LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

THIRD SEMESTER – **NOVEMBER 2023**

UPH 3502 – MATHEMATICAL PHYSICS - II

Date: 04-11-2023   Dept. No.   Max. : 100 Marks
Time: 09:00 AM - 12:00 NOON

SECTION A - K1 (CO1)

	Answer ALL the Questions	**(10 x 1 = 10)**
1.	**Define the following**	
a)	Order of an equation	
b)	Heat equation	
c)	Fourier transform	
d)	Interpolation	
e)	Euler's method	
2.	**Fill in the blanks**	
a)	The equation of motion of a vibrating string is _____.	
b)	Laplace equation is _____	
c)	The Fourier transform of the function $e^{-|x|}$ is _____	
d)	The relation between the shifting operator E and the forward difference operator Δ is _____	
e)	The formula for Trapezoidal rule is _____	

SECTION A - K2 (CO1)

	Answer ALL the Questions	**(10 x 1 = 10)**
3.	**True or False**	
a)	Fourier series cannot be used to find the solution of wave equation.	
b)	In the heat flow equation, the quantity h is called Planck's constant.	
c)	The Fourier transform of $\frac{df}{dt} = i\omega\, FT(f\,(t))$.	
d)	The value of $E^2 f(x)$ with interval h is f (x)	
e)	Using the general quadrature formula, one can obtain the Simpson's rule.	
4.	**Match the following**	
a)	Wave equation - Trapezoidal rule	
b)	$\nabla^2\emptyset = 0$ - Linearity Property	
c)	Fourier Transform - Laplace equation	
d)	Curve fitting - Vibrating string	
e)	Numerical Integration - Method of least squares	

SECTION B - K3 (CO2)

	Answer any TWO of the following	**(2 x 10 = 20)**
5.	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.	
6.	Solve the heat equation by Fourier series.	
7.	State and prove convolution theorem	

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| 8. | Solve the system of equations by Gauss Elimination method.
$x + 2y + z = 3$
$2x + 3y + 3z = 10$
$3x - y + 2z = 13$ |

SECTION C – K4 (CO3)

Answer any TWO of the following   **(2 x 10 = 20)**

9.	Use Newton Raphson method to evaluate the function $f(x) = x^3 - 2x - 5$
10.	The ends A and B of a rod of length 20 cm are at temperatures 30° C and 80° C respectively until steady state prevails. The temperatures at the ends are changed to 40° C and 60° C respectively. Find the temperature distribution in the rod at time t.
11.	Find the Fourier sine and cosine transform of sin ax.
12.	Formulate the one dimensional wave equation of a vibrating string.

SECTION D – K5 (CO4)

Answer any ONE of the following   **(1 x 20 = 20)**

| 13. | Obtain D'Alembert's solution to the wave equation for the vibrating string and give its physical interpretation |
| 14. | a. Find the Fourier transform of the function $f(x) = Ne^{-\alpha x^2}$ where N and α are constants. (10 marks).
b. Find the Fourier sine and cosine transform of the function $f(x) = x^2$; $0 < x < 4$. (10 marks) |

SECTION E – K6 (CO5)

Answer any ONE of the following   **(1 x 20 = 20)**

15. Using the following data, find y at x= 1946 and x = 1976.

x	1941	1951	1961	1971	1981	1991
y	20	24	29	36	46	51

16. Evaluate $\int_0^1 e^x \, dx$ by using (i) Trapezoidal rule (ii) Simpson's 1/3 rule. Also verify the result by actual integration.

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