USN | | | | | | | | | | **06EC65**

Sixth Semester B.E. Degree Examination, December 2010
Information Theory and Coding

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define : i) Amount of information ii) Average source information rate. **(04 Marks)**

b. Derive an expression for average information content of symbols in long independent sequences. **(04 Marks)**

c. A discrete memory less source contains source alphabet

$S = \{S_1, S_2, S_3, S_4\}$ with $P = \left\{\frac{1}{2}, \frac{1}{4}, \frac{1}{8}, \frac{1}{8}\right\}$

i) Calculate the entropy of the source

ii) Calculate the entropy of the second order extension of the source. **(04 Marks)**

d. For the state diagram of the Markov source of the Fig. Q1(d), find

i) State probabilities ii) Entropy of each state iii) Entropy of the source. **(08 Marks)**

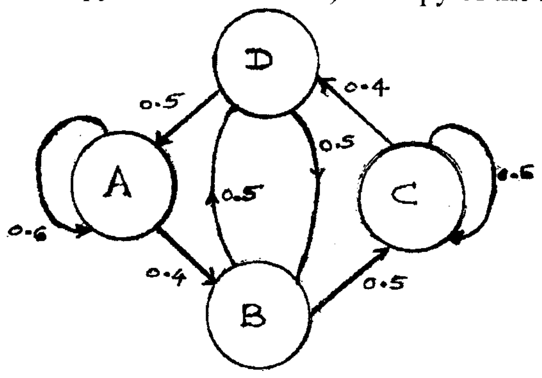

Fig. Q1(d)

2 a. Derive the expression for code efficiency and code redundancy. **(06 Marks)**

b. Explain the steps in the Shannon's encoding algorithm for generating binary codes. **(04 Marks)**

c. Apply Shannon's encoding algorithm and generate binary codes for the set of messages given in table Q2(c), and obtain code efficiency and redundancy. **(10 Marks)**

Table Q2(c)

m_1	m_2	m_3	m_4	m_5
1/8	1/16	3/16	1/4	3/8

3 a. What is a discrete communication channel? Illustrate the model of a discrete channel. **(04 Marks)**

b. A discrete memoryless source has an alphabet of seven symbols with probabilities for its output as described in table Q 3(b). Find

i) Shannon – Fano code for this source ii) Coding efficiency. **(08 Marks)**

Table Q3(b)

S_0	S_1	S_2	S_3	S_4	S_5	S_6
1/4	1/4	1/8	1/8	1/8	1/16	1/16

c. A zero memory source is with

$S = \{S_1, S_2, S_3, S_4, S_5, S_6\}$ and $P = \{0.4, 0.2, 0.1, 0.1, 0.1, 0.05, 0.05\}$

Construct a binary Huffman code by placing the composite symbol as high as possible and determine the variance of the word lengths. **(08 Marks)**

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

4 a. Define mutual information and explain its properties. **(04 Marks)**

b. For a channel, the matrix is given as

$$P(Y/X) = \begin{bmatrix} 0.6 & 0.2 & 0.2 \\ 0.2 & 0.6 & 0.2 \\ 0.2 & 0.2 & 0.6 \end{bmatrix}.$$ **(06 Marks)**

Find I(X : Y) and channel capacity, given the input symbol occur with equal probability.

c. State and explain Shannon – Hartley law. **(06 Marks)**

d. For an AWGN channel with 4 KHz bandwidth and noise power spectral density $\frac{No}{2} = 10^{-12}\ W/Hz$, the signal power required at the receiver is 0.1 mW. Calculate the capacity of this channel. **(04 Marks)**

PART – B

5 a. Illustrate the following terms used in error control coding with examples.
i) Block length ii) Code rate iii) Hamming weight iv) Hamming distance. **(08 Marks)**

b. Prove that $GH^T = HG^T = 0$ for a systematic linear block code. **(04 Marks)**

c. For a systematic (6, 3) linear block code

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

i) Find all the code vectors
ii) Draw encoder circuit for the above code
iii) Find minimum Hamming weight. **(08 Marks)**

6 a. For a (7, 4) binary cyclic code the generator polynomial is given by $g(x) = 1 + x + x^3$. Find the generator and parity check matrices. **(10 Marks)**

b. In a (15, 5) cyclic code the generator polynomial is given by $g(x) = 1 + x + x^2 + x^4 + x^5 + x^8 + x^{10}$. Draw the block diagram of an encoder and syndrome calculator for this code. **(10 Marks)**

7 a. For the convolution encoder shown in Fig. Q7(a), the information sequence is d = 10111. Find the output sequence using time – domain approach. **(06 Marks)**

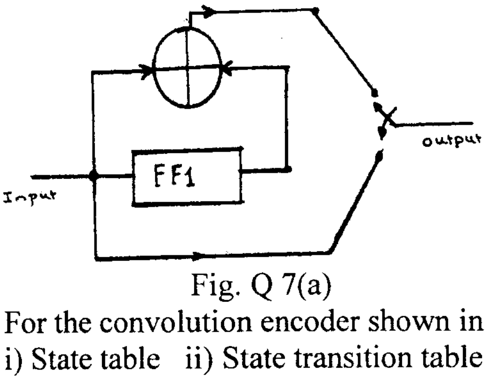

Fig. Q 7(a)

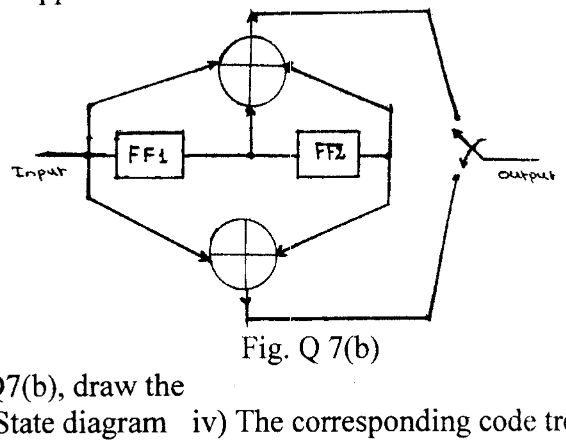

Fig. Q 7(b)

b. For the convolution encoder shown in Fig. Q7(b), draw the
i) State table ii) State transition table iii) State diagram iv) The corresponding code tree
v) Using the code tree find the encoded sequence for the message (10111). **(14 Marks)**

8 Write short notes on
a. Shortened cyclic code
b. Burst error correcting codes
c. BCH code
d. Reed Soloman codes. **(20 Marks)**

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