C033613(033)

B. Tech. (Sixth Semester) Examination, April-May 2022

(AICTE Scheme)

(IT Engg. Branch)

INFORMATION THEORY and CODING

Paper : (BT-3033)

Time Allowed : Three hours

*Maximum Marks : 100*

Minimum Pass Marks : 35

Note : *Attempt all questions. Part (a) of each question is compulsory and carries 4 marks. Attempt any **two** parts from (b), (c) and (d) of each question, and each part carries 8 marks.*

Unit-I

1. (a) Define Logarithmic Measure of Information.

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(b) Explain a digital communication system with block diagram.

(c) Write short note on average mutual information. Define and write the expression for conditional and joint entropies.

(d) Find the channel capacity and mutual information shown in figure $P(X_1) = \cdot3$ and $P(X_2) = \cdot7$.
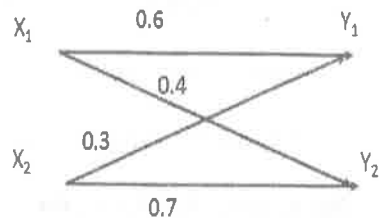
Unit-II

2. (a) Any event has 6 possible outcomes with the probabilities

$P1 = 1/2, P2 = 1/4, P3 = 1/8, P4 = 1/16, P5 = 1/32,$

$P6 = 1/32.$

Find the entropy of the system.

$A = 1/2, B = 1/4, C = 1/8, D = 1/16, E = 1/16$

Find the entropy.

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[3]

(b) Descrete source transmits messages x_1, x_2 and x_3 with the probabilities 0·3, 0·4, 0·3. The source is connected to channels given in the figure. Calculate the entropies $H(X)$, $H(Y)$, $H(X, Y)$, $H(X/Y)$, $H(Y/X)$. Also find the transferred information.
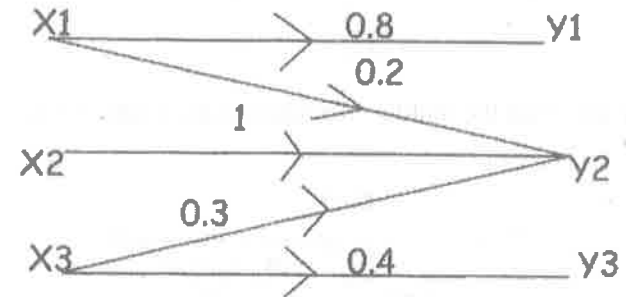
(c) For the given channel matrix find out the mutual information

$P(X1) = 0·6, \ P(X2) = 0·3, \ P(X3) = 0·1$

$$P(Y/X) = \begin{bmatrix} 1/2 & 1/2 & 0 \\ 1/2 & 0 & 1/2 \\ 0 & 1/2 & 1/2 \end{bmatrix}$$

(d) Apply the Shannon-Fano coding procedure for the following message ensemble : Take $M = 2$

$[X] = [\ x1 \quad x2 \quad x3 \quad x4 \quad x5 \quad x6 \quad x7 \quad x8\ ]$

$[Y] = [\ 1/4 \quad 1/8 \quad 1/16 \quad 1/16 \quad 1/16 \quad 1/4 \quad 1/16 \quad 1/8\ ]$

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Unit-III
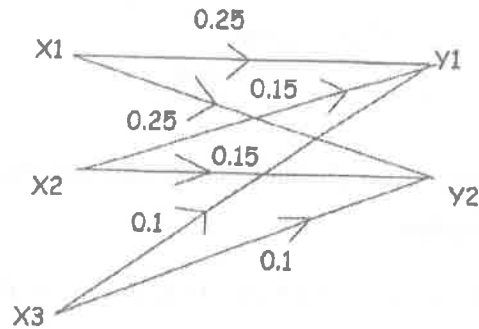
3. (a) Write short notes on following :
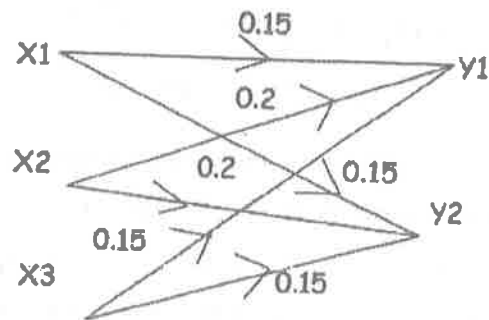
    (i) Noise Free channel

    (ii) Cascaded channels

(b) What is S/N trade off? Prove that

$$C = 1 \cdot 44 \, S/\eta$$

(c) (i) Find the mutual information for the channel given below :

(ii) Find the mutual information of the given channel :

(d) Define Channel Capacity, Channel efficiency and Redundancy with respect to Information Theory.

Unit-IV

4. (a) Parity Check Matrix of a particluar (7, 4) linear block code is given by :

$$\begin{bmatrix} 1110100 \\ 1101010 \\ 1011001 \end{bmatrix}$$

Find the Generator Matrix (G).

(b) For a (6, 3) block code, the generator matrix is given by :

$$G = \begin{bmatrix} 100111 \\ 010011 \\ 001110 \end{bmatrix}$$

    (i) Construct all possible codeword.

    (ii) If received codeword $R = [\,010111\,]$. Find the transmitted codeword.

(c) The General Polynomial of a (7, 4) cyclic code is

$$G(x) = 1 + x + x3 .$$ Find all 16 codewords for this code.

(d) Explain Hamming Distance. Write the Final code after encoding data (1111) into 7 bit Hamming Code format.

Unit-V

5. (a) What is the difference between block code and convolutional code explains with example.

(b) Draw the Encoder for convolutional code explain with state transition diagram and table for that encoder.

(c) Explain two error detecting and two error correcting block code with example.

(d) What do you mean by cyclic code? The generator polynomial of a $(7, 4)$ cyclic code is $g(x) = 1 + x + x3$. Find all the code words of this code.