Fifth Semester B.E. Degree Examination, Jan./Feb. 2021
Information Theory and Coding

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO full questions from each part.***

PART – A

1 a. Define:
   i) Self Information
   ii) Average Information
   iii) Information rate. **(06 Marks)**

b. Find relationship between Hartleys, nats and bits. **(06 Marks)**

c. A code is composed of dots and dashes. Assuming that a dash is 3 times as long as a dot and has one-third the probability of occurrence. Calculate:
   i) The information in a dot and a dash
   ii) The entropy of dot-dash code
   iii) The average rate of information if a dot lasts for 10 m-sec and this time is allowed between symbols. **(08 Marks)**

2 a. Explain the important properties of codes to be considered while encoding source with examples. **(08 Marks)**

b. Apply Shannon's encoding algorithm to the following set of messages and obtain code efficiency and redundancy. Write code tree for the code. **(12 Marks)**

M_1	M_2	M_3	M_4	M_5
1/8	1/16	3/16	1/4	3/8

3 a. Consider a source with 8 alphabets A to H with respective probabilities of 0.22, 0.20, 0.18, 0.15, 0.10, 0.08, 0.05, 0.02. i) Construct a binary compact code and determine the code efficiency ii) Construct a ternary compact code and determine the efficiency of the code. Compare and comment on the result. Draw code tree for all cases. **(12 Marks)**

b. A transmitter transmits 5 symbols with probabilities 0.2, 0.3, 0.2, 0.1 and 0.2. Given the channel matrix P(B/A), calculate: i) H(B) ii) H(A.B). **(08 Marks)**

$$P(B/A) = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 1/4 & 3/4 & 0 & 0 \\ 0 & 1/3 & 2/3 & 0 \\ 0 & 0 & 1/3 & 2/3 \\ 0 & 0 & 1 & 0 \end{bmatrix}$$

4 a. Find the capacity of the discrete channel shown in Fig.Q.4(a).

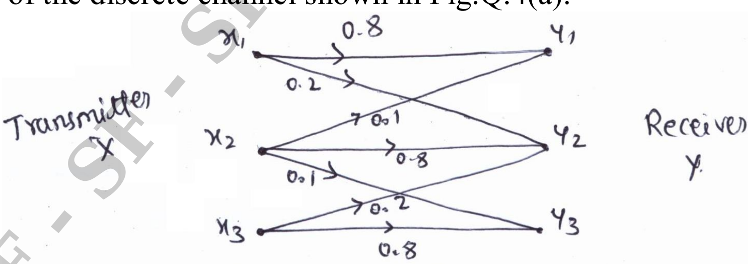

Fig.Q.4(a) **(10 Marks)**

b. State and explain the Shannon-Hartley law. Obtain an expression for the maximum capacity of a continuous channel. **(10 Marks)**

PART – B

5 a. If C is a valid code-vector then prove that $CH^T = 0$ where H^T is the transpose of the parity check matrix H. **(06 Marks)**

b. For a systematic (6, 3) linear block code. The parity matrix 'P' is given by $P = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 1 \\ 1 & 1 & 0 \end{bmatrix}$

i) Find all possible code-vectors
ii) Construct the corresponding encoding circuit
iii) The received code-vector R = [1 1 0 0 1 0]. Detect and correct the single error that occurred due to noise.
iv) The received vector $R = [r_1, r_2, r_3, r_4, r_5, r_6]$ construct the corresponding syndrome calculation circuit. **(14 Marks)**

6 a. Define cyclic code. Explain how cyclic codes are generated from the generating polynomials. **(06 Marks)**

b. A (15, 5) linear cyclic code has a generator polynomial $g(x) = 1 + x + x^2 + x^4 + x^5 + x^8 + x^{10}$
i) Draw the block diagram of an encoder and syndrome calculator for this code.
ii) Find the code polynomial for the message polynomial $D(x) = 1 + x^2 + x^4$ in systematic form.
iii) Is $v(x) = 1 + x^4 + x^6 + x^8 + x^{14}$ a code polynomial. **(14 Marks)**

7 Write a short note on:
a. RS code
b. BCH code
c. Golay code
d. Burst error correcting code. **(20 Marks)**

8 Consider the (3, 1, 2) convolutional code with $g^{(1)} = (1, 1, 0)$, $g^{(2)} = 101$ and $g^{(3)} = 111$
a. Draw the encoder block diagram
b. Find the generator matrix
c. Find the code-word corresponding to the information sequence (11101) using Time-domain and transfer domain approach. **(20 Marks)**

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