QP CODE: 22002351

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Reg No : .....

Name : .....

MSc DEGREE (CSS) EXAMINATION , NOVEMBER 2022

Second Semester

CORE - PH010201 - MATHEMATICAL METHODS IN PHYSICS-II

M Sc PHYSICS,M.Sc.SPACE SCIENCE

2019 Admission Onwards

26E3931F

Time: 3 Hours Weightage: 30

Part A (Short Answer Questions)

*Answer any **eight** questions.*

*Weight **1** each.*

1. What are analytic functions? What are the conditions for a function to be analytic?
2. Evaluate the integral using Cauchy's integral formula, $\oint_c \frac{e^z}{z^2-3z+2}\,dz$ where the contour c is the circle $|z| = \frac{3}{2}$.
3. Expand $f(z) = e^{\frac{1}{z}}$ about $z = 0$ as a Laurent series.
4. Derive the complex form of Fourier series.
5. Give the Fourier integral representation for an even function.
6. Discuss any two properties of Laplace transform?
7. Verify the beta function identity $\beta(a,b) = \beta(a+1,b) + \beta(a,b+1)$.
8. Write any 2 recurrence relations for Laguerre polynomials $L_n(x)$.
9. Write down any four partial differential equations used in physical systems.
10. Express the wave equation in variable separable form in cartesian coordinate system.

(8×1=8 weightage)

Part B (Short Essay/Problems)

*Answer any **six** questions.*

*Weight **2** each.*

11. If c is a simple closed curve in the complex plane, evaluate $\oint_c \frac{dz}{(z-a)}$ when (a) a is outside c (b) a is inside c .

12. Find the residues of $\frac{z^3}{(z-1)^4(z-2)(z-3)}$ at $z=1$.

13. If $g(\omega)$ is the Fourier transform of $f(x)$, show that $g(-\omega)=g^*(\omega)$ is a necessary and sufficient condition for $f(x)$ to be real. [$g^*(\omega)$ is the complex conjugate of $g(\omega)$]

14. Give the momentum representation of harmonic oscillator using Fourier transform.

15. Show that beta function can be expressed as $\beta(a,b)=\int_0^\infty \frac{y^{a-1}}{(1+y)^{a+b}}\,dy$

16. If $P_n(x)$ is Legendre polynomial of degree n , show that $(2n+1)\,P_n(x)=P_{n+1}^{'}(x)-P_{n-1}^{'}(x)$.

17. Define Associated Legendre polynomials and prove their orthogonality relation.

18. Discuss the solutions of the three dimensional Helmholtz equation.

(6×2=12 weightage)

Part C (Essay Type Questions)

*Answer any **two** questions.*

*Weight **5** each.*

19. a) Using contour integration, evaluate the integral $\int_{-\infty}^{+\infty}\frac{dx}{1+x^4}$ b) Evaluate $\int_0^\infty \frac{\cos mx}{1+x^2}dx$

20. Derive Lapace transform of n^{th} order derivative of a function. Also solve the differential equation for LCR circuit using Laplace transform.

21. Obtain the series solution for Bessel differential equation for order n .

22. Obtain a solution of three dimensional Laplace equation in cylindrical coordinate system.

(2×5=10 weightage)