

Fifth Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026
Information Theory and Coding

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. Find the relationship between Hartleys, nats and bits. (08 Marks)
- b. Consider the state diagram of the Markov source of Fig.Q1(b).
 i) Compute the state probabilities
 ii) Find the entropy of each state
 iii) Find the entropy of the source.

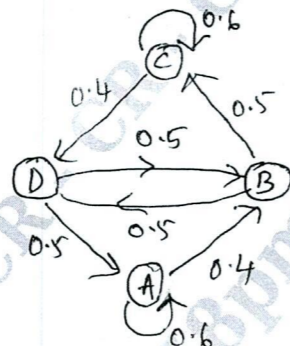


Fig.Q1(b) Markov Source (12 Marks)

OR

- 2 a. A binary source is emitting an independent sequence of 0's and 1's with probability P and 1 - P respectively. Plot the entropy of the source versus P. (10 Marks)
- b. A code is composed of dots and dashes. Assuming that a dash is 3 times as long as a dot and has one third the probability of occurrence. Calculate :
 i) The information in a dot and a dash
 ii) Entropy of dot dash code
 iii) The average rate of information if a dot lasts for 10 m -sec and this time between symbols. (10 Marks)

Module-2

- 3 a. Define the following :
 i) Block code
 ii) Non singular code
 iii) Uniquely decodable code
 iv) Instantaneous codes
 v) Optimal codes. (10 Marks)
- b. Prove Kraft inequality [KMI] theorem $\sum_{k=1}^q r^{-l_k} \leq 1$. (10 Marks)

OR

- 4 a. Apply Shannon's encoding (binary) algorithm to the following set of messages and obtain code efficiency and redundancy.

m ₁	m ₂	m ₃	m ₄	m ₅
1/8	1/16	3/16	1/4	3/8

(12 Marks)

- b. Given the messages x₁, x₂, x₃, x₄, x₅ and x₆ with respective probabilities 0.4, 0.2, 0.2, 0.1, 0.07 and 0.03, construct a binary code by applying Shanon-Fano encoding procedure. Determine the code efficiency and redundancy of a code. (08 Marks)

Module-3

- 5 a. Define joint probability. Explain the properties of JPM. (08 Marks)
- b. For the JPM 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)

OR

- 6 a. Derive the equation for channel capacity of symmetric channel. (10 Marks)
- b. A channel has the following characteristics

$$P(Y/X) = \begin{bmatrix} 1/3 & 1/3 & 1/6 & 1/6 \\ 1/6 & 1/6 & 1/3 & 1/3 \end{bmatrix}$$

Find H(X), H(Y), H(X, Y) and channel capacity if r = 1000 symbols/sec. (10 Marks)

Module-4

- 7 a. For a systematic (6, 3) LBC, the parity matrix 'P' is given by

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

Find all possible code vectors. **CMRIT LIBRARY** BANGALORE - 560 037 (10 Marks)

- b. If 'C' is a valid code vector [C] = [D] [G] then prove that CH^T = 0 when H^T is transpose of parity check matrix 'H'. (10 Marks)

OR

- 8 a. A (6, 3) LBC with a parity matrix is given below. The received code vector $R = [1\ 1\ 0\ 0\ 1\ 0]$ is given. Detect and correct the single error that has occurred due to noise.

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

(08 Marks)

- b. Consider (6, 3) LBC, whose generator matrix is:

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

- Find all hamming weight and distances
- Find minimum weight parity check matrix
- Draw the encoder circuit for the above codes.

(12 Marks)

Module-5

- 9 a. Consider (2, 1, 3) convolutional encoder with message bits $\rightarrow 10111$. Find the o/p sequence.

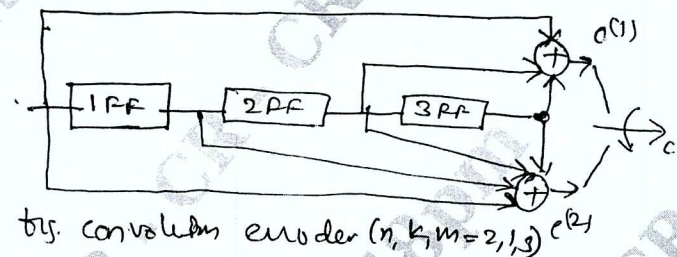


Fig.Q9(a)

(10 Marks)

- b. Consider the (3, 1, 2) convolutional code with $g^{(1)} = (1\ 1\ 0)$, $g^{(2)} = (1\ 0\ 1)$ and $g^{(3)} = (1\ 1\ 1)$.

- Draw the encoder block diagram
- Find the generator matrix
- Find the codeword corresponding to the information sequence (11101) using time domain approach.

(10 Marks)

OR

- 10 Consider the binary convolutional encoder shown in Fig.Q10. Draw the state table state transition table, state diagram and the corresponding code tree, using the code tree, find the encoded sequence for the message (10111). Verify the output sequence so obtained using transform domain.

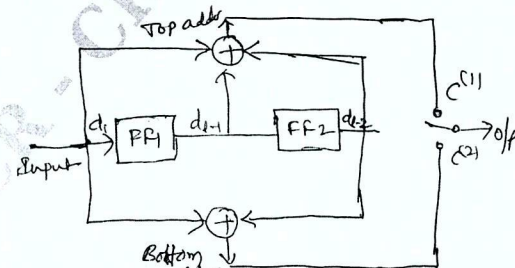


Fig (a) A (2, 1, 2) convolutional encoder.

Fig.Q10

(20 Marks)