Roll No.: | | | | | | | | | | |

Anna University (University Departments)

B.E./B.Tech.(Full Time) End Semester Examinations – April/May – 2024

Common to All Branches

Semester – III

MA5355 – Transform Techniques and Partial Differential Equations

(Regulation 2019)

Time: 3 Hours **Answer all the Questions** **Max. Marks: 100**

CO 1	To introduce the effective mathematical tools for the solutions of partial differential equations that model physical processes.
CO 2	To introduce Fourier series analysis which is central to many applications in engineering.
CO 3	To develop the analytic solutions for partial differential equations used in engineering by Fourier series.
CO 4	To acquaint the student with Fourier transform techniques used in wide variety of situations in which the functions used are not periodic.
CO 5	To develop Z- transform techniques which will perform the same task for discrete time systems as Laplace Transform, a valuable aid in analysis of continuous time systems.

BL – Bloom's Taxonomy Levels

L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analysing, L5 – Evaluating, L6 – Creating.

Q.No.	Question	Marks	CO	BL
	Part – A (10 x 2 = 20 Marks)			
1	Find the partial differential equation of $(x-a)^2+(y-b)^2+z^2=1$.	2	1	L3, L5,
2	Find complete integral of pq = 2.	2	1	L1, L3, L5
3	State the existence condition of Fourier series.	2	2	L1. L2
4	Write briefly about Harmonic Analysis.	2	2	L1, L2
5	Classify the equation $D^2+4DD'+3D'^2 = e^{x+2y}$.	2	3	L1
6	Write briefly about one dimensional wave equation.	2	3	L1
7	State Fourier integral theorem.	2	4	L1
8	State modulation property of Fourier transform.	2	4	L1, L2
9	State initial and Final value theorem of Z - transform.	2	5	L1
10	Form the difference equation of $y_n = a+b3^n$.	2	5	L1, L5

Q.No.	Question	Marks	CO	BL
	Part – B (5 x 13 = 65 Marks)			
11. a.	i. Solve the equation $x^2p + y^2q + z^2 = 0$.	6	1	L1, L2, L3, L5
	ii. Form the partial differential equation by eliminating the arbitrary function from $z = f(2x+y)+g(3x-y)$.	7	1	L1, L3, L6
	Or			
11. b.	Solve the equation $(D^3+2D^2D')z = e^{2x}-3x^2y$.	13	1	L1, L3, L5
12 a.	Find the Fourier cosine series of $f(x) = \begin{cases} x, 0 \le x \le 1 \\ 2-x, 1 \le x \le 2 \end{cases}$.	13	2	L1, L2, L3, L5
	Or			
12 b.	Obtain the Fourier series of $f(x) = x^2$ in $(-\pi, \pi)$ and hence deduce the sum $\frac{1}{1^4}+\frac{1}{2^4}+\frac{1}{3^4}+\ldots\ldots$.	13	2	L1, L2, L3, L5
13 a.	A string is stretched and fastened the end points at a distance L apart. Motion is started by displacing the string in the form $y = a\sin\left(\frac{\pi x}{L}\right)$ $0 < x < L$, from which it is released at time t = 0. Find the displacement at any time t.	13	3	L1, L2, L3, L5
	Or			
13 b.	A bar of 10 cm long, with insulated sides has its ends A and B maintained at temperatures 50°c and 100°c respectively until steady state conditions prevail. The temperature at A is suddenly raised to 90°c and at B is lowered to 60°c. Find the temperature in the bar thereafter.	13	3	L1, L2, L6
14 a.	Find the Fourier Transform of $f(x) = \begin{cases} 1-\lvert x\rvert, \lvert x\rvert < 1 \\ 0, \lvert x\rvert \ge 1 \end{cases}$, and hence evaluate the integral $\int_0^\infty \frac{\sin^4 t}{t^4} dt$.	13	4	L1, L2, L5
	Or			
14 b.	i. Using Fourier Transform technique, determine $\int_0^\infty \frac{dx}{(x^2+4)(x^2+25)}$.	7	4	L1, L2, L3, L5
	ii. Prove that $e^{\frac{-x^2}{2}}$ is a self reciprocal under Fourier Transform.	6	4	L1, L2, L3, L5

15 a.	Solve $.u_{n+2} - 2u_{n+1} + u_n = 2^n$, $u_0 = 2$, $u_1 = 1$, using Z – transform.	13	5	L1, L2, L3, L5
	Or			
15 b.	i. Obtain inverse Z – transform of $\frac{8z^2}{(2z-1)(4z-1)}$, using convolution theorem.	7	5	L1, L2, L3, L5
	ii. If U(z) = $\frac{2z^2+5z+14}{(z-1)^4}$, then find u_2 and u_4.	6	5	L1, L2, L3, L5

Q.No.	Question	Marks	CO	BL
	Part – C (1 x 15 = 15 Marks)			
16	Solve the Laplace equation $\frac{\partial^2 u}{\partial x^2}+\frac{\partial^2 u}{\partial y^2}=0$, subject to the condition u (0, y) = u (l, y) = u(x, 0) = 0 and u(x, a) = $\sin\left(\frac{n\pi x}{l}\right)$.	15	3	L1, L2, L3, L5