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

May-June 2025
Program: B.Tech. Scheme III – EXTC
Regular Examination: SY Semester: IV
Course Code: EXC401and Course Name: Application of Mathematics in Engineering-II
Date of Exam:19/05/2025 Duration: 02.30Hours 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)	Determine the Karl Pearson's Coefficient of correlation between the number of hours studied (**X**) and the exam scores (**Y**) of 8 students.		2	3
b)	Convert the basis $\{(3,1),(2,2)\}$ of $\mathbb{R}^2$ into an orthonormal basis using Gram Schmidt process.		4	3
c)	Prove that the extremal of $\int_0^2 (y'^2/x)\,dx$ with $y(0)=0$ and $y(2)=1$ is parabola.		6	3
Q 2	Solve any **two** questions out of three: (05 marks each)	10		
a)	Evaluate $\int_0^{1+2i}(2x^2+iy)dz$, along the path $y=2x$		1	3
b)	The Athletics federation of India estimates that the mean yearly value of a full athletic scholarship at in-state public universities is ₹19,000. Assume the scholarship value is normally distributed with a standard deviation of ₹2100. (i) For the 10% of athletic scholarships of least value, how much are they worth? (ii) What percentage of athletic scholarships are valued at ₹22,000 or more? Note: *Area from* $z=0$ *to* $z=1.43$ is 0.4236, Area from $z=0$ to $z=0.4$ is 1.285, Area form $z=0$ to $z=0.64$ is 0.7389, Area from $z=0$ to $z=1.42$ is 0.9222.		3	3
c)	Obtain the linear transform of the quadratic form $2x_1{}^2+2x_2{}^2+3x_3{}^2+2x_1x_2-4x_1x_3-4x_2x_3$ under the linear transformation $x_1=y_1-y_2+2y_3, x_2=2y_2+2y_3, x_3=3y_3$ and interpret your result		5	3
Q.3	Solve any **two** questions out of three. (10 marks each)	20		

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a)	(i) The regression lines of a sample are $2x + 5y = 20$, and $4x + 3y = 18$. Find Sample means $\bar{x}$ and $\bar{y}$ and coefficient of correlation between x and y.		2	3
	(ii) Find the Rank correlation coefficient between employees' **years of experience** and their **job performance scores** from the data given below.			

Experience	5	8	6	7	3	9	2	4
Performance Score	78	90	80	85	75	92	60	70

b)	Consider the set $V = \left\{\begin{bmatrix} x \\ y \end{bmatrix} \middle\| x, y \in R\right\}$. Define addition and scalar multiplication as $\begin{bmatrix} x_1 \\ y_1 \end{bmatrix} \oplus \begin{bmatrix} x_2 \\ y_2 \end{bmatrix} = \begin{bmatrix} x_1 + x_2 + 1 \\ y_1 + y_2 \end{bmatrix}$ and $a \odot \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} ax + a - 1 \\ ay \end{bmatrix}$ Check whether $(V, \oplus \quad, \odot)$ forms a vector space		4	3
c)	Using the Rayleigh-Ritz method, find an approximate solution for the extremal of the functional $I(y) = \int_0^1 \left\{xy + \frac{1}{2}y'^2\right\} dx$ subject to $y(0) = y(1) = 0$		6	3
Q.4	Solve any **two** questions out of three. (10 marks each)	20		
a)	(i) Find the residue of the function $f(z) = \frac{z}{(z-1)^2(z^2-1)}$ at $z = 1$.		1	3
	(ii) Expand the function $f(z) = ze^{1/z^2}$ in a Laurent's expansion about $z = 0$, Also name the type of singularity.			
b)	(i) A call center receives an average of 5 customer calls per hour. Assuming the number of calls follows a Poisson distribution, find the probability that: **(A)** Exactly 3 calls are received in an hour. **(B)** At most 2 calls are received in an hour		3	3
	(ii) A continuous random variable has probability density function $f(x) = 6(x - x^2)$, $0 \le x \le 1$ Find mean and Variance of the distribution.			
c)	Reduce the following quadratic form $2x_1^2 + x_2^2 - 3x_3^2 - 8x_2x_3 - 4x_3x_1 + 12x_1x_2$ to normal form through congruent transformation. Also find its rank, signature and value class.		5	3

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