U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

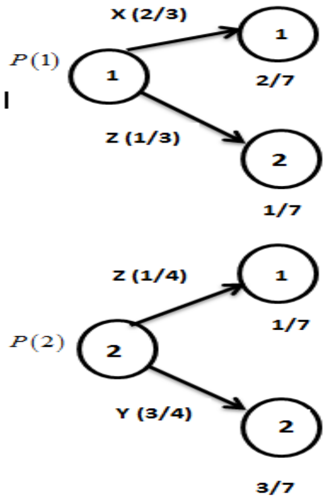
Autonomous Institute Affiliated to VTU

January / February 2025 Semester End Main Examinations

Programme: B.E. **Semester: V**
Branch: Electronics and Telecommunication Engineering **Duration: 3 hrs.**
Course Code: 22ET5PCCS2 **Max Marks: 100**
Course: Communication system-2

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	*CO*	*PO*	**Marks**
1	a)	Prove that the Entropy attains a maximum value when all the source symbols are Equiprobable	*CO2*	*PO1*	**05**
	b)	The Probability of the output symbols are given below. Arrive at the probability of the input symbols and obtain the Joint probability matrix. Calculate H (A), H (B), H (A, B), H (A/B), H (B/A) and I (A, B). $P(b_1) = \frac{1}{5} + \frac{3}{40} + 0 + 0 + 0$ $P(b_2) = 0 + \frac{9}{40} + \frac{1}{15} + 0 + 0$ $P(b_3) = 0 + 0 + \frac{2}{15} + \frac{1}{30} + \frac{1}{5}$ $P(b_4) = 0 + 0 + 0 + \frac{1}{15} + 0$	*CO2*	*PO2*	**07**
	c)	The probabilities and the states at the end of the first symbol interval are given in the figure below. Compute the State probabilities and obtain the state diagram. Extend the tree diagram at the end of the second symbol interval and prove that $G_2 > H$. 	*CO2*	*PO2*	**08**

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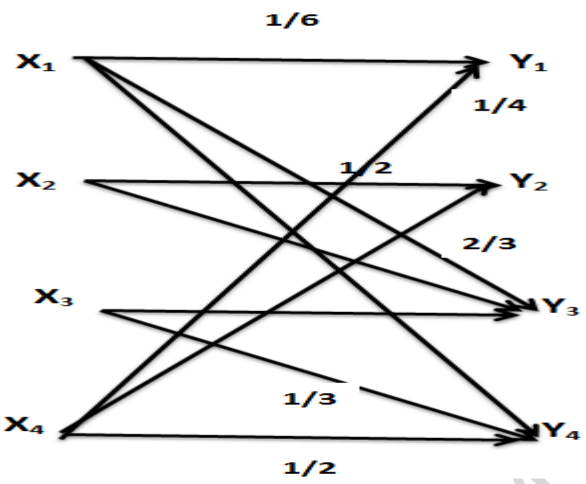
			OR			
	2	a)	The channel diagram of the source is given. Compute the missing probabilities and obtain the channel matrix. Calculate H(X), H(Y), H(X,Y) and I(X,Y) given $P(X_1) = P(X_3) = 0.3$ and $P(X_2) = P(X_4) = 0.2$, P(Y1/X1)= 1/6, P(Y3/X1)= 2/3, P(Y2/X2)= 1/2, P(Y4/X3)= 1/3 P(Y4/X4)= 1/2 and P(Y1/X4) = P(Y2/X4)  	CO2	PO2	**10**
		b)	A black and white TV picture consists of 525 lines of picture information. Assume that each line consists of 525 picture elements (pixels) and that each element can have 256 brightness levels. Pictures are repeated at the rate of 30 frames/sec. Calculate the average rate of information conveyed by a TV set to a viewer.	CO2	PO2	**05**
		c)	A source has a Source alphabet S = {S1, S2, S3} with P= {1/2, 1/4, 1/4}. Find the entropy of this source. Also determine the entropy of its 2nd extension and verify that $H(S^2)= 2\ H(S)$	CO2	PO2	**05**
			UNIT - II			
	3	a)	Obtain an expression for the Channel capacity of Symmetric/Uniform channel.	CO2	PO1	**05**
		b)	A source produces two symbols with probabilities 7/8 and 1/8 respectively. Device a coding scheme using Shannon-Fano encoding procedure to get a coding efficiency of at least 75%	CO2	PO1	**07**
		c)	The source emits 5 symbols A, B, C, D and E. The probability of Occurrence of the symbol A is (6/16). The following sequences are given $\alpha_1 = 0,\ \alpha_2 = \frac{6}{16},\ \alpha_3 = \frac{10}{16},\ \alpha_4 = \frac{13}{16},\ \alpha_5 = \frac{15}{16}$ and $\alpha_6 = 1.$ Compute the probabilities of B, C, D and E. Obtain the Shannon binary encoding algorithm for the source and calculate the efficiency of the source and redundancy.	CO2	PO2	**08**
			OR			
	4	a)	State and prove Noiseless Coding Theorem	CO2	PO1	**06**

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<table>
<tr><td></td><td>b)</td><td>Consider a source with 8 alphabets A to H with respective probabilities of 0.22, 0.20, 0.18, 0.15, 0.10, 0.08, 0.05 and 0.02. Construct a binary Huffman code and determine the efficiency.</td><td>CO2</td><td>PO1</td><td>07</td></tr>
<tr><td></td><td>c)</td><td>Consider the cascading of two BSC channels with one channel having the following noise matrix.
$$P(Y/X) = \begin{bmatrix} 0.8 & 0.2 \\ 0.2 & 0.8 \end{bmatrix}$$
The second channel has the conditional probability of P (Z1/Y1) = 0.4. Obtain the other conditional probabilities and noise matrix P (Z/Y).
(i) Find the noise matrix of the cascaded channel
(ii) Find I (X, Y) and I (X, Z)</td><td>CO2</td><td>PO2</td><td>07</td></tr>
<tr><td></td><td></td><td>UNIT - III</td><td></td><td></td><td></td></tr>
<tr><td>5</td><td>a)</td><td>For a systematic (7, 4) LBC, the parity matrix is given below. Draw the Encoding and Syndrome Calculation circuit. An error has occurred in the received Vector R = [1011100]. Detect and correct the error.
$$\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 1 \end{bmatrix}$$</td><td>CO4</td><td>PO2</td><td>09</td></tr>
<tr><td></td><td>b)</td><td>Prove that $CH^T = 0$, where C is a valid Code vector and H^T is the transpose of the parity check matrix.</td><td>CO4</td><td>PO2</td><td>04</td></tr>
<tr><td></td><td>c)</td><td>Design an encoder for (n, k) binary cyclic code generated by $g(x) = 1+ X+X^2+X^4+X^5+X^8+X^{10}$. Identify ‘n’ for 5 message bits. Compute the input message for the encoder by considering the content of the shift register given below.
<table>
<tr><td rowspan="2">No of Shifts</td><td rowspan="2">Input</td><td colspan="10">Shift Register Contents</td></tr>
<tr><td>R_0</td><td>R_1</td><td>R_2</td><td>R_3</td><td>R_4</td><td>R_5</td><td>R_6</td><td>R_7</td><td>R_8</td><td>R_9</td></tr>
<tr><td colspan="2">Initialization</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>1</td><td>?</td><td>1</td><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td><td>0</td></tr>
<tr><td>2</td><td>?</td><td>0</td><td>1</td><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>3</td><td>?</td><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td></tr>
<tr><td>4</td><td>?</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td><td>0</td></tr>
<tr><td>5</td><td>?</td><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>1</td></tr>
</table></td><td>CO4</td><td>PO3</td><td>07</td></tr>
<tr><td></td><td></td><td>OR</td><td></td><td></td><td></td></tr>
<tr><td>6)</td><td>a)</td><td>A linear hamming code is described by the generator polynomial $g (D) = 1+X+X^3$.
Determine the Generator and the Parity check matrix.</td><td>CO3</td><td>PO2</td><td>05</td></tr>
<tr><td></td><td>b)</td><td>Device a feedback shift register encoding circuit for a (15, 7) cyclic code generated by the polynomial $g(x) = 1+x^4+x^6+x^7+x^8$.
(i) Find the code vector for the message polynomial $d(x) = x^2+x^3+x^4$ in systematic form.</td><td>CO4</td><td>PO2</td><td>07</td></tr>
</table>

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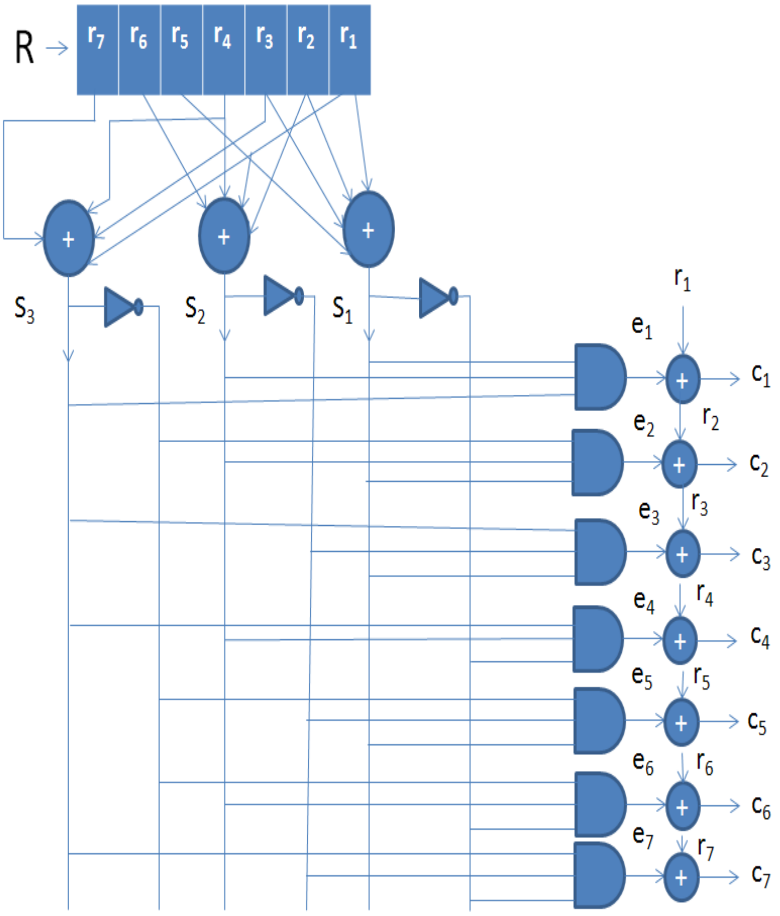
			(ii) Assume the first and the last bit of the code vector suffers transmission errors. Find the syndrome of code vector.			
		c)	Design an encoder for (n, k) binary code given Decoding circuit. Identify the n and K values and obtain Parity Check matrix, Parity matrix, Generator matrix and Generate code words for all the possible combinations.  	*CO4*	*PO3*	**08**
			UNIT - IV			
	7	a)	For a (3, 1, 2) convolutional code, with $g^{(1)} = 110$, $g^{(2)} = 101$ and $g^{(3)} = 111$. (i) Draw the encoder block diagram. (ii) Find the generator matrix. (iii) Find the code word corresponding to the information sequence 11101 using time domain and transform domain approach.	*CO3*	*PO2*	**10**
		b)	For the binary convolutional encoder (2, 1, 2) given below, If the received vector is [11 11 10 01 10 01 11] decode the input sequence using Viterbi Decoding	*CO4*	*PO3*	**10**

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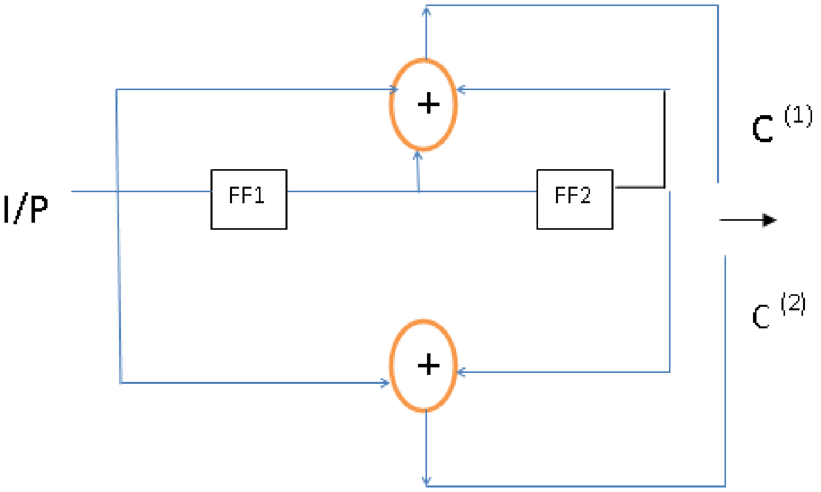
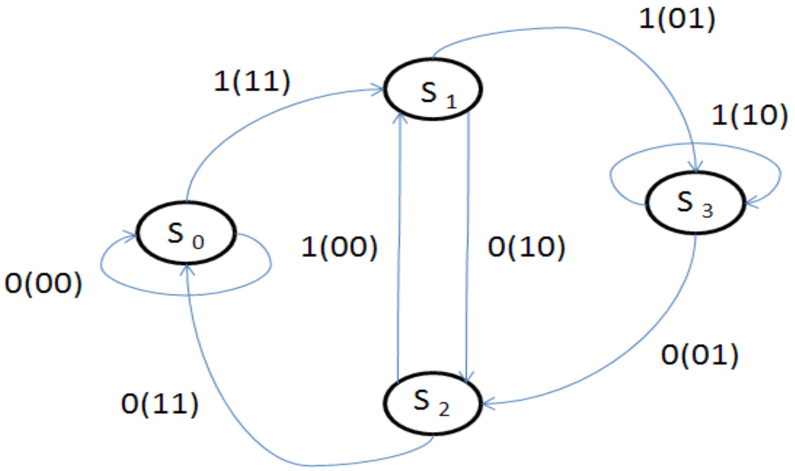
						
			OR			
	8	a)	For the state diagram given, Arrive at the state transition table and draw the encoder block diagram. [HINT: $C^{(1)} = d_l + d_{(l-1)}+d_{(l-2)}$ and $C^{(2)} = d_l + d_{(l-2)}$] 	*CO4*	*PO3*	**07**
		b)	Consider the (2, 1, 2) convolutional code with $g^{(1)} = 111$ and $g^{(2)} = 101$. (i) Find the encoded sequence for the message 10111 by tracing the path through the code tree.	*CO3*	*PO2*	**07**
		c)	For a convolutional code, with $g^{(1)} = 1\ 1\ 0$, $g^{(2)} = 1\ 0\ 1$ and $g^{(3)} = 0\ 1\ 1$. (i) Find the generator matrix. (ii) Find the code word corresponding to the information sequence 1 1 1 0 1 using time domain and transform domain approach.	*CO3*	*PO2*	**06**
			UNIT - V			
	9	a)	Describe the Pseudo noise sequences and Discuss the properties of the Maximum length sequence	*CO2*	*PO1*	**08**
		b)	Briefly describe the generation and detection of the QPSK modulation	*CO2*	*PO1*	**07**

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		c)	For the binary sequence 110010, Sketch the transmitted signal for the DPSK modulation.	*CO2*	*PO1*	**05**
			OR			
	10	a)	Briefly describe the generation and detection of the BPSK modulation	*CO2*	*PO1*	**10**
		b)	Briefly describe the generation and detection of the OFDM modulation	*CO2*	*PO1*	**10**

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