Regular

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

Subject Code: EXC301 Subject Name: Applications of Mathematics in Engineering - I

Date: 25th May 2023 (CKT)

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B.Tech Program: EXTC Engineering

Examination: SY Semester: III

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

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
Q 1	Solve any six questions out of eight:	12		
i)	Find $L^{-1}\left(\frac{s+2}{s^2+4s+7}\right)$	2	CO2	3
ii)	Check whether the following function is Analytic $f(z) = e^z$	2	CO4	3
iii)	Find Laplace transform of $f(t) = \sin(\omega t + \alpha)$	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 $\emptyset = xz^2 - 5yz + xz$, find $\nabla\emptyset$ at (1,-1,2)	2	CO6	3
vi)	If $A = \begin{bmatrix} 8 & -8 & -2 \\ 4 & -3 & -2 \\ 3 & -4 & 1 \end{bmatrix}$ find the eigen values of 4A.	2	CO5	3
vii)	If $f(x)= \begin{cases} 0 & , -c < x < 0 \\ a, & 0 < x < c \end{cases}$ then, find the value of Fourier Coefficient b_2.	2	CO3	3
viii)	If $L[f(t)] = \frac{1}{\sqrt{1+s^2}}$, evaluate $\int_0^\infty f(t)\,dt$.	2	CO1	3
Q.2	Solve any four questions out of six.	16		
i)	Use Cayley-Hamilton theorem to find $2A^4 - 5A^3 - 7A + 6I$ where $A = \begin{bmatrix} 1 & 2 \\ 2 & 2 \end{bmatrix}$	4	CO5	3
ii)	Find $L^{-1}\left[\log\left(1 + \frac{a^2}{s^2}\right)\right]$	4	CO2	3
iii)	If $f(z) = u + iv$ where $u = x^2 - y^2$, $v = -\frac{y}{x^2+y^2}$,	4	CO4	3

	Check whether (i) u is Harmoninc function (ii) f(z) is an analytic function.			
iv)	Find the Laplace transform of $t \sin 2t \cosh t$.	4	CO1	3
v)	It is given that Fourier series of $f(x) = x^2$ in $(-\pi, \pi)$ is given by $x^2 = \frac{\pi^2}{3} + 4\sum(-1)^n.\frac{\cos nx}{n^2}$. Using Parseval's identity prove that $\sum \frac{1}{n^4} = \frac{\pi^4}{90}$	4	CO3	3
vi)	If $\emptyset = x^3 + y^3 + z^3 - 3xyz$ then find $\text{div}\bar{F}$ and curl $\bar{F}$ where $\bar{F} = \nabla\emptyset$.	4	CO6	3
Q.3	Solve any two questions out of three.	16		
i)	Using Laplace transform evaluate $\int_0^\infty \left(\frac{\sin 2t + \sin 3t}{t e^t}\right) dt$.	8	CO1	3
ii)	Obtain Fourier series expansion for $f(x) = \frac{3x^2 - 6x\pi + 2\pi^2}{12}$ in $(0, 2\pi)$. Hence, deduce that $\frac{\pi^2}{6} = \frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \cdots$	8	CO3	3
iii)	Check whether following matrix is diagonalisable. If it is diagonalisable then find the diagonal form and the diagonalising matrix. $\begin{bmatrix} 2 & 2 & 1 \\ 1 & 3 & 1 \\ 1 & 2 & 2 \end{bmatrix}$	8	CO6	3
Q.4	Solve any two questions out of three.	16		
i)	Using convolution theorem find inverse Laplace transform of $\frac{s^2+2s+3}{(s^2+2s+2)(s^2+2s+5)}$	8	CO2	3
ii)	Find an analytic function $f(z) = u + iv$ where $u + v = e^x(\cos y + \sin y)$. Also find the imaginary part of $f(z)$.	8	CO4	3
iii)	Using Green's theorem evaluate $\int_C \bar{F}.d\bar{r}$ where C is the curve enclosing the region bounded by $y^2 = 4ax, x = a$ in the plane $z = 0$ and $\bar{F} = (2x^2y + 3z^2)i + (x^2 + 4yz)j + (2y^2 + 6xz)k$.	8	CO5	3

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