BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: BTECH **SEMESTER : VI**
BRANCH: ECE **SESSION : SP/2023**

SUBJECT: EC359N INFORMATION THEORY AND CODING

TIME: 3 Hours **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

			CO	BL
Q.1(a)	Describe Huffman coding algorithm. Consider a DMS with probabilities 0.37, 0.33, 0.16, 0.07, 0.04, 0.02 and 0.01, respectively. Construct Huffman coding for the DMS and find out the code efficiency.	[5]	01	02
Q.1(b)	Prove that the chain rule for entropy is given by $H(X_1, X_2, \dots, X_n) = \sum_{i=1}^{n} H(X_i \mid X_{i-1}, \dots, X_1)$	[5]	01	04
Q.2(a)	Show that the channel capacity of an ideal AWGN channel with infinite bandwidth is given by 1.44 S/η b/s, where S is the average signal power and η/2 is the power spectral density of the white Gaussian noise.	[5]	02	02
Q.2(b)	Draw the bandwidth efficiency diagram. Find the overall channel capacity of two cascaded connected BSC channels if both have the same transition probability diagram with p=0.3	[5]	02	03
Q.3(a)	Define Galois field and its properties. Prepare multiplication table for the GF (5).	[5]	03	01
Q.3(b)	Define Singleton and Humming bounds for linear block codes. Consider a parity check matrix H= [1 0 0 0 0 1 1; 0 1 0 0 1 0 1; 0 0 1 0 1 1 0; 0 0 0 1 1 1 1], received sequence as r= [0 0 1 1 0 1 1] and error e=[0 1 0 1 0 0 0], then compute the syndrome, s and reconstructed code, c.	[5]	03	04
Q.4(a)	For non-systematic coding in (7, 3) binary cyclic code (under GF (2)) with generator polynomial $\mathbf{g(x)=1 + x^2 + x^3 + x^4}$. Generate all possible codewords.	[5]	04	06
Q.4(b)	What is the role of parity check matrix in error correction and for above question 4(a), determine parity check matrix, **H**.	[5]	04	03
Q.5(a)	Draw convolutional encoder and its one stage of trellis diagram with transfer function matrix $\mathbf{G(x)= [1 + x^2 \quad 1 + x + x^2]}$	[5]	05	04
Q.5(b)	Describe Viterbi decoding of convolutional codes with its advantages.	[5]	05	02

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