

SRM VALLIAMMAI ENGINEERING COLLEGE
(An Autonomous Institution)
S.R.M. Nagar, Kattankulathur - 603203

DEPARTMENT OF MATHEMATICS

QUESTION BANK



III SEMESTER

B.E- AGRI, CIVIL, EEE, EIE, ECE, MDE

MA3321–Transforms and Partial Differential Equations

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DEPARTMENT OF MATHEMATICS

S.No	QUESTIONS	BT Level	Competence	COs
UNIT I-Solutions Lagrange's linear equation - Linear partial differential equations of second and higher order with constant coefficients of homogeneous type.				
Part - A (2 MARK QUESTIONS)				
1.	Define Lagrange's Linear Equation. What is its general form ?	BTL -1	Remembering	CO1
2.	What are the auxiliary (or subsidiary) equations associated with Lagrange's linear equation?.	BTL -1	Remembering	CO1
3.	Solve $p \tan x + q \tan y = \tan z$	BTL -2	Understanding	CO1
4.	Solve $px + qy = 3z$	BTL -2	Understanding	CO1
5.	Solve $p\sqrt{x} + q\sqrt{y} = \sqrt{z}$	BTL -2	Understanding	CO1
6.	Write the working rule for solving $Pp + Qq = R$ by Lagrange's method.	BTL -2	Understanding	CO1
7.	Find the particular integral of $(D^2 - 3DD' + 2D'^2)z = \cos(4x - 2y)$	BTL -1	Remembering	CO1
8.	Solve $(D^3 - 4D^2D' + 4DD'^2)z = 0$	BTL -2	Understanding	CO1
9.	Solve $px^2 + qy^2 = z^2$	BTL -1	Remembering	CO1
10.	Find the complete solution of $(D^2 - DD' - 20D'^2)z = \cos(x + 2y)$	BTL -1	Remembering	CO1
11.	Find the particular integral of $(D^2 - D'^2)z = e^{x+2y}$	BTL -2	Understanding	CO1
12.	Solve $p \cot x + q \cot y = \cot z$	BTL -2	Understanding	CO1
13.	Find the general integral of $p - q = \log(x + y)$	BTL -1	Remembering	CO1
14.	Find the general solution of $pzx + qzy = xy$	BTL -1	Remembering	CO1
15.	Define linear partial differential equations.	BTL -2	Understanding	CO1
16.	Write down the general solution of homogenous linear PDE.	BTL -1	Remembering	CO1
17.	Solve $((D^2 - 6DD' + 9D'^2)z = 0)$ $(D^2 - 4DD' + 4D'^2)z = 0$	BTL -1	Remembering	CO1
18.	Find the particular integral of $(D^2 - 7DD' + 6D'^2)z = x + y$	BTL -2	Understanding	CO1
19.	Solve $(D^3 - D^2D' - 8DD'^2 + 12D'^3)z = 0$	BTL -2	Understanding	CO1
20.	Solve $(D^4 - D'^4)z = 0$	BTL -2	Understanding	CO1
21.	Solve $(D - D')^3 z = 0$	BTL -2	Understanding	CO1
22.	Solve $\frac{\partial^2 z}{\partial x^2} - \frac{\partial^2 z}{\partial x \partial y} + \frac{\partial z}{\partial x} = 0$	BTL -1	Remembering	CO1
23.	Find the particular integral of Solve $\frac{\partial^2 z}{\partial x^2} - 2\frac{\partial^2 z}{\partial x \partial y} - 3\frac{\partial^2 z}{\partial y^2} = xy$	BTL -1	Remembering	CO1
24.	Find the particular integral of $(D^2 - 6DD' + 9D'^2)z = \sin(2x - y)$	BTL -2	Understanding	CO1
25.	Solve $\frac{\partial^2 z}{\partial x^2} - \frac{\partial^2 z}{\partial x \partial y} = 0$	BTL -2	Understanding	CO1
PART - B (16 MARK QUESTIONS)				
1.	Solve $(z^2 - y^2 - 2yz)p + (xy + zx)q = (xy - zx)$	BTL -3	Applying	CO1
2.	Solve $x(y^2 + z)p + y(x^2 + z)q = z(x^2 - y^2)$	BTL -3	Applying	CO1
3.	Solve the Lagrange's equation $(x + 2z)p + (2xz - y)q = x^2 + y$	BTL -4	Analyzing	CO1
4.(a)	Find the general solution of $(3z - 4y)p + (4x - 2z)q = 2y - 3x$	BTL -3	Applying	CO1

4.(b)	Solve $(x^2 - yz)p + (y^2 - xz)q = (z^2 - xy)$	BTL - 3	Applying	CO1
5.	Solve the partial differential equation $(x - 2z)p + (2z - y)q = x - y$	BTL - 4	Analyzing	CO1
6.(a)	Solve $x(y^2 - z^2)p + y(z^2 - x^2)q = z(x^2 - y^2)$	BTL - 3	Applying	CO1
6.(b)	Find the general solution of $(mz - ny)p + (nx - lz)q = ly - mx$	BTL - 4	Analyzing	CO1
7.	Solve $(x^2 - y^2 - z^2)p + 2xyq = 2xz$	BTL - 4	Analyzing	CO1
8.(a)	Solve the PDE $x^2(y - z)p + y^2(z - x)q = z^2(x - y)$	BTL - 3	Applying	CO1
8.(b)	Solve $(y - z)p + (z - x)q = x - y$	BTL - 3	Applying	CO1
9.(a)	Solve $(D^2 - 5DD' + 6D'^2)z = e^{2x+y}$	BTL - 3	Applying	CO1
9.(b)	Find the general solution of $(D^3 - 7DD'^2 - 6D'^3)z = \cos(x + 2y)$	BTL - 3	Applying	CO1
10.	Solve $(D^3 + D^2D' - DD'^2 - D'^3)z = e^{2x+y} + \cos(x + y)$	BTL - 1	Remembering	CO1
11.	Solve $(D^2 - DD' - 2D'^2)z = 2x + 3y + e^{2x+4y}$	BTL - 1	Remembering	CO1
12.a)	Solve $(D^2 + DD' - 6D'^2)z = x^2y$	BTL - 4	Analyzing	CO1
12.(b)	Solve $(D^3 - 2D^2D')z = 2e^{2x}$	BTL - 3	Applying	CO1
13.	Solve $(D^2 - DD' - 20D'^2)z = e^{5x+y} + \sin(4x - y)$.	BTL - 4	Analyzing	CO1
14.(a)	Solve $[D^2 - 3DD' + 2D'^2]z = \sin x \cos y$	BTL - 3	Applying	CO1
14.(b)	Find the general solution of $(D^2 + D'^2)z = x^2y^2$	BTL - 3	Applying	CO1
15.	Solve $(D^2 + 3DD' + 2D'^2)z = xy + \cos(2x + y)$	BTL - 3	Applying	CO1
16.	Solve $(D^2 + 2DD' + D'^2)z = x^2y + e^{x-y}$	BTL - 4	Analyzing	CO1
17.	Solve $(D^3 - 7DD'^2 - 6D'^3)z = \sin(x + 2y) + x^3y^3$	BTL - 3	Applying	CO1
18.	Solve $((D^2 - 4DD' + 4D'^2)z = e^{2x+y} + \sin(x + y))$	BTL - 4	Analyzing	CO1

UNIT II FOURIER SERIES: Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Harmonic analysis.

PART-A(2 MARK QUESTIONS)

1.	State the Dirichlet's conditions for Fourier series.	BTL - 1	Remembering	CO2
2.	Does $f(x) = \tan x$ possess a Fourier expansion?	BTL - 1	Remembering	CO2
3.	If $f(x)$ is an odd function defined in $(-l, l)$. What are the values of a_0 and a_n ?	BTL - 1	Remembering	CO2
4.	Write a_0, a_n in the expression $x + x^3$ as a Fourier series in $(-l, l)$	BTL - 1	Remembering	CO2
5.	Determine the value of a_n in the Fourier series expansion of $f(x) = x^3$ in $(-\pi, \pi)$.	BTL - 2	Understanding	CO2
6	Find b_n in the expansion of $f(x) = x^2$ as a Fourier series in $(-\pi, \pi)$	BTL - 2	Understanding	CO2
7.	Find the Fourier constant b_n for $x \sin x$ in $(-\pi, \pi)$.	BTL - 2	Understanding	CO2
8.	Find the constant term in the expansion of $f(x) = x^2 + x$ as a Fourier series in the interval $(-\pi, \pi)$.	BTL - 2	Understanding	CO2
9.	Find the value of b_n for $f(x) = x $ in $(-\pi, \pi)$	BTL - 2	Understanding	CO2
10	Expand $f(x) = 1$, in $(0, \pi)$ as a half sine series.	BTL - 2	Understanding	CO2
11.	Find the Fourier coefficient b_n for the function $f(x) = 2x - x^2$ defined in the interval $0 < x < 2$.	BTL - 2	Understanding	CO2
12.	Find the constant a_0 of the Fourier series for the function $f(x) = e^x$ in $(0, 2\pi)$	BTL - 1	Remembering	CO2
13.	State the convergence condition on Fourier series	BTL - 2	Understanding	CO2
14.	If the function $f(x) = x$ in the interval $0 < x < 2\pi$ then find the constant term of the Fourier series expansion of the function	BTL - 2	Understanding	CO2
15.	If $(\pi - x)^2 = \frac{\pi^2}{3} + 4 \sum_{n=1}^{\infty} \frac{\cos nx}{n^2}$ in $0 < x < 2\pi$ then deduce that value of $\sum_{n=1}^{\infty} \frac{1}{n^2}$.	BTL - 2	Understanding	CO2

16.	If $x^2 = \frac{\pi^2}{3} + 4 \sum_{n=1}^{\infty} \frac{(-1)^n}{n^2} \cos(nx)$, deduce that $\frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \dots = \frac{\pi^2}{6}$.	BTL -1	Remembering	CO2
17.	Write the Fourier series for a function $f(x)$ defined in $-l < x < l$	BTL -2	Understanding	CO2
18.	Write down the Half range Fourier Sine series formula.	BTL -2	Understanding	CO2
19.	Write down the Fourier Cosine series formula.	BTL -2	Understanding	CO2
20.	Find the root mean square value of $f(x) = x^2$ in $(0, \pi)$	BTL -2	Understanding	CO2
21.	Find the RMS value of $f(x) = x(l-x)$ in $0 \leq x \leq l$	BTL -2	Understanding	CO2
22.	Find the RMS value of $f(x) = x - x^4$ in $(0, l)$	BTL -2	Understanding	CO2
23.	Define the RMS value of a function $f(x)$ over the interval (a, b)	BTL -1	Remembering	CO2
24.	Find the R.M.S value of $f(x) = x$ in $0 < x < 1$.	BTL -2	Understanding	CO2
25.	What do you mean by Harmonic Analysis?	BTL -1	Remembering	CO2
PART B (16 Mark Questions)				
1.	Find the Fourier series for the function $f(x) = \frac{1}{2}(\pi - x)$ in $0 < x < 2\pi$. Hence deduce that $1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \dots = \frac{\pi}{4}$.	BTL -2	Understanding	CO2
2.	Find the Fourier series expansion of $f(x) = \begin{cases} x & \text{for } 0 \leq x \leq \pi \\ 2\pi - x & \text{for } \pi \leq x \leq 2\pi. \end{cases}$			
3.	Find the Fourier series of $f(x) = \cos x $ in $-\pi \leq x \leq \pi$.	BTL -4	Analyzing	CO2
4.	Find the Fourier series of $f(x) = x + x^2$ in $(-\pi, \pi)$ with period 2π . Hence deduce that $\sum_{n=1}^{\infty} \frac{1}{n^2} = \frac{\pi^2}{6}$.	BTL -3	Applying	CO2
5.	Obtain the Fourier series for the function $f(x)$ given by $f(x) = \begin{cases} 1-x, & -\pi < x < 0 \\ 1+x, & 0 < x < \pi \end{cases}$ Hence deduce that $1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \dots = \frac{\pi}{4}$.	BTL -4	Analyzing	CO2
6.	Expand $f(x) = \begin{cases} 1 + \frac{2x}{\pi}, & -\pi < x < 0 \\ 1 - \frac{2x}{\pi}, & 0 < x < \pi \end{cases}$ as a full range Fourier series in the interval $(-\pi, \pi)$.	BTL -3	Applying	CO2
7(a)	Find the Fourier series of $f(x) = x $ in $-\pi \leq x \leq \pi$.	BTL -4	Analyzing	CO2
7(b)	Find the Fourier series of $f(x) = 2x - x^2$ in $0 < x < 3$.	BTL -3	Applying	CO2
8.	Find the Fourier expansion of the following periodic function of period 4 $f(x) = \begin{cases} 2+x, & -2 \leq x \leq 0 \\ 2-x, & 0 \leq x \leq 2 \end{cases}$ Hence deduce that $\frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \dots \infty = \frac{\pi^2}{8}$.	BTL -4	Analyzing	CO2
9.	Find the Fourier series $f(x) = \begin{cases} l-x & 0 < x < l \\ 0 & l < x < 2l \end{cases}$ in $(0, 2l)$. Hence deduce that $1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \dots = \frac{\pi}{4}$ and $\frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \dots \infty = \frac{\pi^2}{8}$.	BTL -3	Applying	CO2
10.	Find the Fourier series for $f(x) = x^2$ in $(-l, l)$. Hence show that $\frac{1}{2^2} + \frac{1}{3^2} + \dots \infty = \frac{\pi^4}{6}$	BTL -4	Analyzing	CO2

11(a)	Find the half range Fourier cosine series of $f(x) = (\pi - x)^2$ in the interval $(0, \pi)$.	BTL -4	Analyzing	CO2																
11(b)	Find the Half – range cosine series of $f(x) = x(\pi - x)$ in $0 < x < \pi$	BTL -3	Applying	CO2																
12(a)	Express $f(x) = \begin{cases} Kx & 0 < x < \frac{l}{2} \\ K(l - x) & \frac{l}{2} < x < l \end{cases}$ in a Half range Fourier cosine series.																			
12(b)	Find the Sine series for $f(x) = x$ in $-l < x < l$	BTL -3	Applying	CO2																
13.	Find the half range sine series of $f(x) = 4x - x^2$ in the interval $0 < x < 4$	BTL -3	Applying	CO2																
14.	Express $f(x) = \begin{cases} x & 0 < x < \frac{\pi}{2} \\ (\pi - x) & \frac{\pi}{2} < x < \pi \end{cases}$ in a Half range Fourier sine series. Hence deduce the sum of the series that $\sum_{n=1}^{\infty} \frac{1}{(2n-1)^2}$	BTL -4	Analyzing	CO2																
15.	Compute the first two harmonics of the Fourier series of $f(x)$ from the table given <table><tr><td>x</td><td>0</td><td>$\pi/6$</td><td>$\pi/3$</td><td>$\pi/2$</td><td>$2\pi/3$</td><td>$5\pi/6$</td></tr><tr><td>f(x)</td><td>0</td><td>9.2</td><td>14.4</td><td>17.8</td><td>17.3</td><td>11.7</td></tr></table>	x	0	$\pi/6$	$\pi/3$	$\pi/2$	$2\pi/3$	$5\pi/6$	f(x)	0	9.2	14.4	17.8	17.3	11.7	BTL -3	Applying	CO2		
x	0	$\pi/6$	$\pi/3$	$\pi/2$	$2\pi/3$	$5\pi/6$														
f(x)	0	9.2	14.4	17.8	17.3	11.7														
16.	Find the Fourier series up to second harmonic to represent the function given by the following data <table><tr><td>x</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr><tr><td>y</td><td>9</td><td>18</td><td>24</td><td>28</td><td>26</td><td>20</td></tr></table>	x	0	1	2	3	4	5	y	9	18	24	28	26	20	BTL -3	Applying	CO2		
x	0	1	2	3	4	5														
y	9	18	24	28	26	20														
17.	<table><tr><td>t sec x:</td><td>0</td><td>T/6</td><td>T/3</td><td>T/2</td><td>2T/3</td><td>5T/6</td><td>T</td></tr><tr><td>A amps y:</td><td>1.98</td><td>1.30</td><td>1.05</td><td>1.30</td><td>-0.88</td><td>-0.25</td><td>1.98</td></tr></table> The table gives the time (t) in seconds as x and current (A) in amps as y, Obtain the first two harmonics from the given data.	t sec x:	0	T/6	T/3	T/2	2T/3	5T/6	T	A amps y:	1.98	1.30	1.05	1.30	-0.88	-0.25	1.98	BTL -3	Applying	CO2
t sec x:	0	T/6	T/3	T/2	2T/3	5T/6	T													
A amps y:	1.98	1.30	1.05	1.30	-0.88	-0.25	1.98													
18.	Find the Fourier cosine series up to second harmonic to represent the function given by the following data: $l = 6$ <table><tr><td>x</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr><tr><td>y</td><td>4</td><td>8</td><td>15</td><td>7</td><td>6</td><td>2</td></tr></table>	x	0	1	2	3	4	5	y	4	8	15	7	6	2	BTL -4	Analyzing	CO2		
x	0	1	2	3	4	5														
y	4	8	15	7	6	2														

UNIT III - LAPLACE TRANSFORMS

Existence conditions – Transforms of elementary functions – Basic properties – Inverse transforms – Convolution theorem – Transform of periodic functions.

PART-A(2 Mark Questions)

1.	State the sufficient conditions for the existence of Laplace transform.	BTL -1	Remembering	CO3
2.	State and prove change of scale property	BTL -1	Remembering	CO3
3.	Find $L(e^{-3t})$	BTL -1	Remembering	CO3
4.	Tell whether $L\left[\frac{\cos t}{t}\right]$ exist? Justify.	BTL -2	Understanding	CO3
5.	Give example of two functions for which Laplace Transform do not exist?	BTL -1	Remembering	CO3
6.	Estimate $L[t \cos t]$	BTL -2	Understanding	CO3
7.	Estimate $L\left[\frac{\sin at}{t}\right]$	BTL -2	Understanding	CO3
8.	Find $L((t-1)^2)$	BTL -1	Remembering	CO3

9.	Find $L(te^{-t})$	BTL -1	Remembering	CO3
10	Find $L(t \cosh 3t)$	BTL -2	Understanding	CO3
11.	Find $L[t \sinh 2t]$	BTL -2	Understanding	CO3
12.	Evaluate $L\left[\frac{e^t}{t}\right]$	BTL -1	Remembering	CO3
13.	Find $L\left[\frac{e^{at}-e^{-bt}}{t}\right]$	BTL -2	Understanding	CO3
14.	Find $L[t \cos at]$	BTL -2	Understanding	CO3
15.	Define Inverse Laplace transforms	BTL -1	Remembering	CO3
16.	Define Laplace transform of periodic functions.	BTL -1	Remembering	CO3
17.	Find $L(3e^{5t}+5\cos t)$	BTL -2	Understanding	CO3
18.	Find $L(\sin 2t \cos 4t)$	BTL -2	Understanding	CO3
19.	Define convolution.	BTL -1	Remembering	CO3
20.	Evaluate $L^{-1}\left[\frac{1}{(s+2)^4}\right]$	BTL -1	Remembering	CO3
21.	Evaluate $L\left[\frac{e^t}{t}\right]$	BTL -2	Understanding	CO3
22.	Formulate $L^{-1}\left[\frac{1}{s(s-4)}\right]$	BTL -1	Remembering	CO3
23.	Find $L\left[\frac{1-e^t}{t}\right]$	BTL -2	Understanding	CO3
24.	Find $L^{-1}\left[\frac{s}{(s+4)(s+5)}\right]$	BTL -1	Remembering	CO3
25.	Find $L^{-1}\left[\log \frac{s+1}{s-1}\right]$	BTL -2	Understanding	CO3
PART-B (16 Marks Questions)				
1.	Give $L[f(t)]$, if $f(t)=\begin{cases} t, & \text{for } 0 \leq t \leq 1 \\ 2-t, & \text{for } 1 < t < 2 \end{cases}$ and $f(t+2) = f(t)$, for all t.	BTL -3	Applying	CO3
2.	Find the Laplace transform of $f(t)$ if $f(t) = e^t, 0 < t < 2\pi$ and $f(t+2\pi) = f(t)$	BTL -3	Applying	CO3
3.	Find the Laplace transform of the square-wave function of period a defined as $f(t)=\begin{cases} K, & \text{when } 0 < t < a \\ -K, & \text{when } a < t < 2a \end{cases}$ and $f(t+2a) = f(t)$, for all t.	BTL -3	Applying	CO3
4.	Find the inverse Laplace Transform of $\log\left(\frac{s^2+a^2}{s^2+b^2}\right)$	BTL -3	Applying	CO3
5.	Identify the Laplace transform of the square-wave function of period a defined as $f(t) = \begin{cases} 1, & \text{when } 0 < t < a/2 \\ -1, & \text{when } a/2 < t < a \end{cases}$	BTL -3	Applying	CO3
6.	Find $f(t)$, if $L(f(t)) = \frac{s}{(s+5)^2}$	BTL -2	Understanding	CO3
7.(a)	Find the Laplace transform of the square-wave function of period 2 defined as $f(t)=\begin{cases} 1, & \text{when } 0 < t < 1 \\ 0, & \text{when } 1 < t < 2 \end{cases}$ and $f(t+2) = f(t)$, for all t.	BTL -3	Applying	CO3
7.(b)	Evaluate $L\left[\frac{\cos at - \cos bt}{t}\right]$	BTL -3	Applying	CO3
8.	Using Convolution theorem, Evaluate $L^{-1}\left[\frac{1}{s(s^2+1)}\right]$	BTL-5	Evaluating	CO3
9.	Estimate $L[f(t)]$, if $f(t)=\begin{cases} \sin \omega t, & \text{for } 0 < t < \frac{\pi}{\omega} \\ 0, & \text{for } \frac{\pi}{\omega} < t < \frac{2\pi}{\omega} \end{cases}$ and $f\left(t + \frac{2\pi}{\omega}\right) = f(t)$, for all t.	BTL -4	Analyzing	CO3

10.	Using Convolution theorem calculate the inverse Laplace transform of $L^{-1} \left[\frac{s^2}{(s^2 + 1)(s^2 + 4)} \right]$	BTL- 6	Creating	CO3
11.(a)	Find the Laplace transform of f(t) if $f(t) = e^t, 0 < t < 2\pi$ and $f(t + 2\pi) = f(t)$	BTL -4	Analyzing	CO3
11.(b)	Identify the Laplace Transform of the function $\left[\frac{1 - \cos t}{t} \right]$	BTL -4	Analyzing	CO3
12.	Using convolution theorem, find $L^{-1} \left[\frac{4}{(s^2 + 2s + 5)^2} \right]$	BTL-4	Analyzing	CO3
13.	Estimate L[f(t)], if $f(t) = \begin{cases} \sin \omega t, & \text{for } 0 < t < \frac{\pi}{\omega} \\ 0, & \text{for } \frac{\pi}{\omega} < t < \frac{2\pi}{\omega} \end{cases}$ and $f\left(t + \frac{2\pi}{\omega}\right) = f(t)$, for all t.	BTL -3	Applying	CO3
14.	Identify the Inverse Laplace transform of $\left[\tan^{-1} \left(\frac{2}{s} \right) + \cot^{-1} \left(\frac{s}{3} \right) \right]$	BTL-3	Applying	CO3
15.	Using Convolution theorem calculate the inverse Laplace transform of $L^{-1} \left[\frac{1}{(s + 1)(s^2 + 1)} \right]$	BTL-4	Analyzing	CO3
16.	Give L [f(t)], if $f(t) = \begin{cases} t, & \text{for } 0 \leq t \leq c \\ 2c - t, & \text{for } c < t < 2c \end{cases}$ and $f(t + 2c) = f(t)$, for all t.	BTL -3	Applying	CO3
17.	Using convolution theorem find (i) $L^{-1} \left[\frac{1}{(s + a)(s + b)} \right]$ (ii) $L^{-1} \left[\frac{2}{(s + 1)(s^2 + 4)} \right]$	BTL-4	Analyzing	CO3
18.	Using Convolution theorem calculate the inverse Laplace transform of $L^{-1} \left[\frac{s^2}{(s^2 + a^2)(s^2 + b^2)} \right]$	BTL -3	Applying	CO3

UNIT –IV FOURIER TRANSFORM

Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity

PART-A(2 Mark Questions)

1.	State Fourier integral Theorem	BTL -1	Remembering	CO4
2.	Write Fourier transform pair.	BTL -1	Remembering	CO4
3.	If the Fourier transform of $f(x)$ is $F(s) = F[f(x)]$, then show that $F[f(x - a)] = e^{ias} F(s)$.	BTL -1	Remembering	CO4
4.	Find the Fourier Transform of $e^{-a x }$.	BTL -2	Understanding	CO4
5.	Find the Fourier Transform of $f(x) = \begin{cases} e^{ikx}, & \text{if } a < x < b \\ 0, & \text{if } x \leq a \text{ or } x > b \end{cases}$	BTL -2	Understanding	CO4
6.	State and Prove any one Modulation theorem on Fourier Transform	BTL -1	Remembering	CO4
7.	Define self-reciprocal with respect to Fourier Transform	BTL -1	Remembering	CO4
8.	Prove that $F[f(ax)] = \frac{1}{a} F_s \left(\frac{s}{a} \right)$ if $a > 0$.	BTL -1	Remembering	CO4
9.	If $F(s)$ is the Fourier Transform of $f(x)$. Show that the Fourier Transform of $e^{iax} f(x)$ is $F(s + a)$.	BTL -1	Remembering	CO4
10.	Write Fourier Sine transform pair	BTL -1	Remembering	CO4

11.	Find the Fourier sine Transform of e^{-ax} .	BTL -2	Understanding	CO4
12.	Prove that $F_S[f(ax)] = \frac{1}{a} F_S\left(\frac{s}{a}\right)$	BTL -2	Understanding	CO4
13.	Find the Fourier sine transform of $\frac{1}{x}$.	BTL -2	Understanding	CO4
14.	Find the Fourier sine transform of $f(x) = \begin{cases} 1, & 0 \leq x \leq 1 \\ 0, & x > 1 \end{cases}$	BTL -2	Understanding	CO4
15.	Write Fourier Cosine transform pair	BTL -2	Understanding	CO4
16.	Find the Fourier cosine Transform of $e^{-2x} + 2e^{-x}$	BTL -1	Remembering	CO4
17.	Find the Fourier cosine transform of e^{-ax} .	BTL -2	Understanding	CO4
18.	Find the Fourier cosine Transform of $f(x) = 2x$ in $0 < x < 4$	BTL -2	Understanding	CO4
19.	Prove that $F_C[f(ax)] = \frac{1}{a} F_C\left(\frac{s}{a}\right)$	BTL -2	Understanding	CO4
20.	If $F(s) = F[f(x)]$, then find $F[xf(x)]$	BTL -3	Applying	CO4
21.	Find the Fourier cosine Transform of $f(x) = \begin{cases} x, & 0 \leq x \leq \pi \\ 0, & x > \pi \end{cases}$	BTL -2	Understanding	CO4
22.	Define Convolution of two functions $f(x)*g(x)$.	BTL -2	Understanding	CO4
23.	State Convolution theorem for Fourier Transform	BTL -3	Applying	CO4
24.	State Parseval's Identity for Fourier Transform	BTL -2	Understanding	CO4
25.	State Parseval's Identity for Fourier sine and cosine transform.	BTL -2	Understanding	CO4
PART-B (16 Mark Questions)				
1.	Find the Fourier Transform of $f(x) = \begin{cases} 1, & x \leq a \\ 0, & x > a > 0 \end{cases}$ and hence evaluate (i) $\int_0^\infty \left(\frac{\sin t}{t}\right)$ also using Parseval's Identity Prove that $\int_0^\infty \left(\frac{\sin t}{t}\right)^2 dt = \frac{\pi}{2}$	BTL -3	Applying	CO4
2.	Show that the Fourier Transform of $f(x) = \begin{cases} a - x , & \text{if } x \leq a \\ 0, & \text{if } x > a > 0 \end{cases}$ is $\sqrt{\frac{2}{\pi}} \left(\frac{1 - \cos as}{s^2}\right)$. Hence deduce that (i) $\int_0^\infty \left(\frac{\sin t}{t}\right)^2 dt = \frac{\pi}{2}$, (ii) $\int_0^\infty \left(\frac{\sin t}{t}\right)^4 dt = \frac{\pi}{3}$.	BTL -4	Analyzing	CO4
3.	Find the Fourier Transform of the function $f(x) = \begin{cases} 1 - x , & \text{if } x \leq 1 \\ 0, & \text{if } x > 1 \end{cases}$ Hence deduce that (i) $\int_0^\infty \left(\frac{\sin t}{t}\right)^2 dt = \frac{\pi}{2}$ (ii) $\int_0^\infty \left(\frac{\sin t}{t}\right)^4 dt = \frac{\pi}{3}$.	BTL -3	Applying	CO4
4.(a)	Show that the function $e^{\frac{-x^2}{2}}$ is self-reciprocal under the Fourier Transform.	BTL -3	Applying	CO4
4.(b)	Find the infinite Fourier sine transform of $\frac{1}{x}$.	BTL -3	Applying	CO4
5.	Find the Fourier Transform of $f(x) = \begin{cases} 1 - x^2, & \text{if } x \leq 1 \\ 0, & \text{if } x > 1 \end{cases}$ Hence Show	BTL -3	Applying	CO4

	that $\int_0^\infty \left(\frac{\sin s - s \cos s}{s^3} \right) \cos \frac{s}{2} ds = \frac{3\pi}{16}$			
6.(a)	Find $F_C \left[\frac{e^{-ax}}{x} \right]$ and hence find $F_C \left[\frac{e^{-ax} - e^{-bx}}{x} \right]$	BTL -3	Applying	CO4
6.(b)	Find the function whose Fourier Sine Transform is $\frac{e^{-as}}{s}, a > 0$	BTL -3	Applying	CO4
7.	Show that the Fourier transform of $f(x) = \begin{cases} a^2 - x^2, & x < a \\ 0, & x > a \end{cases}$ is $2 \sqrt{\frac{2}{\pi}} \left(\frac{\sin as - as \cos as}{s^3} \right)$. Hence deduce that (i) $\int_0^\infty \left(\frac{\sin t - t \cos t}{t^3} \right) dt = \frac{\pi}{4}$ (ii) $\int_0^\infty \left(\frac{\sin t - t \cos t}{t^3} \right)^2 dt = \frac{\pi}{15}$.	BTL -4	Analyzing	CO4
8.(a)	Find the Fourier sine transform of e^{-ax} ($a > 0$). Hence find $F_s[xe^{-ax}]$ and $F_s \left[\frac{e^{-ax}}{x} \right]$	BTL -4	Analyzing	CO4
8.(b)	Find the Fourier cosine Transform of e^{-ax} . Hence use Parseval's identity to evaluate $\int_0^\infty \frac{dx}{(x^2+a^2)(x^2+b^2)}$.	BTL -3	Applying	CO4
9.	Find the Fourier Transform of $e^{-a x }$ and hence deduce that (i) $\int_0^\infty \frac{\cos xt}{a^2+t^2} dt = \pi/2a e^{-a x }$ (ii) $F[xe^{-a x }] = i \sqrt{\frac{2}{\pi}} \frac{2as}{(a^2+s^2)^2}$, here F stands for Fourier Transform.	BTL -4	Analyzing	CO4
10.(a)	Find the Fourier Transform of $e^{- x }$ and hence find the Fourier Transform of $f(x) = e^{- x } \cos 2x$.	BTL -4	Analyzing	CO4
10.(b)	Using Parseval's Identity evaluate $\int_0^\infty \frac{dx}{(x^2+25)(x^2+9)}$. Use Fourier cosine Transform of e^{-ax} .	BTL -3	Applying	CO4
11.	Find the Fourier cosine & sine Transform of e^{-x} . Hence evaluate (i) $\int_0^\infty \frac{1}{(x^2+1)^2} dx$ and (ii) $\int_0^\infty \frac{x^2}{(x^2+1)^2} dx$.	BTL -4	Analyzing	CO4
12.(a)	Prove that $F_c[xf(x)] = \frac{d}{ds}[F_s\{f(x)\}]$ and $F_s[xf(x)] = -\frac{d}{ds}[F_c\{f(x)\}]$	BTL -3	Applying	CO4
12.(b)	Find the Fourier Sine Transform of the function $f(x) = \begin{cases} \sin x, & 0 \leq x < a \\ 0, & x > a \end{cases}$	BTL -3	Applying	CO4
13.	Using Fourier Sine transform prove that $\int_0^\infty \frac{x^2 dx}{(x^2+a^2)(x^2+b^2)} = \frac{\pi}{2(a+b)}$	BTL -4	Analyzing	CO4
14.(a)	Find the Fourier transform of $f(x) = \begin{cases} x, & x < a \\ 0, & x \geq a \end{cases}$	BTL -3	Applying	CO4
14.(b)	Find the Fourier cosine transform of $f(x) = \begin{cases} x, & 0 < x < 1 \\ 2-x, & 1 < x < 2 \\ 0, & x > 2 \end{cases}$	BTL -3	Applying	CO4
15.	Find the Fourier transform of $f(x) = \begin{cases} 1, & x < 2 \\ 0, & x \geq 2 \end{cases}$ Hence deduce that (i) $\int_0^\infty \left(\frac{\sin t}{t} \right)^2 dt = \frac{\pi}{2}$, (ii) $\int_0^\infty \frac{\sin x}{x} dx$	BTL -4	Analyzing	CO4
16.(a)	Find the Fourier Transform of $f(x) = \begin{cases} e^{iax}, & \text{if } 0 < x < 1 \\ 0, & \text{otherwise} \end{cases}$.	BTL -4	Analyzing	CO4

16.(b)	Using Fourier cosine Transform of e^{-ax} , evaluate $\int_0^{\infty} \frac{dx}{(x^2+1)(x^2+4)}$.	BTL -3	Applying	CO4
17.	Find the Fourier cosine transform of $e^{-a^2 x^2}$ and hence find the Fourier cosine transform of $e^{-\frac{x^2}{2}}$	BTL -2	Understanding	CO4
18.	Using Parseval's Identity evaluate the following integrals. (i) $\int_0^{\infty} \frac{dx}{(a^2+x^2)^2}$, (ii) $\int_0^{\infty} \frac{x^2 dx}{(a^2+x^2)^2}$, $a > 0$. Use Fourier sine Transform of e^{-ax} .	BTL -3	Applying	CO4

UNIT –V: Z - TRANSFORMS AND DIFFERENCE EQUATIONS

Z- transforms – Elementary properties – Inverse Z – transform (using partial fraction and residues) – Convolution theorem – Solution of difference equations using Z – transform.

PART-A (2 Mark Questions)

1.	Define Z – Transform of the sequence $\{f(n)\}$.	BTL -1	Remembering	CO5
2.	Find $Z(3^{n+2})$	BTL -2	Understanding	CO5
3.	Find $Z\left[\frac{a^n}{n!}\right]$	BTL -1	Remembering	CO5
4.	Find $Z\left[\frac{1}{n!}\right]$	BTL -2	Understanding	CO5
5.	Find $Z\left[\frac{1}{n(n+1)}\right]$	BTL -2	Understanding	CO5
6	Find $Z\left[\sin \frac{n\pi}{2}\right]$	BTL -2	Understanding	CO5
7.	Find the z – transform of n^2 .	BTL -2	Understanding	CO5
8	Find $z(na^n)$	BTL -2	Understanding	CO5
9.	Find $z(a^n)$	BTL -2	Understanding	CO5
10	Find $z(n)$	BTL -2	Understanding	CO5
11.	Find Z transform of $\frac{1}{n}$	BTL -2	Understanding	CO5
12.	Find the Z $((n+1)(n+2))$	BTL -2	Understanding	CO5
13.	Find $Z\left[\cos \frac{n\pi}{2}\right]$	BTL -2	Understanding	CO5
14.	Prove that $Z[a^n f(n)] = f\left(\frac{z}{a}\right)$	BTL -1	Remembering	CO5
15.	Find $Z\left[\frac{1}{(n+1)!}\right]$	BTL -2	Understanding	CO5
16.	Find $Z[e^t \sin 2t]$.	BTL -1	Remembering	CO5
17.	Find $z^{-1}\left[\frac{z}{(z+1)^2}\right]$	BTL -2	Understanding	CO5
18.	Find $z^{-1}\left[\frac{z}{(z-1)^2}\right]$	BTL -2	Understanding	CO5
19.	Find inverse Z transform of $\frac{z}{(z-1)(z-2)}$	BTL -1	Remembering	CO5
20.	Find $z^{-1}\left[\frac{z}{(z+4)(z+5)}\right]$	BTL -2	Understanding	CO5
21.	Prove that $Z[f(n+1)] = zF(z) - zf(0)$.	BTL -1	Remembering	CO5
22.	State Convolution theorem in Z – Transforms	BTL -1	Remembering	CO5
23.	Find the difference equation generated by $y_n = A2^{n+1}$.	BTL -2	Understanding	CO5
24.	Solve $y_{n+1} - 2y_n = 0$ given that $y_0 = 2$	BTL -2	Understanding	CO5
25.	Find the difference equation generated by $y_n = a + b3^n$.	BTL -2	Understanding	CO5

PART-B (16 Mark Questions)

1.	Find the inverse Z – Transform of $\frac{z^2+z}{(z-1)(z^2+1)}$ by partial fraction method, and Cauchy Residue theorem.	BTL -3	Applying	CO5
2.(a)	Find the z transform of $f(n) = \frac{2n+3}{(n+1)(n+2)}$.	BTL -4	Analyzing	CO5
2.(b)	Find the inverse Z – Transform using partial fraction method of $\frac{z^2}{(z-3)(z-4)}$	BTL -4	Analyzing	CO5
3.	Using convolution theorem find the inverse Z – Transform of $\frac{12z^2}{(3z-1)(4z+1)}$	BTL -3	Applying	CO5
4.(a)	Using convolution theorem find inverse Z transform of $\left[\frac{z^2}{(z-a)(z-b)} \right]$	BTL -3	Applying	CO5
4.(b)	Using Z transform solve $y_{n+2} - 3y_{n+1} - 10y_n = 0$ with $y(0) = 0, y(1) = 1$.	BTL -3	Applying	CO5
5.	Form the difference equation, $y(k+3) - 3y(k+1) + 2y(k) = 0$ with $y(0) = 4, y(1) = 0$ and $y(2) = 8$	BTL -4	Analyzing	CO5
6.(a)	Using Residue theorem and Partial fraction method find the inverse Z transform of $U(z) = \left[\frac{z^2}{(z+2)(z+4)} \right]$	BTL -3	Applying	CO5
6.(b)	Solve $y_{n+2} + y_n = 2$ given that $y(0) = 0, y(1) = 0$	BTL -3	Applying	CO5
7.	Using Z transform solve $u_{n+2} + 6u_{n+1} + 9u_n = 2^n$ given that $u(0) = 0, u(1) = 0$	BTL -4	Analyzing	CO5
8.(a)	Using convolution theorem evaluate $Z^{-1} \left[\frac{z^2}{\left(z-\frac{1}{2}\right)\left(z-\frac{1}{4}\right)} \right]$	BTL -4	Analyzing	CO5
8.(b)	Find the z transform of $f(n) = \frac{4}{(n+2)(n+3)}$	BTL -3	Applying	CO5
9.	Solve the equation using Z – Transform $y_{n+2} - 5y_{n+1} + 6y_n = 36$ given that $y(0) = y(1) = 0$	BTL -4	Analyzing	CO5
10.(a)	Find the inverse Z-transform of $\left[\frac{z}{z^2+2z+2} \right]$ by residue theorem	BTL -4	Analyzing	CO5
10.(b)	Find inverse z-transform of $\frac{z^3}{(z-1)^2(z-2)}$ using partial fraction	BTL -3	Applying	CO5
11.	Solve $y_{n+2} - 4y_{n+1} + 4y_n = 0$ with $y_0 = 1$ and $y_1 = 0$, using Z-transform.	BTL -4	Analyzing	CO5

12.(a)	Find the z transform of $f(n) = \frac{1}{(n+1)(n+2)}$	BTL -3	Applying	CO5
12.(b)	Find the inverse Z-transform of $\left[\frac{z^2}{z^2+4}\right]$ by residue theorem	BTL -3	Applying	CO5
13.	Solve $y_{n+2} + 6y_{n+1} + 9y_n = 2^n$ with $y_0 = 0$ and $y_1 = 0$, using Z-transform.	BTL -4	Analyzing	CO5
14.(a)	Find $Z^{-1}\left(\frac{z^2}{z^2-7z+10}\right)$	BTL -3	Applying	CO5
14.(b)	Using Convolution theorem find $Z^{-1}\left[\frac{z^2}{(z+a)^2}\right]$.	BTL -3	Applying	CO5
15.	Solve $y_{n+2} - 7y_{n+1} + 12y_n = 2^n$ with $y_0 = 0$ and $y_1 = 0$, using Z-transform.	BTL -4	Analyzing	CO5
16.(a)	Find $Z^{-1}\left[\frac{z(z+1)}{(z-1)^3}\right]$ using residue theorem	BTL -4	Analyzing	CO5
16.(b)	Find z-transform of $\frac{1}{n(n+1)}$	BTL -3	Applying	CO5
17.	Solve $u_{n+2} - u_{n+1} + 6y_n = 4^n$ with $u_0 = 0$ and $u_1 = 1$, using Z-transform.	BTL -4	Analyzing	CO5
18.(a)	Find the inverse Z-transform of $\left[\frac{z^2-3z}{(z-5)(z+2)}\right]$ by residue theorem.	BTL -3	Applying	CO5
18.(b)	Using Z-transform solve $u_{n+2} - 3u_{n+1} + 2u_n = 0$, given that $u_0 = 0, u_1 = 1$	BTL -3	Applying	CO5
