LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

THIRD SEMESTER – **NOVEMBER 2022**

17/18UPH3MC01 – MATHEMATICAL PHYSICS

Date: 24-11-2022 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	Express the complex number $\frac{1-i}{1+i}$ in $a + ib$ form.	
2	Simplify the following: (a) i^4 and (b) i^{999}.	
3	Find grad φ if $\varphi = x^2y^3$.	
4	Define scalar and vector point functions.	
5	Write the Dirichlet conditions for a Fourier series.	
6	Find the Fourier transform of $f(x) = \begin{cases} 1, & for\ \|x\| < a \\ 0, & for \|x\| > a \end{cases}$.	
7	Write the one-dimensional heat flow equation.	
8	Distinguish between ordinary and partial differential equations.	
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	Derive Cauchy-Riemann equations for a function to be analytic.	
12	State and Prove Cauchy's integral theorem.	
13	Prove that $(y^2 - z^2 + 3yz - 2x)\hat{\imath} + (3xz + 2xy)\hat{\jmath} + (3xy - 2xz + 2z)\hat{k}$ is both solenoidal and irrotational.	
14	Solve the differential equation $2x\frac{\partial f(x,y)}{\partial x} - 3y\frac{\partial f(x,y)}{\partial y} = 0$ by the method of separation of variables.	
15	Using the method of least squares, fit a straight line to the following data.	

x	1	2	3	4
y	1.7	1.8	2.3	3.2

16	Use Newton-Raphson method to evaluate the roots of the function $f(x) = x^3 - 2x - 5 = 0$	

PART – C

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

17 (i) Express in polar form: $1-\sqrt{2}+i$ **(2.5)**

(ii) Evaluate $\int_{c(z-1)(z-4)} \frac{e^z}{} dz$,Where '$c$' is the circle $|z|=2$ by using Cauchy's integral formula. **(10)**

18 If $\vec{v}=\frac{x\hat{\imath}+y\hat{\jmath}+z\hat{k}}{\sqrt{x^2+y^2+z^2}}$, find the values of $div\ \vec{v}$ and $curl\ \vec{v}$.

19 Find the Fourier series of the function

$$f(x)=\begin{cases}-1, & if\ -\pi<x<-\frac{\pi}{2}\\ 0, & if\ -\frac{\pi}{2}<x<\frac{\pi}{2}\\ +1, & if\ \frac{\pi}{2}<x<\pi\end{cases}$$

20 Obtain the solution of the wave equation $\partial^2y/\partial t^2=c^2\partial^2y/\partial x^2$ using the method of separation of variables.

21 The following table gives the population of a town during the last six census. Estimate using any suitable interpolation formula, the increase in population during the period from 1946 to 1948.

Year	1911	1921	1931	1941	1951	1961
Population in thousands	12	15	20	27	39	52

22 Use (i) Trapezoidal rule and (ii) Simpson's 1/3rd rule, to evaluate the approximate value of $\int_0^1 \frac{dx}{1+x}$ correct to 3 decimals taking h =0.25.

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