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14ELD22

Second Semester M.Tech. Degree Examination, June/July 2015
Coding Theory

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions.***

1 a. Show that entropy achieves maximum value when all its i/p symbols occur with equal probability. **(06 Marks)**

b. Prove that $H(S^2) = 2H(S)$. **(04 Marks)**

c. For the second order Markov source shown in Fig.Q.1(c), find: i) State probabilities; ii) Entropy of each state; iii) Entropy of source; iv) P.T $G_1 > G_2 > H(S)$. **(10 Marks)**

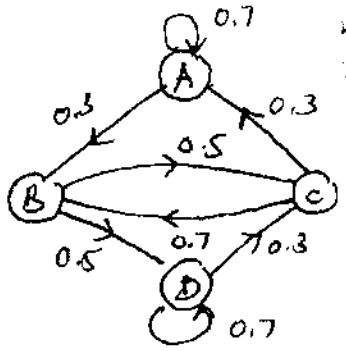

Fig.Q.1(c)

2 a. A non symmetric binary channel shown in Fig.Q.2(a) has a symbol rate of 1000 symbols/sec.

i) Find H(x), H(y), H(x, y), H(x/y), H(y/x), I(x, y). Take P(x = 0) = ¼, P(x = 1) = 3/4, $\alpha = 0.75$ and $\beta = 0.9$.

ii) Find the capacity of channel for case (i).

iii) Find the capacity of the binary symmetric channel when $\alpha = \beta = 0.75$. **(10 Marks)**

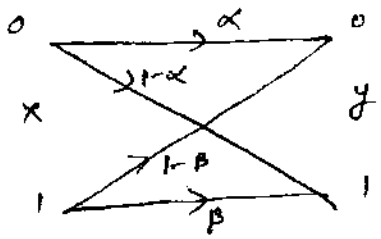

Fig.Q.2(a)

b. Explain the properties of mutual information and prove that mutual information is non negative. **(06 Marks)**

c. Prove that H(x, y) = H(x/y) + H(y). **(04 Marks)**

3 a. Explain binary erasure channel and derive the expression for channel capacity. **(08 Marks)**

b. Explain Noiselen channel and prove that H(A/B) = 0. **(06 Marks)**

c. Explain the important properties of the codes to be considered while encoding a source. **(06 Marks)**

4 a. Consider a source S = {S_1, S_2} with probabilities 3/4 and 1/4 respectively. Obtain Shannon Fano code for source S its 2nd and 3rd extension. Calculate the efficiency for each case. **(10 Marks)**

b. Consider a zero memory source with
S = {S_1, S_2, S_3, S_4, S_5, S_6, S_7)
P = {0.4, 0.2, 0.1, 0.1, 0.1, 0.05, 0.05}.
i) Construct a binary Huffman code by replacing the composite symbol "as low as possible" and "as high as possible".
ii) Compute the variable of the word length in both cases and find the efficiency. **(10 Marks)**

5 a. For a systematic (7, 4) linear block code the parity matrix P is given by

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

i) Find all possible valid code vectors.
ii) Draw the corresponding encoding circuit.
iii) A single error has occurred in each of these received vectors. Detect and correct the errors (i) R_A = [0111110]; (ii) R_b = [1010000].
iv) Draw the syndrome calculation circuits. **(10 Marks)**

b. Design (n, k) hamming code with a minimum distance of d_{min} = 3 and a message length of 4 bits. **(06 Marks)**

c. Define the following terms: i) Hamming weight; ii) Hamming distance; iii) Minimum distance; iv) Galois field. **(04 Marks)**

6 a. 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 encoder and syndrome calculator for this code.
ii) Find the code polynomial for the message polynomial $D(x) = 1 + x^2 + x^4$ in systematic form.
iii) Is $V(x) = 1 + x^4 + x^6 + x^8 + x^{14}$ is a code polynomial? **(14 Marks)**

b. Write a short note on (23, 12) Golay code. **(06 Marks)**

7 Write short note on:
a. BCH codes
b. Reed Solomon codes
c. Viterbi Decoding Algorithm
d. LDPC codes. **(20 Marks)**

8 Consider (3, 1, 2) convolutional code with $g^{(1)}$ = 110, $g^{(2)}$ = 101, $g^{(3)}$ = 111.
a. Draw the encoder block diagram.
b. Find the generator matrix.
c. Find the code word corresponding to the information sequence (11100) using time domain and transform domain approach.
d. Draw state table.
e. Draw the state diagram.
f. Draw the code tree and find encoder o/p for message sequence (11100). **(20 Marks)**

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