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

May-June 2025
(B. Tech) Program: Artificial Intelligence-DS Scheme: III
Regular Examination: SY Semester: IV
Course Code: AIC401 and Course Name: Mathematics for Data Science
Date of Exam: 19 /05/25 Duration: 02 3Hours 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)	10		
a)	A total number of 3759 individuals were interviewed in a public opinion survey on a political proposal. Of them, 1872 were men and the rest were women. A total of 2257 individuals were in favor of the proposal, and 917 were opposed to it. A total of 243 men favour were undecided, and 442 women opposed the proposal. Do you justify or contradict the hypothesis that there is no association between gender and Opinion? [The table value of χ^2 at LOS 0.05, and at dof 2 is 5.991, at dof 1 is 3.841, at dof 3 is 7.815]		CO5	3
b)	Find Cholesky composition of matrix A. $A = \begin{bmatrix} 4 & 12 & -16 \\ 12 & 37 & -43 \\ -16 & -43 & 98 \end{bmatrix}$		CO2	3
c)	If $A = \begin{bmatrix} x & 4x \\ 2 & y \end{bmatrix}$ has eigenvalues 5 *and* -1, then find x and y values.		CO1	3
Q 2	Solve any **two** questions out of three: (05 marks each)	10		
a)	The incomes of a group of 10,000 people were found to be normally distributed with a mean of Rs. 520 and a standard deviation of Rs. 60. Find i) the number of people having income between Rs. 400 and Rs. 550, and ii) the lowest income of the richest 5% of the people. [Area under standard normal curve from $z = 0$ to 2 is 0.6915, from $z =$ 0 to 0.5 is 0.0228, area from 0 to 0.51 is 0.1950 , area from 0 to 0.45 is 0.1736 , area for 0 to 56 is 0.2123 , area from 0 t0 0.55 is 0.2088]		CO4	3
b)	Calculate the Kendall's Tau rank correlation coefficient for the following data:		CO3	2

X	5	11	2	10	8	7
Y	4	10	13	5	8	9

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c)	Find an optimal solution to the following L.P.P. by computing all basic solutions and then finding one that maximizes the objective function. Maximize $z = 2x_1 - 2x_2 + 4x_3 - 5x_4$ Subject to $x_1 + 4x_2 - 2x_3 + 8x_4 = 2,$ $-x_1 + 2x_2 + 3x_3 + 4x_4 = 1,$ $x_1, x_2, x_3, x_4 \geq 0$		CO6	03
Q.3	Solve any **two** questions out of three. (10 marks each)	20		
a)	The following table presents a frequency distribution of a dataset. Calculate the first quartile (Q□), the second quartile (Q□), the third quartile (Q□), the mean, and the variance from the data below:		CO3	3
b)	(i)Verify Cayley-Hamilton theorem and find A^{-1} for $A = \begin{bmatrix} 1 & 4 \\ 2 & 3 \end{bmatrix}$ Hene find $A^5 - 4A^4 - 7A^3 + 11A^2 - A - 10I$ interms of A. (5 marks) (ii) Show that the matrix $\begin{bmatrix} 4 & 2 & -2 \\ -5 & 3 & 2 \\ -2 & 4 & 1 \end{bmatrix}$ is diagonalizable . Find the transforming matrix and the diagonal matrix. (5 marks)		CO1	3
c)	Find the Singular Value Decomposition (SVD) of A= $\begin{bmatrix} 1 & 1 \\ 1 & 1 \\ 1 & -1 \end{bmatrix}$		CO2	3
Q.4	Solve any **two** questions out of three. (10 marks each)	20		
a)	A car manufacturer wants to compare the fuel efficiency (miles per gallon)		CO5	3

Class Interval (CI)	Frequency (F)
0-50	5
50-100	10
100-150	3
150-200	4
200-250	0
250-300	15
300-350	6
350-400	5
400-450	2

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	of three car brands (Brand A, Brand B, and Brand C). The fuel efficiency data for 5 cars of each brand is as follows: Brand A: 9, 11, 13, 9, 8 Brand B: 13, 12, 10, 15, 5 Brand C: 14, 13, 17, 7, 9 Perform a One-Way ANOVA to test if there is a significant difference in the mean fuel efficiency among the three brands at a 5% significance level. [Table value of F distribution at DOF F(3,16),F(2,12), F(2,9),F(3,11) at LOS 0.05 are 3.2389, 3.89, 4.26, 3.59 respectively].			
b)	(i) It is known that the probability of an item produced by a certain machine being defective is 0.05. If the produced items are sent to the market in packets of 20, find the number of packets containing exactly, at least, and at most 2 defective items in a consignment of 1000 packets. (4 marks) (ii) Using the method of Lagrange's multipliers, solve the following N.L.P.P. Optimize $Z = 4x_1 + 8x_2 - x_1^2 - x_2^2$ Subject to $x_1 + x_2 = 4$, $x_1, x_2 \geq 0 \geq 0$ (6 marks)		CO4,CO6	3
c)	(i) Use the Simplex method to solve the following L.P.P. Maximise $z = 4x_1 + 10x_2$ $subject\ to\ 2x_1 + x_2 \leq 50$, $2x_1 + 5x_2 \leq 100$, $2x_1 + 3x_2 \leq 90$ $x_1, x_2 \geq 0$. (6 marks) (ii)The time (in hours) required to repair a watch is exponentially distributed with parameter $\lambda = 1/2$. (I) What is the probability that the repair time exceeds 2 hours? (II) Given that its duration exceeds 8 hours, what is the probability that it will take more than 11 hours in total? (4 marks)		CO6,CO4	3

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