QP CODE: 20000681

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Reg No : ....

Name : ....

MSc DEGREE (CSS) EXAMINATION , NOVEMBER 2020

Second Semester

M Sc PHYSICS

CORE - PH010201 - MATHEMATICAL METHODS IN PHYSICS-II

2019 Admission Onwards

6039F8AC

Time: 3 Hours

Weightage: 30

Part A (Short Answer Questions)

*Answer any **eight** questions.*

*Weight **1** each.*

1. Find the analytic function $f(z) = u(x,y) + iv(x,y)$ in which $u(x,y) = x^3 - 3xy^2$.
2. Evaluate $\oint_c (x^2 - y^2 + 2ixy)\, dz$ where c is the contour $|z| = 1$.
3. Expand $f(z) = e^z$ as a Taylor series about $z = 0$.
4. Explain the periodicity in the output of a full wave rectifier.
5. Describe the periodicity of harmonic oscillator.
6. What is the Laplace transform of $\sinh at$?
7. Evaluate $\int_0^\infty e^{-x} x^{\frac{-2}{5}}\, dx$.
8. Evaluate Laguerre polynomials $L_0(x)$, $L_2(x)$ and $L_3(x)$.
9. What are circular harmonics?
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. Find the residue of $f(z) = \frac{e^z}{z^2+a^2}$ at its singularities.
12. Evaluate $\int\limits_0^\infty \frac{1}{1+x^2}\, dx$
13. Show that if $f(x)$ is an odd function, then its real Fourier series expansion contains no cosine terms.

14. 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 pure imaginary. [$g^*(\omega)$ is the complex conjugate of $g(\omega)$]

15. Obtain the relation between Beta and Gamma functions.

16. If $J_n(x)$ is n^{th} order Bessel function, show that $J_{n-1}(x) - J_{n+1}(x) = 2J_n'(x)$.

17. If $P_n(x)$ is Legendre polynomial of degree n , using recurrence relations show that $(1 - x^2)\, P_n''(x) - 2x\, P_n'(x) + n(n+1)P_n(x) = 0$.

18. Find the general solution of 1-Dimensional heat equation.

(6×2=12 weightage)

Part C (Essay Type Questions)

*Answer any **two** questions.*

*Weight **5** each.*

19. a) State and prove Cauchy's integral formula for derivatives. b) Evaluate $\oint_c \frac{\sin^2 z - z^2}{(z-a)^4}\, dz$, where c is the circle $|z - a| = 5$ by using Cauchy's integral formula.

20. Derive laplace transform of n^{th} order derivative of a function. Also solve for earth's nutation using Laplace transform.

21. Obtain the series solution of the Hermite differential equation.

22. Solve the differential equation $\frac{\partial^2 u}{\partial r^2} - \frac{1}{r}\frac{\partial u}{\partial r} + \frac{1}{r^2}\frac{\partial^2 u}{\partial \theta^2} = 0$ for $u(r, \theta)$ using method of seperation of variables

(2×5=10 weightage)