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

July/Aug 2024
Program: B.Tech Scheme :II/IIB
Supplementary: Examination: SY Semester: IV
Course Code: CEC401/ITC401/AIC401
Course Name: Applications of Mathematics in Engineering-II
Date of Exam: 07/8/2024(Tuesday)　　　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.

		Max. Marks	CO	BT level
Q 1	Solve any six questions out of eight:	12		
i)	If $A = \begin{bmatrix} x & 4x \\ 2 & y \end{bmatrix}$ has eigen values 5 and -1 , find the values of x and y .	2	1	Ap
ii)	$\int_C (\bar{z} + 2z)\, dz$ along the circle $x^2 + y^2 = 1$	2	2	Ap
iii)	If R^3 has the Euclidean inner product , find k such that u,v are orthogonal where u = (k,k,1) , v = (k,5,6)	2	2	Ap
iv)	If X and Y are independent Poisson variates with mean 2 and 3 . Find the variance of 3X-2Y .	2	4	Ap
v)	Consider the following LPP $$Maximise \quad z = 2x_1 - 3x_2 + 4x_3$$ Subject to $2x_1 + x_2 + 4x_3 = 11, 3x_1 + x_2 + 5x_3 = 14 , \quad x_1, x_2, x_3 \geq 0$ Determine(i) all basic solutions (ii) feasible basic solutions	2	5	Ap
vi)	Find the stationary point of $\quad -6x_1 - 8x_2 - 10x_3 + x_1{}^2 + x_2{}^2 + x_3{}^2$	2	6	Ap
vii)	Find the eigen values of $A^3 + 5A + 8I \quad if \quad A = \begin{bmatrix} -1 & 2 & 3 \\ 0 & 3 & 5 \\ 0 & 0 & -2 \end{bmatrix}$	2	1	Ap
viii)	Evaluate $\int_C \frac{\cos z\, dz}{z}$ where C is the ellipse $9x^2 + 4y^2 = 1$	2	2	Ap
Q.2	Solve any four questions out of six.	16		
i)	Find the characteristic equation of the matrix A and find the matrix represented by $A^8 - 5A^7 + 7A^6 - 3A^5 + A^4 - 5A^3 + 8A^2 - 2A + I$,	4	1	Ap

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		Marks	CO	BT
	where $\begin{bmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{bmatrix}$	4	2	Ap
ii)	Obtain Laurent's expansion of $\frac{4z+3}{z(z-3)(z+2)}$ valid for $2 < |z| < 3$.	4	3	Ap
iii)	Show that $V = \{(x,y)\mid x = 3y\}$ is a subspace of R^2.	4	4	Ap
iv)	The income of a group of 10,000 was found to be normally distributed with mean of ₹750 and standard deviation of ₹50. What is lowest income of richest 250 ?	4	5	Ap
v)	Construct the dual of the following LPP $$\text{Minimise} \quad z = 3x_1 - 2x_2 + x_3$$ Subject to $2x_1 - 3x_2 + x_3 \leq 5$, $4x_1 - 2x_2 \geq 9$, $-8x_1 + 4x_2 + 3x_3 = 8$, $x_1, x_2 \geq 0$ x_3 unrestricted	4	6	Ap
vi)	Using Lagrange's multipliers, solve the following NLPP Optimise $z = 6x_1^2 + 5x_2^2$, Subject to $x_1 + 5x_2 = 7$, $x_1, x_2 \geq 0$.			
Q.3	Solve any two questions out of three.	16		
i)	Show that the following matrix is diagonalisable. Also find the diagonal form and a diagonalising matrix $\begin{bmatrix} 2 & 1 & 1 \\ 1 & 2 & 1 \\ 0 & 0 & 1 \end{bmatrix}$	8	1	Ap
ii)	Evaluate $\int_C \frac{2z-1}{z(2z+1)(z+2)} dz$ where C is the circle $|z| = 1$	8	2	Ap
iii)	Let R^3 have the Euclidean inner product. Use Gram-Schmidt process to transform the basis of subspace $\{u_1, u_2, u_3\}$ into orthonormal basis, where $u_1 = (1,0,1,1), u_2 = (-1,0,-1,1), u_3 = (0,-1,1,1)$	8	?	Ap