

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

Nov - Dec 2023

(B.Tech) Program: EXTC Scheme II/IIB

Examination: SY/DSY Semester: III

Course Code: EXC301 and Course Name: Applications of Mathematics in Engineering - I

Date of Exam: 29-Nov-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.

		Max. Marks	CO	BT level
<b>Q 1</b>	<b>Solve any six questions out of eight:</b>	<b>12</b>		
i)	If $A = \begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$ , find eigen values of $A^{-1}$ .	2	5	Ap
ii)	If $\vec{F} = xye^{2z}\vec{i} + xy^2 \cos z \vec{j} + x^2 \cos xy \vec{k}$ find $\text{div} \vec{F}$ .	2	6	Ap
iii)	$f(t) = \begin{cases} 0, & 0 \leq t \leq 1 \\ t, & 1 < t < 2 \\ 0, & t \geq 2 \end{cases}$ find $L f(t)$ .	2	1	Ap
iv)	$f(x) = \begin{cases} x + \pi, & 0 \leq x \leq \pi \\ -x - \pi, & -\pi \leq x \leq 0 \end{cases}$ find the value of Fourier coefficient $a_0$ .	2	3	Ap
v)	Define: (a) State Cauchy Riemann equations for a function $f(z) = u + iv$ (b) Define : Harmonic function	2	4	Ap
vi)	Find $L(\sqrt{1 + \sin t})$	2	1	Ap
vii)	Find $L^{-1}\left(\frac{(s+1)^2}{s^3}\right)$	2	2	Ap
viii)	Find the sum of the eigen values of the matrix $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 5 & 0 \\ 0 & 0 & 3 \end{bmatrix}$ .	2	5	Ap
<b>Q.2</b>	<b>Solve any four questions out of six.</b>	<b>16</b>		
i)	Find the characteristic equation of the matrix $A = \begin{bmatrix} 1 & 1 & 3 \\ 1 & 3 & -3 \\ -2 & -4 & -4 \end{bmatrix}$ and hence find its inverse.	4	5	Ap
ii)	Evaluate the Fourier coefficients $a_0$ and $a_n$ of $f(x) = \begin{cases} \sin x, & 0 \leq x \leq \pi \\ 0, & \pi \leq x \leq 2\pi \end{cases}$ in $(0, 2\pi)$ .	4	3	Ap

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iii)	Find $L \left[ \frac{d}{dt} \left( \frac{1 - \cos 2t}{t} \right) \right]$	4	1	Ap
iv)	Find $L^{-1} \left( \left( \frac{2}{s^2} \right) \right)$	4	2	Ap
v)	Determine whether the function $x^2 - y^2 + 2ixy$ is analytic.	4	4	Ap
vi)	Find the value of a for which $F = (ax^2y + yz)\mathbf{i} + (xy^2 - xz^2)\mathbf{j} + (2xyz - 2x^2y^2)\mathbf{k}$ is solenoidal.	4	6	Ap
<b>Q.3</b>	<b>Solve any two questions out of three.</b>	<b>16</b>		
i)	Check whether $A = \begin{bmatrix} 8 & -8 & -2 \\ 4 & -3 & -2 \\ 3 & -4 & 1 \end{bmatrix}$ is diagonalisable. If so find the diagonal matrix and transforming matrix.	8	5	Ap
ii)	State Convolution Theorem and using convolution theorem find $L^{-1} \left( \frac{s^2}{(s^2+1)(s^2+4)} \right)$ .	8	2	Ap
iii)	Obtain the Fourier series expansion of $f(x) = \{x, 0 \leq x \leq \pi, 2\pi - x, \pi \leq x \leq 2\pi\}$	8	3	Ap
<b>Q.4</b>	<b>Solve any two questions out of three.</b>	<b>16</b>		
i)	Find the orthogonal trajectories of the given family of curves $e^x \cos y - xy = c$ .	8	4	Ap
ii)	Find Laplace Transform of $\frac{e^{-2t} \sin 2t \cosh t}{t}$ .	8	1	Ap
iii)	If $\vec{F} = xye^{2z}\mathbf{i} + xy^2 \cos z\mathbf{j} + x^2 \cos xy\mathbf{k}$ find curl and divergence of $\vec{F}$ .	8	6	Ap

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