Roll No ....

MEDC-301(A)

M.E./M.Tech. III Semester

Examination, June 2014

Information Theory and Coding (Elective-I)

Time : Three Hours

Maximum Marks: 70

Note : Answer any five questions out of eight.

1. Define entropy, joint entropy, conditional entropy and differential entropy by giving equations for them.
   Consider a discrete memoryless source with source probabilities [0.30, 0.25, 0.20, 0.15, 0.10]. Find the source entropy $H(X)$ and $H(X^2)$.

2. Consider a DMS with source probabilities [0.20, 0.18, 0.12, 0.10, 0.10, 0.08, 0.06, 0.06, 0.06, 0.04].
   a) Determine the Huffman code for this source.
   b) Determine the average codeword length.
   c) What is the efficiency of the code?
   d) What is the redundancy in the code?
   e) Determine the Huffman code for this source taking two symbols at a time.
   f) Compare the efficiency of these two codes and comment on the results.

3. What is a BSC? What is the capacity of a BSC? State and explain Shannon's theorem on channel capacity.

4. Calculate the capacity of the following channel and show how C varies with p.

$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & p & (1-p) \\ 0 & (1-p) & p \end{bmatrix}$$

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

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

   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?
   d) Is this a perfect code?

6. What is syndrome and syndrome decoding in linear block codes?
   What is standard array? How is it constructed and what are cosets and coset leaders?

7. Let the polynomial
   $g(x) = x^{10} + x^8 + x^5 + x^4 + x^2 + x + 1$
   be the generator polynomial of a cyclic code over GF(2) with block length 15.
   a) Find the generator polynomial G.
   b) Find the parity check matrix H.
   c) How many errors can this code detect?
   d) How many errors can this code correct?
   e) Write the generator matrix in the systematic form.

8. Write short notes on:
   a) BCH Codes
   b) Convolutional Codes.