QP CODE: 22001486

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Reg No : .....

Name : .....

M Sc DEGREE (CSS) EXAMINATION, JULY 2022

First Semester

CORE - PH010101 - MATHEMATICAL METHODS IN PHYSICS - I

M Sc PHYSICS,M.Sc.Space Science

2019 ADMISSION ONWARDS

AA815DB6

Time: 3 Hours Weightage: 30

Part A (Short Answer Questions)

*Answer any **eight** questions.*

*Weight **1** each.*

1. A vector field is given by $\vec{A} = (x^2 + xy^2)\hat{i} + (y^2 + x^2y)\hat{j}$. Show that the field is irrotational.
2. Describe the coordinate surfaces and coordinate curves for cylindrical coordinates.
3. Express $\nabla^2\phi$ in spherical polar co-ordinates
4. Normalize the vector $(1, -5i)$ where $i = \sqrt{-1}$.
5. Define probability. Explain mutually exclusive events.
6. What is a diagonal matrix? Give one example.
7. Distinguish between Hermitian and skew-Hermitian matrices.
8. Show that the trace of a matrix remains invariant under similarity transformation.
9. What is Kronecker delta?
10. What are associated tensors? Give examples.

(8×1=8 weightage)

Part B (Short Essay/Problems)

*Answer any **six** questions.*

*Weight **2** each.*

11. Calculate the scalar potential for the centrifugal force per unit mass m.
12. What are orthogonal curvilinear coordinates? Find out the differential volume in cylindrical and spherical polar co-ordinates.

13. A vector $|\Psi\rangle$ is expanded in a basis $(|\Phi_1\rangle, |\Phi_2\rangle, |\Phi_3\rangle)$ as $|\Psi\rangle = 3i|\Phi_1\rangle + 2|\Phi_2\rangle - 4i|\Phi_3\rangle$ where $i = \sqrt{-1}$. Normalize $|\Psi\rangle$.

14. What are the conditions under which a binomial distribution tends to a normal distribution? What are the parameters of normal distribution?

15. Find the inverse of the matrix $\begin{bmatrix} 1 & 2 \\ 2 & 1 \end{bmatrix}$ by Gauss- Jordan method.

16. Solve the system of equations by Gauss elimination method, $x - 3y + 2z = 2, 5x - 15y + 7z = 10$.

17. A covariant tensor has components $xy, 2y- z^2, xz$ in rectangular coordinates. Find its covariant components in spherical coordinates.

18. Find the Christoffel symbols of the first and second kind for the metric $ds^2 = (dx^1)^2 + [(x^2)^2 - (x^1)^2](dx^2)^2$.

(6×2=12 weightage)

Part C (Essay Type Questions)

*Answer any **two** questions.*

*Weight **5** each.*

19. Find out $grad\,\Phi$, $div\,\vec{A}$, $curl\,\vec{A}$ and Laplacian of Φ in any of the orthogonal curvilinear coordinates. (Φ - a scalar function, $\vec{A}$ - a vector function.

20. Explain with three examples, the properties of a linear vector space.

21. Find the eigen values and the corresponding eigen vectors of the matrix $\begin{bmatrix} 2 & 2 & 1 \\ 1 & 3 & 1 \\ 1 & 2 & 2 \end{bmatrix}$.

22. Determine the Christoffel symbols of the first kind in (a) rectangular (b) cylindrical and (c) spherical coordinates.

(2×5=10 weightage)