits 10,000 sym/sec.	**06**	**L2**	**CO3**
	c.	Briefly explain Self Information, Entropy and Information Rate.	**06**	**L2**	**CO3**

OR

Q.6	**a.**	(i) Apply Huffman encoding procedure for the following set of messages and determine the efficiency of the binary code so formed.	**12**	**L3**	**CO3**

x_1	x_2	x_3
0.7	0.15	0.15

(ii) If the same technique is applied to the 2nd order extension for the above message. How much will the efficiency be improved?

	b.	Consider the following source $S = \{x_1, x_2, x_3, x_4, x_5, x_6\}$ with respective probabilities $P = \{0.4, 0.2, 0.2, 0.1, 0.07, 0.03\}$. Compute the code words for the symbols using Shannon's Fano encoding algorithm. Also find the code efficiency and redundancy.	**08**	**L3**	**CO3**

Module – 4

Q.7	**a.**	Indicate the advantages and disadvantages of Error Control Coding.	**04**	**L2**	**CO4**
	b.	For a systematic (6, 3) LBC the parity matrix P is given by $[P] = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 1 \\ 1 & 1 & 0 \end{bmatrix}$ Obtain the possible code vector.	**06**	**L2**	**CO4**
	c.	Consider a (6, 3) LBC whose generator matrix is $G = \begin{bmatrix} 1 & 0 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & 1 & 0 \\ 0 & 0 & 1 & 0 & 1 & 1 \end{bmatrix}$ Calculate the (i) all code vector (ii) Hamming weight and distance (iii) Minimum weight parity check matrix (iv) Draw the encoder circuit for the above codes.	**10**	**L3**	**CO4**

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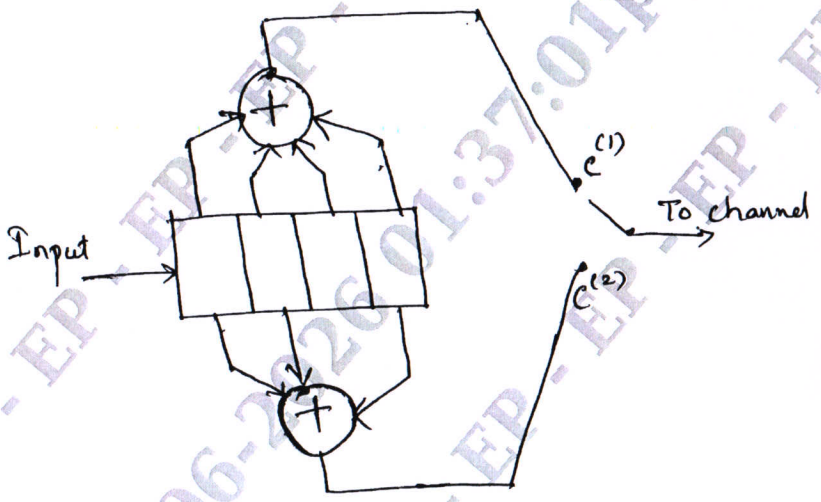
		OR			
Q.8	**a.**	Design an encoder circuit for (7, 4) binary cyclic code generated by $g(x) = 1 + x + x^3$ and verify its operation using message vector (1 0 0 1).	**08**	**L3**	**CO4**
	b.	A (15, 5) cyclic code has a generator polynomial $g(x) = 1 + x + x^2 + x^4 + x^5 + x^8 + x^{10}$ (i) Draw the block diagram of an encoder and syndrome calculator for this code. (ii) Express the code polynomial for the message polynomial $D(x) = 1 + x^2 + x^4$ in systematic form.	**12**	**L3**	**CO4**
		Module – 5			
Q.9	**a.**	Consider (3, 1, 2) convolution code with $g^{(1)} = (1\ 1\ 0)$; $g^{(2)} = (1\ 0\ 1)$ and $g^{(3)} = (1\ 1\ 1)$. (i) Draw the encoder block diagram (ii) Compute the generator matrix (iii) Represent the code word corresponding to the information sequence (1 1 1 0 1) using time domain and transfer domain approach.	**14**	**L3**	**CO5**
	b.	For the convolutional encoder shown in Fig.Q9(b) represent the impulse response and hence calculate the output produced by the information sequence 10111.  Fig.Q9(b)	**06**	**L3**	**CO5**
		OR			
Q.10		For a (3, 1, 2) convolutional encoder with $g^{(1)} = (1\ 1\ 0)$; $g^{(2)} = (1\ 0\ 1)$ and $g^{(3)} = (1\ 1\ 1)$ (i) Write state table (ii) Write the state transition table (iii) Draw state diagram and find the encoder output produced by the message sequence (1 1 1 0 1) by traversing through the state. (iv) Draw code tree and find the encoder output produced by the message sequence (1 1 1 0 1) by traversing through the code. (v) Draw code Trellis and obtain the output of the encoder for the same input sequence of (1 1 1 0 1).	**20**	**L3**	**CO5**

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