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 **PRESIDENCY UNIVERSITY**

  **Bengaluru**

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| **End - Term Examinations – JANUARY 2025** |
| Date: 07 – 01- 2025 Time: 09:30 am – 12:30 pm |

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| **School:** SOCSE | **Program:** B. Tech-CSE |
| **Course Code:** CSE3086 | **Course Name:** Information Theory and Coding |
| **Semester**: VII | **Max Marks**: 100 | **Weightage**: 50% |

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| **CO - Levels** | **CO1** | **CO2** | **CO3** | **CO4** | **CO5** |
| **Marks** | **24** | **24** | **26** | **26** | **NA** |

**Instructions:**

1. *Read all questions carefully and answer accordingly.*
2. *Do not write anything on the question paper other than roll number.*

**Part A**

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| **Answer ALL the Questions. Each question carries 2marks. 10Q x 2M=20M** |
| **1** | What is the formula for calculating the average information content for a discrete source. | **2 Marks** | **L1** | **CO1** |
| **2** | What is the difference between zero-memory sources and sources with memory? | **2 Marks** | **L1** | **CO1** |
| **3** | Define Kraft's inequality for a code. | **2 Marks** | **L1** | **CO2** |
| **4** | What is the significance of Shannon’s Noiseless Coding Theorem? | **2 Marks** | **L1** | **CO2** |
| **5** | Explain the rate of information transmission over a discrete channel? | **2 Marks** | **L2** | **CO3** |
| **6** | Compare the difference between a deterministic channel and a noiseless channel? | **2 Marks** | **L2** | **CO3** |
| **7** | Summarize the significance of Shannon’s theorem on channel capacity. | **2 Marks** | **L2** | **CO3** |
| **8** | What is a cyclic code? | **2 Marks** | **L1** | **CO4** |
| **9** | Define the role of a shift register in encoding cyclic codes. | **2 Marks** | **L1** | **CO4** |
| **10** | How do you calculate the syndrome of a received codeword? | **2 Marks** | **L1** | **CO4** |

**Part B**

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| **Answer the Questions Total 80 Marks.** |
| **11.** | **a.** | A source generates two symbols, A and B, with probabilities P(A)=0.3 and P(B)=0.7. The sequence of symbols is dependent and follows a second-order Markov model. If the second-order transition matrix is given as: P = $\left[\begin{matrix}0.4&0.6\\0.5&0.5\end{matrix} \begin{matrix}0.3\\0.4\end{matrix} \begin{matrix}0.7\\0.6\end{matrix} \right]$Identify the entropy rate for this Markov source. Experiment how the dependency affects the entropy compared to a memory-less source. | **20 Marks** | **L3** | **CO1** |
| **Or** |
| **12.** | **a.** | Explain the significance of entropy rate in the context of a stationary process. How does the entropy rate help in determining the efficiency of data compression and error correction in a communication system? | **20 Marks** | **L2** | **CO1** |
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| **13.** | **a.** | Given the source symbols S={A,B,C,D,E} with probabilities P(A)=0.3, P(B)=0.25, P(C)=0.2, P(D)=0.15, P(E)=0.1:i) Develop the Huffman tree and determine the binary code for each symbol.ii) Identify the average codeword length.iii) Build the code efficiency and redundancy of the Huffman code. | **20 Marks** | **L3** | **CO2** |
| **Or** |
| **14.** | **a.** | Explain the Kraft's inequality for uniquely decodable codes and explain how Kraft's inequality is used to test the instantaneous property of codes with example where Kraft’s inequality helps determine if a code is feasible. | **20 Marks** | **L2** | **CO2** |

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| **15.** | **a.** | Consider a cascaded channel consisting of two identical discrete memoryless sub-channels where the transition probability matrix of each channel is: P(Y∣X)= $\left[\begin{matrix}0.7&0.3\\0.4&0.6\end{matrix}\right]$Tasks:i) Apply and represent the overall cascaded channel using a transition probability matrix.ii) Identify the mutual information for the cascaded channel.iii) Identify the channel capacity. | **20 Marks** | **L3** | **CO3** |
| **Or** |
| **16.** | **a.** | Explain the classification of channels into Noiseless, Deterministic, and Cascaded channels. Discuss their characteristics with diagrams and appropriate examples. | **20 Marks** | **L2** | **CO3** |

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| **17.** | **a.** | Classify the linear block codes? Explain the matrix representation of a linear block code and derive the generation of codewords using a generator matrix. Include a clear explanation of systematic and non-systematic codes. | **20 Marks** | **L2** | **CO4** |
| **Or** |
| **18.** | **a.** | Illustrate the syndrome calculation in cyclic codes. Explain its role in detecting errors. Provide a step-by-step procedure to calculate the syndrome for a received codeword. | **20 Marks** | **L2** | **CO4** |

**\*\*\*\*\* BEST WISHES \*\*\*\*\***