Register No : ____________________

THE KAVERY ENGINEERING COLLEGE

(An Autonomous Institution)

B.E/B.TECH DEGREE END SEMESTER THEORY EXAMINATIONS, NOV/DEC 2025

Fourth Semester

Chemical Engineering

MA3451 - Transform Techniques

Regulations - 2021

Duration : 3 Hrs *Maximum : 100 Marks*

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

Q.No	Questions	BLT	CO	Marks
1.	Find the unit normal vector to the surface $x^2+y^2=z$ at $(1,-2,5)$.	L2	1	2
2.	State Stoke's theorem.	L1	1	2
3.	State Dirichlet's condition for the convergence of the Fourier series of $f(x)$.	L1	2	2
4.	Obtain the root mean square value of the function $f(x)=x$ in $(0,l)$.	L2	2	2
5.	State Fourier Transform pair.	L1	3	2
6.	If $f(s)=F[f(x)]$, Show that $F[f(ax)]=\frac{1}{a}F\left(\frac{s}{a}\right)$.	L2	3	2
7.	Find $L(e^{3t}+cos5t)$.	L3	4	2
8.	State initial value theorem.	L1	4	2
9.	Find the Z-transform of $\frac{1}{n}$.	L2	5	2
10.	State Convolution theorem on Z transforms.	L1	5	2

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

Q.No			Questions	BLT	CO	Marks
11.	a	i	Find the angle between the normals to the surface $xy^3z^2=4$ at the points (-1, -1, 2) and (4, 1, -1).	L3	1	8
		ii	If $\bar{r}$ is the position vector of the point (x,y,z), prove that $\nabla^2 r^n = n(n+1)r^{n-2}$.	L3	1	8
			Or			
	b		Verify Gauss - divergence theorem for the vector function $\bar{F}=(x^3-yz)\bar{i}-2x^2y\bar{j}+2\bar{k}$ over the cube bounded by $x=0, y=0, z=0$ and $x=a, y=a, z=a$.	L3	1	16
12.	a	i	Obtain the Fourier series expansion for $f(x)=x^2$ in $[0,2\pi]$ and periodic with period 2π.	L3	2	8
		ii	Find the Fourier series for $f(x)=2x-x^2$ in $0<x<2$.	L3	2	8
			Or			

b i Obtain the half range cosine series for the function $f(x)=x(\pi-x)$ in $0<x<\pi$. Hence show that $\frac{1}{1^4}+\frac{1}{2^4}+\frac{1}{3^4}+...=\frac{\pi^4}{90}$. L3 2 8

ii Make use of following table to find the first two harmonics of the Fourier series of $f(x)$: L3 2 8

x	0	$\frac{\pi}{3}$	$\frac{2\pi}{3}$	π	$\frac{4\pi}{3}$	$\frac{5\pi}{3}$	π
$f(x)$	1.0	1.4	1.9	1.7	1.5	1.2	1.0

13. a Find the Fourier transform of $f(x)=\begin{cases} a^2-x^2 & , \ if \quad |x|<a \\ 0 & , \ if \quad |x|>a>0 \end{cases}$. Hence deduce that $\int_0^\infty \left(\frac{\sin t - t\cos t}{t^3}\right)dt=\frac{\pi}{4}$ .Using Parseval's identity, show that $\int_0^\infty \left(\frac{\sin t - t\cos t}{t^3}\right)^2 dt=\frac{\pi}{15}$. L3 3 16

Or

b i Apply Fourier transform for $f(x)$ if $f(x)=\begin{cases} 1, & if \quad |x|<1 \\ 0, & if \quad |x|>1 \end{cases}$ and hence deduce that $\int_0^\infty \left(\frac{\sin t}{t}\right)^2 dt=\frac{\pi}{2}$. L3 3 8

ii Apply Parseval's identity to evaluate $\int_0^\infty \frac{dx}{(x^2+a^2)^2}$. L3 3 8

14. a i Apply Laplace transform to find $te^{-2t}\cos 3t$. L3 4 8

ii Find the Laplace transform of the Half wave rectifier L3 4 8

$$f(t)=\begin{cases} \sin \omega t, & 0<t<\frac{\pi}{\omega} \\ 0, & \frac{\pi}{\omega}<t<\frac{2\pi}{\omega} \end{cases}$$

and $f\left(t+\frac{2\pi}{\omega}\right)=f(t)$ for all t.

Or

b i Using inverse Laplace find $L^{-1}\left[\frac{1}{(s+1)(s+2)}\right]$. L3 4 6

ii Solve the equation $y''-3y'+2y=1$, given $y(0)=0$, and $y'(0)=1$ by using Laplace transform. L3 4 10

15.	a	i	Solve $Z(na^n \sin n\theta)$.	L3	5	8
		ii	Apply inverse Z - transform, to find the value of $\dfrac{10Z}{z^2 - 3z + 2}$.	L3	5	8
			Or			
	b	i	Apply convolution theorem to determine the inverse Z - transform of $\left(\dfrac{z^2}{(z+a)^2}\right)$.	L3	5	8
		ii	Solve $y_{(n+2)} + 4y_{(n+1)} + 3y_{(n)} = 2^n$ with $y_0 = 0$ & $y_1 = 1$ using Z-transform.	L3	5	8