CBCS SCHEME

USN

15EC54

(10 Marks)

(06 Marks)

Fifth Semester B.E. Degree Examination, June/July 2018 Information Theory and Coding

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing one full question from each module.

Module-1

- a. With neat sketch, explain the block diagram of an information system. (04 Marks)
 - b. Define entropy. State various properties of the entropy. (04 Marks)
 - c. A code is composed of dots and dashes. Assuming a dash is 3 times as long as a dot and has one-third the probability of occurrence. Calculate:
 - i) The information in a dot and a dash.
 - ii) The entropy of dot-dash code.
 - iii) The average rate of information if a dot lasts for 10mili seconds and the same time is allowed between symbols. (08 Marks)

OR

- a. Derive an expression for the entropy of nth extension of a zero memory source. (06 Marks)
 - b. The first order Markoff model shown in Fig.Q.2(b). Find the state probabilities, entropy of each state and entropy of the source. (10 Marks)

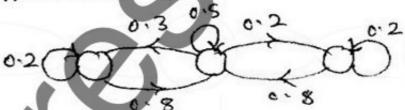


Fig.Q.2(b)

Module-2

a. Apply Shannon's binary encoding algorithm to the following set of symbols given in table below. Also obtain code efficiency. (08 Marks)

 Symbols
 A
 B
 C
 D
 E

 P
 1/8
 1/16
 3/16
 1/4
 3/8

b. Consider a source S = {s₁, s₂} with probabilities 3/4 and 1/4 respectively. Obtain Shannon-Fano code for source S and its 2nd extension. Calculate efficiencies for each case. Comment on the result.

OR

- 4 a. Consider a source with 8 alphabets A to H with respective probabilities of 0.22, 020, 018, 015, 0.10, 0.08, 0.05 and 0.02. Construct Huffman's code and determine its efficiency.
 - b. With an illustrative example, explain arithmetic coding technique.

I of 3

15EC54

Module-3

- 5 a. Define: i) Input entropy ii) Output entropy iii) Equivocation iv) Joint entropy and v) Mutual information with the aid of respective equations. (04 Marks)
 - b. In a communication system, a transmitter has 3 input symbols $A = \{a_1, a_2, a_3\}$ and receiver also has 3 output symbols $B = \{b_1, b_2, b_3\}$. The matrix given below shows JPM. (08 Marks)

$$a_1 = b_1 = b_2 = b_3$$
 $a_1 = \frac{1}{12} = \frac{5}{36}$
 $a_2 = \frac{5}{36} = \frac{1}{9} = \frac{5}{36}$
 $a_3 = \frac{1}{6} = \frac{5}{36}$
 $a_4 = \frac{1}{6} = \frac{5}{36}$
 $a_5 = \frac{1}{9} = \frac{5}{36}$
 $a_6 = \frac{1}{3} = \frac{1}{36} = \frac{1}{36}$

- i) Find missing probabilities (*) in the table.
- ii) Find $P\left(\frac{b_3}{a_1}\right)$ and $P\left(\frac{a_1}{b_3}\right)$.
- c. A transmitter has 5 symbols with probabilities 0.2, 0.3, 0.2, 0.1 and 0.2. Given the channel matrix P(B/A) as shown below, calculate H(B) and H(A, B). (04 Marks)

$$P(B/A) = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 1/4 & 3/4 & 0 & 0 \\ 0 & 1/3 & 2/3 & 0 \\ 0 & 0 & 1/3 & 2/3 \\ 0 & 0 & 1 & 0 \end{bmatrix}$$
Fig.Q.5(c)

OR

- 6 a. A Gaussian channel has a 10MHz bandwidth. If (S/N) ratio is 100, calculate the channel capacity and the maximum information rate. (04 Marks)
 - b. A binary symmetric channel has channel matrix $P(Y/X) = \begin{vmatrix} 3/4 & 1/4 \\ 1/4 & 3/4 \end{vmatrix}$ with source

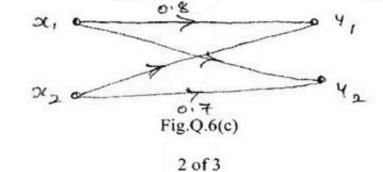
probabilities of $P(X_1) = \frac{2}{3}$ and $P(X_2) = \frac{1}{3}$.

- i) Determine H(X), H(Y), H(Y/X) and H(X, Y).
- ii) Find the channel capacity.

(06 Marks)

c. Find the channel capacity of the channel shown in Fig.Q.6(c) using Muroga's method.

(06 Marks)



15EC54

Module-4

a. Distinguish between "block codes" and "convolution codes".

(02 Marks)

b. For a systematic (6, 3) linear block code, the parity matrix is $P = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 1 \\ 1 & 1 & 0 \end{bmatrix}$. Find all possible

code vectors.

(08 Marks)

c. The parity check bits of a (8, 4) block code are generated by $c_5 = d_1 + d_2 + d_4$, $c_6 = d_1 + d_2 + d_3$, $c_7 = d_1 + d_3 + d_4$ and $c_8 = d_2 + d_3 + d_4$ where d_1 , d_2 , d_3 and d_4 are message bits. Find the generator matrix and parity check matrix for this code. (06 Marks)

OR

- 8 a. A (7, 4) cyclic code has the generator polynomial g(x) = 1 + x + x³. Find the code vectors both in systematic and nonsystematic form for the message bits (1001) and (1101).(12 Marks)
 - b. Consider a (15, 11) cyclic code generated by $g(x) = 1 + x + x^4$. Device a feed back shift register encoder circuit. (04 Marks)

Module-5

9 a. Write a note on BCH codes.

(06 Marks)

- b. Consider the (3, 1, 2) convolutional encoder with $g^{(1)} = (110)$, $g^{(2)} = (101)$ and $g^{(3)} = (111)$.
 - i) Draw the encoder diagram.
 - ii) Find the generator matrix.
 - iii) Find the code word for the message sequence (11101).

(10 Marks)

QR

- 10 a. For a (2, 1, 3) convolutional encoder with g⁽¹⁾ = (1101), g⁽²⁾ = (1011), draw the encoder diagram and code tree. Find the encoded output for the message (11101) by traversing the code tree.
 (10 Marks)
 - b. Describe the Viterbi decoding algorithm.

(06 Marks)