Model Question Paper -1 with effect from 2020-21(CBCS Scheme)

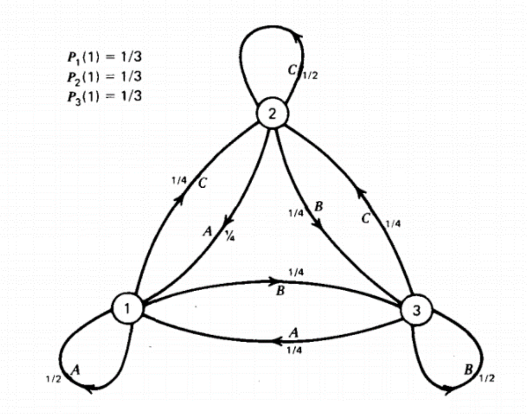
USN | | | | | | | | | |

Fifth Semester B.E. Degree Examination

Information Theory and Coding

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

Note: 01. Answer any **FIVE** full questions, choosing at least **ONE** question from each **MODULE**.
02.
03.

		Module – 1	
Q.1	**(a)**	Define (i) Self information Also justify why to take logarithmic function for measurement of self-information? (ii)Entropy (iii)Rate of source	6
	(b)	(i) State the properties of entropy (ii) Drive an expression for average information content of symbols in long independent sequence.	8
	(c)	The international Morse code uses a sequence of dots and dashes to transmit letters of the English alphabet. The dash is represented by a current pulse that has a duration of 3 units and the dot has a duration of 1 unit. The probability of occurrence of a dash is l of the probability of occurrence of a dot. (i) Calculate the information content of a dot and a dash. (ii) Calculate the average information in the dot-dash code. (iii) Assume that the dot lasts 1 msec, which is the same time interval as the pause between symbols. Find the average rate of information transmission.	6
		OR	
Q.2	**(a)**	For the markov source shown below find i) State entropies ii)Source entropy iii) G1 G2 and show that G1≥G2≥H(s). 	10
	(b)	Prove that entropy of zero memory extension source is given by $H(S^n)=nH(S)$.	5
	(c)	A binary source is emitting an independent sequence of O's and 1 's with probabilities p and 1 - p, respectively. Plot the entropy of this source versus p (0 < P < 1).	5
		Module – 2	
	(a)	State and prove source encoding theorem	8
	(b)	A Memory less source emits six messages with probabilities {0.4, 0.2, 0.2, 0.1, 0.1}. Find the Shannon - Fano code and determine its efficiency	6

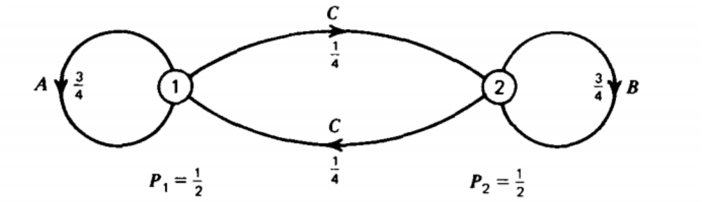
Q.3 **(c)** Construct the Huffman code with minimum code variance for the following probabilities and also determine the code variance and code efficiency: {0.25, 0.25. 0.125, 0.125, 0.125, 0.0625, 0.0625} — 6

OR

Q.4

(a) State and prove Kraft McMillan Inequality — 10

(b) Design a source encoder using Shannon encoding algorithm for the information source given Compare the average output bit rate and efficiency of the coder for N = 1 and 2 — 10



(c)

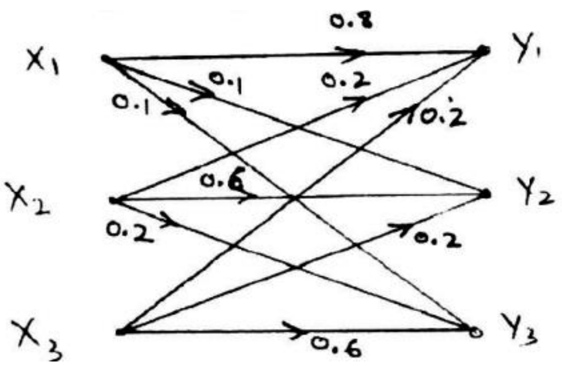
Module – 3

Q.5

(a) What is mutual information? Mention its properties. — 4

(b) Discuss the Binary Erasure Channel and also derive channel capacity equation for BEC — 8

(c) The noise characteristics of a channel as shown below. Find the capacity of a channel if r_s=2000 symbols/sec using Muroga's method. — 8



OR

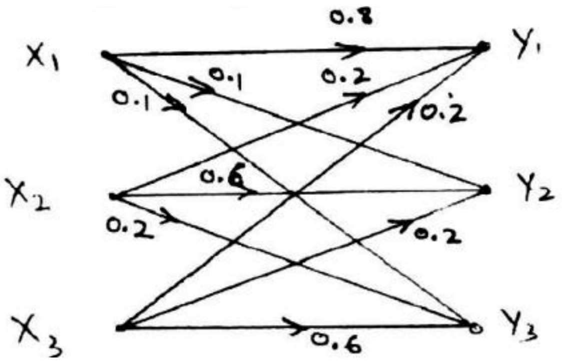
Q.6

(a) What is joint probability matrix? State its properties — 4

(b) Find the Channel capacity of the channel with channel matrix shown below — 6

$$= \begin{array}{c} \\ x_1 \\ x_2 \\ x_3 \\ x_4 \end{array} \begin{array}{c} \begin{array}{cccc} y_1 & y_2 & y_3 & y_4 \end{array} \\ \begin{bmatrix} 0.2 & 0 & 0 & 0.05 \\ 0 & 0.15 & 0.15 & 0 \\ 0 & 0 & 0.10 & 0.05 \\ 0.10 & 0.10 & 0 & 0.10 \end{bmatrix} \end{array}$$

(c) Consider that two sources emit messages xl , x2, x3 and y1, y2, y3 with the joint probabilities p (X, Y) as shown in the matrix form: — 10



		(i) Calculate the entropies of X and Y. (ii) Calculate the joint and conditional entropies, H (X,Y), H (X/Y), H(Y/X) between X and Y (iii) Calculate the average mutual information I(X;Y).	
		Module – 4	
Q.7	**(a)**	Consider a (6,3) linear block code whose generator matrix is given by $\begin{bmatrix} 1 & 0 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & 1 & 0 \\ 0 & 0 & 1 & 0 & 1 & 1 \end{bmatrix}$ (i) Find the parity check matrix. (ii) Find the minimum distance of the code. (iii) Draw the encoder and syndrome computation circuit.	10
	(b)	In a (15,5) cyclic code, the generator polynomial is given by : $g(X) = 1+X+X^2+X^4+X^5+X^8 + X^{10}$ (i) Draw the block diagram of encoder and syndrome calculator. (ii) Find whether $r(X) = 1+X^4+X^6+X^8+X^{14}$ a valid code word or not.	10
	(c)		
		OR	
Q.8	**(a)**	Define G and H matrix and show that $CH^T = 0$.	5
	(b)	Design a linear block code with a minimum distance of 3 and a message block size of 8 bits.	5
	(c)	The generator polynomial of a (7,4) cyclic code is $g(x) = 1 + x + x^3$, find the 16 code words of this code by forming the code polynomials V(x) using $V(x) = D(x)g(x)$, where D(x) is the message polynomial.	10
		Module – 5	
Q.9	**(a)**	Explain general form of a decoder for cyclic codes with error correction procedure	8
	(b)	For (2,1,3) Convolution Encoder with $g^{(1)}=1101$, $g^{(1)}=1011$ (i) Write transition table (ii) State diagram (iii) Draw the code tree (iv) Draw the trellis diagram (v) Find the encoded output for the message(11101) by traversing the code tree	12
	(c)		

OR			
Q.10	(a)	Consider a (3,1,2) Convolution Encoder with $g^{(1)}$=110, $g^{(1)}$=101 and $g^{(1)}$=111 (i) Draw the encoder diagram (ii) Find the code word for the message sequence (11101) using Generator Matrix and Transform domain approach.	15
	(b)	Explain Viterbi decoding	5
	(c)		

Table showing the Bloom's Taxonomy Level, Course Outcome and Programme Outcome				
Question		**Bloom's Taxonomy Level attached**	**Course Outcome**	**Programme Outcome**
Q.1	(a)	L1	CO1	PO1,PO2
	(b)	L1	CO1	PO1,PO2
	(c)	L2	CO1	PO1,PO2
Q.2	(a)	L2	CO1	PO1,PO2
	(b)	L1	CO1	PO1,PO2
	(c)	L2	CO1	PO1,PO2
Q.3	(a)	L1	CO2	PO1,PO2,PO3
	(b)	L2	CO2	PO1,PO2,PO3
	(c)	L3	CO2	PO1,PO2,PO3
Q.4	(a)	L1	CO2	PO1,PO2,PO3
	(b)	L2	CO2	PO1,PO2,PO3
	(c)			
Q.5	(a)	L1	CO3	PO1,PO2,PO3
	(b)	L2	CO3	PO1,PO2,PO3
	(c)	L3	CO3	PO1,PO2,PO3
Q.6	(a)	L1	CO3	PO1,PO2,PO3
	(b)	L3	CO3	PO1,PO2,PO3
	(c)	L3	CO3	PO1,PO2,PO3
Q.7	(a)	L2	CO4	PO1,PO2,PO3
	(b)	L3	CO4	PO1,PO2,PO3
	(c)			
Q.8	(a)	L1	CO4	PO1,PO2,PO3
	(b)	L3	CO4	PO1,PO2,PO3
	(c)	L2	CO4	PO1,PO2,PO3
Q.9	(a)	L1	CO5	PO1,PO2,PO3,PO4
	(b)	L2	CO5	PO1,PO2,PO3,PO4
	(c)			
Q.10	(a)	L2	CO5	PO1,PO2,PO3,PO4
	(b)	L1	CO5	PO1,PO2,PO3,PO4
	(c)			

Bloom's Taxonomy Levels	**Lower order thinking skills**		
	Remembering(knowledge): L_1	Understanding Comprehension): L_2	Applying (Application): L_3
	Higher order thinking skills		
	Analyzing (Analysis): L_4	Valuating (Evaluation): L_5	Creating (Synthesis): L_6