Previous Year M.Sc., Degree Examinations
December 2017
(Directorate of Distance Education)
PHYSICS
Paper– I: DPA 510: Mathematical Methods and Classical Mechanics

Time: 3 hrs] *[Max. Marks: 75/85*

Note:

Answer any FIVE questions from parts A, B and C without omitting any part (Common to All) Part – D is for the students whose max. marks is 85.

PART – A

1. a) Define analytic function.

   b) Express the divergence of a vector in a orthogonal curvilinear coordinates.

   $(3 + 12)$

2. a) Obtain solution of the Legendre's equation using power series method.

   b) Show that $2xH_n(x) = 2nH_{n-1}(x) + H_{n+1}(x)$ for Hermite polynomials. $(10 + 5)$

3. a) State Gauss's and Stoke's theorems and deduce Gauss's law of electrostatics from the divergence theorem.

   b) Explain the concept of Gradient, divergence and Curl. $(10 + 5)$

PART – B

4. a) Define Hermitian matrix and Skew – Hermitian Matrix. Give examples. Show that any arbitrary matrix can be written as the sum of a hermitian and skew hermitian matrix.

   b) Define (Orthogonal) matrix and show that the given matrix is orthogonal

   $$\begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

   c) What is Unitary matrix? Show that the given matrix unitary. $(5 + 5 + 5)$

   $$\begin{bmatrix} 1/\sqrt{2} & i/\sqrt{2} \\ -i/\sqrt{2} & 1/\sqrt{2} \end{bmatrix}$$

5. a) What are contravarient and covariant vectors? Explain each with examples.

   b) Explain symmetric and antisymmetric Tensors. $(6 + 9)$

6. a) State and prove Convolution theorem of fourier transform.

   b) Write down the properties of fourier integrals.

   c) Find the inverse Laplace transform of $\dfrac{1}{(s+1)(s^2+1)}$. (5 + 5 + 5)

PART – C

7. Describe the mechanic of system of particles and obtain the conservations of linear momentum, angular momentum and energy of a particle. (15)

8. a) What are generalized coordinates? Explain.

   b) Derive the Lagranges equation of motion using D – Alemberts principles.

   (5 + 10)

9. a) What are Poisson brackets? Explain the properties of Poisson brackets.

   b) Derive the Hamilton's equations of motion. (10 + 5)

PART – D

10. *Answer any TWO of the following:* $2 \times 5 = 10$

    a) State and prove Green's theorem.

    b) Find the eigen values and normalized eigen vector of the matrix.

    $$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 1 \\ 0 & 1 & 1 \end{bmatrix}$$

    c) State and explain Kepler's laws of planetary motion.

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