



QP CODE: 24018797



24018797

Reg No :

Name :

MSc DEGREE (CSS) EXAMINATION , APRIL 2024

Second Semester

CORE - PH010201 - MATHEMATICAL METHODS IN PHYSICS-II

M Sc PHYSICS, M.Sc. SPACE SCIENCE

2019 Admission Onwards

5555670A

Time: 3 Hours

Weightage: 30

Part A (Short Answer Questions)

Answer any **eight** questions.

Weight 1 each.

1. If $z = x + iy$, check whether $f(z) = i^z$ is analytic.
2. Evaluate using Cauchy's integral formula, $\oint_c \frac{1}{(z^2+4)^2} dz$, where c is the circle $|z - i| = 2$.
3. Show that $\int_{-\infty}^{+\infty} \frac{\sin sx}{k^2+x^2} dx = 0$ ($s > 0, k > 0$)
4. Distinguish between odd and even functions.
5. Find Fourier sine transform of e^x .
6. Find inverse Laplace transform of $F(s) = \frac{s}{s^2-k^2}$.
7. Show that $\Gamma(\frac{1}{2}) = \sqrt{\pi}$.
8. Show that $\sqrt{\frac{\pi x}{2}} J_{-\frac{1}{2}}(x) = \cos x$
9. Express Laplacian operator in cartesian and polar coordinates.
10. Express the Green's function of self adjoint operator.

(8×1=8 weightage)

Part B (Short Essay/Problems)

Answer any **six** questions.

Weight 2 each.

11. Show that $\int_c e^{-2z} dz$ is independent of the path c joining the points $1 - i$ and $2 + 3i$ and determine its value.
12. Expand $\frac{1}{z^2-3z+2}$ as Laurent series in the region $1 < |z| < 2$.





13. Express the output of a full wave rectifier using fourier series expansion.
14. Using Laplace transform, solve the differential equation $m \frac{d^2 x}{dt^2} + kx = 0$ simple harmonic oscillator.
15. Prove the Legendre Duplication formula.
16. If $H_n(x)$ is Hermite polynomial of degree n show that $H'_n(x) = 2nH_{n-1}(x)$.
17. If $L_n(x)$ is Laguerre polynomial of degree n show that
 $(n+1)L_{n+1}(x) - (2n+1-x)L_n(x) + nL_{n-1}(x) = 0$.
18. Explain how the method of separation of variables can be applied in the case of solution of partial differential equations.

(6×2=12 weightage)

Part C (Essay Type Questions)

Answer any **two** questions.

Weight 5 each.

19. a) State and prove Cauchy's residue theorem. Using Cauchy's residue theorem, evaluate $\oint_c \frac{1}{z^3(z-1)} dz$ where c is the circle: (a) $|z| = 1$ (b) $|z+1-i| = 2$ (c) $|z+1+i| = 2$
20. Using Fourier transform, bring out the momentum representation of hydrogen atom and harmonic oscillator.
21. Obtain the series solution for Legendre differential equation. Hence find the value of Legendre polynomial $P_2(x)$.
22. A thin rectangular plate whose surface is impervious to heat flow has arbitrary distribution of temperature $f(x, y)$ at $t = 0$. Its four edges $x = 0, x = a, y = 0, y = b$ are kept at zero temperature. Determine the subsequent temperature of the plate after time t .

(2×5=10 weightage)

