

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

Subject Code: EXC301

Subject Name: Application of Mathematics in Engineering-I

Nov – Dec 2022 (B.Tech / M.Tech.) Program: B.Tech <u>EXTC</u> Examination: SY Semester: III			
Course Code: EXC301 and Course Name: Application of Mathematics in Engineering-I		Max. Marks: 60	
Duration: 2.5 Hours			
Instructions:			
(1) All questions are compulsory.			
(2) Draw neat diagrams wherever applicable.			
(3) Assume suitable data, if necessary.			
		Max. Marks	C O BT level
Q 1	Solve any six questions out of eight	12	
i)	Find the Laplace transform of $(\sin 2t - \cos 2t)^2$		1 3
ii)	Find the Inverse Laplace transform of $1/\sqrt{(2s+1)}$		2 3
iii)	Obtain the inverse Laplace transform of $\frac{1}{(s+2)^4}$		2 3
iv)	Find p if $f(z) = r^2 \cos 2\theta + i r^2 \sin p\theta$ is analytic		4 3
v)	Prove that z^3 is analytic.		4 3
vi)	If $f(x) = \frac{1}{2}(\pi - x)$ in $(0, 2\pi)$. Find Fourier series coefficient a_0 .		3 3
vii)	If $A = \begin{bmatrix} -1 & 1 & -2 \\ 0 & -3 & 4 \\ 0 & 0 & -2 \end{bmatrix}$ find the eigenvalues of A^2		5 3
viii)	If $u = x + y + z$, $v = x^2 + y^2 + z^2$, $w = x^2y + yz + xz$ find grad u , grad v , grad w .		6 3
Q.2	Solve any four questions out of six.	16	
i)	Evaluate using Laplace Transformation $\int_0^{\infty} e^{-t} (t^2 - 3t + 5 + t^2 e^{2t}) dt$		1 3
ii)	Find Inverse Laplace Transform of $\log \left[1 - \frac{1}{s^2} \right]$		2 3

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iii)	Find the analytic functions $f(z) = u + iv$ whose real part is $u = (x - 1)^3 - 3xy^2 + 3y^2$	4	3
iv)	Find the Fourier Series of $f(x) = \frac{3x^2 - 6x\pi + 2\pi^2}{12}$ in $(0, 2\pi)$	3	3
v)	Find the constant a, b so that the surface $ax^2 - byz = (a + 2)x$ will be orthogonal to the surface $4x^2y + z^3 = 4$ at $(1, -1, 2)$.	6	3
vi)	For the matrix $A = \begin{bmatrix} 1 & 2 & -2 \\ -1 & 3 & 0 \\ 0 & -2 & 1 \end{bmatrix}$, prove that $A^{-1} = A^2 - 5A + 9I$.	5	3
Q.3	Solve any two questions out of three.	16	
i)	Find the Laplace transform of (i) $\frac{d}{dt} \left(\frac{1 - \cos 2t}{t} \right)$ (ii) $\frac{e^{-2t} \sin 2t \cosh t}{t}$	1	3
ii)	Show that the following matrix is diagonalisable. Also find the diagonal matrix D and a diagonalising matrix M. $\begin{bmatrix} -9 & 4 & 4 \\ -8 & 3 & 4 \\ -16 & 8 & 7 \end{bmatrix}$	5	3
iii)	Using Green's Theorem in the plane, evaluate $\int_C (xy + y^2)dx + x^2 dy$ around the Boundary of the region defined by $y = x^2$ and $y = x$.	6	3
Q.4	Solve any two questions out of three.	16	
i)	Obtain the inverse L.T using convolution theorem $\frac{s}{(s^2 + a^2)(s^2 + b^2)}$	2	3
ii)	Find the orthogonal trajectories of the family of curves $3x^2y + 2x^2 - y^3 - 2y^2 = c$	4	3
iii)	Find the Fourier Series of $f(x) = \frac{x(\pi - x)(\pi + x)}{12}$ in $(-\pi, \pi)$. Hence, find $\frac{1}{1^3} - \frac{1}{3^3} + \frac{1}{5^3} - \frac{1}{7^3} + \dots$	6	3
