CEC

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

May-June 2025
IT C401 / AI C401 Program: B. Tech. Scheme: IIB comp / IT / AI-DS
KT Examination: SY Semester: IV
Course Code: CEC401 and Course Name: Applications of Mathematics in Engineering II
Date of Exam: 19/5/2025 Duration: 02.30 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)	10		
a)	Verify Cayley Hamilton theorem for the following matrix A and express $A^6 - 6A^5 + 9A^4 - 2A^3 - 12A^2 + 23A - 9I$, as a linear polynomial in A. Where $A = \begin{bmatrix} 2 & -1 & 1 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{bmatrix}$.	5	CO1	3
b)	Apply Gram Schmidt Process to convert the vectors $a = (1, -1, 0, 0)$, $b = (0, 1, -1, 0)$ and $c = (0, 0, 1, -1)$ to orthonormal vectors.	5	CO3	3
c)	Find all the basic-feasible solution of the following LPP Maximize $Z = 3x_1 + 2x_2$ Subject to $x_1 + x_2 \leq 6$ $2x_1 + x_2 \leq 10$ $x_1, x_2 \geq 0$	5	CO5	3
Q 2	Solve any **two** questions out of three: (05 marks each)	10		
a)	Evaluate $\int_C \frac{e^{3z}}{z+2i} dz$ where C is the curve (i) $\|z\| = 3$ (ii) $\|z\| = 1$.	5	CO2	3
b)	If 2% of electric bulbs manufactured by a certain company are defective. Find the probability that in a sample of 200 bulbs i) less than 2 bulbs ii) more than 3 bulbs, are defective	5	CO4	3
c)	Solve the following NLPP by Kuhn Tucker Method Maximize $z = 10x_1 + 4x_2 - 2{x_1}^2 - {x_2}^2$ Subject to $2x_1 + x_2 \leq 5$, $x_1, x_2 \geq 0$	5	CO6	3
Q.3	Solve any **two** questions out of three. (10 marks each)	20		

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a)	I) Determine whether following matrix is diagonalizable, if yes find the modal matrix P and diagonal form D. Where $A = \begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$	7	CO1	3
	II) If the matrix A is given as follows, find eigen values of A^t, A^{-1}, $adj(A)$. Where $A = \begin{bmatrix} 4 & 6 & 6 \\ 1 & 3 & 2 \\ -1 & -4 & -3 \end{bmatrix}$	3		
b)	(i) Is the set $W = \{(x, y, z) \in R^3 \mid x + y + z = 0\}$ a subspace of R^3? (ii) Is the set $W = \{p(x) \in P_3 \mid p(1) = 0\}$ a subspace of P_3 (Polynomials of degree$\leq$ 3)? (iii) Is the set of all 2×2 matrices with zero trace is a subspace of $R^{2\times2}$?	10	CO3	3
c)	I) Solve the following LPP using Simplex Method Maximize $Z = 4x_1 + 3x_2 + 6x_3$ Subject to $2x_1 + x_2 + x_3 \leq 8$ $x_1 + 3x_2 + 2x_3 \leq 12$ $x_1 + 2x_2 + 4x_3 \leq 16$ $x_1, x_2, x_3 \geq 0$	7	CO5	3
	II) Write the dual of the following LPP. Maximize $Z = 2x_1 - x_2 + 4x_3$ Subject to $x_1 + 2x_2 - x_3 \leq 5$ $2x_1 - x_2 + x_3 \leq 6$ $x_1 + x_2 + 3x_3 \leq 10$ $4x_1 + x_3 \leq 12$ $x_1, x_2, x_3 \geq 0$	3		
Q.4	Solve any **two** questions out of three. (10 marks each)	20		
a)	Obtain Taylor's and Laurent's expansions of $f(z) = \frac{1}{(z-1)(z-2)}$ indicating regions of convergence.	10	CO2	3
b)	I) Following results were obtained when body fat % of men and women who work out in gym is measured. Men (x_1): Sample Size 13, Mean 14.95, S.D. 6.84 Women (x_2): Sample Size 10, Mean 22.29, S.D. 5.32	7	CO4	3

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	Is the difference between the means of the samples significant? (take 5% LOS).			
	II) Student of a class were given an aptitude test. Their marks were found to be normally distributed with mean 60 and standard deviation 5. Find the percentage of students scored more than 60 marks?	3		
c)	Using the method of Lagrange's multipliers solve the following problem Optimize $z = 4x_1^2 + 2x_2^2 + x_3^2 - 4x_1x_2$ Subject to $x_1 + x_2 + x_3 = 15, 2x_1 - x_2 + 2x_3 = 20, x_1, x_2, x_3 \geq 0$	10	CO6	3

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