USN

06EC65

Sixth Semester B.E. Degree Examination, June 2012
Information Theory and Coding

Time: 3 hrs. Max. Marks:100

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

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.

PART – A

1 a. A binary source is emitting independent sequence of 0's and 1's with probabilities p and (1 - p) respectively. Plot the entropy of this sources versus probability (0 < p < 1). Write the conclusion. **(04 Marks)**

b. Find the interrelationships between hartleys, hats and bits. **(06 Marks)**

c. For the 1st order Markov sources shown in the Fig.Q1(c)

i) Find the stationary distribution ii) Entropy of each state and hence entropy of source

iii) Entropy of adjacent source and verify whether $H(s) < H(\bar{s})$ **(10 Marks)**

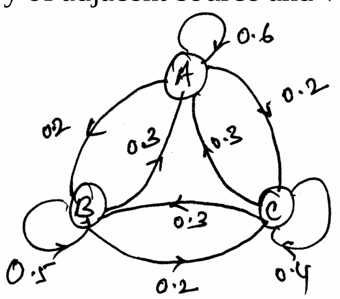

Fig.Q1(c)

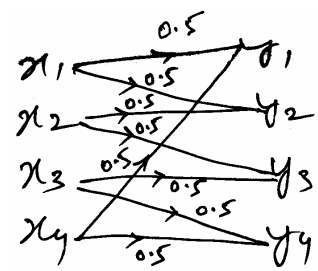

Fig.Q2(c)

2 a. Explain the important properties of codes to be considered while encoding a source. **(05 Marks)**

b. Using Shannon's binary encoding procedure, construct a code for the following discrete source.

$S = \{ s_1, s_2, s_3, s_4, s_5 \}$

$P = \{ 0.4, 0.25, 0.15, 0.12, 0.08 \}$ **(10 Marks)**

c. Determine the channel capacity of the discrete channel depicted in the Fig.Q2(c). **(05 Marks)**

3 a. A discrete memoryless source with alphabets A to H has respective probabilities 0.22, 0.20, 0.18, 0.15, 0.10, 0.08, 0.05 and 0.02. Construct binary and ternary codes for the same using Huffman's encoding algorithm. Determine code efficiency in each case. **(12 Marks)**

b. Noise matrix of a binary symmetric channel is illustrated below which has the following source symbol probabilities:

$P(x_1) = 2/3$; $P(x_2) = 1/3$; $P(y/x) = \begin{bmatrix} 3/4 & 1/4 \\ 1/4 & 3/4 \end{bmatrix}$

i) Determine H(x), H(y), H(x, y), H(x/y), H(y/x) and I(x, y)

ii) Also determine channel capacity. **(08 Marks)**

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

b. A b/w TV picture may be viewed as consisting of approximately 3×10^5 elements, each one of which may occupy 10 distinct brightness levels with equal probability. Assuming the rate of transmission as 30 picture frames/sec and an SNR of 30 db, calculate the minimum bandwidth required to support the transmission of the resultant video signal. **(10 Marks)**

PART – B

5 a. Parity matrix for a systematic (6, 3) linear block code is given as

$$P = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 1 \\ 1 & 1 & 0 \end{bmatrix}$$, find all the possible code vectors. **(10 Marks)**

b. Define hamming weight, hamming distance and minimum distance of linear block codes. **(06 Marks)**

c. If 'C' is a valid code vector such as C = DG, then prove that $CH^T = 0$, where H is the parity check matrix. **(04 Marks)**

6 a. A (15, 5) 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 of this code.

ii) Find code polynomial for $D(x) = 1 + x^2 + x^4$ in systematic form.

iii) If $V(x) = 1 + x^4 + x^6 + x^8 + x^{14}$ check whether it is a valid code polynomial or not. **(12 Marks)**

b. Consider a (15, 11) cyclic code generated using $g(x) = 1 + x + x^4$.

i) Design a feedback resister encoder for the same.

ii) Illustrate the encoding procedure with the message vector [11001101011] by listing the states of the register assuming right most bit as the earliest bit. **(08 Marks)**

7 Write short notes on:

a. RS codes

b. Shortened cyclic codes

c. Golay codes

d. Burst error correcting codes. **(20 Marks)**

8 a. For the convolutional encoder shown in Fig.Q8(a), if information sequence D = 10011, find the output sequence using

i) time domain approach ii) transform domain approach. **(12 Marks)**

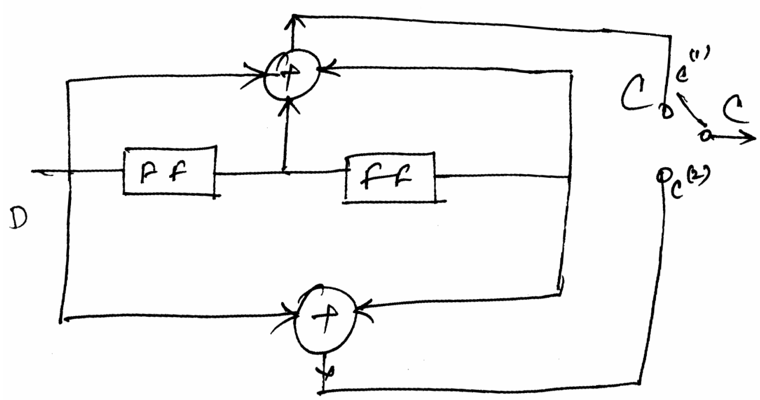

Fig.Q8(a)

b. For a (3, 1, 2) convolutional code with $g^{(1)} = (110)$, $g^{(2)} = (101)$ and $g^{(3)} = (111)$. Draw the encoder block diagram and also find the generator matrix. **(08 Marks)**

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