Roll No. .....

(12/24)

15204

M. Sc. (2 Year) EXAMINATION

(For Batch 2021 & Onwards)

(First Semester)

MATHEMATICS

MSc/Maths/1/CC3

Mechanics

Time : Three Hours *Maximum Marks : 70*

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

1. (a) Find moment of inertia of a rod of length '2a' and of mass 'm' about an axis passing through one its end and normal (perpendicular) to its length.

(b) What do you mean by holonomic and non-holonomic systems ?

(c) What do you mean by generalized forces ? Explain.

(d) Explain the concept of Poisson's Bracket.

(e) Describe in detail the concept of canonical transformation. 2×5=10

Unit I

2. (a) State and prove parallel axes theorem. 7

(b) A uniform rectangular lamina PQRS is such that PQ = $2a$, QR = $2b$. Find the directions of principal axes at P. 8

3. (a) Show that the sufficient conditions for the two systems to be equimomental are : 5

(i) They have the same total mass

(ii) They have the same centroid

(iii) They have the same principal axes and the same principal moment of inertia at the centroid.

(b) Find the equimomental system for a uniform triangular lamina. 10

Unit II

4. (a) Derive the Lagrange's equation of first kind. 10

(b) Write a note on the Possible and Virtual displacements. 5

5. (a) Find the Lagrange's equation of motion of a simple pendulum in motion in a vertical plane. 8

(b) Describe Lagrange's equation for potential forces. 7

Unit III

6. (a) Derive the Hamilton canonical equations. 9

   (b) Find the Poisson Jacobi identity

   $$[x, [y, z]] + [y, [z, x]] + [z, [x, y]] = 0,$$

   Where x, y, z are functions of q and p only. 6

7. (a) State and prove Donkin's Theorem. 10

   (b) State and prove principle of least action. 5

Unit IV

8. (a) For what values of α and β the transformation, $Q = q^{\alpha} \cos \beta p$, $P = q^{\alpha} \sin \beta p$ represent a canonical transformation. 7

   (b) Describe the method of separation of variable to solve Hamilton-Jacobi equation. 8

9. (a) Find the Hamilton-Jacobi equation in planetary motion. 8

   (b) Prove that Lagrange's bracket is invariant under a free univalent canonical transformation. 7