USN | | | | | | | | | | 14ELD22

Second Semester M.Tech. Degree Examination, June/July 2016

Coding Theory

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions.***

1 a. Obtain an expression for entropy of a zero memory information source emitting independent sequence of symbols and discuss the various properties of entropy. **(10 Marks)**

b. Define binary symmetric channel and obtain the expression for its channel capacity. **(10 Marks)**

2 a. Show that H(x, y) = H(x/y) + H(y). **(08 Marks)**

b. For the joint probability matrix given below, compute individually H(x), H(y), H(x, y), H(x/y), H(y/x) and I(x, y). Verify the relationship among these entropies.

$$P(x,y)=\begin{bmatrix}0.05 & 0 & 0.20 & 0.05\\ 0 & 0.10 & 0.10 & 0\\ 0 & 0 & 0.20 & 0.10\\ 0.05 & 0.05 & 0 & 0.10\end{bmatrix}$$

(12 Marks)

3 a. List the steps involved in Shannon-Fano encoding algorithm. **(08 Marks)**

b. Consider a zero memory source with seven symbols with probabilities $P = \{0.4, 0.2, 0.1, 0.1, 0.1, 0.05, 0.05\}$.

i) Construct a binary Huffman code by placing the composite symbol as low as you can.

ii) Repeat (i) by moving composite symbol as high as possible.

In each case, (i) and (ii) above, compute the variance of the word lengths of comment on the result. **(12 Marks)**

4 a. Construct a table for GF(2^4) based on the primitive polynomial $p(x) = 1 + x + x^4$. Display the power, polynomial and vector representation of each element. **(12 Marks)**

b. Show that any irreducible polynomial over GF(2) of degree m divides $x^{2^m-1}+1$, with an example. **(08 Marks)**

5 a. For a systematic (7, 4) linear block code. The parity check matrix P is given by

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

i) Find all possible valid code vectors.

ii) Draw the corresponding encoding circuit.

iii) Draw the syndrome calculation circuit. **(12 Marks)**

b. Define Hamming weight, Hamming distance and minimum distance of linear block code, with example. **(08 Marks)**

6 a. Consider the (7, 4) cyclic code generated by the $g(x) = 1 + x + x^3$.
   i) Determine the parity polynomial.
   ii) Suppose that the message is u = (1 0 1 0), then compute the codeword and write the code polynomial.
   iii) Draw the encoding circuit. **(10 Marks)**

b. Draw the general cyclic code decoder and explain the working. **(10 Marks)**

7 a. Consider the (3, 1, 2) convolutional code with $g^{(0)} = (1\ 1\ 0)$, $g^{(1)} = (1\ 0\ 1)$, $g^{(2)} = (1\ 1\ 1)$.
   i) Draw the encoder block diagram.
   ii) Find the generator matrix.
   iii) Find the codeword v corresponding to the information sequence u = (1 1 1 0 1). **(12 Marks)**

b. For the convolutional encoder shown below:
   i) Draw the state diagram.
   ii) Draw the code tree.
   iii) Find the encoder output produced by the message sequence 10111.

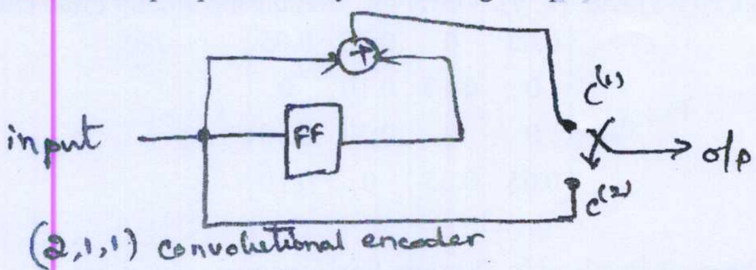

Fig.Q7(b) **(08 Marks)**

8 a. Explain the encoding circuit for q-ary Rs code with generator polynomial $g(x) = g_0 + g_1x + g_2x^2 + \ldots + \ldots + g_{2t-1}x^{2t-1} + x^{2t}$. **(10 Marks)**

b. Draw a decoder circuit for q-ary BCH code and explain the working. **(10 Marks)**

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