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42114

May 2019

M.Tech. (ECE) Ist Semester (Reappear)

INFORMATION AND COMMUNICATION THEORY

(E16C 607)

Time : 3 Hours] [Max. Marks : 75

Instructions :

(i) It is compulsory to answer all the questions (1.5 marks each) of Part-A in short.

(ii) Answer any four questions from Part-B in detail.

(iii) Different sub-parts of a question are to be attempted adjacent to each other.

(iv) Assume necessary and relevant data if missing.

PART–A

1. (a) What is the channel capacity of a binary symmetric channel with error probability 0.01? (1.5)

(b) What do you mean by burst error? Name anyone coding method used for burst error correction. Explain. (1.5)

(c) Differentiate between fixed length and variable length coding. Which one is better and why? (1.5)

(d) Show that self information is a special case of mutual information. What are the conditions when both self and mutual information are same? (1.5)

(e) Define G and H matrix and show that $G \cdot H^T = 0$. (1.5)

(f) Is it true that any information source has a unique code attaining the minimum average length? (1.5)

(g) What do you mean by symmetric channel ? Write down state transition matrices for symmetric channels. (1.5)

(h) What do you mean by perfect code ? Under what conditions a code is said to be a perfect code ?(1.5)

(i) What is meant by constraint length and free distance of a convolution code? (1.5)

(j) What is lower and upper bound of code incurable error probability? (1.5)

PART–B

2. (a) Draw a noiseless channel with m inputs and n outputs. Write down channel matrix and prove that :

(i) $H(x) = H(y)$ (ii) $H(y/x) = 0$.

Where x and y are the source and receiver respectively.

Give physical significance of these statements. (8)

(b) Differentiate between hamming distance and minimum hamming distance. The minimum hamming distance of a block code is $d = 11$. Determine the error correction and error-detection capability of this code. (7)

3. (a) A source is generating seven messages such that $x_i = \{x_1, x_2, x_3, x_4, x_5, x_6, x_7,\}$ with probabilities $p(x_i) = \{0.17, 0.25, 0.2, 0.13, 0.12, 0.08, 0.05\}$.

(i) Find entropy and information rate of the source.

(ii) Using three symbols, construct Huffman Coding for this source.

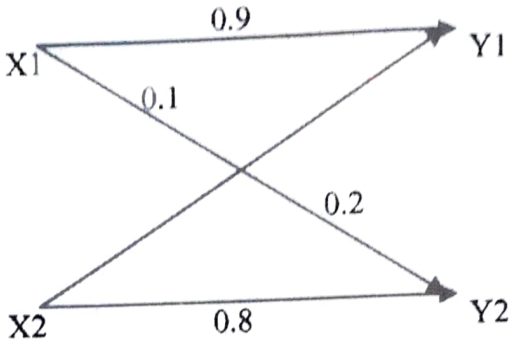
(iii) Find coding efficiency and redundancy. (8)

(b) Construct a symmetric (7, 4) cyclic code using the generator polynomial $g(x) = x^3 + x + 1$. What are the error correcting capabilities of this code? For the received word 1101100, determine the transmitted code word. (7)

4. (a) Derive an expression for mutual information of continuous channel and prove that it is always non-negative. (8)

(b) Construct single, double and triple error correcting generator polynomial for BCH code with block length $n = 15$ over $GF(2^4)$. (7)

5. (a) A binary channel is shown in figure given below :



Find (i) Channel matrix of the channel.

(ii) Overall channel matrix of the resultant channel when such two channels are connected in cascade.

(iii) Draw the resultant equivalent channel. If the outputs of the resultant channel are Z_1 and Z_2 if $P(x_1) = P(x_2) = 0.5$. (8)

(b) Explain Viterbi algorithm for decoding of convolution code. (7)

6. (a) Define rate distortion function (RDF). Derive an expression of RDF for discrete channel. (8)

(b) What do you mean by Reed Solomon code. How this code is differ from BCH code. (7)

7. (a) What are different performance measures of Convolution and linear block codes. Explain how performance of these codes can be improved. (10)

(b) Differentiate discrete and continuous entropy. Prove the condition for maximum entropy and show that entropy is measure of uncertainty. (5)