PAPER ID-310086

Roll No: | | | | | | | | | | | |

# BTECH
## (SEM VII) THEORY EXAMINATION 2024-25
## INFORMATION THEORY & CODING

**TIME: 3 HRS**  **M.MARKS: 100**

**Note:** Attempt all Sections. In case of any missing data; choose suitably.

### SECTION A

**1.**  **Attempt *all* questions in brief.**  **2 x 10 = 20**

| Q no. | Question | CO | Level |
|---|---|---|---|
| a. | What is mutual information, and how is it related to entropy? | 1 | K1 |
| b. | Explain the relationship between relative entropy and mutual information. | 1 | K2 |
| c. | Explain the Kraft inequality and its significance in coding theory. | 2 | K2 |
| d. | Differentiate between Huffman coding and Shannon–Fano coding. | 2 | K2 |
| e. | Describe the channel coding theorem. | 3 | K2 |
| f. | Define symmetric channels in the context of channel capacity. | 3 | K1 |
| g. | What is the minimum distance of a block code? | 4 | K1 |
| h. | Explain the purpose of parity-check matrices in block codes. | 4 | K2 |
| i. | Explain the Viterbi algorithm and its significance in decoding. | 5 | K2 |
| j. | What are convolutional codes, and how are they represented? | 5 | K1 |

### SECTION B

**2.**  **Attempt any *three* of the following:**  **10 x 3 = 20**

| | | | |
|---|---|---|---|
| a. | Define entropy, joint entropy, and conditional entropy. Provide mathematical expressions and examples. | 1 | K1 |
| b. | State and prove the Asymptotic Equipartition Property (AEP) theorem. | 2 | K1 |
| c. | Explain the concept of jointly typical sequences and their application in coding theory. | 3 | K2 |
| d. | Explain single-parity-check code with example. | 4 | K2 |
| e. | What is the Viterbi algorithm, and how is it used in decoding convolutional codes? | 5 | K1 |

### SECTION C

**3.**  **Attempt any *one* part of the following:**  **10 x 1 = 10**

| | | | |
|---|---|---|---|
| a. | An event has six outcomes with the probabilities $P_1 = 1/2$, $P_2 = 1/4$, $P_3 = /8$, $P_4 = 1/16$, $P_5 = 32$ and $P_6 = 132$. Find the entropy of the system. Also, find the rate of information, if there are 16 outcomes per second. | 1 | K1 |
| b. | State log-sum inequality and its applications. | 1 | K2 |

**4.**  **Attempt any *one* part of the following:**  **10 x 1 = 10**

| | | | |
|---|---|---|---|
| a. | What do you mean by data compression and give its type? | 2 | K2 |
| b. | Write an algorithm for Shannon-Fano-Elias coding. | 2 | K1 |

**5.**  **Attempt any *one* part of the following:**  **10 x 1 = 10**

| | | | |
|---|---|---|---|
| a. | Discuss the properties of channel capacity and its impact on communication systems. | 3 | K2 |
| b. | What is the channel coding theorem, and why is it fundamental to information theory? | 3 | K1 |

**6.**  **Attempt any *one* part of the following:**  **10 x 1 = 10**

| | | | |
|---|---|---|---|
| a. | Given the (8, 7) single-parity-check code, with even parity, find the probability of correct decoding, a decoding error and a decoding failure when p = 0.01. | 4 | K2 |
| b. | What is Hamming distance? Give relation between minimum distance and error detecting and correcting capability. | 4 | K2 |

**7.**  **Attempt any *one* part of the following:**  **10 x 1 = 10**

| | | | |
|---|---|---|---|
| a. | Describe generator matrices for convolutional codes. | 5 | K2 |
| b. | Write short notes on : (i) code tree (ii) trellis diagram (iii) state diagram | 5 | K2 |