23003147

QP CODE: 23003147

Reg No : .....

Name : .....

M Sc DEGREE (CSS) EXAMINATION, APRIL 2023

First Semester

CORE - PH010101 - MATHEMATICAL METHODS IN PHYSICS - I

M Sc PHYSICS,M.Sc.Space Science

2019 ADMISSION ONWARDS

5AD6F8C5

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. What are curvilinear coordinate systems? Describe coordinate surfaces and curves. What are scale factors and unit vectors in orthogonal curvilinear coordinate systems?
3. Express $\nabla\phi$ in spherical polar co-ordinates
4. Does functions form a linear vector space? If so give one example.
5. Can basis be unique for a linear vector space? Explain.
6. Define direct product of matrices.
7. Prove that any two eigen vectors corresponding to two distinct eigen values of a Hermitian matrix are orthogonal.
8. Illustrate Gauss elimination method.
9. Given two tensors, prove that their sum is also a tensor.
10. If A^p is a tensor, show that $A^p_{,q}$ is also a tensor.

(8×1=8 weightage)

Part B (Short Essay/Problems)

*Answer any **six** questions.*

*Weight **2** each.*

11. Verify Stoke's theorem for the vector field $F = (x^2 + y^2)\hat{i} - 2xy\hat{j}$ taken around the rectangle bounded by lines $x = \pm a, y = 0, y = b$
12. Write a note on scalar potential. Give an example.
13. A production department has 35 similar milling machines. The number of breakdowns on each machine averages 0.06 per week. Determine the probabilities of having (a) one, and (b) less than three machines breaking down in any week
14. Summarize the essential features of normal distribution.
15. What are Dirac matrices? List their properties.
16. Find the inverse of the matrix $\begin{bmatrix} 1 & 2 \\ 1 & 1 \end{bmatrix}$ using Cayley - Hamilton theorem.
17. Determine the metric tensor in spherical coordinates. How will you evaluate its conjugate?
18. Determine the Christoffel symbols of the second kind in (a) rectangular, (b) cylindrical and (c) spherical coordinates.

(6×2=12 weightage)

Part C (Essay Type Questions)

*Answer any **two** questions.*

*Weight **5** each.*

19. What are orthogonal curvilinear coordinates? Find out the scale factors and differential volume in cylindrical and spherical co-ordinates.
20. Describe the general uncertainty relation as an application of the Cauchy-Schwarz inequality.
21. Find the inverse of the matrix $\begin{bmatrix} 1 & 2 & -4 \\ -1 & -1 & 5 \\ 2 & 7 & -3 \end{bmatrix}$ by Gauss- Jordan method.

22. What is a tensor? How will you distinguish various types of tensors? Distinguish between scalars, vectors and tensors. Give proper examples.

(2×5=10 weightage)