comp/IT/AIDS.

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**K. J. Somaiya Institute of Technology, Sion, Mumbai-22**
**(Autonomous College Affiliated to University of Mumbai)**
Supplementary Examination
Scheme : II
Examination: SY Semester: IV Course Code: CEC401, AIC401, ITC401
Course Name: Applications of Mathematics in Engineering-II

**Date of Exam: 23/08/2023** **Duration: 2.5 Hours** **Max. Marks: 60**

Instructions:
(1)All questions are compulsory.
(2)Draw neat diagrams wherever applicable.
(3)Assume suitable data, if necessary.
(4) Use of Statistical Tables permitted.

| | | Max. Marks | CO | BT level |
|---|---|---|---|---|
| Q 1 | Solve any six questions out of eight: | 12 | | |
| i) | Find the eigenvalues of $A^3 - 3A^2 + A$ , where A is $\begin{bmatrix} 4 & 6 & 6 \\ 1 & 3 & 2 \\ -1 & -4 & -3 \end{bmatrix}$ | 2 | 1 | Ap |
| ii) | $\int_C (z+1)dz$ where C is the boundary of square whose vertices are $z = 0, z = 1, z = 1+i, z = i.$ | 2 | 2 | Ap |
| iii) | Verify whether the Pythagorean theorem is applicable for u=(-3,-5,-2) and v=(1,2,-3) | 2 | 3 | Ap |
| iv) | If X is a normal variate with mean 10 and standard deviation 4 , find $P(5 \leq X \leq 18)$ | 2 | 4 | Ap |
| v) | The mean height of soldiers is 68.22" with variance 10.8". Find the expected number of soldiers in a regiment of 1000 whose height will be more than 6" (Area from z=0 to z=1.15 is 0.3749) | 2 | 4 | Ap |
| vi) | Convert the following LPP into standard form<br>Maximize $Z = 3x_1 + 4x_2 - 2x_3$<br>Subject to $6x_1 - 4x_2 \leq 0,\ 3x_1 + x_2 + 4x_3 \geq 11,\ 4x_1 + 3x_2 \leq 0$ | 2 | 5 | Ap |
| vii) | Find the stationary point of the function<br>$z = 2x_1 + x_3 + 3x_2x_3 - x_1^2 - 3x_2^2 - 3x_3^2 + 17$ | 2 | 6 | Ap |
| viii) | If A is a square matrix of order 2 with $\|A\| = 1$ then prove that A and $A^{-1}$ have the same eigenvalues. | 2 | 1 | Ap |

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| Q.2 | Solve any four questions out of six. | 16 | | |
| i) | For the matrix $= \begin{bmatrix} 1 & 2 & -2 \\ -1 & 3 & 0 \\ 0 & -2 & 1 \end{bmatrix}$, prove that $A^{-1} = A^2 - 5A + 9I$ | 4 | 1 | Ap |
| ii) | Evaluate $\int_C \frac{2z+3}{z} dz$ where C is<br>(i) the upper half of the circle $\|z\| = 2$<br>(ii) the lower half of the circle $\|z\| = 2$ | 4 | 2 | Ap |
| iii) | If $u = (2,2,-3), v = (4,3,-1)$ . Find (i) $\|2u + 3v\|$ (ii) $\frac{(u-v)}{\|u-v\|}$ | 4 | 3 | Ap |
| iv) | Solve following Linear programming problems by simplex method.<br>Maximize $z = 7x_1 + 5x_2$ , subject to $-x_1 - 2x_2 \geq -6$ , $4x_1 + 3x_2 \leq 12$ | 4 | 5 | Ap |
| v) | Using Lagrange's multipliers, solve the following NLPP<br>Optimise $z = 4x_1 + 8x_2 - x_1^2 - x_2^2$ . Subject to $x_1 + x_2 = 2$ , $x_1, x_2 \geq 0$. | 4 | 6 | Ap |
| vi) | A machine is designed to produce insulating washers for electrical devices of average thickness of 0.025 cms. A random sample of 10 washers was found to have average thickness of 0.024 cms., with SD of 0.002 cms . Test the significance of the deviation. | 4 | 4 | Ap |
| Q.3 | Solve any two questions out of three. | 16 | | |
| i) | Find the eigenvalues and eigenvector of $\begin{bmatrix} 3 & 10 & 5 \\ -2 & -3 & -4 \\ 3 & 5 & 7 \end{bmatrix}$ | 8 | 1 | Ap |
| ii) | Evaluate $\int_C \frac{z^2+4}{(z-2)(z+3i)} dz$ where C is the circle<br>$(i)$ $\|z+1\| = 2$ $(ii)$ $\|z-2\| = 2$ | 8 | 2 | Ap |
| iii) | Maximize $z = 10x_1 + 6x_2 + 5x_3$,subject to $x_1 + x_2 + x_3 \leq 100$, , 10<br>$x_1 + 4x_2 + 5x_3 \leq 600$, $2x_1 + 2x_2 + 6x_3 \leq 300$ $x_1, x_2, x_3 \geq 0$.<br>Use Big M method to solve following LPP | 8 | 5 | Ap |
| Q.4 | Solve any two questions out of three. | 16 | | |
| i) | Let $R^4$ have the Euclidean inner product. Use Gram-Schmidt process to transform the basis of subspace$\{\mathbf{u_1}, \mathbf{u_2}, \mathbf{u_3}\}$ into orthonormal basis, where | 8 | 3 | Ap |

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|---|---|---|---|---|
| | $\mathbf{u_1}$=(1,1,1,1),$\mathbf{u_2}$=(1,2,4,5), $\mathbf{u_3}$=(1,-3,-4,-2) | | | |
| ii) | The following are the gain in weights of cows fed on two types of diets X and Y.<br><br>Diet X: 30, 37, 35, 37, 29, 19, 37<br>Diet Y: 29, 39, 27, 35, 47, 37, 45, 35, 37, 40<br><br>Test at 5% level of significance whether the diets differ as regards their effect on mean increase in weight. | 8 | 4 | Ap |
| iii) | Using Lagrange's multipliers, solve the following NLPP<br><br>Optimise $z = 4x_1^2 - x_2^2 - x_3^2 - 4x_1x_2$ . Subject to $x_1 + x_2 + x_3 = 15$ , $2x_1 - x_2 + 2x_3 = 20, x_1, x_2, x_3 \geq 0$. | 8 | 6 | Ap |

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