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

Nov – Dec 2025
Program: B. Tech (Electronics and Telecommunication Engineering) Scheme: III
Regular Examination: SY Semester: III
Course Code: EXC 301 and Course Name: Applications of Mathematics in Engineering-I
Date of Exam: 25/11/2025 Duration: 2 Hours 30 Minutes 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)	If $\int_0^\infty e^{-2t}\sin(t+\alpha)\cos(t-\alpha)\,dt = \frac{1}{4}$, then find α.		CO1	03
b)	Find the Fourier series for $f(x) = 1 - x^2$ when $-1 \le x \le 1$.		CO3	03
c)	Verify the Cayley-Hamilton theorem for the matrix $A = \begin{bmatrix} 1 & 2 & -2 \\ -1 & 3 & 0 \\ 0 & -2 & 1 \end{bmatrix}$ and hence, find A^{-1}.		CO5	03
Q 2	Solve any two questions out of three: (05 marks each)	10		
a)	Find $L^{-1}\left\{\frac{5s^2-15s-11}{(s+1)(s-2)^2}\right\}$		CO2	03
b)	If u, v are harmonic conjugate functions, show that uv is a harmonic function.		CO4	03
c)	If $\Phi = x^3 + y^3 + z^3 - 3xyz$, find **(a)** $\bar{r}.\nabla\Phi$ **(b)** div $\bar{F}$ **(c)** curl $\bar{F}$ where $\bar{F} = \nabla\Phi$.		CO6	03
Q.3	Solve any **two** questions out of three. (10 marks each)	20		
a)	i) Find $L\left\{\cosh t \cdot \int_0^t e^x \sinh x\,dx\right\}$	7	CO1	03
	ii) If $f(t) = (\sin 2t - \cos 2t)^2$, obtain $L\{f(t)\}$	3		

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b)	i) A function $f(x)$ is defined within the range $(0, 2\pi)$ by the relations $f(x) = \begin{cases} x, & 0 \le x \le \pi \\ 2\pi - x, & \pi \le x \le 2\pi. \end{cases}$ Prove that: $f(x) = \frac{\pi}{2} - \frac{4}{\pi}\left(\cos x + \frac{1}{3^2}\cos 3x + \frac{1}{5^2}\cos 5x + ..\right)$	7	CO3	03
	ii) Obtain Fourier Cosine transform for $f(x) = \begin{cases} x, & 0 < x < 1 \\ 2 - x, & 1 < x < 2 \\ 0, & x > 2 \end{cases}$.	3		
c)	i) Show that the matrix $A = \begin{bmatrix} -9 & 4 & 4 \\ -8 & 3 & 4 \\ -16 & 8 & 7 \end{bmatrix}$ is diagonisable. Find the diagonal form D and the diagonalizing matrix M.	7	CO5	03
	ii) Prove that the eigen values of $\begin{vmatrix} \frac{(1+i)}{2} & \frac{-(1-i)}{2} \\ \frac{(1+i)}{2} & \frac{(1-i)}{2} \end{vmatrix}$ are of unit modulus.	3		
Q.4	Solve any **two** questions out of three. (10 marks each)	20		
a)	i) Find $L^{-1}\left[\frac{1}{(s+3)(s^2+2s+2)}\right]$ using Convolution Theorem.	6	CO2	03
	ii) Find $L^{-1}\left[\log\left(1 + \frac{a^2}{s^2}\right)\right]$.	4		
b)	i) Construct an analytic function whose real part is $u = e^{-x}\{(x^2 - y^2)\cos y + 2xy \sin y\}$	6	CO4	03
	ii) If $f(z) and \overline{f(z)}$ are both analytic, prove that $f(z)$is constant.	4		
c)	i) Verify Green's Theorem in the plane for $\int_C (xy + y^2)dx + x^2 dy$ where C is the closed curve of the region bounded by $y = x$ and $y = x^2$	6	CO6	03
	ii) Prove that $(y^2 - z^2 + 3yz - 2x)\hat{\imath} + (3xz + 2xy)\hat{\jmath} + (3xy - 2xz + 2z)\hat{k}$ is both solenoidal and irrotational.	4		

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