CBCS SCHEME

USN | | | | | | | | | | 15EC54

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

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

2 a. Derive an expression for the entropy of n^{th} 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)**

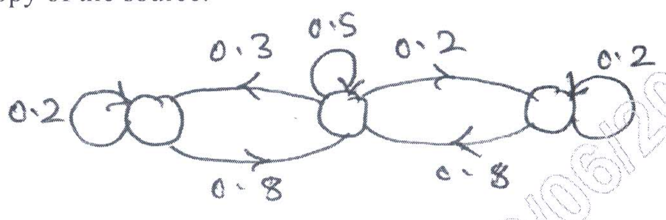

Fig.Q.2(b)

Module-2

3 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 $S = \{s_1, s_2\}$ with probabilities 3/4 and 1/4 respectively. Obtain Shannon-Fano code for source S and its 2^{nd} extension. Calculate efficiencies for each case. Comment on the result. **(08 Marks)**

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. **(10 Marks)**

b. With an illustrative example, explain arithmetic coding technique. **(06 Marks)**

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_i \ b_j	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	*	$\frac{1}{6}$	*
$P(b_j)$	$\frac{1}{3}$	$\frac{14}{36}$	*

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)**

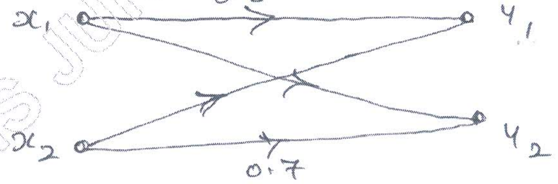

Fig.Q.6(c)

Module-4

7 a. Distinguish between "block codes" and "convolution codes". **(02 Marks)**

b. For a systematic (6, 3) linear block code, the parity matrix is $P = \begin{vmatrix} 1 & 0 & 1 \\ 0 & 1 & 1 \\ 1 & 1 & 0 \end{vmatrix}$. 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 $g(x) = 1 + x + x^3$. 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)**

OR

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)**

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