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B. E. (Sixth Semester) Examination, April-May 2020

(New Scheme)

(Information Technology Engg. Branch)

INFORMATION THEORY & CODING

Time Allowed : Three hours

Maximum Marks : 80

Minimum Pass Marks : 28

Note : *All questions are compulsory. Part (a) is compulsory and attempt any two from (b), (c) and (d).*

1. (a) Define uncertainty. 2

(b) What is entropy? Derive formula for entropy and show that the Entropy is maximum when all the messages are equi-probable, Assume $M = 2$. 7

(c) Draw the block diagram of Communication System and explain each block. 7

(d) An analog signal is band limited to B Hz and sampled at nyquist rate. The samples are quantized into 4 Levels. Each level represents one message. Thus there are 4 messages. The probabilities of occurance of these 4 level are $P_1 = P_4 = 1/8$ and $P_2 = P_3 = 3/8$. Find out information rate of the source. 7

2. (a) Define rate of information transmission across the channel. 2

(b) What is Mutual Information? Prove that : 7

(i) $I(X, Y) = H(X) - H(X/Y)$

(ii) $I(X, Y) = H(Y) - H(Y/X)$

(c) Encode the following messages with their respective probability using Shanon-Fano Coding Algorithm.

M_1	M_2	M_3	M_4	M_5	M_6	M_7	M_8
1/4	1/8	1/16	1/16	1/16	1/4	1/16	1/8

Calcuate the efficiency of coding and comment on the result. 7

(d) Apply Huffman coding Procedure for the following message ensemble : 7

$[X] = [x_1, x_2, x_3, x_4, x_5, x_6, x_7]$

$[P] = [0{\cdot}4, 0{\cdot}2, 0{\cdot}12, 0{\cdot}08, 0{\cdot}08, 0{\cdot}08, 0{\cdot}04]$

Take $M = 2$ and find the efficiency of the code.

3. (a) State channel capacity theorem. 2

(b) Write short notes on : (any **three**) 7

(i) Binary Communication Channel

(ii) BEC

(iii) Binary symmetric channel

(iv) State and prove the upper bound and lower bound of Entropy

(c) Explain the capacity of gaussian channel : Shanon-Hartley Theorem. Explain trade off between BW and signal to noise ration. 7

(d) Find the channel capacity of cascaded channel shown in fig. 1. 7

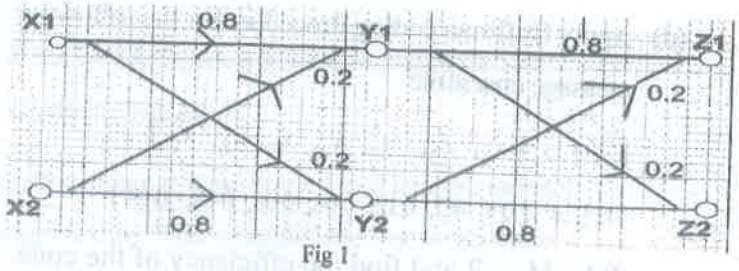

Fig 1

4. (a) What is meant by systematic and non systematic codes? 2

(b) The generator matrix for a (6, 3) Linear block code is given below. Find all the code vectors. 7

$$G = \begin{matrix} 1 & 0 & 0 & : & 0 & 1 & 1 \\ 0 & 1 & 0 & : & 1 & 0 & 1 \\ 0 & 0 & 1 & : & 1 & 1 & 0 \end{matrix}$$

(i) Find all the code vectors

(ii) Find all hamming weights and distances

(iii) Find minimum weight parity check matrix

(iv) Draw the encoder circuit

(c) Explain Syndrome decoding with example. How errors can be corrected and detected with the use of it? 7

(d) Consider the generator of a (7, 4) cyclic code by generator polynomial

$$G(P) = 1 + P + P^3$$

Calculate all the code vectors for the code in systematic form. 7

5. (a) What is error control code? 2

(b) Explain convolutional code functionality. 7

(c) A rate 1/3 convolutional encoder has generating vectors as $g_1 = (100), g_2 = (111), g_3 = (101)$.

(A) (i) Sketch the encoder configuration

(ii) Draw state diagram

Or

(B) (i) Find output sequence for the input sequence $m = 10110$. 7

(d) Write short note on : (any **two**)

(i) Viterbi Algorithm for Decoding of Convolutional Codes.

(ii) Turbo Codes

(iii) Trellis and State Diagram 7