K. J. Somaiya Institute of Technology, Sion, Mumbai-22
(Autonomous College Affiliated to University of Mumbai)

Nov – Dec 2025
(B. Tech.) Program: Artificial Intelligence and Data Science Scheme :III
Regular/ Examination: /TY/ Semester: V
Course Code:AIC503 and Course Name: Information Theory and Coding
Date of Exam: 01-12-25 Duration: 2.30 Hours   Max. Marks: 60

Instructions:
(1)All questions are compulsory.
(2)Draw neat diagrams wherever applicable.
(3)Assume suitable data, if necessary.

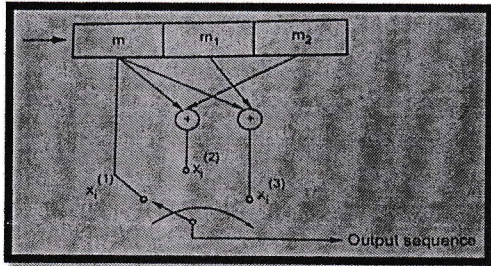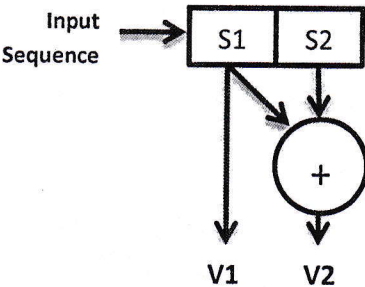| Q. No.	Question	Max. Marks	CO	BT level
Q 1	Solve any **two** questions out of three: (05 marks each)			
a)	(I) Calculate amount of information if two binary digits 0 and 1 occur equally likely. (II) A communication system uses 4 distinct messages. If all messages are equally likely and the Nyquist Rate is 2B samples per second per message, calculate the information rate of the system in bits per second.	10	CO1	Ap
b)	(I) State one key advantage of Arithmetic coding over Huffman coding and one practical reason why Huffman coding is still widely used. (II) Apply the Shannon-Fano encoding procedure to the following message symbols $X=\{x1,x2,x3,x4,x5,x6,x7,x8,x9\}$ with probabilities $P(X)=\{0.49,0.14,0.14,0.07,0.07,0.04,0.02,0.02,0.01\}$. Find the efficiency of the resulting code		CO2	Ap
c)	(I) Explain the fundamental concept behind the Sliding Window method in one sentence. Provide one key application area. (II) What is the worst-case situation of the LZ77 compression algorithm? Explain it with a suitable example. How does the LZ78 algorithm solve this problem?		CO3	U
Q 2	Solve any **two** questions out of three: (05 marks each)			
a)	(I) What is the key difference between a P-frame and a B-frame in MPEG compression? State one advantage of using B-frames. (II) What are the key distortion measure parameters used in video compression? Explain the concept of Motion Compensation in video compression		CO4	U
b)	(I) How does the human ear's limitation, as described by Frequency Masking, allow for irrelevance reduction in audio codecs? (II) Explain the Differential Pulse Code Modulation (DPCM) audio compression technique. Also, state the main disadvantage of the DPCM technique		CO5	U
c)	(I) The generator matrix for a (6,3) block code is given below. Find all code vectors of this code. $$G = \begin{bmatrix} 1 & 0 & 0 & 0 & 1 & 1 \\ 0 & 1 & 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 1 & 1 & 0 \end{bmatrix}$$ (II) Demonstrate the cyclic property using the code word $V=(c0,c1,c2,c3)$, Show, what a single cyclic shift produces.	10	CO6	Ap
Q.3	Solve any **two** questions out of three. (10 marks each)	20		

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a)	(I) For the given convolution encoder draw the state diagram and trellis diagram. Determine the output digit sequence for the data digits 11010100 (II) What are the advantages and Disadvantages of Convolutional codes.and For the given convolution encoder rate is ½, constraint length K=2, sketch the code tree.		CO6	Ap
b)	(I) Explain how the probability of an event is related to the entropy of a source. (II) Show that the entropy of a discrete memoryless source is maximum when all the messages are equally likely.		CO1	Ap
c)	Define LZW dictionary technique with example .and Given the following primed dictionary and the received sequence below, build and LZW dictionary and decode the transmitted sequence. Received sequence: 4,5,3,1,2,8,2,7,9,7,4. Initial dictionary is as shown below Index Entry 1 S 2 # 3 I 4 T 5 H		CO3	Ap
Q.4	Solve any **two** questions out of three. (10 marks each)			
a)	(I) Explain the different fundamental approaches to image compression. (II) Explain the Discrete Cosine Transform (DCT) and its role in image compression in detail.	20	CO4	U
b)	A source emits letters from an alphabet A={m,n,o,p,q} with probabilities {0.1, 0.3,0.3,0.15,0.15} respectively. Find Shannon Fano code. Find Huffman code. Compare average length and redundancies for both the codes		CO2	Ap

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c)	(I)Explain the parameters used to measure performance of data compression methods (II) A given source alphabet consists of 300 words of which 15 occur with probability 0.006 each and remaining words occur with probability 0.00035 each. If 1000 words are transmitted each second, what is the average rate of information transmission?		CO1	Ap

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