Reg. No ..... Name **22P1005**

M. Sc. DEGREE END SEMESTER EXAMINATION : OCTOBER 2022

SEMESTER 1 : PHYSICS

COURSE : **21P1PHYT01 : MATHEMATICAL METHODS IN PHYSICS - I**

(For Regular - 2022 Admission and Supplementary - 2021 Admission)

Duration : Three Hours Max. Weights: 30

PART A

Answer any 8 questions **Weight: 1**

1. Define Schwarz's inequality (R, CO 3)
2. Obtain the expression for $\nabla \times \vec{A}$ in cylindrical coordinates by assuming the scale factors. (R, CO 2)
3. Give the expression for segmental length in cylindrical coordinates. (A, CO 2)
4. Explain the significance of the force $F = -\nabla\phi$. (An, CO 1)
5. State and explain Cayley - Hamilton's theorem. (R, CO 5)
6. Prove that Kronecker delta is an invariant mixed tensor of rank 2. (A, CO 6)
7. State central limit theorem. (R, CO 4)
8. Write the metric tensor in spherical polar coordinates. (U, CO 6)
9. What is meant by similarity transformation? (U, CO 5)
10. Prove that eigen values of a Hermitian matrix are always real. (U, CO 5)

(1 x 8 = 8)

PART B

Answer any 6 questions **Weights: 2**

11. Define the direct product of a matrix. Find out the direct product of $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$ and $\begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$. (A, CO 5)
12. Prove that Kronecker Delta is an invariant mixed tensor of rank 2. (A, CO 6)
13. Obtain general expression for vector operators in general curvilinear coordinate system. (U, CO 2)
14. Verify Stoke's theorem for vector field **A** = (3x – 2y) **i** + x^2z **j** + y^2(z+1) **k** in the rectangular plane with vertices (0, 0), (1, 0), (1, 2), (0, 2). (A, CO 1)
15. Determine the eigen values of the following matrix: $\begin{bmatrix} 3 & 1 & 1 \\ 1 & 3 & 2 \\ 2 & 2 & 3 \end{bmatrix}$ (A, CO 5)
16. Explain the differences between Binomial, Poisson and normal distributions. (U, CO 4)

17. Deduce the set of orthonormal basis for (1, 1, 1), (1, 0, 1) and (1,1, 0) using Schmidt orthogonalization procedure. (A, CO 3)

18. What is Levi – Civita Symbol? Explain its properties. (R, CO 6)

(2 x 6 = 12)

PART C

Answer any 2 questions **Weights: 5**

19. Obtain general expression for vector operators in general curvilinear coordinates and find Laplacian in spherical polar coordinates. (A, CO 2)

20. Explain Gaussian distribution. Derive the expression for median and mode in Gaussian distribution. (A, CO 4)

21. Obtain general expression for vector operators in general curvilinear coordinates and find Laplacian in cylindrical coordinates. (A, CO 2)

22. Determine the Eigen values and normalized Eigen vectors.

$$\begin{bmatrix} 3 & 1 & 1 \\ 1 & 3 & 2 \\ 2 & 2 & 3 \end{bmatrix}$$

(A, CO 5)

(5 x 2 = 10)

OBE: Questions to Course Outcome Mapping

CO	Course Outcome Description	CL	Questions	Total Wt.
CO 1	Understand the basic theory of Vector analysis and to apply it to various Theorems	U	4, 14	3
CO 2	Transformation of co-ordinates systems	A	2, 3, 13, 19, 21	14
CO 3	understand the principals linear vector space	U	1, 17	3
CO 4	apply Probability concepts and remember distribution theory's	A	7, 16, 20	8
CO 5	analyze various Matrices	An	5, 9, 10, 11, 15, 22	12
CO 6	understand and apply tensor calculus to various physicals situation	U	6, 8, 12, 18	6

Cognitive Level (CL): Cr - CREATE; E - EVALUATE; An - ANALYZE; A - APPLY; U - UNDERSTAND; R - REMEMBER;