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10EC55

Fifth Semester B.E. Degree Examination, May 2017
Information Theory and Coding

Time: 3 hrs. Max. Marks:100

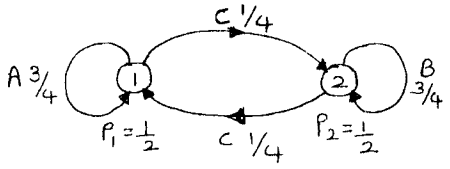
Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

PART – A

1 a. State and prove the extremal property of entropy, with an example. **(08 Marks)**

b. For the Markov source whose state diagram is shown in fig. Q1(b). Find the source entropy H and the average information content per symbol in messages containing one, two and three symbols that is find G_1 , G_2 and G_3. Show that $G_1 > G_2 > G_3 > H$. **(12 Marks)**

Fig.Q1(b)



2 a. Explain the steps in the Shannons encoding algorithm for generating Binary codes. **(04 Marks)**

b. Apply Shannons encoding algorithm and generate binary codes for the set of messages given in table 2(b) and obtain code efficiency and redundancy. **(10 Marks)**

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

c. Discuss the different entropies defined for communications systems with respective expressions. **(06 Marks)**

3 a. Apply Huffman encoding procedure for the following set of messages and determine the coding efficiency of the binary code so formed from table 3(a).

X_1	X_2	X_3
0.7	0.15	0.15

If the same technique is applied to the 2nd order extension for the above messages by how much will the efficiency be improved? **(10 Marks)**

b. For a Binary symmetric channel, find H(x) , H(y) , H(x/y) , H (x, y) , H(y/x) , I(x, y), capacity of the channel , channel efficiency and redundancy. The Noise matrix of the given Binary symmetric channel is as follows. The input symbol probabilities

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

4 a. State and explain Shannon Hartley law and derive an expression for maximum capacity of a noisy channel. **(10 Marks)**

b. A voice grade channel of the telephone network has a bandwidth of 3.4 KHz, calculate
i) Channel capacity of the telephone channel for a signal to Noise ratio of 30dB.
ii) Calculate the minimum signal to noise radio required to support information transmission through the telephone channel at the rate of 4800 bits/second. **(10 Marks)**

PART – B

5 a. Define the following terms used in error control coding :
i) Block length ii) Code rate iii) Hamming weight iv) Hamming distance
v) Minimum Hamming distance. **(10 Marks)**

b. 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 code vectors.
ii) Draw encoding circuit for the above code.
iii) A single error has occurred in the received vector R = [1 0 1 1 1 0 0] Detect and correct the error.
iv) Draw the syndrome calculation circuit. **(10 Marks)**

6 a. Discuss the properties of cyclic codes. **(04 Marks)**

b. The generator polynomial of a (7, 4) cyclic code is $g(x) = 1 + x + x^3$. Find the code words of the message vector 1010 in the systematic form and non systematic form. **(06 Marks)**

c. Design an encoder for the (7, 4) binary cyclic code generated by $g(x) = 1 + x + x^3$ and verify its operation using the message vector 1011. **(10 Marks)**

7 Write short notes on :
a. RS codes.
b. Golay codes.
c. Shortened cyclic codes.
d. Burst error correcting codes. **(20 Marks)**

8 a. For the convolutional encoder shown in fig.Q8(a) the information sequence is d = 10011. Find the output sequence using the following two approaches :
i) Time domain approach ii) Transform domain approach. **(14 Marks)**

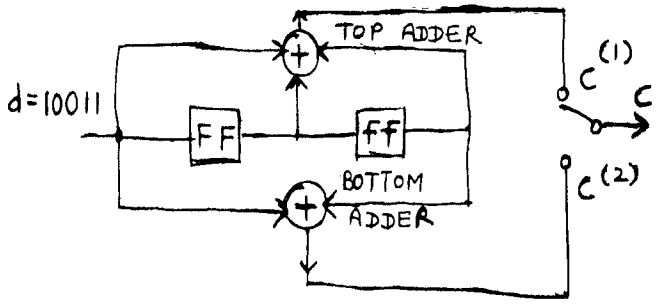


Fig.Q8(a)

b. Write the state diagram for the convolutional encoder of fig.Q8(a) and explain the same with the help of a state table. **(06 Marks)**

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