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Roll No. :

333652(33)

B. E. (Sixth Semester) Examination, April-May 2021

(New Scheme)

(IT Branch)

INFORMATION THEORY & CODING

Time Allowed : Three hours

Maximum Marks : 80

Minimum Pass Marks : 28

Note : All questions are compulsory and carry equal marks. Part (a) is compulsory and attempt any two part from (b), (c) and (d) of each unit.

Unit-I

1. (a) What relationship exist in between Uncertainty and Information?

2

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- (b) Explain, why information measure is logarithmic? What is entropy of an information source? What is the condition of maximum entropy? 7
- (c) What is mutual information? Explain and prove different properties of mutual information. 7
- (d) The data is to be transmitted at the rate of 10000 bits/sec over a channel having bandwidth of 3000 Hz. Determine the signal to noise ratio required. If the bandwidth is increased to 10000 Hz, then determine the signal to noise ratio. 7

Unit-II

2. (a) Define efficiency and redundancy of source coder. 2
- (b) What is the goal of a source coder? If a source generates messages that are all equiprobable, would coding improve the entropy? 7
- (c) For the discrete message source having two coding schemes, one with fixed length and another with variable length as shown in table.

[3]

Message	Probability	Fixed length code	Variable length code
x_1	1/2	0 0	0
x_2	1/4	0 1	1 0
x_3	1/8	1 0	1 1 0
x_4	1/8	1 1	1 1 1

Find the efficiency and redundancy for each coding scheme. 7

- (d) Consider a discrete memoryless source with the following messages and its corresponding probabilities

x_i	:	x_1	x_2	x_3	x_4	x_5	x_6	x_7
P_i	:	0.4	0.25	0.15	0.1	0.05	0.03	0.02

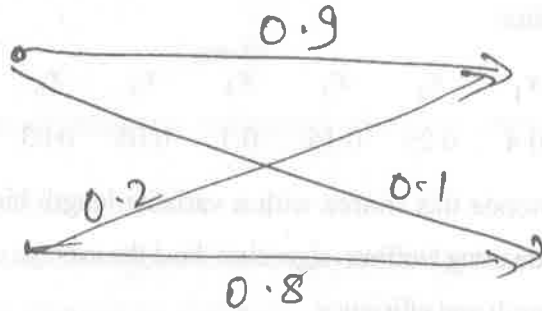
Encode this source with a variable length binary code using Huffman algorithm. Find the average code length and efficiency. 7

Unit-III

3. (a) Explain channel capacity theorem. 2

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- (b) Define mutual information and differential entropy for continuous random variable in the channels. 7
- (c) State and explain Shannon-Hartley law. Derive the upper limit of the channel capacity with increasing bandwidth. What does it mean? 7
- (d) Consider a binary channel shown in fig.
- Find the channel matrix
 - If $P(x_1) = P(x_2) = 0.5$ find $P(y_1)$ and $P(y_2)$
 - Find $P(x_1, y_2)$ and $P(x_2, y_1)$ 7



Unit-IV

4. (a) What is Hamming Weight? How it is related to Hamming distance? 2

[5]

- (b) What are the different types of linear block codes? What are the advantages of linear block codes? Explain the process of Hamming codes. 7
- (c) The generator matrix for a (6, 3) block code is given below. Find all the code vectors of this code. 7

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

- (d) What is the role of syndrome vector in error correction? Explain with example. 7

Unit-V

5. (a) What are the basic differences between block codes and convolutional codes? 2
- (b) What is a Convolutional Code? Describe the various methods used in representing a convolutional encoder. 7
- (c) Explain the Viterbi algorithm for decoding of convolutional code. 7

(d) Explain the process of turbo encoder with an example.

7

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