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Roll No. :

333652(33)

B. E. (Sixth Semester) Examination, Nov.-Dec. 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 is information? How uncertainty is related to information?

2

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[2]

- (b) Draw the block diagram of digital communication system using various model. 7
- (c) What is mutual information? Write its properties. Prove that : 7

$$I(X : Y) = H(x) - H(x/y)$$

- (d) A transmitter has an alphabet of 4 letters (x_1, x_2, x_3, x_4) and receiver has an alphabet of 3 letters (y_1, y_2, y_3) . The joint probability matrix is given below. Calculate all the entropies. 7

$$P(x, y) = \begin{bmatrix} 0.3 & 0.05 & 0 \\ 0 & 0.25 & 0 \\ 0 & 0.15 & 0.05 \\ 0 & 0.05 & 0.15 \end{bmatrix}$$

Unit-II

2. (a) Write Shanon's source coding theorem. 2

[3]

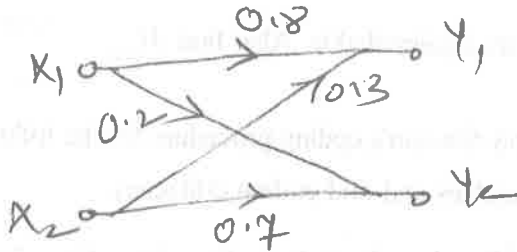
- (b) Define entropy. Derive formula for entropy and prove that $H(x)$ is maximum when both x_1 and x_2 are equiprobable. Also find H_{\max} . 7
- (c) Apply Shanon's coding procedure for the following ensembles and find coding efficiency. 7
- $[X] = [x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8]$
 $[P] = [1/4, 1/8, 1/16, 1/16, 1/16, 1/4, 1/16, 1/8]$
- (d) A DMS has five symbols x_1, x_2, x_3, x_4, x_5 with probabilities 0.4, 0.19, 0.16, 0.15 and 0.15 respectively construct a Huffman code for the source and find code efficiency. 7

Unit-III

3. (a) Give Shanon's theorem on channel capacity and its negative. 2
- (b) State Shanon's Hartley theorem and prove the statement Trade off between Bandwidth and signal to noise ratio. 7

[4]

- (c) Find the mutual information and channel capacity of the given channel of $P(x_1) = 0.6$, $P(x_2) = 0.4$. 7



- (d) A black and white TV picture consists of about 2×10^6 picture elements with 16 different brightness levels, with equal probabilities. If pictures are repeated at the rate of 32 per second, calculate average rate of information conveyed by this TV picture source. If $S/N = 30$ dB, what is minimum BW required to support the transmission of resultant video signal. 7

Unit-IV

4. (a) What is Hamming code? 2
 (b) The generator matrix for a (6, 3) block code is given below. Find all the code vectors of this code. 7

[5]

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

- (c) What is syndrome decoding? How errors can be detected and corrected with syndrome decoding. 7

- (d) What do you mean by cyclic property? The generator polynomial of a (7, 4) cyclic code is $g(p) = p^3 + p + 1$.

Find all the code vectors for the code in non systematic form. 7

Unit-V

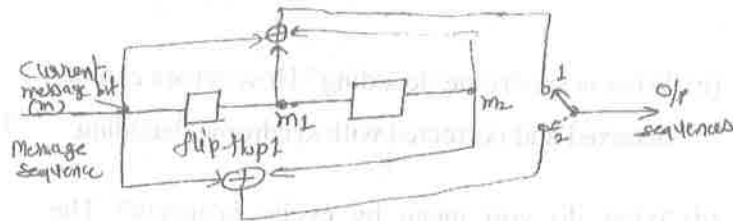
5. (a) Define convolutional coding. 2
 (b) For given convolutional encoder, determine the following : 7
 (i) Dimension of code
 (ii) Code rate
 (iii) Constraint length

[6]

(iv) Generating sequence

(v) Output sequence for message sequence of

$$m = \{10011\}.$$



Convolutional Encoder

(c) A rate 1/3 convolution encoder has generating

vectors as $g_1 = (100)$, $g_2 = (111)$ and $g_3 = (101)$. 7

(i) Sketch the encoder configuration

(ii) Draw the code tree

(iii) Draw the state diagram

(iv) Draw Trellis diagram

(d) Explain viterbi algorithm for decoding of convolutional codes. 7

Or

[7]

Write short note on : (any two)

(i) Code Tree

(ii) Code Trellis

(iii) State Diagram

(iv) Turbo codes