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

May-June 2024
Program: B.Tech Scheme :II/IIB
Regular Examination: SY Semester: IV
Course Code: CEC401/ITC401/AIC401
Course Name: Applications of Mathematics in Engineering-II

Date of Exam: 14.05.2024(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)	Consider A= $\begin{bmatrix} 4 & 6 & 6 \\ 1 & 3 & 2 \\ -1 & -4 & -3 \end{bmatrix}$.Find eigen values of A^3-3A^2+A	2	CO1	Ap
ii)	Find the residue of $f(z) = \frac{e^z}{z-1}$ at its pole.	2	CO2	Ap
iii)	If a random variable X follows Poisson distribution with parameter λ and P(X=1) = P(X=2), find P(X=4)	2	CO4	Ap
iv)	If $\mathbb{R}^3$ has Euclidean inner product and u =(k,k,1), v =(k,5,6) find k such that u and v are orthogonal vectors. Hence find norm of u and v.	2	CO3	Ap
v)	To make use of dual simplex method express the following linear programming problem into standard form Minimize $Z = 2x_1 + x_2$ Subject to $3x_1 + x_2 \geq 3$, $4x_1 + 3x_2 \geq 6$, $x_1 + 2x_2 \leq 3$ and $x_1, x_2 \geq 0$	2	CO5	Ap
vi)	State the Kuhn-Tucker conditions for solving an N.L.P.P Maximize $f(x_1, x_2)$ Subject to the constraint $h(x_1, x_2) \leq b$, $x_1, x_2 \geq 0$	2	CO6	Ap
vii)	Evaluate $\int_C (z+4)\,dz$, where C is circle | z-i | =1	2	CO2	Ap

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viii)	FInd all the basic solutions to the following problem. Also find which are degenerate , feasible and optimal : Maximise $Z = x_1 + 3x_2 + 3x_3$ Subject to $x_1 + 2x_2 + 3x_3 = 4$ $2x_1 + 3x_2 + 5x_3 = 7$ $x_1, x_2, x_3 \geq 0$	2	CO5	Ap
Q.2	**Solve any four questions out of six.**	**16**		
i)	Evaluate: $\int_0^{1+i}(x - y + ix^2)dz$ along the parabola $y^2 = x$.	4	CO2	Ap
ii)	Verify Cayley-Hamilton theorem for A= $\begin{bmatrix} 1 & 2 & 3 \\ 2 & -1 & 4 \\ 3 & 1 & -1 \end{bmatrix}$ Hence find A^4 and A^{-1} .	4	CO1	Ap
iii)	If i) p=1, ii) $p=x^2$, find $\|p\|$ where $<p,q> = \int_{-1}^{1} p(x)q(x)dx$	4	CO3	Ap
iv)	A certain injection administered to each of 12 patients resulted the following increases of blood pressure: 5, 2, 8, -1, 3, 0, 6, -2, 1, 5, 0, 4 can it be concluded that the injection will be in general accompanied by an increase in B. P.?	4	CO4	Ap
v)	Construct the duals of the following L.P.P. Maximise $Z = x_1 + 3x_2 - 2x_3 + 5x_4$ Subject to $3x_1 - x_2 + x_3 - 4x_4 = 6$, $5x_1 + 3x_2 - x_3 - 2x_4 = 4$ $x_1, x_2 \geq 0$ x_3, x_4 unrestricted.	4	CO5	Ap
vi)	Solve the following non-linear programming problem Maximise $Z = 16x_1 + 6x_2 - 2x_1^2 - x_2^2 - 17$ Subject to $2x_1 + x_2 \leq 8$, $x_1, x_2 \geq 0$	4	CO6	Ap
Q.3	**Solve any two questions out of three.**	**16**		
i)	Consider A = $\begin{bmatrix} 1 & 0 & -1 \\ 1 & 2 & 1 \\ 2 & 2 & 3 \end{bmatrix}$.	8	CO1	Ap

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	Check if the matrix A^3 is diagonalizable. If so, find the transforming matrix and diagonal form.			
ii)	The Marks obtained by students in a class are normally distributed with mean 75 and standard deviation 5, if top 5% got grade A and bottom 25% got grade B what are the marks of the lowest of A and highest of B?	8	CO4	Ap
iii)	Use the Penalty method to solve the following L.P.P. Minimise $z = x_1 + 2x_2 + x_3$ Subject to $x_1 + \frac{x2}{2} + \frac{x3}{2} \le 1$, $\frac{3x_1}{2} + 2x_2 + x_3 \ge 8$, $x_1, x_2, x_3 \ge 0$	8	CO5	Ap
Q.4	**Solve any two questions out of three.**	**16**		
i)	Obtain Laurent's series expansion of $f(z) = \frac{z-1}{z^2-2z-3}$ indicating all possible regions of convergence	8	CO2	Ap
ii)	Construct an orthonormal basis of R^3 using Gram-Schmidt process to $S=\{(1,1,1), (-1,1,0), (1,2,1)\}$.	8	CO3	Ap
iii)	Using the method of Lagrange's multipliers, solve the following N.L.P.P. Optimise $Z = x_1^2 + x_2^2 + x_3^2$ Subject to $x_1+x_2+3x_3 = 2$, $5x_1+2x_2+x_3 = 5$ $x_1, x_2, x_3 \ge 0$	8	CO6	Ap

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