28/07/2025 Sem-IV Scheme III / IT / Comp

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

July
~~May-June~~ 2025
Program: B. Tech Scheme: III
Supplementary ~~Regular~~ Examination: SY Semester: IV
Course Code: CEC401_ITC401_IV and Course Name: Applications of Mathematics in Engineering-II
Date of Exam: 28/07/2025 Duration: 02.5 Hours Max. Marks: 60

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

Q. No.	Questions	Max. Marks	CO	BT level
Q 1	Solve any **two** questions out of three: (05 marks each)	10		
a)	Find eigenvalues of the matrix A, also find the matrix represented by $A^6 - 6A^5 + 9A^4 + 4A^3 - 12A^2 + 2A - I$, where A is $\begin{bmatrix} 3 & 10 & 5 \\ -2 & -3 & -4 \\ 3 & 5 & 7 \end{bmatrix}$.		CO 1	03
b)	Let's say we have the following data representing the marks of students in a class, grouped into intervals. Calculate the mean and the median.		CO 3	03
c)	300 digits were chosen at random from a table of random numbers. The frequency of digits was as follows. Using χ^2 test examine the hypothesis that the digits were distributed in equal numbers in the table (take LOS 5%) (Note: Critical value at 5% LOS with at dof 1 is 3.841, at dof 3 is 7.815, at dof 9 is 16.92)		CO 5	03
Q 2	Solve any two questions out of three: (05 marks each)	10		
a)	Find Cholesky decomposition of matrix = $\begin{bmatrix} 4 & 12 & -16 \\ 12 & 37 & -43 \\ -16 & -43 & 98 \end{bmatrix}$. Also find its nullity.		CO 2	03
b)	In a certain factory producing cycle tyres, there is a small chance of 1 in 500 tyres to be defective. The tyres are supplied in lots of 10. Using Poisson distribution calculate the approximate number of lots containing no defective, one defective and two defective tyres, respectively in a consignment of 10,000 lots.		CO 4	03

Marks interval	0-10	10-20	20-30	30-40
Frequency f_i	3	5	8	4

Digit	0	1	2	3	4	5	6	7	8	9
Frequency	28	29	33	31	26	35	32	30	31	25

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c)	Solve the following L.P.P. using Simplex Method. Maximize: $z = 2x_1 + x_2$ Subject to : $-x_1 + 2x_2 \leq 2$ $x_1 + x_2 \leq 4$ $x_1 \leq 3,$ And $x_1, x_2 \geq 0.$		CO 6	03
Q.3	Solve any **two** questions out of three. (10 marks each)	20		
a)	i) Determine whether following matrix A is diagonalizable, if yes find the modal matrix P and diagonal form D, where $A = \begin{bmatrix} 2 & 2 & 1 \\ 1 & 3 & 1 \\ 1 & 2 & 2 \end{bmatrix}$.	7	CO 1	03
	ii) If the matrix A is given as follows, find eigenvalues of A^t, A^{-1} and $adj(A)$ where $= \begin{bmatrix} 4 & 6 & 6 \\ 1 & 3 & 2 \\ -1 & -4 & -3 \end{bmatrix}$.	3		
b)	i) Find Q1, Q2, Q3 and interquartile range and range for the following data: Class Interval: 0-10 | 10-20 | 20-30 | 30-40 | 40-50 Frequency f_i: 5 | 8 | 12 | 20 | 10	7	CO 3	03
	ii) Find Kendall's rank correlation coefficient for the given data. X ranks: 1 | 2 | 3 | 4 | 5 | 6 Y Ranks: 3 | 1 | 4 | 2 | 6 | 5	3		
c)	i) To assess the significance of possible variations in performance in a certain test between the convent schools of a city, a common test was given. The results are given below. Make an analysis of variance of the data at 5% of LOS. [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] A: 8, 10, 12, 8, 7 B: 12, 11, 9, 14, 4 C: 18, 12, 16, 6, 8 D: 13, 9, 12, 16, 15	6	CO 5	03
	ii) Following results were obtained when body fat % of men and women who work out in gym is measured. Is the difference between the means of the samples significant? (take 5% LOS) (Note: Critical (take 5% LOS) (Note: Critical value at 5% LOS with DOF 21 is 2.080, with DOF 22 is 2.074, with DOF 23 is 2.069)	4		

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	Sample Size	Mean	S.D.
Men (x_1):	13	14.95	6.84
Women (x_2):	10	22.29	5.32

Q.4	Solve any **two** questions out of three. (10 marks each)	20		
a)	i) Find the singular value decomposition of the matrix $A = \begin{bmatrix} 2 & 3 \\ 0 & 2 \end{bmatrix}$	8	CO 2	03
	ii) Find LU decomposition of matrix $A = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 8 & 10 \\ 7 & 14 & 22 \end{bmatrix}$	2		
b)	i) In a sample of 1000 cases. The mean of a certain test is 14 and SD is 2.5. Assuming the distribution to be normal, find 1) How many students score between 12 and 15? 2) How many score above 18? Note: Area under the z curve from $z = 0$ to $z = 0.8$ is 0.2881, from $z = 0$ to $z = 0.4$ is 0.1554, from $z = 0$ to $z = 1.6$ *is* 0.4452, from $z = 0$ to $z = 0.51$ is 0.1950 , area from $z = 0$ to $z = 0.45$ is 0.1736 , area for $z = 0$ to $z = 0.56$ is 0.2123.	6	CO 4	03
	ii) A magnetic disk is exposed to corrosive gas. Life time of a disk follows Weibull distribution with parameters $\lambda = 300$ and $k = 0.5$. What will be the probability of it i) failing before 500 hours? ii) lasts 600 hours or more.	4		
c)	i) Using the method of Lagrange's Multiplier solve the following NLPP. Optimize $Z = 4x_1 + 8x_2 - x_1^2 - x_2^2$ Subject to $x_1 + x_2 = 4$ $x_1, x_2, x_3 \geq 0$	6	CO 6	03
	ii) Find all the basic-feasible solution of the following LPP Maximize $Z = 2x_1 + 3x_2 + 4x_3 + 7x_4$ Subject to $2x_1 + 3x_2 + x_3 + 4x_4 = 8$ $x_1 - 2x_2 + 6x_3 - 7x_4 = -3$ $x_1, x_2, x_3. x_4 \geq 0$	4		