23P107 (Pages: 2) Name: ....

Reg.No: ....

FIRST SEMESTER M.Sc. DEGREE EXAMINATION, NOVEMBER 2023

(CBCSS - PG)

(Regular/Supplementary/Improvement)

CC19P PHY1 C02 - MATHEMATICAL PHYSICS - I

(Physics)

(2019 Admission onwards)

Time : 3 Hours

Maximum : 30 Weightage

Section A

Answer ***all*** questions. Each question carries 1 weightage.

1. Show that angular velocity of rotation of a rigid body is half the curl of a velocity vector within the body.
2. Express Laplacian operator in cylindrical coordinates.
3. What is meant by symmetric,antisymmetric matrices?Give examples.
4. What are pseudo tensors? Give examples of a pseudo scalar and a pseudo vector.
5. What do you mean by an Hermitian operator? Explain the significance of Hermitian operator in theoretical Physics.
6. Show that $\Gamma(n) = (n-1)!$
7. Derive the Sturm – Liouville theory.
8. Define Laplace transformation. Find the laplace transformation of $f(t) = cosat$.

(8 × 1 = 8 Weightage)

Section B

Answer any ***two*** questions. Each question carries 5 weightage.

9. What are orthogonal curvilinear coordinate system? From general mathematical expressions for different vector differential operations, and from that form expressions for it in Cartesian,cylindrical and spherical polar systems.
10. Given an ODE of the form y'' + P(x)y' + Q(x)y = 0. Let one of the two independent solutions be y_1 . Explain how you can find the second solution.
11. Derive Trigonometric Expansion Involving Bessel Function. Prove That $J_n(x)$ is the coefficient of z^n in the expansion of $e^{\frac{x}{2}\left(z-\frac{1}{z}\right)}$.
12. (a) Derive the generating function of Hermite Polynomial.
(b) Derive Rodrigues formula of Hermite Polynomial.

(2 × 5 = 10 Weightage)

Section C

Answer any ***four*** questions. Each question carries 3 weightage.

13. A rigid body is rotating about a fixed axis with a constant angular velocity $\vec{\omega}$. Take ω to lie along the z axis. Express $\vec{r}$ in circular cylindrical coordinates and using circular cylindrical coordinates calculate
    a) $\vec{v} = \vec{\omega} \times \vec{r}$ b) $\nabla \times \vec{v}$ c) $\nabla \cdot \vec{r}$ d) $\nabla \times \vec{r}$

14. Diagonalise the matrix $M = \begin{bmatrix} cosx & -sinx & 0 \\ sinx & cosx & 0 \\ 0 & 0 & 1 \end{bmatrix}$

15. Show that Legendre's equation has regular singularities at x = -1, 1 and ∞

16. Evaluate $\int_0^{\infty} sin^p\theta \, d\theta$ and $\int_0^{\infty} cos^q\theta \, d\theta$

17. Prove that $\int_{-1}^{+1} P_m(x)\, P_n(x) \mathrm{d}x = 0$

18. Derive Dirac Delta Function from fourier complex integral equation.

19. Find the Fourier transform of $f(x) = \begin{cases} 1 & \text{for } |x| < a \\ 0 & \text{for } |x| > a \end{cases}$

(4 × 3 = 12 Weightage)

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