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Paper Id: 131415 Roll No. | | | | | | | | | |

B. TECH
(SEM. IV) THEORY EXAMINATION 2017-18
INFORMATION THEORY AND CODING

Time: 3 Hours *Total Marks: 70*

Note: 1. Attempt all Sections.
2. Assume any missing data.

SECTION A

1. Attempt *all* questions in brief. 2 x 7 = 14

a. Prove the statement stated as under: "If a receiver knows the message being transmitted, the amount of information carried will be zero."
b. What is entropy? Explain.
c. Explain Kraft-Mcmillan Equality?
d. What is channel matrix and channel diagram of BSC?
e. What is channel capacity theorem?
f. Explain the advantages of cyclic codes.
g. Write short note on Golay codes?

SECTION B

2. Attempt any *three* of the following: 7 x 3 = 21

a. Given a noiseless channel with m input symbols and m output symbols as shown in figure. Prove that H(X) = H(Y) and H(Y|X) = 0.
b. A DMS X has seven symbols with probabilities $P(x_1)=0.4$, $P(x_2)=0.2$, $P(x_3)=0.12$, $P(x_4)=0.08$, $P(x_5)=0.08$ & $P(x_6)=0.08$ & $P(x_7)=0.04$. Construct a Shannon-Fano code for X and calculate the code efficiency.
c. Given a binary symmetric channel (BSC) with $P(x_1) = \alpha$ & $P(x_2) = 1- \alpha$.

i) Show that the mutual information I(X;Y) is given by
$$I(X;Y) = H(Y) + p \log_2 p + (1- p) \log_2 (1 - p)$$
ii) Calculate I(X;Y) for $\alpha = 0.5$ and $p = 0.1$

d. Given a (7,4) linear block code with the following parity check matrix H:

$$H = \begin{bmatrix} 1\,1\,1\,0 : 1\,0\,0 \\ 1\,1\,0\,1 : 0\,1\,0 \\ 1\,0\,1\,1 : 0\,0\,1 \end{bmatrix}$$

(i) Find the Generator matrix G.
(ii) Find all code vectors.
(iii) What will the minimum distance between code vectors?
(iv) How many errors can be detected? How many errors can be corrected?

e. Explain BCH codes, RS codes and Shortened cyclic codes.

SECTION C

3. Attempt any one parts of the following: 7 x 1 = 7

a. Given a telegraph source having two symbols, dot and dash. The dot duration is 0.2s. The dash duration is 3 times the dot duration. The probability of the dot's occurring is twice that of the dash, and the time between symbols is 0.2s. Calculate the information rate of the telegraph source.

b. What is Mutual information? Explain its different properties with proper example.

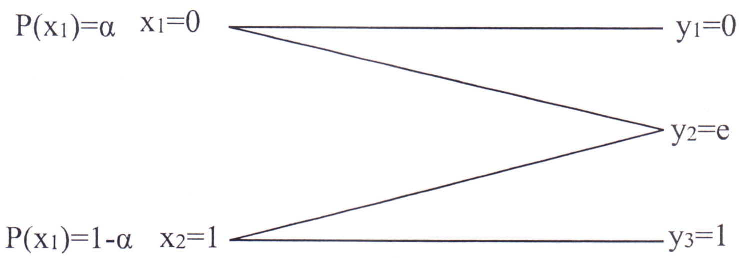
4. Attempt any one parts of the following: **7 x 1 = 7**

a) A DMS X has six symbol x_1, x_2, x_3, x_4, x_5 & x_6 with probabilities $P(x_1)=0.3$, $P(x_2)=0.25$, $P(x_3)=0.2$, $P(x_4)=0.1$, $P(x_5)=0.1$ & $P(x_6)=0.05$. Construct a Huffman code for X and calculate the code efficiency.

b) Explain the block code and its properties in detail.

5. Attempt any one parts of the following: **7 x 1 = 7**

a) Find the channel capacity of binary erasure channel of blow figure.



b) Explain different types of channels with their channel matrix and channel diagram.

6. Attempt any one parts of the following: **7 x 1 = 7**

a) Write different methods of Error Detection. Explain with the help of suitable examples.

b) A (6,3) linear block code is generated according to the following generator matrix G:

$$G = \begin{bmatrix} 1\ 0\ 0 : 1\ 0\ 1 \\ 0\ 1\ 0 : 0\ 1\ 1 \\ 0\ 0\ 1 : 1\ 1\ 0 \end{bmatrix}$$

For a particular code word transmitted, the received code word is 100011. Find the corresponding data word transmitted.

7. Attempt any one parts of the following: **7 x 1 = 7**

a) Explain Convolution Code? Describe generator matrix for convolution code.

b) Consider the (7,4) Hamming code defined by the generator polynomial

$$g(X) = 1+X+X^3$$

The code word 0111001 is sent over a noisy channel, producing the received word 0101001 that has a single error. Determine the syndrome polynomial s(X) for this received word, and show that it is identical to the error polynomial e(X)