Roll No. .... Exam Code : D-25

Subject Code—26119

M. Sc. EXAMINATION

(First Semester)

MATHEMATICS

U25MAT111T

Classical Mechanics

Time : 3 Hours *Maximum Marks* : 70

Note : Attempt *Five* questions in all, selecting *one* question from each Unit. Q. No. **1** is compulsory. All questions carry equal marks.

Compulsory Question

1. (a) State and prove perpendicular axis theorem.

(b) What do you mean by equimomental systems ?

P.T.O.

(c) Define Hamilton's variables and cyclic co-ordinates.

(d) What do you mean by Holonomic and non-Holonomic systems ?

(e) State Hamilton's principle.

(f) Show that transformation :

$$P = \frac{1}{2}(p^2 + q^2), \; Q = \tan^{-1}\left(\frac{q}{p}\right)$$

is canonical.

(g) Define solid harmonics.

Unit I

2. (a) Find the directions of the principle axes at one corner P of a uniform rectangular lamina PQRS of dimensions $2a \times 2b$.

(b) Derive kinetic energy of a rigid body rotating about a fixed point in terms of moments and products of inertia.

3. (a) Show that a uniform solid cuboid of mass M is equimomental with masses $\frac{M}{24}$ at its corners and $\frac{2}{3}M$ at its centre.

(b) Define principle axes and prove that the three principal axes through any point of a rigid body are mutually orthogonal.

Unit II

4. (a) Derive Lagrange's equation of motion for a particle moving under the inverse square law of attraction $\frac{\mu m}{r^2}$.

(b) Using Lagrangian approach, when time is explicitly absent, show that :

$$\sum_{j=1}^{n} p_j \dot{q}_j = 2t$$

Where symbols have their usual meaning.

P.T.O.

5. (a) State and derive Poisson's identity.

(b) State and derive Hamilton's canonical equations.

Unit III

6. (a) Write a short note on Poincare-Carten integral invariant.

(b) State and prove Whittaker's equations.

7. (a) State and derive Hamilton-Jacobi equations.

(b) Discuss the canonical character of a transformation in terms of Poisson Bracket.

Unit IV

8. (a) Find the expression for potential at any point outside a spherical shell.

(b) Find the condition that $f(x, y, z) =$ constant, may represent the family of equipotential surfaces.

9. (a) Derive the expression for attraction at any point inside a solid sphere.

(b) State and derive Poisson's equation for potential in a system of attracting matter.