TM241510G

Reg. No :.....

Name :.....

MASTER'S DEGREE (C.S.S) EXAMINATION, NOVEMBER 2024

2020, 2021, 2022, 2023 ADMISSIONS SUPPLEMENTARY

SEMESTER I - CORE COURSE PHYSICS

PH1C01TM20 - Mathematical Methods in Physics - I

Time : 3 Hours **Maximum Weight : 30**

Part A

I. Answer any Eight questions. Each question carries 1 weight **(8x1=8)**

1. List down the axioms for inner product space.
2. Illustrate positive, negative and zero divergence .
3. Give an expression of line integral for the flow of a fluid along the curve in the velocity field.
4. Distinguish between Scalar and Vector fields with necessary examples,
5. Obtain the mean and standard deviation of normal distribution from its probability density function.
6. Explain the significance of Poisson distribution with one example
7. Prove that the determinant of an orthogonal matrix is ± 1
8. Write terms in each of the following (i) $A^{pq}A^{qr}$ and (ii) $g^{rs} = g_{jk}\frac{\partial x^j}{\partial y^r}\frac{\partial x^k}{\partial y^s}$
9. Explain the physical significance of metric tensor.
10. Prove that the inner product of two tensors is equivalent to outer product followed by contraction.

Part B

II. Answer any Six questions. Each question carries 2 weight **(6x2=12)**

11. Define and explain the following operators: (1) Hermitian operator (2) Unitary operator (3) Projection operator
12. Derive the equation of continuity.
13. Discuss the conditions under which a binomial distribution becomes Poisson distribution.
14. Obtain the divergence of a vector in general curvilinear coordinates.
15. Discuss Hermitian, Unitary, and Orthogonal matrix with example. Show that eigen vectors of Hermitian matrix are orthogonal and eigen values are real.
16. Prove that Trace(ABC) = Trace(CBA) if any of the three matrices commute.
17. Define a covariant vector and also prove that the gradient of a scalar is a covariant vector.
18. Obtain the metric for the two-dimensional cartesian coordinate and two-dimensional spherical polar coordinate systems.

Part C

III. Answer any Two questions. Each question carries 5 weight **(2x5=10)**

19. Find out the flux coming out of the surface using Gauss's theorem, if $\vec{F} = 4xi + 2y^2 j + z^2 k$ and S is a cylinder $x^2 + y^2 = 4$ where $0 \leq x \leq 3$
20. Explain about cylindrical and spherical polar coordinates and deduce expression for unit vectors in spherical coordinates and show that they are orthogonal.
21. Illustrate the application of the matrix technique in finding the normal modes of vibration of a CO_2 molecule.
22. Write notes on the following. (i) Inner Product (ii) Outer products (iii) Kronecker delta tensor and (iv) Mixed Tensors