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

July ~~May-June~~ 2025

Program: B.Tech. Scheme III

Supplementary ~~Regular~~ Examination: SY Semester: IV

Course Code: EXC401 and Course Name: Application of Mathematics in Engineering-II

Date of Exam: ~~19/05/2025~~ 8/07/25   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.

Q. No.	Question	Max. Marks	CO	BT level
Q 1	Solve any **two** questions out of three: (05 marks each)	10		
a)	Calculate the value of Spearman's rank correlation coefficient for the following data 	5	2	3

X	10	12	18	18	15	40
Y	12	18	25	25	50	25

Q. No.	Question	Max. Marks	CO	BT level
b)	Verify Cauchy-Schwartz inequality for $u = (2, -1, 1)$ & $v = (1, 1, 2)$. Also find angle between u and v.	5	4	3
c)	Find the extremal of $\int_{x_1}^{x_2}\left(y'^2 - y^2 + 2xy\right)dx$	5	6	3
Q 2	Solve any **two** questions out of three: (05 marks each)	10		
a)	Evaluate using Cauchy residue theorem $\oint_c \frac{z^2+3}{(z-1)(z+1)}\, dz.$	5	1	3
b)	If X is continuous random variable with probability density function $$f(x) = \begin{cases} k(x - x^3) & 0 \le X \le 1 \\ 0 & otherwise \end{cases}$$ Find I) k II) Mean III) Variance	5	3	3
c)	Reduce the matrix of quadratic form $6x_1^2 + 3x_2^2 + 3x_3^2 - 4x_1x_2 + 4x_1x_3 - 2x_2x_3$ to the diagonal form using congruent transformation and interpret in terms of quadratic form.	5	5	3

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Q.3	Solve any **two** questions out of three. (10 marks each)	20		
a)	I) For the following data ,	6	2	3

X	36	32	34	31	32	32	35
Y	35	33	31	30	34	32	36

	Find the regression line of y on x and hence find regression coefficient b_{yx}. II) The regression lines of sample are $x + 6y = 6$ & $3x + 2y = 10$. Find i.sample means $\bar{X}$ & $\bar{Y}$ ii.coefficient of correlation between x & y iii.y when $x = 12$	4		
b)	I)Find an orthonormal basis of $\mathbb{R}^3$ by applying Gram-Schmidt orthogonalisation to $\{(1,1,1),(-1,1,0),(1,2,1)\}$	7	4	3
	II) Show that $W = \{(x,y)\epsilon\ \mathbb{R}^2\ /\ \ x = 3y\}$ is subspace of $\mathbb{R}^2$	3		
c)	I) Find the curve $y = f(x)$ for which extremal of $\int_{x_1}^{x_2} y'^2\, dx$ subject to the condition $\int_{x_1}^{x_2} y\, dx = k$.	7	6	3
	II) Find extremal of $\int_{x_1}^{x_2} \frac{y'^2}{x^2}\, dx$	3		
Q.4	Solve any **two** questions out of three. (10 marks each)	20		
a)	I) Find Laurent's series expansions of the function $f(z) = \frac{1}{z(z+1)(z-2)}$ within i) $0 < |z| < 1$ ii)$1 < |z| < 2$ iii)$|z| > 2$	7	1	3
	II) Evaluate $\int_0^{1+i}(x^2 + 2xyi - y^2)dz$ along the line y = x .	3		

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b)	I) A discrete random variable X has the following probability distribution	4	3	3

X	1	2	3	4	5	6	7
P(X = x)	k	2k	3k	k^2	k^2+k	$2k^2$	$4k^2$

Find I) k   II) $P(X < 5)$ III) $P\left(\frac{1<X\leq3}{2\leq X\leq5}\right)$

	II) The number of accidents in a year attributed to taxi drivers in a city follows Poisson's distribution with mean 3. Out of 1000 taxi drivers, find approximately the number of drivers with no accident in a year and more than 3 accidents in a year. (Given: $e^{-1} = 0.3679, e^{-1} = 0.1353, e^{-3} = 0.0498$)	6		
c)	I)Find singular value decomposition of $A = \begin{bmatrix} 3 & 0 \\ 4 & 5 \end{bmatrix}$	7	5	3
	II) Obtain the transform of the quadratic form $x_1^2 + 2x_2^2 - 7x_3^2 - 4x_1x_2 + 8x_1x_3$ under the linear transformation $x_1 = y_1 + 2\,y_2 + 4\,y_3$ $x_2 = y_2 + 4\,y_3$ $x_3 = y_3$	3		

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