Registration no: | | | | | | | | | | |

Total Number of Pages: 03 **M.TECH**

WCPC102

1st Sem MTech Regular/ Back Examination – 2015-16

INFORMATION THEORY AND CODING

BRANCH(S): WCT

Time: 3 Hours

Max marks: 70

Q.CODE:T1219

Answer Question No.1 which is compulsory and any five from the rest.
The figures in the right hand margin indicate marks.

Q1 Answer the following questions: (2 x 10)

a) Define self information. What is the condition of getting maximum self information and what is the maximum value?

b) For a binary symmetric channel prove that $C = 1 - H(p)$.

c) A DMS has an alphabet of five letters, x_i , i=1,2,….5, each occurring with probability 1/5. Evaluate the efficiency of a fixed-length binary code in which two letters at a time are encoded into a binary sequence.

d) Draw the Bandwidth efficiency diagram? Define Shannon Limit from the Bandwidth efficiency diagram.

e) Explain the decoding mechanism in a linear block code using the Nearest Neighbour Decoding.

f) Write down the steps for decoding a linear block code using syndrome decoding.

g) How many elements are there in the ring $F[x]/(x^2 + x + 1)$ defined over GF (2)? Write down the elements.

h) How do the Tree codes differ from linear block codes?

i) What do you mean by Burst Errors? What information does the Rieger Bound give on the burst error correcting linear block code?

j) What are the Ungerboeck's TCM design rules?

Q2 a) Define average mutual information between two random variables. Show that (5)

$$I(X;Y) = H(X) - H(X \mid Y)$$

Under what conditions the equality condition is possible?

b) The source probabilities of a DMS are {0.40, 0.25, 0.15, 0.10, 0.05, 0.05}. (5)

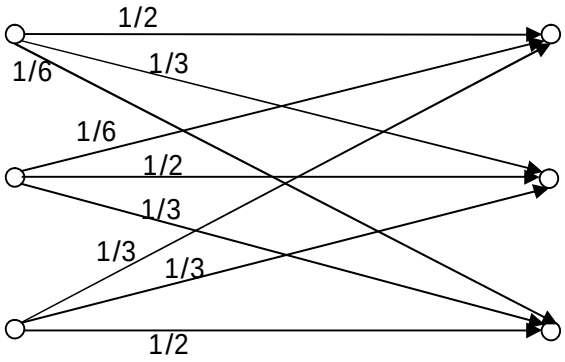
i) Determine an efficient fixed length code for the source.

ii) Determine the Huffman code for this source.

iii) Determine the average length $\overline{R}$ of the codewords.

iv) What is the efficiency η of the code?

Q3 a) Determine the channel capacity of the following channel (5)



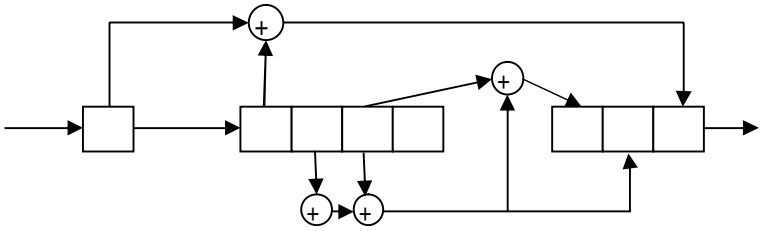
b) How is Limple-Ziv code is advantageous that Huffman coding? Determine the Limple-Ziv code for the following bit stream 01001111100101000001010101100110000. (5)

Q4 Consider a (7,4) linear block code whose generator matrix is given as (10)

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

i.) Find all the codeword of the code.
ii.) Find the parity check matrix.
iii.) Design the standard array.
iv.) Compute the syndrome for the received vector 1101101. Is this a valid code vector?

Q5 For the following Convolutional encoder (10)



i.) Draw its state diagram.
ii.) Draw the trellis diagram.
iii.) Write down the values of k_0, n_0, v, m and R of this code.

iv.) Give the generator polynomial matrix for this encoder

Q6

a) For a (7, 4) cyclic code with generator polynomial $g(x) = x^3 + x + 1$ (10)
Find the generator polynomial matrix 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.

Q7 a) Explain the steps to be taken to find out the frame check sequence (FCS) for a (n, k) CRC code. For a message D= 1010001101 and the pattern, P = 110101, find out the transmitted codeword. (5)

b) Explain the set partitioning mechanism of 8 – QAM in TCM. (5)

Q8 Write short notes on any TWO (5 x 2)

a) BCH codes
b) Trellis Code
c) Turbo codes