

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

End Semester Exam

Nov – Dec 2021

(B. Tech) Program: EXTC Engineering

Examination: SY Semester: III

Course Code: 1UEXC301 Course Name: Applications of Mathematics in Engineering-I

Duration: 03 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	Ma x. Ma rks	CO	BT Le vel
Q 1	Solve any six questions out of eight:	12		
i)	Find $L^{-1}\left(\frac{1}{(s-4)^3}\right)$	2	CO2	3
ii)	Check whether the following function is Harmonic $u = 3x^2y - y^3$	2	CO4	3
iii)	Evaluate: $\int_0^{\infty} e^{-2t} \cosh t dt$	2	CO1	3
iv)	Find Fourier cosine transform of $f(x) = \begin{cases} \cos x, & 0 < x < a \\ 0, & x \geq a \end{cases}$	2	CO3	3
v)	If $\vec{f} = x^2i + 5xyj + xyz^3k$, find $\text{curl } \vec{f}$ at $(1, -1, 1)$	2	CO6	3
vi)	If $A = \begin{bmatrix} -2 & 0 & 0 \\ 2 & -5 & 0 \\ 1 & 4 & -2 \end{bmatrix}$, find the eigen values of A^{-1} .	2	CO5	3
vii)	If $f(x) = \begin{cases} 0, & -\pi < x < 0 \\ 8, & 0 < x < \pi \end{cases}$ Then, the value of Fourier Coefficient b_2	2	CO3	3
viii)	Find the Laplace transform of $3t + e^{-2t} \sin 2t$	2	CO1	3
Q.2	Solve any four questions out of six.	16		
i)	Verify Cayley Hamilton theorem for $A = \begin{bmatrix} 1 & 1 & 3 \\ 1 & 0 & -3 \\ -2 & 1 & 0 \end{bmatrix}$.	4	CO5	3

ii)	Using convolution theorem evaluate $L^{-1}\left[\frac{s^2+s}{(s^2+9)(s^2+2s+4)}\right]$	4	CO2	3
iii)	Find the analytic function whose real part is $u = 5x^2 - y^2 - x + y + 4$	4	CO4	3
iv)	If $\int_0^\infty e^{-2t} \sin(t) \cos(t - \alpha) dt = \frac{1}{8}$, find α .	4	CO1	3
v)	Expand $f(x) = \begin{cases} x^2, & -3 \leq x \leq 0 \\ 0, & 0 \leq x \leq 3 \end{cases}$ as a Fourier series.	4	CO3	3
vi)	If $\phi = x^3 + y^3 + z^3 - 3xyz$ then find $\text{div } \vec{F}$ and $\text{curl } \vec{F}$ where $\vec{F} = \nabla \phi$.	4	CO6	3
Q.3	Solve any two questions out of three.	16		
i)	1) Find the Laplace Transform of $\frac{e^{-3t} \cos 2t}{t}$ 2) Evaluate using Laplace Transform: $\int_0^\infty e^{4t} \frac{\sin 2t}{t} dt$	8	CO1	3
ii)	State Parseval's identity for $f(x)$ in $(0, 2\pi)$. Expand $f(x) = \begin{cases} \sin x, & 0 \leq x \leq \pi \\ 0, & \pi \leq x \leq 2\pi \end{cases}$ as a Fourier series and find the values of a_5 and b_3 .	8	CO3	3
iii)	Check whether following matrix is diagonalisable. If it is diagonalisable the find the diagonal form and the diagonalising matrix. $\begin{bmatrix} 4 & 2 & -2 \\ -5 & 3 & 2 \\ -2 & 4 & 1 \end{bmatrix}$	8	CO6	3
Q.4	Solve any two questions out of three.	16		
i)	Find: (a) $L^{-1}\left(\frac{(s+5)^2}{(s^2+10s+18)^2}\right)$ (b) $L^{-1}\left(\log\left(1 + \frac{3}{s}\right)\right)$	8	CO2	3
ii)	a) Show that $f(z) = \bar{z}$ is not analytic. b) Find the orthogonal trajectories of the family of curves $x^2 - y^2 + x = c$	8	CO4	3
iii)	Use Stoke's theorem to evaluate $\int_C [(x^2 + y^2)i + (x^2 - y^2)j] \cdot d\vec{r}$ where C is the boundary of the region enclosed by circles $x^2 + y^2 = 4, x^2 + y^2 = 16$.	8	CO5	3