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

Autonomous Institute Affiliated to VTU

June / July 2025 Semester End Main Examinations

Programme: B.E. **Semester: V**

Branch: Electronics & Telecommunication Engineering **Duration: 3 hrs.**

Course Code: 22ET5PCCS2 **Max Marks: 100**

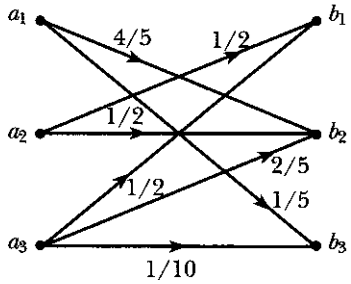
Course: COMMUNICATION SYSTEMS – 2

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

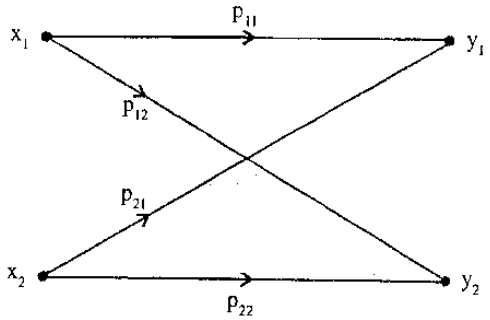
REAPPEAR EXAMS 2024-25

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)	For a discrete memoryless source emitting symbols in an independent sequence, show that the entropy of the source is maximum when all its output symbols are equiprobable.	*CO2*	*PO2*	**06**
	b)	In a bolt factory, machines A, B and C manufacture 25%, 35% and 40% of the total output respectively. Of their outputs, 5%, 4% and 2% respectively are defective bolts. A bolt is chosen at random and is found to be defective. What is the probability that the bolt came from machine A?, B? and C ?	*CO2*	*PO2*	**06**
	c)	Design an information system which gives the information that every year for about 200 students passing out with B.E. in ETE from VTU. The students are found to get into the following: i. Go abroad for higher studies → A ii. Join MBA or civil services → B iii. Join industries in India → C Based on the above information, construct the model for the source and find the source entropy. a. On the average 100 students go abroad b. Out of 100 going abroad this year, 50 were reported going abroad next year, while 25 each went to MBA and Civil services or joined industries in India. c. Out of 100 remaining in India this year, 50 continued to do so while 50 went abroad next year. Those joining MBA or Civil Services or Industry could not swap the two fields next year.	*CO2*	*PO1*	**08**
		OR			
2	a)	Define and derive an expression for Average information of long independent source.	*CO2*	*PO2*	**06**
	b)	Three newspapers A, B and C are published in a city and a survey of readers indicate the following: 20% read A, 16% read B, 14% read C, 8% read A and B, 5% read A and C, 2% read A B and C, 4% read B and C. For one adult chosen at random, compute the probability that:	*CO2*	*PO2*	**06**

			i. The reader reads none of the papers ii. The reader reads exactly one of the papers The reader reads atleast A and B knowing that the reader reads atleast one of the papers published			
		c)	Students graduating from an engineering college in Telecommunication show the following tendency: Some go abroad for higher studies, some join companies in India and the remaining become entrepreneurs with the percentage as follows: (i) 50% of those who went abroad for higher studies will return to India out of which 80% join companies and the remaining become entrepreneurs. (ii) Among those who remained in India 80% go abroad for higher studies. (iii) Those who had remained in India cannot swap their fields. Based on the information given above, construct a suitable model and determine the entropy of the source of information.	*CO2*	*PO2*	**08**
			UNIT - II			
	3	a)	State and prove Kraft inequality.	*CO2*	*PO1*	**06**
		b)	Consider the three input-output channel shown in the figure below with $P(a_1) = 9/27$, $P(a_2) = 16/27$ and $P(a_3) = 2/27$. Determine H(A), H(B), H(A,B), H(B/A) and H(A/B).  	*CO2*	*PO1*	**08**
		c)	Consider a discrete memoryless source emitting six symbols with probabilities {0.1, 0.1, 0.2, 0.1, 0.1, 0.2, 0.1, 0.1}. i. Compute a binary Huffman code by moving the combined symbol as high as possible and thereby determine the average codeword length and variance of the codeword length over the group of letters. ii. Repeat (i) by moving the combined symbol as low as possible and thereby determine the average codeword length and variance of the codeword length over the group of letters.	*CO2*	*PO1*	**06**
			OR			
	4	a)	Explain the Non-singular property and optimal code property of source coding with an example each.	*CO1*		**06**
		b)	Consider a binary input-output channel shown below:	*CO2*	*PO1*	**06**

REAPPR... MS 2024-25

			 Consider $P(x_1) = P(x_2) = 0.5$. $P_{11} = 0.7$, $P_{22} = 0.6$ i. Find the Channel matrix of the channel ii. Find the probabilities $P(y_1)$ and $P(y_2)$ iii. Find $P(x_1,y_1)$ and $P(x_2, y_1)$			
	c)	The output of a source consists of letters x_1,x_2,x_3,x_4,x_5 and x_6 with corresponding probabilities {1/3, 1/4, 1/8, 1/8, 1/12, 1/12}. Construct compact Huffman code for the source by taking the code alphabet A = {0, 1, 2} and also find η_c and E	*CO2*	*PO1*	**08**
		UNIT - III			
5	a)	Prove that the minimum distance of a LBC is the smallest Hamming weight of a non-zero codeword in the code.	*CO2*	*PO1*	**04**
	b)	For a systematic (6,3) linear block code, the parity matrix P is given by $P=\begin{pmatrix}1 & 0 & 1\\ 0 & 1 & 1\\ 1 & 1 & 0\end{pmatrix}$ i. Find all the possible code vectors. ii. Draw the encoder circuit iii. Construct the corresponding syndrome calculation circuit for the received vector R={r1 r2 r3 r4 r5 r6 } iv. Draw the error correcting circuit	*CO2*	*PO2*	**10**
	c)	A (5, 1) repetition code has G = [1 1 1 1 1] i. Construct the parity check matrix ii. Find the syndrome S for all possible single error patterns	*CO2*	*PO2*	**06**
		OR			
6	a)	Define and list the properties of Cyclic code.	*CO1*		**06**
	b)	For the (7,4) single error correcting cyclic code $D(x) = d_o+d_1x+d_2 x^2+d_3 x^3$ Using the generator polynomial $g(x)= 1+x +x\ 3$.Find the code vectors for the message data in both non – systematic and systematic form. i. $D = (d_0\ d_1\ d_2\ d_3) = (1\ 1\ 1\ 0)$ ii. $D = (1\ 0\ 0\ 1)$	*CO2*	*PO1*	**10**
	c)	Consider a single error correcting code for a message block of size 11. i. How many check bits are required? ii. Find a parity check matrix for this code.	*CO2*	*PO1*	**04**

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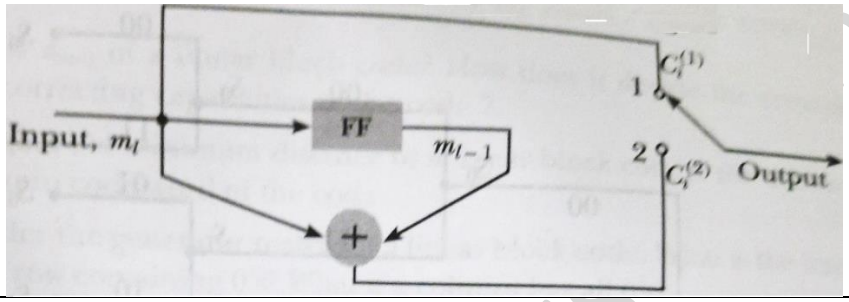
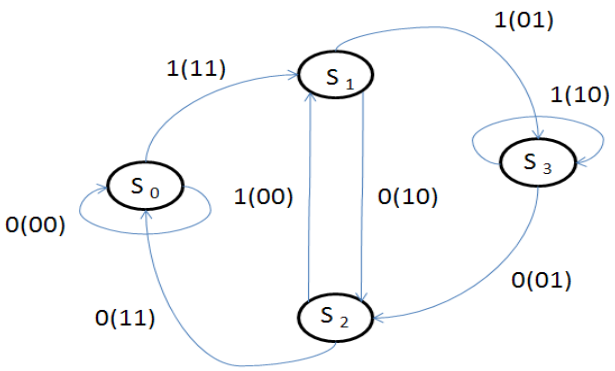
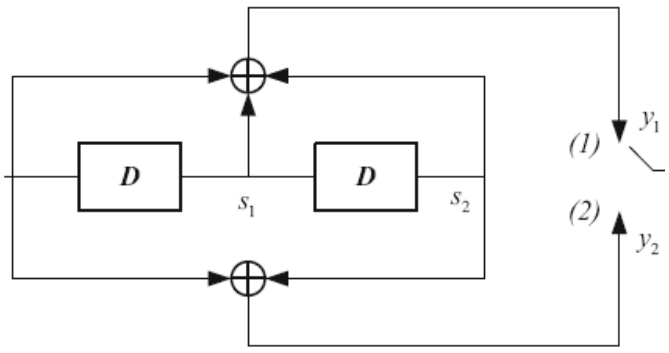
			UNIT - IV			
	7	a)	Consider a (3, 1, 2) convolutional code with $g^{(1)}$ = (1 1 0), $g^{(2)}$ = (1 0 1) and $g^{(3)}$ = (1 1 1). (i) Draw the encoder block diagram (ii) Find the generator matrix. (iii) Find the code word corresponding to the information sequence (1 1 1 0 1) using both time domain and transform domain approach. (iv) Draw the state diagram and the corresponding code tree.	*CO2*	*PO2*	**15**
		b)	For the given convolutional encoder below: i. Draw the state diagram ii. Draw the tree diagram iii. Find the free distance of this code 	*CO2*	*PO2*	**05**
			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*	**10**
		b)	For the given convolutional encoder if the received vector is 01010101010111, obtain the input by tracing the path through Viterbi decoding. 	*CO2*	*PO2*	**10**

			UNIT - V			
	9	a)	Sketch the in-phase and quadrature components of a QPSK signal for the binary sequence **1 1 0 0 1 0 1 1 1**. Assume that the carrier frequency $f_c = 1/T_b$ and choose appropriate basis functions.	*CO2*	*PO1*	**10**
		b)	A three stage LFSR generates the sequence **0 1 0 1 1 1 0 0 1 0 1 1 1 1 0** … i. Determine the period of the given infinite sequence ii. Verify the three properties of the PN sequence for the given sequence	*CO2*	*PO1*	**10**
			OR			
	10	a)	Briefly describe the generation and detection of the BPSK modulation	*CO2*	*PO1*	**10**
		b)	A binary data stream **$\{b_k\}$ = 0 1 0 0 1 0 0 1 1** is to be transmitted using DPSK. Choose **d_{-1} = 0**. Determine the DPSK output along with the phase for each bit.	*CO2*	*PO1*	**10**

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