Total No. of Questions : 8] *[Total No. of Printed Pages : 2*

Roll No .....

MEDC-301(A)

M.E./M.Tech., III Semester

Examination, November 2018

Information Theory and Coding

(Elective-I)

Time : Three Hours

Maximum Marks: 70

Note : i) Attempt any five questions out of eight.
ii) All questions carry equal marks.

1. a) What is Entropy, joint Entropy, conditional Entropy. Show that the entropy is maximum when all the symbols are equi-probable. Assume M = 3. 7
   b) A discrete source emits one of five symbols once every millisecond with probabilities $\frac{1}{4}, \frac{1}{8}, \frac{1}{16}, \frac{1}{32}$ and $\frac{1}{64}$ respectively. Determine the source entropy H(X) and $H(X^2)$. 7

2. a) Apply Huffman coding procedure for determining coding efficiency. [Take M = 3] 7
   $[x] = [x_1 \quad x_2 \quad x_3 \quad x_4 \quad x_5 \quad x_6 \quad x_7 \quad x_8]$
   [P] = [0.3 0.50 0.15 0.10 0.05 0.20 0.25 0.15]
   b) State and explain Shannon's theorem on capacity. Also discuss bandwidths and signal to Noise ratio trade off. 7

3. a) For the binary symmetric channel with transition probabilities: P(0/1) = P(1/0) = P. Find the channel capacity. Also plot the variations of channel capacity as a function of P. 7
   b) Explain and discuss mutual information and its properties. 7

4. What are linear block codes? What are its properties? For a (5, 3) code over GF(4) the generator matrix is given by

$$G = \begin{bmatrix} 1 & 1 & 0 & 0 & 1 \\ 0 & 1 & 1 & 0 & 2 \\ 0 & 1 & 0 & 1 & 3 \end{bmatrix}$$ 14

   a) Find the parity check matrix for this code.
   b) How many errors can this code detect?
   c) How many errors can this code correct?

5. a) Explain cyclic codes and its basic properties. 7
   b) The generator polynomial of a (7, 4) cyclic code: $g(x) = 1 + x + x^3$. Find the 16 code words of this code. 7

6. a) What are BCH codes? Discuss its encoding and decoding procedures. 7
   b) Explain the decoding processes of convolutional code including Viterbi Algorithm. 7

7. a) What is syndrome computation and error detection? 7
   b) For the (7, 4) Hamming code, the parity check matrix H is given by $H = \begin{bmatrix} 1 & 0 & 1 & 1 & 0 & 0 & 0 \\ 1 & 1 & 0 & 1 & 0 & 1 & 1 \\ 0 & 1 & 1 & 0 & 0 & 1 & 0 \end{bmatrix}$ 7
      i) Construct the generator matrix.
      ii) If the received code word Y is 0111100, then decode this received code word.

8. Write short notes on any two of the following: 14
   a) Binary symmetric channel
   b) Data compression
   c) Systematic codes and its encoding circuit

******