Enrolment No/ Roll No .....

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**Odd Semester Examination-2024**

**Paper Code: BTECE DEI13 (BACKLOG)** **Time: 3 Hours**

**Paper Name: Information Theory and Coding** **Maximum Marks: 75**

***Note: Follow proper numbering for answering the questions.***

CO1: Understand the fundamental concepts of information theory and coding theorems.
CO2: Understand Shannon's theorem for coding.
CO3: Calculate of channel capacity and bounds for discrete channels.
CO4: Analyse various techniques for coding and decoding.
CO5: Apply various coding techniques.

## Section A

**All questions are compulsory in this Section.** **7 x 5 = 35**

| Q No. | Questions | Marks | CO | BL |
|---|---|---|---|---|
| | Define the following:<br>i. Forward error correction ii.Entropy iii.Equivocation H(X/Y)<br>iv.Mutual Information v. Information Rate | 5 | 1 | 1 |
| 2. | A voice-grade channel of the telephone network has a bandwidth of 3.2 kHz.<br>a. Calculate the information capacity of the telephone channel for SNR of 15 dB.<br>b. Calculate the minimum SNR required to support information transmission through the channel at 9.6 kb/s. | 5 | 2,3 | 5 |
| 3. | State Shannon-Hartley 's Law and mention its real-world applications. Consider a communication channel with a bandwidth of 20,000 Hz and a signal-to-noise ratio of 35 dB. Apply Shannon-Hartley's Law to determine the channel capacity in bits per second. | 5 | 2 | 4 |
| 4. | Explain the concept of quantization and how it can be used to discretize a continuous source for transmission over a digital communication system. | 5 | 1 | 1 |
| 5. | A convolutional encoder has single shift register with two stages, constraint length=3, three modulo-2 adders and an output multiplexer. The generation sequence of the encoder are as follows:<br>$g_1 = (101)$; $g_2 = (110)$; $g_3 = (111)$. Realize a convolutional encoder. | 5 | 5 | 6 |
| 6. | Distinguish between Block codes and Convolutional codes. | 5 | 4 | 4 |
| 7. | Assume k=2 and n=3. Table 1 shows the list of datawords and codewords. Find the minimum Hamming distance of the coding scheme.<br>Table 1 A code for error detection<br>*Datawords* / *Codewords*: 00 / 001; 01 / 010; 10 / 101; 11 / 110 | 5 | 4 | 3 |

## Section-B

Attempt any **FOUR** Questions from this Section **4 x 10 = 40**

| Q No. | Questions | Marks | CO | BL |
|---|---|---|---|---|
| 8. | Derive Shannon-Fano coding for the source having P($x$) = {0.49,0.14,0.14,0.07,0.07,0.04,0.02,0.02,0.01}. Calculate the coding efficiency and redundancy. | 10 | 5 | 5 |
| 9. | The probability matrix P ($x$, $y$) of the channel with binary input is given below. $\begin{bmatrix} 0.25 & 0.25 \\ 0.25 & 0.25 \end{bmatrix}$ Find all entropies and mutual information. | 10 | 3 | 5 |
| 10. | Consider the convolutional code encoder consists of $g_1$ = (110); $g_2$= (010); $m$=11101 and constraint length=3. Find out encoded codeword<br>i. Using Time domain approach.<br>ii. Using Transform domain. | 10 | 5 | 6 |
| 11. | Construct a (7,4) linear block code. The parity information is given as<br>$b_0=m_0+m_1+m_2$<br>$b_1= m_0+m_2+m_3$<br>$b_2= m_1+m_2+m_3$<br>Give the codeword for the message vector 1010 and correct the error if the error had occurred in the position $c_5$ of the codeword. | 10 | 5 | 5 |
| 12. | Write short note on ***Any Two***<br>i. Error control coding -Types, Advantage and disadvantages.<br>ii. Hamming Codes<br>iii. Syndrome and its properties. | 10 | 4,5 | 4 |
| 13. | Consider convolutional encoder with constraint length 3 and message sequence= 10011; $g_1$ = (110); $g_2$= (011).<br>Find the codeword using<br>i. State Table.<br>ii. Tree diagram. | 10 | 5 | 6 |

BL-Bloom's Taxonomy Levels(1-Remembering,2-Understanding,3-Applying,4-Analysing,5-Evaluting,6-Creating)