LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

B.Sc. DEGREE EXAMINATION – **PHYSICS**

THIRD SEMESTER – **NOVEMBER 2022**

UPH 3502 – MATHEMATICAL PHYSICS - II

Date: 03-12-2022 Dept. No. Max. : 100 Marks

Time: 09:00 AM - 12:00 NOON

PART – A

Q. No.	**Answer ALL questions** **(10 x 2 = 20 Marks)**
1	Distinguish between ordinary and partial differential equations.
2	Find the general solution of the differential equation $(D'' + 16)y = 0$.
3	Solve the differential equation $\frac{\partial^2 u}{\partial y^2} = 0$.
4	Write the Laplacian equation in cylindrical coordinates.
5	State the derivative property of Fourier's transform.
6	Find the Fourier transform of $f(x) = \begin{cases} 1, & for\ \|x\| < a \\ 0, & for \|x\| > a \end{cases}$
7	Write the Newton's backward interpolation formula.
8	What is meant by interpolation?
9	Using Newton-Raphson formula find the square root of a positive number k.
10	Write the Lagrange's interpolation formula.

PART – B

Answer any FOUR questions **(4 x 7.5 = 30 Marks)**

11	Using the method of separation of variables, solve $\frac{\partial u}{\partial x} = 2\frac{\partial u}{\partial t} + u,\ where\ u(x,0) = 6e^{-3x}$.
12	Analyze the D'Alembert's solution of wave equation $\frac{\partial^2 u}{\partial x^2} = \frac{1}{c^2}\frac{\partial^2 u}{\partial t^2}$.
13	Find the Fourier sine and cosine transforms for $f(x) = e^{-2x} + 4\,e^{-3x}$.
14	State and prove convolution theorem of Fourier series.
15	Find the positive root of $x^4 - x = 10$ and correct to three decimal places using Newton's Raphson method.
16	Fit a straight line to the following data using the least square method

x	1	2	3	4
y	16	19	23	26

PART – C

Answer any FOUR question **(4 x 12.5 = 50 Marks)**

17 Solve the wave equation $\frac{\partial^2 u}{\partial t^2} = a^2 \frac{\partial^2 u}{\partial x^2}$ for the boundary condition u = 0 when x = 0 and x = π, $\frac{\partial u}{\partial t} = 0 \; when \; t = 0 \; and \; u(x,0) = x, 0 < x < \pi$

18 Solve $\frac{\partial^2 u}{\partial r^2} + \frac{1}{r}\frac{\partial u}{\partial r} + \frac{1}{r^2}\frac{\partial^2 u}{\partial \theta^2} = 0$ by the method of separation of variables.

19 Write the one-dimensional heat equation and derive its general solution.

20 Find the Fourier transform of the function

$$f(x) = \begin{cases} 1 - x^2 \; if & |x| \le 1 \\ 0 \quad if & |x| > 1 \end{cases}$$

21 The population of a city in census taken once in 10 years is given below. Estimate the population in the year 1956. (Use Newton's forward interpolation)

Year	1951	1961	1971	1981
Population in thousands	35	42	58	84

22 Evaluate $\int_{-3}^{3} x^4 \, dx$ using Trapezoidal rule and Simpson's one third rule. Verify your answer with actual integration.

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