



QP CODE: 25050524



25050524

Reg No :

Name :

MSc DEGREE (CSS) EXAMINATION DECEMBER 2025

First Semester

M Sc PHYSICS (MATERIAL SCIENCE)

Core Courses - PH020101 - APPLIED MATHEMATICS FOR PHYSICS-I

2019 Admission Onwards

A54E67E3

Time: 3 Hours

Weightage: 30

Part A (Short Answer Questions)

Answer any **eight** questions.

Weight **1** each.

1. Show that the vector field is given by $\vec{V} = (\sin y + z)\hat{i} + (x \cos y - z)\hat{j} + (x - y)\hat{k}$ is irrotational.
2. Does orthogonality implies linear independence? Explain.
3. If A is diagonal with all diagonal elements different and A and B commute, show that B is diagonal.
4. Find the eigen values of the matrix $\begin{bmatrix} 0 & a \\ -a & 0 \end{bmatrix}$.
5. What is meant by the propagation of errors?
6. Write the common form of first and second order ordinary differential equation.
7. Find the relation between beta and gamma functions
8. Show that $\delta(a^2 - x^2) = \frac{1}{|2a|} [\delta(x - a) + \delta(x + a)]$
9. If a tensor is symmetric (skew-symmetric), show that repeated contraction of the tensor are also symmetric (skew-symmetric)?
10. What is meant by an arbitrary tensor.

(8×1=8 weightage)

Part B (Short Essay/Problems)

Answer any **six** questions.

Weight **2** each.

11. Write a note on Scalar Potential. Give an example.
12. Show that the vectors $\begin{pmatrix} 1/\sqrt{2} \\ 1/\sqrt{2} \end{pmatrix}$ and $\begin{pmatrix} 1/\sqrt{2} \\ -1/\sqrt{2} \end{pmatrix}$ are orthogonal.





13. Verify Cayley- Hamilton theorem for the matrix $\begin{bmatrix} a & b \\ c & d \end{bmatrix}$.
14. Show that the matrix $\begin{bmatrix} \cos \theta & 0 & \sin \theta \\ 0 & 1 & 0 \\ -\sin \theta & 0 & \cos \theta \end{bmatrix}$ is orthogonal.
15. Express $J_5(x)$ in terms of $J_0(x)$ and $J_1(x)$
16. If n is a positive integer, prove that $\int_{-1}^1 P_n(x)[1 - 2x + z^2]^{\frac{-1}{2}} dx = \frac{2Z^n}{2n+1}$
17. Find the metric of 3-dimensional space in spherical polar coordinates.
18. Show that $\frac{\partial A_p}{\partial x^q}$ is not a tensor even though A_p is a tensor of rank one.

(6×2=12 weightage)

Part C (Essay Type Questions)

Answer any **two** questions.

Weight **5** each.

19. Find $\nabla \times \vec{V}$ in orthogonal curvilinear coordinates.
20. Find the inverse of the matrix using Gauss – Jordan method $\begin{bmatrix} 3 & 2 & 1 \\ 2 & 3 & 1 \\ 1 & 1 & 4 \end{bmatrix}$
21. What are Laguerre polynomials. Write the recurrence relations for Laguerre polynomial.
22. A covariant tensor has components $xy, 2y - z^2, xz$ in rectangular coordinates. Find its covariant and contravariant components in spherical and cylindrical coordinates.

(2×5=10 weightage)

