Register No : ____________________

THE KAVERY ENGINEERING COLLEGE

(An Autonomous Institution)

B.E/B.TECH DEGREE END SEMESTER THEORY EXAMINATIONS, APRIL/MAY 2026

Fourth Semester

Chemical Engineering

UMAT24401 / MA3451 – Transform Techniques

Regulations – 2024 & 2021

Duration : 3 Hrs *Maximum : 100 Marks*

*PART – A (ANSWER ALL QUESTIONS) (Marks 10*2=20)*

Q.No	Questions	BTL	CO	Marks
1.	Prove that $\vec{F} = (y^2 \cos x + z^3)\vec{i} + (2y\sin x - 4)\vec{j} + 3xz^2\vec{k}$ is irrotational.	L2	1	2
2.	State Stoke's theorem.	L1	1	2
3.	Define Dirichlet's conditions.	L1	2	2
4.	Find the Fourier constants b_n for x sinx in $(-\pi,\pi)$.	L2	2	2
5.	Define Fourier transform Pair.	L1	3	2
6.	If $F_c[e^{-ax}] = \sqrt{\frac{2}{\pi}}\left[\frac{a}{s^2+a^2}\right]$ find $F_c[x\, e^{-ax}]$.	L2	3	2
7.	State and prove Initial Value Theorem.	L1	4	2
8.	If $f(t) = e^{-2t} \sin 2t$, find $L[f'(t)]$.	L2	4	2
9.	State the convolution theorem on Z – Transform.	L1	5	2
10.	Find $Z[e^{-at}]$	L2	5	2

*PART – B (ANSWER ALL QUESTIONS) (Marks 5*16 = 80)*

Q.No			Questions	BLT	CO	Marks
11.	a		Verify Gauss divergent theorem for $\vec{F} = x^2\vec{i} + y^2\vec{j} + z^2\vec{k}$ .the cube bounded by the planes $x = 0, x = 1, y = 0, y = 1, z = 0, z = 1$.	L4	1	16
			Or			
	b		Verify Stoke's theorem for vector field $\vec{F} = xy\vec{i} - 2yz\vec{j} - zx\vec{k}$.where s is the surface of the rectangular parallelepiped formed by $x = 0, y = 0, z = 0, x = 1, y = 2, z = 3$ above the xy-plane.	L4	1	16
12.	a	i	Determine the Fourier series expansion of $f(x) = x^2$ in $(-\pi, \pi)$ and hence show that $\frac{1}{1^4} + \frac{1}{2^4} + \frac{1}{3^4} + \ldots = \frac{\pi^4}{90}$.	L2	2	8
		ii	Find the fourier series of period 2π for the function $f(x)= x \cos x$ in $0<x<2\pi$.	L3	2	8
			Or			

	b	i	Obtain a Fourier expansion for f(x)=$\lvert x\rvert$ in $-\pi \le x \le \pi$.	L2	2	8
		ii	Find the first fundamental harmonic of the Fourier series of f(x) given by the following table. x : 0 1 2 3 4 5 f(x): 9 18 24 28 26 20	L3	2	8
13.	a	i	Find the Fourier transform of $f(x)=e^{\frac{-x^2}{2}}$ in $(-\infty,\infty)$.	L3	3	8
		ii	Find the Fourier transform of $f(x)=\begin{cases} a^2-x^2, & \lvert x\rvert < a \\ 0 & \lvert x\rvert > 0 \end{cases}$ Hence prove that $\int_0^{\infty} \frac{\sin x - x\cos x}{x^3}\,dx = \frac{\pi}{4}$	L3	3	8
			Or			
	b	i	Evaluate $\int_0^{\infty} \frac{s^2}{(s^2+a^2)+(s^2+b^2)}\,ds$ using Fourier Transforms.	L3	3	8
		ii	Find the Fourier transform of the function $f(x)=\begin{cases} 1-\lvert x\rvert, & \lvert x\rvert \le 1 \\ 0, & \lvert x\rvert > 1 \end{cases}$. Hence deduce that $\int_0^{\infty} \left(\frac{\sin t}{t}\right)^4 dt = \frac{\pi}{3}$.	L3	3	8
14.	a	i	(a) Find $L[t^2e^{-3t}sin2t]$ (b) Find $L\left[\frac{e^{-t}sin2t}{t}\right]$.	L2	4	8
		ii	Using Convolution theorem find the inverse Laplace Transform of $\frac{1}{(s^2+4)^2}$	L3	4	8
			Or			
	b	i	Solve $\frac{d^2y}{dt^2}+4y$=sin2t . where $y(0)=3$ and $y'(0)=4$.using Laplace transform.	L3	4	8
		ii	Find the L.T of the triangular wave function f(t) defined by $f(t)=\begin{cases} t, & 0\le t<1 \\ 2-t, & 1\le t<2 \end{cases}$ and f(t+2)=f(t) $for\ all\ t$	L2	4	8

15.	a	i	Find $z^{-1}\left[\frac{10z}{(z-1)(z-2)}\right]$ by using Cauchy's Residue Theorem.	L2	5	8
		ii	Find Z [e^{t} sin2t] and Z [e^{-2t} sin3t].	L3	5	8
			Or			
	b	i	Use convolution theorem to evaluate $Z^{-1}\left\{\frac{z^2}{(z-3)(z-4)}\right\}$.	L2	5	8
		ii	Solve $y(n+2)+6y(n+1)+9y(n)=2^n \, given \, y(0)=y(1)=0$.	L3	5	8