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

End Semester Exam

April - May 2022

B.Tech. Program: COMP/IT/AI-DS

Examination: SY Semester: IV

Course Code: 1UCEC401/1UITC401/1UAIC401

Course Name: Application of Mathematics in Engineering -II

Duration: 03 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 $A = \begin{bmatrix} 2 & 4 \\ 0 & 8 \end{bmatrix}$, then find the eigenvalues of, $6A^{-1} + 2A^3 + 2I$	2	1	3
ii)	Corresponding to which eigenvalue $(2, 3, -2, -3)'$ is an eigenvector of $\begin{bmatrix} 1 & -4 & -1 & -4 \\ 2 & 0 & 5 & -4 \\ -1 & 1 & -2 & 3 \\ -1 & 4 & -1 & 6 \end{bmatrix}$	2	1	3
iii)	Verify Cauchy-Schwartz inequality for the vectors $U = (-3, 1, 0)$ and $V = (3, 1, 1)$	2	3	3
iv)	Define basis and dimension of a vector space.	2	3	3
v)	Evaluate $\int_0^{1+i} z \, dz$ along $y = x$	2	2	3
vi)	If X is normal variate with mean 10 & standard deviation 4, then what is $P(X \leq 12)$? (Given: Area from $z = 0$ to $z = 0.5$ is 0.1915)	2	4	3
vii)	The Standard form of following LPP is Minimise $Z = 3x_1 - 4x_2$, Subject to $4x_1 + 2x_2 \leq 1$, $-2x_1 + 5x_2 \geq 4$, $x_1, x_2 \geq 0$	2	5	3
viii)	Find stationary point of $z = 2x_1 + x_3 + 3x_2x_3 - x_1^2 - 3x_2^2 - 3x_3^2 + 17$	2	6	3
Q.2	Solve any four questions out of six.	16		
i)	The mean of two samples of size 9 and 7 are 196.42 and 198.82 respectively. the sum of the square of the deviations from the mean are 26.94 and 18.73 respectively. What is the value of test statistic t in order to test the significance of difference between sample means?	4	4	3

ii)	Obtain Laurent 's series for $\frac{2}{(z-2)(z-3)}$ in the region: $2 < z < 3$	4	2	3
iii)	Find the characteristic equation of following matrices and obtain the inverse $\begin{bmatrix} 1 & 2 & 4 \\ -1 & 0 & 3 \\ 3 & 1 & -2 \end{bmatrix}$	4	1	3
iv)	Find the relative maximum or minimum of the function $z = x_1^2 + x_2^2 + x_3^2 - 6x_1 - 10x_2 - 14x_3 + 103$	4	6	3
v)	Determine all basic feasible solutions of the equations $x_1 + 6x_2 + 2x_3 + x_4 = 6, \quad 3x_1 + 4x_2 + 4x_3 + 6x_4 = 12$	4	5	3
vi)	Determine whether the following vectors span the vector space in R^3 $u = (2, -1, 3), v = (4, 1, 3), w = (8, -1, 8)$	4	3	3
Q.3	Solve any two questions out of three.	16		
i)	Solve using dual simplex method Minimize $z = 2x_1 + 2x_2 + 4x_3$ Subject to $2x_1 + 3x_2 + 5x_3 \geq 2, \quad 3x_1 + x_2 + 7x_3 \leq 3,$ $x_1 + 4x_2 + 6x_3 \leq 5, \quad x_1, x_2, x_3 \geq 0$	8	5	3
ii)	Show that the following matrices are diagonalizable. Also find the diagonal form and a diagonalizing matrix $\begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$	8	1	3
iii)	Obtain all possible Laurent's series expansions of $f(z) = \frac{z-1}{z^2-2z-3}$ and indicate the region of convergence.	8	2	3
Q.4	Solve any two questions out of three.	16		
i)	Solve the following NLPP by using Kuhn-Tucker conditions: Maximize $-2x_1^2 - 2x_2^2 + 12x_1 + 21x_2 + 2x_1x_2$ Subject to $x_1 + x_2 \leq 10, \quad x_2 \leq 8, \quad x_1, x_2 \geq 0$	8	6	3
ii)	Let R^3 have the Euclidean inner product. Use Gram-Schmidt process to transform the basis $\{u_1, u_2, u_3\}$ into an orthonormal basis where $u_1 = (1, 0, 0), u_2 = (3, 7, -2), u_3 = (0, 4, 1)$	8	3	3
iii)	In a survey of 200 boys of which 75 were intelligent, 40 had educated fathers, while 85 of the unintelligent boys had uneducated fathers. Do these figures support the hypothesis that educated fathers have intelligent boys?	8	4	3