LOYOLA COLLEGE (AUTONOMOUS) CHENNAI – 600 034

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

THIRD SEMESTER – **NOVEMBER 2024**

UPH 3502 – MATHEMATICAL PHYSICS - II

Date: 12-11-2024 Dept. No. Max. : 100 Marks

Time: 09:00 am-12:00 pm

	SECTION A - K1 (CO1)	
	Answer ALL the Questions	**(10 x 1 = 10)**
1.	**MCQ**	
a)	Which of the following equation is an one-dimensional wave equation? (i) $\frac{\partial^2 y}{\partial x^2}=a\frac{\partial^2 y}{\partial t^2}$ (ii) $\frac{\partial y}{\partial x}=a\frac{\partial^2 y}{\partial t^2}$ (iii) $\frac{\partial y}{\partial x}=a^2\frac{\partial^2 y}{\partial x^2}$ (iv) $\frac{\partial^2 y}{\partial t^2}=a^2\frac{\partial^2 y}{\partial x^2}$	
b)	In two-dimensional heat flow equation $\frac{\partial^2 u}{\partial t^2}=c^2[\frac{\partial^2 u}{\partial x^2}+\frac{\partial^2 u}{\partial y^2}]$,the term c^2refers (i) thermal conductivity (ii) Specific heat (iii) diffusivity (iv) heat flow from lower to higher temperature.	
c)	Fourier sin transform of $\frac{1}{x}$is (i) $\frac{\pi}{2}$ (ii)$\frac{\sqrt{\pi}}{2}$ (iii) $\sqrt{\frac{\pi}{2}}$ (iv) $\sqrt{\frac{2}{\pi}}$	
d)	In Newton's forward interpolation formula the value of a_2 is given by (i) $a_2=\frac{1}{h^2}\nabla y_0$ (ii) $a_2=\frac{1}{h}\nabla y_0 (iii) a_2=\frac{1}{2!h^2}\nabla^2 y_0$ (iv) $a_2=\frac{1}{h^2}\nabla^2 y_0$	
e)	Which of the following is correct for Trapezoidal rule? (i) $h¿$ (ii) $\frac{h}{2}¿$ (iii) $\frac{h}{4}¿$ (iv) $\frac{h}{3}¿$	
2.	**Fill in the blanks**	
a)	Laplace equation in cylindrical co-ordinate system is ……..	
b)	If the roots α and β of second order differential equation are real and distinct then the general solution is ……..	
c)	Fourier sine transform is defined as ----------.	
d)	The word extrapolation is used to denote the process of finding the values of ----------.	
e)	Numerical integration process when applied to a function of a single variable, then it is known as ----------.	
	SECTION A - K2 (CO1)	
	Answer ALL the Questions	**(10 x 1 = 10)**
3.	**True or False**	

a)	Partial differential equation can be formed either by eliminating arbitrary constants or functions
b)	The equation of heat-flow in polar coordinates for steady-state is $\frac{\partial^2 u}{\partial r^2}+\frac{1}{r}\frac{\partial u}{\partial r}+\frac{1}{r^2}\frac{\partial^2 u}{\partial r^2}=\frac{1}{\alpha^2}\frac{\partial u}{\partial t}$.
c)	The convolution of two function is defined as $f(x)*g(x)=\int_{-\infty}^{\infty} f(u)g(x-u)du$.
d)	The Newton's forward interpolation formula contain the term y_0.and the forward difference of y_0
e)	In Euler's method, the actual curve is approximated by a sequence of long straight line.

4.	**Match the following**
a)	Assumption in method of separation : for unequally spaced value of x
b)	$F_s[e^{-ax}$¿ $:\frac{h}{3}[(y_0+y_n)+4(y_1+y_3+\ldots+y_{n-1})+2(y_2+y_4+\ldots+y_{n-2})]$
c)	$F[af_1(x)+bf_2(x)$¿ $: u_x=\frac{\partial u}{\partial x}, u_y=\frac{\partial u}{\partial y}$
d)	Lagrange's interpolation formula $:\frac{1}{\sqrt{2\pi}}\int_{-\infty}^{\infty} e^{isx}[af_1(x)+bf_2(x)]dx$
e)	Simpson's one-third rule $:\sqrt{\frac{2}{\pi}}\frac{s}{a^2+s^2}$

SECTION B - K3 (CO2)

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

5.	By method of separation of variables solve the partial differential equation $\frac{\partial u}{\partial x}=2\frac{\partial u}{\partial t}$+u
6.	Find the Fourier sine transform of $f(x)=\frac{e^{-ax}}{x}$
7.	Using the method of least squares, fit the curve $y=ax^2+\frac{b}{x}$ to the following data X: 1 2 3 4 Y: -1.51 0.99 3.88 7.66
8.	Evaluate the integral $\int_0^1 \frac{x^2}{1+x^3}dx$ using Simpson's 1/3rd rule. Compare the error with exact value.

SECTION C – K4 (CO3)

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

9.	Solve $\frac{\partial^2 z}{\partial x^2}+2\frac{\partial^2 z}{\partial x\partial y}+\frac{\partial^2 z}{\partial y^2}=x^2+xy+y^2$
10.	Solve the equation $\frac{\partial u}{\partial t}=\frac{\partial^2 u}{\partial x^2}$ with boundary condition u(x,0) = 3sin nπx. u (0,t), u(l,t)=0 where 0¿ $x<l$.
11.	Apply Lagrange's formula to calculate f (3) from the following data: X: 0 1 2 5 Y: 2 3 12 147
12.	Using improved Euler method find y at x = 0, 0.1 and 0.2 given $\frac{dy}{dx}=y-\frac{2x}{y}, y(0)=1$.

SECTION D – K5 (CO4)

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

13.	Solve the Laplace equation $\frac{\partial^2 u}{\partial x^2}+\frac{\partial^2 u}{\partial y^2}=0$ in a rectangle in the xy -plane with u(x,0)=0, u(x,b)=0, u(0,y) and u(a,y)=f(y) parallel to y axis

14.	Find the positive root of $x^4 - x = 10$ correct to three decimal places using Newton-Raphson method.
	SECTION E – K6 (CO5)
Answer any ONE of the following	**(1 x 20 = 20)**
15.	Find Fourier cosine transform of $\frac{1}{1+x^2}$ and hence find Fourier sine transform of $\frac{x}{1+x^2}$.
16.	The population of certain town is given below. Find the rate of growth of the population in 1931, 1941, 1951, 1961 and 1971. Year X: 1931 1941 1951 1961 1971 Population in thousand Y: 40.62 60.80 79.95 103.56 132.65

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