

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

~~May-June~~ **July** 2025

Program: **B. Tech.** Scheme: **IE3**

Supplementary ET Examination: SY Semester: IV

Course Code: CEC401 and Course Name: Applications of Mathematics in Engineering II

Date of Exam: ~~19/07/2025~~ **28/07/25** 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.	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)	State Cauchy-Schwartz inequality and verify it for vectors $u = (-4, 2, 1)$ & $v = (8, -4, 2)$	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)	If a force of $\vec{F} = 2x^2y \hat{i} + 3xy \hat{j}$ displaces a particle in the xy-plane from (0,0) to (1,4) along a curve $y = 4x^2$. Find the work done.	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)	Using the method of Lagrange's Multiplier solve the following NLPI. Optimize $Z = 4x_1 + 8x_2 - x_1^2 - x_2^2$ Subject to $x_1 + x_2 = 4$ $x_1, x_2, x_3 \geq 0$	5	CO6	3
Q.3	Solve any two questions out of three. (10 marks each)	20		

Seat No.:

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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) Show that the set $R^2 = R \times R$ is a vector space with respect to usual scalar addition and multiplication. Where R is set of all real numbers.	7	CO3	3
	II) Show that $S = \{(0, b, c) : b, c \in R\}$ is a subspace of real vector space R^3 .	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)	I) Find all possible Laurent's series for $f(z) = \frac{z-1}{z^2-2z-3}$ around $z = 0$ indicating the region of convergence in each case.	7	CO2	3
	II) Use Cauchy's Residue theorem to evaluate $\int_C \frac{3(z+1)}{z(z-1)(z-3)} dz$, where C is $ z = 2$.	3		

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b)	<p>I) Following results were obtained when body fat % of men and women who workout in gym is measured.</p> <table style="margin-left: auto; margin-right: auto; border-collapse: collapse;"> <thead> <tr> <th style="padding: 0 10px;"></th> <th style="padding: 0 10px;">Sample Size</th> <th style="padding: 0 10px;">Mean</th> <th style="padding: 0 10px;">S.D.</th> </tr> </thead> <tbody> <tr> <td style="padding: 0 10px;">Men (x_1):</td> <td style="padding: 0 10px;">13</td> <td style="padding: 0 10px;">14.95</td> <td style="padding: 0 10px;">6.84</td> </tr> <tr> <td style="padding: 0 10px;">Women (x_2):</td> <td style="padding: 0 10px;">10</td> <td style="padding: 0 10px;">22.29</td> <td style="padding: 0 10px;">5.32</td> </tr> </tbody> </table> <p>Is the difference between the means of the samples significant? (take 5% LOS).</p>		Sample Size	Mean	S.D.	Men (x_1):	13	14.95	6.84	Women (x_2):	10	22.29	5.32	7	CO4	3
	Sample Size	Mean	S.D.													
Men (x_1):	13	14.95	6.84													
Women (x_2):	10	22.29	5.32													
	<p>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?</p>	3														
c)	<p>Using the Kuhn-Tucker conditions solve the following problem.</p> <p>Maximize $Z = 10x_1 + 10x_2 - x_1^2 - x_2^2$</p> <p>Subject to $x_1 + x_2 \leq 8$</p> <p style="margin-left: 20px;">$-x_1 + x_2 \leq 5$</p>	10	CO6	3												
