

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

Nov – Dec 2024			DSY
Program: B. Tech Scheme: III			
Regular Examination: SY Semester: III			
Course Code: EXC301 and Course Name: Applications of Mathematics in Engineering-I			
Date of Exam: 23-12-2024	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.

Q. No.	Question	Max. Marks	CO	BT level
Q.1	Solve any two questions out of three: (05 marks each)	10		
a)	Find $L(t \sin 2t \cos ht)$	5	CO1	03
b)	Using partial fraction method, find $L^{-1}\left(\frac{1}{(s-2)(s+2)^2}\right)$	5	CO2	03
c)	Find the Fourier series of $f(x) = x \cos x$ in $(-\pi, \pi)$	5	CO3	03
Q.2	Solve any two questions out of three: (05 marks each)	10		
a)	Find the analytic function whose real part is $u = e^x \cos y - xy$	5	CO4	03
b)	Verify Cayley- Hamilton theorem and hence find A^{-1} $A = \begin{bmatrix} 1 & 2 & -2 \\ -1 & 3 & 0 \\ 0 & -2 & 1 \end{bmatrix}$	5	CO5	03
c)	If $\vec{F} = (x + 2y + az)i + (bx - 3y - z)j + (4x + cy + 2z)k$ is irrotational, find the constants a, b, c.	5	CO6	03
Q.3	Solve any two questions out of three. (10 marks each)	20		
a)	i) Find $L\left(\frac{d}{dt}\left(\frac{1-\cos t}{t}\right)\right)$	6	CO1	03
	ii) Find $L(e^{-4t} \int_0^t u \sin 3u \, du)$	4		
b)	i) Using convolution theorem, find $L^{-1}\left(\frac{s^2}{(s^2+9)^2}\right)$	6	CO2	03
	ii) Find $L^{-1}\left(\log\left(\frac{s+a}{s+b}\right)\right)$	4		

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c)	i) Find the Fourier series of $f(x) = \frac{1}{2}(\pi - x)$ in $(0, 2\pi)$.	6	CO3	03
	ii) Obtain Fourier series of $f(x) = \begin{cases} -c & -a < x < 0 \\ c & 0 < x < a \end{cases}$ (where c is constant)	4		
Q.4	Solve any two questions out of three. (10 marks each)	20		
a)	i) Find the analytic function $f(z) = u + iv$ in terms of z if $u + v = \frac{x}{x^2+y^2}$	6	CO4	03
	ii) Determine whether $v = \frac{1}{2} \log(x^2 + y^2)$ is harmonic function.	4		
b)	i) Determine whether $A = \begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$ is diagonalizable, if yes find the transforming matrix P and diagonal matrix D.	6	CO5	03
	ii) If the matrix $A = \begin{bmatrix} 1 & 2 & 3 \\ 0 & 3 & 2 \\ 0 & 0 & -2 \end{bmatrix}$, Find Eigen values of $3A^3 + 5A^2 - 6A + 2I$.	4		
c)	i) Using Green's theorem, evaluate $\int (x^2y dx + x^2dy)$ along c, where c is the boundary described by counter clockwise of the triangle with the vertices (0,0), (1,0), (1,1).	6	CO6	03
	ii) Find the line integral of $\vec{F} = x^2i + xyj$ along the parabola $y^2 = x$ between (0,0) to (1,1)	4		
