ONE TIME EXIT SCHEME

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10EC55

# Fifth Semester B.E. Degree Examination, April 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. Consider the symbols $S_1$, $S_2$, $S_3$ with the probabilities of $\frac{1}{4}$, $\frac{1}{2}$ and $\frac{1}{4}$. Show that $H(s^2) = 2H(s)$. **(04 Marks)**

b. For the given first order Markov source in Fig.Q1(b) find :
i) State probabilities
ii) Entropy of each state
iii) Entropy of the source
iv) Find $G_1$ and $G_2$. **(12 Marks)**

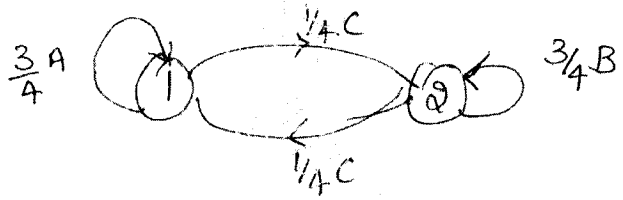


Fig.Q1(b)

c. A black and white TV picture consists of 526 lines of picture information. Assume that each line consists of 526 picture elements (pixels) and that each can have 255 brightness levels. Picture is repeated at the rate of 30 frames/sec calculate the average rate of information conveyed by a TV set to a viewer. **(04 Marks)**

2 a. Explain all the properties of entropy. **(05 Marks)**

b. Derive an expression for the average information content of long independent message. **(05 Marks)**

c. A source emits an independent sequence of symbols from an alphabet consisting of five symbols A, B, C, D, E with probabilities $\frac{1}{4}, \frac{1}{8}, \frac{1}{8}, \frac{3}{16}$ and $\frac{5}{16}$ respectively. Find the Shannon binary code for each of the symbols and also find efficiency and redundancy of the coding scheme using Shannon source coding theorem. Draw decision tree for the obtained code. **(10 Marks)**

3 a. Show that $H(x, y) = H(x) + H(y/x)$. **(05 Marks)**

b. For the given channel matrix compute individually H(x), H(y), H(x, y), H(y/x), H(x/y) and I(x/y). Given : $P(x_1) = 0.3$, $P(x_2) = 0.2$, $P(x_3) = 0.3$, $P(x_4) = 0.2$.

$$P(y/x) = \begin{bmatrix} 1/6 & 0 & 2/3 & 1/6 \\ 0 & 1/2 & 1/2 & 0 \\ 0 & 0 & 2/3 & 1/3 \\ 1/4 & 1/4 & 0 & 1/2 \end{bmatrix}.$$ **(10 Marks)**

c. Compute the channel capacity of a binary erasure channel with $r_s = 1$ symbol/sec. **(05 Marks)**

4 a. A discrete memoryless source has an alphabet of five symbols with their probabilities a given below :

| Symbols | $S_0$ | $S_1$ | $S_2$ | $S_3$ | $S_4$ |
|---|---|---|---|---|---|
| Probabilities | 0.55 | 0.15 | 0.15 | 0.10 | 0.05 |

Compute two different Huffman binary codes for this source. Find :
i) The average code word length
ii) The efficiency and redundancy. **(10 Marks**

b. State and explain Shannon Hartley law. Derive the expression for the upper limit of th channel capacity. **(05 Marks**

c. The voice grade channel of the telephone network has the bandwidth of 3.4 KHz calculate:
i) The channel capacity for a SNR of 30 db
ii) The minimum SNR required to support
Information transmission at the rate of 4800bits/sec. **(05 Marks**

## PART – B

5 a. If 'C' is a valid code vector, then prove that $CH^T = 0$ where $H^T$ is transpose of parity chec matrix H. **(05 Marks**

b. The generator matrix of a linear block code is given by:

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

i) Find all possible valid code vectors
ii) Find parity check matrix
iii) Find minimum distance
iv) Draw encoding circuit
v) Draw syndrome calculation circuit. **(15 Marks**

6 a. A (15, 5) linear cyclic has a generator polynomial,
$g(x) = 1 \oplus x \oplus x^2 \oplus x^4 \oplus x^5 \oplus x^8 \oplus x^{10}$
i) Draw block diagram of an encoder and syndrome calculator circuit for this code
ii) Find the code polynomial for the message polynomial $D(x) = 1 \oplus x^2 \oplus x^4$ (in a systemati form)
iii) Is $V(x) = 1 \oplus x^4 \oplus x^6 \oplus x^8 \oplus x^{14}$ a code polynomial? If not, find the syndrome of V(x). **(16 Marks**

b. Consider a (7, 4) binary cyclic code generated by $g(x) = 1 + x + x^2 + x^4$. Find its generat matrix. **(04 Marks**

7 a. Write short notes on : i) BCH code ii) Reed Solomon code. **(10 Marks**

b. Discuss properties of mutual information. **(10 Marks**

8 a. Consider the (3, 1, 2) convolutional code with $g^1 = 110$, $g^2 = 101$, $g^3 = 111$.
i) Draw the encoder block diagram
ii) Find the generator matrix
iii) Find the code word corresponding to the information sequence (1 1 0 1) using tim domain and transform domain approach. **(16 Marks**

b. List out the difference between block codes and convolution code. **(02 Marks**

c. Define the following :
i) Average information
ii) Information rate. **(02 Marks**