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

CLASS: BTECH **SEMESTER : VI**
BRANCH: ECE **SESSION : SP/2025**

SUBJECT: EC359 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)	Define basic concept of variable length coding. Is Huffman code a variable length code? Construct a Huffman code for a DMS with four symbols of equal probabilities and determine the maximum possible code efficiency for the code.	[5]	01	02
Q.1(b)	Explain Arithmetic coding with an example. Also, consider a DMS with source probabilities {0.25, 0.25, 0.2, 0.15, 0.15} and design Shannon-Fano-Elias code. Also determine its average code word length.	[5]	01	04
Q.2(a)	Prove that the information capacity of a continuous channel of bandwidth W hertz, perturbed by additive Gaussian noise of power spectral density $N_0/2$ is given by $C = W \log_2\left(1 + \frac{P}{N_0 W}\right)$ bits/sec.	[5]	02	02
Q.2(b)	Determine and compare the overall channel capacity of two cascaded connected binary symmetric channels if both have the same transition probability by taking three cases of transition probability: p=0.3(<0.5), p=0.5 and p=0.7(>0.5).	[5]	02	03
Q.3(a)	Define Galois field and its properties. Prepare addition and multiplication table for the GF (3).	[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 **$g(x)= (1+x)(x^3+x+1)$**. determine generator matrix, G & parity check matrix, H.	[5]	04	06
Q.4(b)	Determine code polynomial/codeword for message **$m(x) = 1 + x^2$**. Assume systematic coding in (7, 3) binary cyclic code (under GF (2)). Take **$g(x)= (1+x)(x^3+x+1)$**	[5]	04	03
Q.5(a)	Draw convolutional encoder, state diagram for the transfer function matrix **$G(x)= [1 \quad (1+x+x^2)/(1+x^2)]$.** Also determine the code rate and all possible output of this encoder.	[5]	05	04
Q.5(b)	Determine the original message bits sent from the convolutional encoder with the transfer function matrix **$G(x)= [x^2 + 1 \quad x^2 + x + 1]$** if the received sequence bits at Viterbi decoder of the convolutional code is **r** = [**11 10 11 01 11 01 00 01** ….]	[5]	05	02

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