USN

Fifth Semester B.E. Degree Examination, Feb./Mar. 2022
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. Define : i) Self information ii) Entropy iii) Rate of source. **(05 Marks)**

b. A source emits an independent sequence of a symbols form an alphabet consisting of five symbols S_1, S_2, S_3, S_4 and S_5 with probabilities $\frac{1}{4}, \frac{1}{8}, \frac{1}{8}, \frac{3}{16}$ and $\frac{5}{16}$ respectively. Find the binary code using Shannon's binary algorithm also find coding efficiency. **(10 Marks)**

c. Explain with basic block diagram of an information system. **(05 Marks)**

2 a. A binary source produces symbols 0 and 1 with probability P and 1–P determine the entropy of this source and sketch the variation of the entropy with P. **(10 Marks)**

b. For the given first order Markov source in Fig.Q2(b) shown.

i) Find state probabilities ii) Entropy of each state

iii) Entropy of the source iv) Find G_1, G_2.

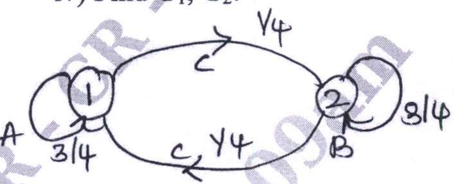

Fig.Q2(b) **(10 Marks)**

3 a. For Mark off source shown below find :

i) State entropies ii) Source entropy iii) G_1, G_2 and show that $G_1 \geq G_2 \geq H(s)$.

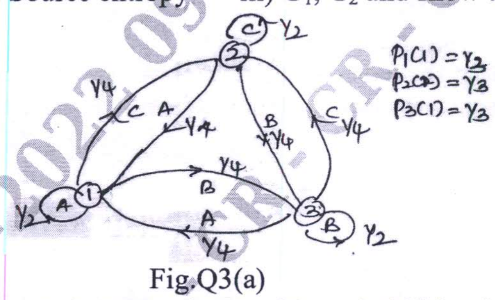

Fig.Q3(a) **(10 Marks)**

b. A source produces two symbols 'A' and 'B' with probabilities 0.05 and 0.95 respectively construct a suitable binary code such that the efficiency of coding is at least 65%. **(10 Marks)**

4 a. Define mutual information and explain its properties. **(05 Marks)**

b. A black and white television picture may be viewed as consisting of approximately 3×10^5 elements each one of which may occupy one of 10 distinct brightness levels with equal probabilities. Assume :

i) the rate of transmission is 30 picture frames per second

ii) The signal-to-noise ratio is 3dB. Using the channel capacity theorem, calculate the minimum bandwidth required to support the transmission of the resultant video signal. **(10 Marks)**

c. A channel has of 10MHz bandwidth. If (S/N) ratio is 100, calculate the channel capacity and the maximum information rate. **(05 Marks)**

PART – B

5 a. Define hamming weight, hamming distance and minimum distance of linear black code. **(06 Marks)**

b. Consider a (6, 3) linear code whose generator matrix is

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

i) Find all code vector
ii) Find all the Hamming weight distance
iii) Find minimum weight parity check matrix
iv) Draw the encoder circuit for the above codes. **(14 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 black diagram of an encoder and syndrome calculator for this code
ii) find the code polynomial for the message polynomial $D(x) = 1 + x^2 + x^4$ in systematic form
iii) is $V(x) = 1\ x^4 + x^6 + x^8 + x^{14}$ a code polynomial? **(10 Marks)**

b. Explain with basic black diagram of encoding using (n – k) bit shift register. **(06 Marks)**

c. Explain briefly properties of cyclic codes. **(04 Marks)**

7 a. Explain briefly :
i) Golay code
ii) Cyclic code
iii) Burst – error correcting codes
iv) Burst and random error. **(10 Marks)**

b. Determine the parameters of a q-ary Rs code vector for a $d_{min} = 9$. Also find the total number of code words in the code and also the nearest neighbours for any code word at a distance of $d_{min} = 9$. **(10 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.

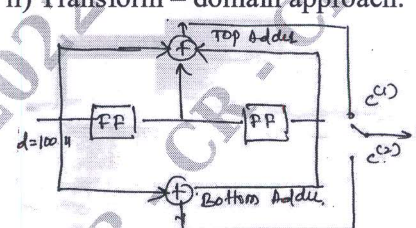

Fig.Q8(a) **(10 Marks)**

b. Consider the convolution encode shown in Fig.Q8(b) the code is systematic
i) Draw the state diagram
ii) Draw the code tree
iii) Find the encoder output produced by the message sequence 10111.

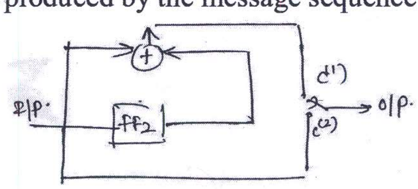

Fig.Q8(b) **(10 Marks)**

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