USN ☐☐☐☐☐☐☐☐☐☐

10TE65

Sixth Semester B.E. Degree Examination, June/July 2018
Information Theory and Coding

Time: 3 hrs.   Max. Marks:100

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

PART – A

1 a. The state diagram of a Markoff source is as shown in the Fig.Q1(a). Given $P(1) = P(2) = P(3) = 1/3$. Find (i) Entropy of each state (ii) Entropy of source (iii) G_1, G_2 & G_3. **(12 Marks)**
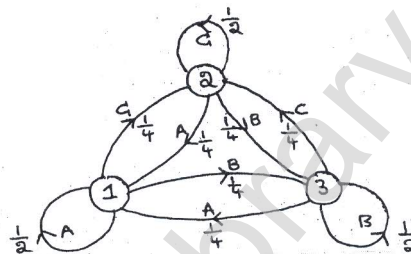

Fig.Q1(a)

   b. Define : (i) Amount of Information (ii) Average source information rate. **(04 Marks)**
   c. Derive an expression for Average Information Content of symbols in long independent sequences. **(04 Marks)**

2 a. Construct the Shanon's code and Efficiency for the following using Shanon's binary encoding procedure:
   $$S = \{A, B, C, D, E\} \ ; \qquad P = \left\{\frac{1}{4}, \frac{1}{8}, \frac{1}{8}, \frac{3}{16}, \frac{5}{16}\right\}.$$ **(10 Marks)**

   b. For the Binary Symmetric channel shown in Fig.Q2(b), find the rate of information transmission over the channel when p = 0.9 and 0.8. Given the symbol rate is 1000/sec and $P(x = 0) = \frac{1}{2}$ and $P(x = 1) = \frac{1}{2}$. **(05 Marks)**
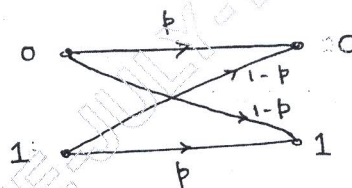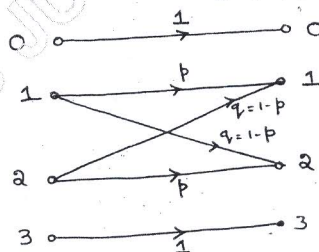

Fig.Q2(b)

   c. Given the Discrete channel as shown in Fig.Q2(c).

$P(x = 0) = P$
$P(x = 1) = Q$
$P(x = 2) = Q$
$P(x = 3) = P$

Fig.Q2(c)

   Calculate the capacity of the Discrete channel. Assume $r_s = 1$ symbol/sec. **(05 Marks)**

3 a. What is source encoding? Compare variable length coding versus Fixed-length coding.
(06 Marks)

b. State Kraft-McMillan Inequality. Explain the same with respect to the prefix code.
(02 Marks)

c. For the IPM shown in Table Q3(c) below, find H(A), H(B), H(A, B), H(A/B), H(B/A) and I(A, B).

Table Q3(c) $P(A, B) = \begin{bmatrix} 0.05 & 0 & 0.20 & 0.05 \\ 0 & 0.1 & 0.1 & 0 \\ 0 & 0 & 0.20 & 0.1 \\ 0.05 & 0.05 & 0 & 0.1 \end{bmatrix}$
(12 Marks)

4 a. Given $S = \{s_1, s_2, s_3, s_4, s_5, s_6, s_7\}$ and $P = \left\{\dfrac{9}{32}, \dfrac{3}{32}, \dfrac{3}{32}, \dfrac{2}{32}, \dfrac{9}{32}, \dfrac{3}{32}, \dfrac{3}{32}\right\}$.

$X = \{0, 1, 2, 3\}$ and $X = \{0, 1\}$.

Design Quaternary and binary source code. Also find the coding efficiency. **(12 Marks)**

b. State channel coding theorem. **(02 Marks)**

c. If $f_X(x)$ = probability density function of continuous random variable X, $f_{x,y}(x, y)$ = Joint probability density function of X and Y, $f_x(x/y)$ = conditional probability density function of X. Define (i) h(x) i.e., Differential entropy of X, (ii) Mutual Information between X and Y i.e., I(X, Y) (iii) conditional differential entropy of X i.e, h(X/Y) **(06 Marks)**

PART – B

5 a. Explain the Matrix Description of Linear Block codes. **(05 Marks)**

b. Give the Generator Matrix in Table 5(b).

Table 5(b) $G = \begin{bmatrix} 1 & 0 & 0 & 0 & \vdots & 1 & 1 & 1 \\ 0 & 1 & 0 & 0 & \vdots & 1 & 1 & 0 \\ 0 & 0 & 1 & 0 & \vdots & 1 & 0 & 1 \\ 0 & 0 & 0 & 1 & \vdots & 0 & 1 & 1 \end{bmatrix}$

(i) Find all the code vectors.
(ii) Find the parity check matrix.
(iii) Find the minimum weight of this code. **(10 Marks)**

c. Why do we need error control coding? What are the types of errors and types of coding to combat them? **(05 Marks)**

6 a. The generator polynomial of a (7, 4) cyclic code is $g(x) = 1 + x + x^3$. Find the 16 codewords of this code. **(08 Marks)**

b. Describe the encoding of cyclic codes using (n – k) bit shift register with a neat diagram. **(08 Marks)**

c. Write short note on BCH code. **(04 Marks)**

7 Write short notes on :
(i) RS codes
(ii) Shortened cyclic code
(iii) Golay code
(iv) q burst_error_correcting code. **(20 Marks)**

8 a. Explain the difference between block codes and convolution codes. **(06 Marks)**

b. For the convolution encoder shown in Fig.Q8(b), if the information sequence D = 10011, find the output sequence using
   (i) Time Domain approach
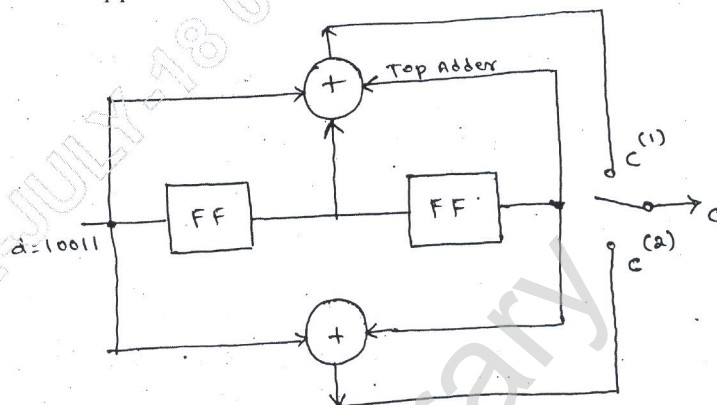   (ii) Transform Domain approach **(14 Marks)**

Fig.Q8(b)

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