Unit III

6. (a) State and prove Jacobi-Poisson Theorem.

(b) A particle of mass m moves in a force field whose potential in spherical co-ordinates is $V = -\frac{\mu \cos\theta}{r^2}$. Write the Hamilton-Jacobi equation describing its motion. Also find its solution.

7. (a) Show that the following transformation

$$Q = \log\left(\frac{1}{q}\sin p\right); P = q\cot p$$

is canonical.

(b) Show that Poisson's bracket is invariant under canonical transformation.

Unit IV

8. (a) Find the expression for attraction of a thin spherical shell at any point outside the shell.

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18AA1903

M. Sc. EXAMINATION, May 2019

(First Semester)

(C Scheme) (Re-appear)

MATHEMATICS

MAT505C

Mechanics

Time : 3 Hours] [*Maximum Marks :* 75

Before answering the question-paper candidates should ensure that they have been supplied to correct and complete question-paper. No complaint, in this regard, will be entertained after the examination.

Note : Q. No. **1** is compulsory. Attempt *Four* more questions by selecting *one* question from each Unit I-IV. All questions carry equal marks.

Compulsory Question

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

(b) Define Scleronomic and Rheonomic systems. Also define generalized potential.

(c) Derive Hamilton's Canonical equations.

(d) Define Poisson's bracket along with its two properties.

(e) Obtain the potential at an external point due to a solid sphere of mass M.

5×3=15

Unit I

2. (a) Define principal axes. Prove that, in general, there are three principal axes through a point of a rigid body.

(b) A uniform solid rectangules block is of mass M and dimensions $2a \times 2b \times 2c$. Find the equation of the momental ellipsoid for a corner of the block, referred to the edges through O as co-ordinate axes.

3. (a) Define equimomental system. Derive the necessary and sufficient conditions for two systems to be equimomental.

(b) A square of side "b" has particles of masses m, 2 m, 3 m and 4 m at its vertices. Find the principal moments of inertia and principal directions at the centre of the square.

Unit II

4. (a) State and prove Lagrange's equation of second kind.

(b) Show that for a holonomic dynamical system, the kinetic energy is a quadratic function of velocities.

5. (a) State and derive Jacobi's equations for a conservative system.

(b) Write a short note on Poincare-Cartan Integral Invariant.

(b) Find the potential at a point on the axis of a uniform circular disc of radius "*a*" and mass M.

9. (a) Derive Poisson's equation for potential in a system of attracting matter.

(b) Show that a family of right circular cones with a common axis and vertex is a possible family of equipotential surfaces and find the potential function.

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