EXTC | EXC301

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

Nov – Dec 2024
(B. Tech) Program: EXTC Engineering Scheme III/IIB/II
Regular/Supplementary Examination: SY Semester: III
Course Code: EXC301 and Course Name: Applications of Mathematics in Engineering I

Date of Exam: 26·11·24 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 $L(t\,e^t \sin 2t \cos t)$	5	1	3
b)	Using Partial fraction evaluate $L^{-1}\left(\frac{3s+7}{s^2-2s-3}\right)$	5	2	3
c)	Find Fourier series of $f(x) = 1 - x^2$ in $(-1,1)$	5	3	3
Q 2	Solve any **two** questions out of three: (05 marks each)	10		
a)	Determine the constants a ,b ,c ,d so that the function $f(z) = \mathbf{x^2 + axy + by^2} + i\,(\mathbf{cx^2 + dxy + y^2})$ is analytic.	5	4	3
b)	Find the Eigen values of $3A^3 + 5A^2 - 6A + 2I$, if $A = \begin{bmatrix} 1 & 2 & 3 \\ 0 & 3 & 2 \\ 0 & 0 & -2 \end{bmatrix}$.	5	5	3
c)	Prove that vector $(y^2 - z^2 + 3yz - 2x)i + (3xz + 2xy)j + (3xy - 2xz + 2z)k$ is both solenoidal and irrotational.	5	6	3
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	1	3
	ii) Find $L\left(\int_0^t \frac{1-e^{-au}}{u}\,du\right)$	4		

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b)	i) Using Convolution theorem find $L^{-1}\left(\frac{1}{(s-2)(s+2)^2}\right)$.	6	2	3
	ii) Find $L^{-1}\left(ln\left(\frac{s+a}{s+b}\right)\right)$.	4		
c)	i) Find Fourier series of $f(x) = \frac{1}{2}(\pi - x)$ in $(0,2\pi)$.	6	3	3
	ii) Find Fourier coefficient a_n of the Fourier series of $f(x) = \lvert x \rvert$ in $(-\pi, \pi)$.	4		
Q.4	Solve any **two** questions out of three. (10 marks each)	20		
a)	i) Find the orthogonal trajectory of family of curve $3x^2y - y^3 = c$.	6	4	3
	ii) Find the analytic function whose real part is $u = x^2 - y^2 - 2xy - 2x + 3y$.	4		
b)	i) Determine whether following matrix A is diagonalizable, if yes find the modal matrix P and diagonal form D, where $A = \begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$.	6	5	3
	ii) Verify Cayley-Hamilton theorem for the following matrix $\begin{bmatrix} 1 & 2 & 3 \\ 2 & -1 & 4 \\ 3 & 1 & -1 \end{bmatrix}$.	4		
c)	i) Using Green's theorem evaluate $\oint(xy + y^2)\,dx + x^2\,dy$ where c is the closed curve of the region bounded by $y = x$ & $y = x^2$.	6	6	3
	ii) If $F = x^2 i + xyj$ then find $\int F.dr$ from (0,0) to(1,1) along the curve $y = x^2$.	4		

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