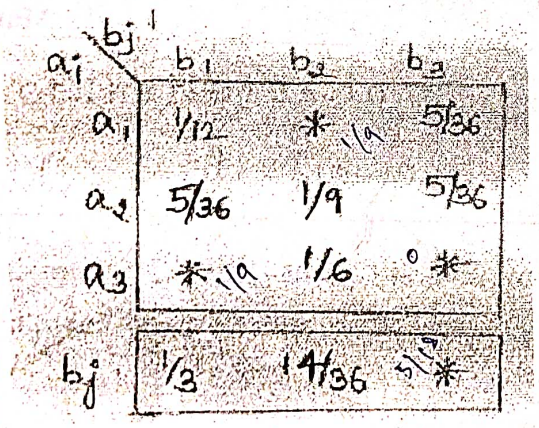
24.5.2023 (E)

SOMAIYA VIDYAVIHAR UNIVERSITY

Maximum Marks: 100	Semester: January 2023 –May 2023 Examination: ESE Examination	Duration:3 Hrs.
Programme code: 04 Programme: B Tech	Class: SY	Semester:IV (SVU 2020)
Name of the Constituent College: K. J. Somaiya College of Engineering	Name of the department: IT	
Course Code: 116U04C402	Name of the Course: Information Theory and Coding	
Instructions: 1)Draw neat diagrams 2) All questions are compulsory 3) Assume suitable data wherever necessary		

Que. No.	Question	Max. Marks
Q1	Solve any Four	20
(i)	Define self information. Why is logarithmic expression chosen for measuring information?	5
(ii)	A code is composed of dots and dashes. A dash is 3 times as long as a dot, but has one third the probability of a dot. Calculate the information in the dash and the dot.	5
(iii)	What is Joint Probability Matrix? Explain their properties.	5
(iv)	Consider a source S = {S1, S2, S3} with P = {½, ¼, ¼}. Find the following: a) Self-information of each symbol b) Entropy of Source S	5
(v)	A discrete source emits one of the six symbols once every m-sec. The symbol probabilities are 1/2, 1/4, 1/8, 1/16, 1/32 and 1/32 respectively. Find the source entropy and information rate.	5
(vi)	A Joint Probability Matrix P(A,B) is given below:-  Find the missing probabilities in the table.	5

Que. No.	Question	Max. Marks
Q2 A	Solve the following	10
(i)	Given the messages $X_1, X_2, X_3, X_4, X_5, X_6$ with respective probabilities of 0.4, 0.2, 0.2, 0.1, 0.07, 0.03. Construct a binary code by applying Huffman encoding procedure. Determine the efficiency and redundancy of the code so formed.	5
(ii)	Explain Run Length Encoding with example.	5

	OR	
Q2 A	Show the message encoding for the message "**SAHARA**" using the following encoding methods. Also calculate the source entropy, average length per symbol and the coding efficiency in each case: a) Shannon-Fano coding b) Huffman coding	10
Q 2 B	Solve any **One**	**10**
i)	Explain LZW technique with example and how LZW is different from arithmetic coding?	10
ii)	Write a note on Shannon-Fano Algorithm. Create a coding tree for the word "SPEAKER" using Shannon Fano. Explain how it is different from Huffman Coding	10

Que. No.	Question	Max. Marks
Q3	Solve any **Two**	**20**
i)	Define standard array. How is it used in syndrome decoding? Explain with an example.	10
ii)	Consider a (6,3) Linear Block Code whose generator matrix is $\begin{bmatrix} 1 & 0 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & 1 & 0 \\ 0 & 0 & 1 & 0 & 1 & 1 \end{bmatrix}$ a) Find all code vectors (4 Marks) b) Find the minimum hamming distance d_{min} (3 Marks) c) Check if the received vector r = [110111] contains any error using the syndrome method. (3 Marks)	10
iii)	Explain error control coding with a block diagram	10

Que. No.	Question	Max. Marks
Q4	Solve any **Two**	**20**
i)	Use the Chinese Remainder theorem to find x such that: a) $x \equiv 2 \bmod 3$ b) $x \equiv 1 \bmod 5$ c) $x \equiv 6 \bmod 7$	10
ii)	Explain the following terms:- (a) Asymmetric Cryptography (b) Substitution Cipher	10
iii)	Use the Vigenere cipher method to encode and decode the message "GIRAFFE" using the encryption key "XYZ".	10

Que. No.	Question	Max. Marks
Q5	(Write notes / Short question type) on any **four**	**20**
i)	Fermat's little theorem with example	5
ii)	Joint and Conditional Entropy	5
iii)	Image compression	5
iv)	Explain error detection using Cyclic Redundancy Check with an example	5
v)	Explain the importance of Prime number generation with two application areas	5
vi)	Affine cipher with example	5