25P107 (Pages: 2) Name: ....

Reg.No: ....

FIRST SEMESTER M.Sc. DEGREE EXAMINATION, NOVEMBER 2025

(CBCSS - PG)

(Regular/Supplementary/Improvement)

CC19PPHY1C02 - MATHEMATICAL PHYSICS - I

(Physics)

(2019 Admission onwards)

Time : 3 Hours Maximum : 30 Weightage

Section A

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

1. Give a physical meaning for divergence of a vector.
2. Express Laplacian operator in cylindrical coordinates.
3. What are properties of Hermitian matrices?
4. Explain the quotient rule of tensors.
5. Evaluate $\int_0^\infty \sqrt{x}\, e^{-x}\, dx$ and $\int_0^\infty x^4\, e^{-x^2}\, dx$.
6. Define Neumann function.
7. Define Associated Legendre Functions.
8. State Laguerre's ordinary differential equation and Laguerre polynomial Ln(x).

(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. Find the similarity transformation that diagonalises matrix A given by

$$A = \begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$$

11. Separate Hermholtz equation in cartesian and cylindrical coordinates
12. 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.

(2 × 5 = 10 Weightage)

Section C

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

13. Transform the unit vectors i,j,k into their components in cylindrical coordinate system.

14. Using Gram-Schmidt orthogonalisation process, form an orthonormal set from the set of functions Un(x) = x^n , n = 0,1,2,… in the interval $-1 \leq x \leq 1$ with the density functions w(x) =1.

15. Show that $\delta\,(ax) = \frac{1}{|a|}\delta\,(x)$

16. Given that $f(x) = x + x^2$ for $-\pi < x < \pi.$ Find the fourier expansion of f(x). Deduce that $\frac{\pi^2}{6} = 1 + \frac{1}{2^2} + \frac{1}{3^2} + \cdots$

17. Derive Dirac Delta Function from fourier complex integral equation

18. Obtain Fourier cosine and sin transforms

19. Using partial fraction expansion, find inverse Laplace transform of $\frac{s+1}{s(s^2+s-6)}$

(4 × 3 = 12 Weightage)

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