

M.Sc. DEGREE END SEMESTER EXAMINATION - APRIL 2026**SEMESTER 2 : PHYSICS****COURSE : 21P2PHYT05 : MATHEMATICAL METHODS IN PHYSICS II***(For Supplementary 2023/2022/2021 Admissions)*

Time : Three Hours

Max. Weights: 30

PART A**Answer any 8 questions****Weight: 1**

1. Evaluate $\mathcal{L}(e^{-t}t^3)$. (A)
2. Write the other forms of gamma function. (A)
3. Evaluate $\mathcal{L}(e^{at} \cos wt)$. (A, CO 2)
4. Evaluate $\mathcal{L}(e^{at} \sin wt)$. (A)
5. Separate the partial differential equation $\nabla^2 \psi(x, y, z) = 0$, into three ordinary differential equations. (A, CO 4)
6. State and explain Cauchy's residue theorem. (A)
7. Explain poles and residues with an example. (U)
8. If $f(z) = \sin(z)$, find $f^*(z)$ for complex z . (A, CO 1)
9. Write down two fundamental equations of Physics that are in the form of partial differential equation. (A, CO 4)
10. Write the Hermite's differential equation and its solution. (U)

(1 x 8 = 8)**PART B****Answer any 6 questions****Weights: 2**

11. State and explain any five different types of partial differential equations that occur in Physics and the phenomena to which they are applied. (An, CO 4)
12. Given $w(x,y) = u(x,y) + iv(x,y)$. If u and v are real functions and if w is analytic, show that $\nabla^2 u = \nabla^2 v = 0$. (A)
13. Express Poisson's equation in spherical polar coordinates. (A, CO 4)
14. Show that $2xH_n(x) = 2nH_{n-1}(x) + H_{n+1}(x)$ (A)
15. Obtain the generating function for Laguerre polynomial. (A)
16. Discuss the Earth's nutation as an application of Laplace transform. (A, CO 2)
17. Evaluate $\int_0^{2\pi} \frac{1}{5-3\sin\theta} d\theta$. (A, CO 1)
18. Find the Fourier series of a function $f(t)$ that represents a square wave. (A)

(2 x 6 = 12)**PART C****Answer any 2 questions****Weights: 5**

19. Obtain the orthogonal property of Legendre's polynomial. (An)
20. Evaluate $\oint \frac{\sin \pi z^3 + \cos \pi z^3}{(z-1)(z-2)} dz$ and $\oint \frac{e^z}{(z+1)^4} dz$ (I)
21. Explain the momentum representation of a quantum particle. Show that the hydrogenic momentum wavefunction is (A, CO 2)
 $g(p) = 2^{3/2} a_0^{3/2} \hbar^{5/2} / \pi (a_0^2 p^2 + \hbar^2)^2$
22. Separate Helmholtz' equation in Cartesian coordinates. (A, CO 4)

(5 x 2 = 10)

OBE: Questions to Course Outcome Mapping

CO	Course Outcome Description	CL	Questions	Total Wt.
CO 1	Apply methods of functions of complex variables for calculations of integrals	A	8, 17	3
CO 2	Understand the concepts of Laplace and Fourier transforms.	U	3, 16, 21	8
CO 4	Apply partial differential equations to solve problems.	A	5, 9, 11, 13, 22	11

Cognitive Level (CL): Cr - CREATE; E - EVALUATE; An - ANALYZE; A - APPLY; U - UNDERSTAND; R - REMEMBER;