

Reg. No

Name

24P2004

M. Sc. DEGREE END SEMESTER EXAMINATION - MARCH 2024
SEMESTER 2 - PHYSICS

COURSE : 21P2PHYT05 - MATHEMATICAL METHODS IN PHYSICS II

(For Regular 2023 Admission and Improvement/Supplementary 2022/2021 Admissions)

Duration : Three Hours

Max. Weights: 30

PART A

Answer any 8 questions

Weight: 1

1. Write the expression for gamma function. (U)
 2. Find the inverse Laplace transform of $\frac{s+2}{s^2-4s+13}$ (A, CO 2)
 3. Write the Rodrigue's formulae for Hermite polynomial. (U)
 4. Find the point (x, y) at which the function $f(z) = |z|^2$ is analytic. (A, CO 1)
 5. Find the Laplace transform of $3t^2 + 5$. (A)
 6. Differentiate between Fourier series and Fourier transform. (An)
 7. Find the solution of one dimensional Laplace equation in Cartesian coordinates. (A, CO 4)
 8. Describe nonlinear PDEs (U, CO 4)
 9. What are harmonic functions? (U)
 10. What is an essential singularity? Give an example. (U)
- (1 x 8 = 8)**

PART B

Answer any 6 questions

Weights: 2

11. Explain the different types of singularities with examples. (U)
 12. Obtain the relation $(1 - 2xz + z^2)^{-1/2} = \sum_{n=0}^{\infty} z^n P_n(x)$. (An)
 13. Show that a homogeneous equation with a nonhomogeneous boundary conditions is same as a nonhomogeneous equation with homogeneous boundary conditions. (A, CO 4)
 14. Show that Green's function is symmetric with respect to its two variables. (A, CO 4)
 15. Derive the conditions for a complex function to be analytic. (A, CO 1)
 16. State and prove the convolution theorem of Laplace transforms. (A, CO 2)
 17. Prove that the Fourier transform of a Gaussian is a Gaussian. (A, CO 2)
 18. Show the transformation of gamma function. (A)
- (2 x 6 = 12)**

PART C

Answer any 2 questions

Weights: 5

19. Obtain the general solution of Hermite differential equation. Also obtain the Hermite polynomials of order zero, one and two. (A)
20. Find the Fourier transform of (i) $e^{-|t|}$ and (ii) $e^{-a^2x^2}$; $a > 0$ (A, CO 2)

21. Transform the Laplace's equation into spherical polar coordinates and hence solve it to obtain the expressions for spherical harmonics. (A, CO 4)
22. Show that $\int_0^{\infty} \frac{dx}{(x^2+1)(x^2+9)} = \frac{\pi}{24}$. ()
- (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	4, 15	3
CO 2	Understand the concepts of Laplace and Fourier transforms.	U	2, 16, 17, 20	10
CO 4	Apply partial differential equations to solve problems.	A	7, 8, 13, 14, 21	11

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