USN

10EC55

Fifth Semester B.E. Degree Examination, June/July 2013
Information Theory and Coding

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. The state diagram, of the stationary Markoff source is shown in the Fig. Q1 (a) below, find the average information rate for the source if symbol rate of source is 1/sec. **(10 Marks)**

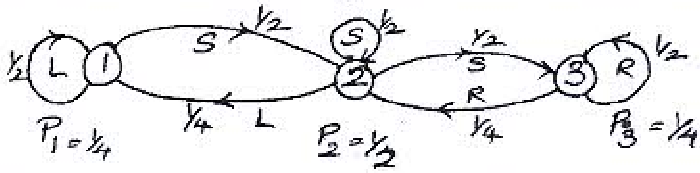

Fig. Q1 (a)

b. Show that the entropy of n^{th} extension of a zero memory source 's' is $H(S^n) = nH(S)$. **(06 Marks)**

c. What is the dependence of H on the probabilities of messages? Plot entropy versus probability of a source with two symbols 0 and 1. **(04 Marks)**

2 a. State Shannon's source encoding theorem and list out the properties of codes using Shannon's encoding algorithm. **(06 Marks)**

b. The source emits messages consisting of 2 symbols each as per table given below. Design a source encoder using Shannon's encoding algorithm and find code efficiency and redundancy. **(08 Marks)**

Symbol	AA	AC	CC	CB	CA	BC	BB
Probability	$\frac{9}{32}$	$\frac{3}{32}$	$\frac{1}{16}$	$\frac{3}{32}$	$\frac{3}{32}$	$\frac{3}{32}$	$\frac{9}{32}$

c. An analog signal is band limited as 4 kHz. It is sampled at 2.5 times an Nyquist rate and each sample is quantized to 256 levels. These levels are equally likely to occur. The samples are assumed to be statistically independent. Find information rate of the sampled signal. **(06 Marks)**

3 a. For a channel whose matrix is given below:

$$P\left(\frac{Y}{X}\right) = X\begin{bmatrix} 0.6 & 0.2 & 0.2 \\ 0.2 & 0.6 & 0.2 \\ 0.2 & 0.2 & 0.6 \end{bmatrix}$$

Find I(X:Y) and channel capacity given the input symbol occur with equal probabilities. **(06 Marks)**

b. Prove that $H(X, Y) = H(X/Y) + H(Y) = H(Y/X) + H(X)$ **(04 Marks)**

c. For the Markoff source model shown in Fig. Q3 (c). Compute H(S) and verify that $G_1 > G_2 > G_3 > H(S)$ **(10 Marks)**

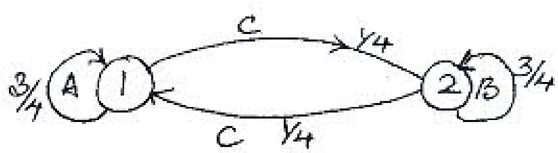

Fig. Q3 (c)

4 a. State Shannon-Hartely law for channel capacity and illustrate its implications. (06 Marks)

b. Prove that mutual information,

$I(X, Y) = H(X) - H(X/Y) = H(Y) - H(Y/X)$ (06 Marks)

c. An information source produces a sequence of independent symbols having the following probabilities:

A	B	C	D	E	F	G
$\frac{1}{3}$	$\frac{1}{27}$	$\frac{1}{3}$	$\frac{1}{9}$	$\frac{1}{9}$	$\frac{1}{27}$	$\frac{1}{27}$

Construct binary and ternary code using Huffman encoding procedure and find its efficiency. (08 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 check matrix H. (06 Marks)

b. In a linear block code the syndrome is given by,

$S_1 = r_1 + r_2 + r_3 + r_5$

$S_2 = r_1 + r_2 + r_4 + r_6$

$S_3 = r_1 + r_3 + r_4 + r_7$

i) Find the codeword of all the messages.

ii) Write the standard array.

iii) Find the syndrome for the received data 1011011. (06 Marks)

c. A (6, 3) code has the following check bits $C_4 = d_1+d_2$, $C_5 = d_1+d_3$ and $C_6 = d_2+d_3$

i) Write G and H matrices.

ii) Construct encoder and error correcting circuits.

iii) Construct standard array. (08 Marks)

6 a. What are binary cyclic codes? Describe the features of encoder and decoder used for cyclic code using (n-K) bit shift register. (10 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. $D(x) = (1+x^2+x^4)$.

iii) Find the syndrome $V(x) = 1+x^4+x^6+x^8+x^{14}$, is V(x) a code polynomial or not. (10 Marks)

7 Consider the (3, 1, 2) convolution code with $g^{(1)} = (110)$, $g^{(2)} = (101)$ and $g^{(3)} = (111)$

i) Draw the encoder block diagram.

ii) Find the generator matrix.

iii) Find the code word corresponding to the message sequence (11101) using time domain and transform domain approach. (20 Marks)

8 Explain briefly the following :

a. RS codes.

b. Shortened cyclic codes.

c. Golay codes.

d. BCH code. (20 Marks)

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