LOYOLA COLLEGE (AUTONOMOUS) CHENNAI – 600 034

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

THIRD SEMESTER – **NOVEMBER 2024**

16UPH3MC01 – MATHEMATICAL PHYSICS

Date: 08-11-2024 Dept. No. Max. : 100 Marks

Time: 09:00 am-12:00 pm

SECTION A

Answer ANY FOUR of the following **4 × 10 = 40 Marks**

1. State and Prove Cauchy's Integral Theorem.
2. Derive Cauchy-Riemann equations for a function to be analytic
3. Find the values of a, b, c so that the function $\vec{f}=(x+2y+az)\hat{i}+(bx-3y-3z)\hat{j}+(4x+cy+2z)\hat{k}$ is irrotational.
4. Find the divergence and curl of $\vec{v}=(xyz)\hat{i}+(3x^2y)\hat{j}+(xz^2-y^2z)\hat{k}$ at (2, -1, 1).
5. Using the method of separation of variable to find the solution of wave equation $\frac{\partial^2 u}{\partial x^2}=\frac{1}{c^2}\frac{\partial^2 u}{\partial t^2}$
6. Find the Fourier series for the periodic function $f(x)=\begin{cases}0, \wedge -\pi<x<0\\ x, \wedge 0<x<\pi\end{cases}$, $f(x+2\pi)=f(x)$.
7. Find the real root of the following equation, correct to 3 decimal places using Newton-Rapshon method $x^3-2x-5=0$.
8. Using Lagrange's formula to find f (2) from the following table

x	0	1	3	4	5
f(x)	0	1	81	256	625

SECTION B

Answer ANY THREE of the following **3 × 20 = 60 Marks**

9. Evaluate the following integral using Cauchy's integral formula $\int_{c¿¿}¿$, where 'c' is the circle $|z-2|=\frac{1}{2}$.
10. A string is stretched and fastened to two point's l apart. Motion is started by displacing the string in to the form $y=k(lx-x^2)$ from which it is released at time t = 0. Find the displacement of any point on the string at a distance of 'x' from one end at time 't'.
11. Prove that $U=x^2-y^2$ and $V=\frac{y}{x^2+y^2}$ are harmonic functions of (x, y), but are not Harmonic conjugates.
12. An alternating current after passing through a rectifier has the form

    $i=I\sin\theta$ for $0<\theta<\pi$

    ¿0 for $\pi<\theta<2\pi$, find the Fourier series of the function.
13. Prepare the table to estimate the population in the year 1946 of the given data by using Newton's forward and backward interpolation formulas.

Year	1911	1921	1931	1941	1951	1961

Population in thousands	12	15	20	27	39	52

14. Calculate $\int_0^{\pi} sinx\,dx$ by using Trapezoidal rule and Simpson's one third rule.

Verify your answer with actual integration.

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