647510 **MSC2MatE201x** **Seat No :________**

M.Sc. (Maths) Semester - 2 (*CBCS*) Examination
May/June -2021 [NEW COURSE]
Classical Mechanics – 2 (Elective)

Time: 1:30 Hours **Marks: 42**

Instructions:

1. Figure to the right indicate marks.
2. There are five questions in the question paper.
3. Answer any three of the following questions

Q-1(a) Three equal mass points are located at points $(a, 0,0)$, $(0, a, 2a)$ and $(0,2a, a)$. Find the principal moments of inertia about the origin. (4)

Q-1(b) Attempt any **TWO** (10)

(1) Describe Euler angles for a rigid body.

(2) Giving all details define inertia tensor for a rigid body.

(3) Show that, the general displacement of a rigid body with one point fixed is a rotation about some axis.

Q-2(a) State the meaning of space-time interval. Describe space-like interval. (4)

Q-2(b) Attempt any **TWO** (10)

(1) State postulates of special relativity.

(2) Show that $c^2dt^2 - dx^2 - dy^2 - dz^2$ is invariant under special Lorentz transformation.

(3) Define 4-velocity. Show that it is a time-like vector.

Q-3(a) Discuss Legendre transformation. (4)

Q-3(b) Attempt any **TWO** (10)

(1) Derive Lagrange's equations of motion from Hamilton's equations of motion.

(2) Obtain Hamiltonian corresponding to the Lagrangian $L = \frac{m}{2}(\dot{x}^2 + \dot{y}^2 + \dot{z}^2) + \frac{wm}{2}(x\dot{y} - y\dot{x})$.

(3) State Lagrangian for a simple harmonic oscillator and hence obtain Hamilton's equations of motion for it.

Q-4(a) State Hamilton's equations of motion. (4)

Q-4(b) Attempt any **TWO** (10)

(1) Show that, $\frac{dH}{dt} = \frac{\partial H}{\partial T}$

(2) Show that, a coordinate cyclic in Hamiltonian is also cyclic in Lagrangian.

(3) Describe Routhian procedure.

Q-5(a) Obtain expressions of all fundamental Poisson brackets. (4)

Q-5(b) Attempt any **TWO** (10)

(1) Describe Hamilton-Jacobi theory for solving a mechanical problem.

(2) Evaluate $[q_1, [2q_1 + p_2, p_1 - 2q_2]]$

(3) Show that $\frac{\partial}{\partial t}[u, v] = \left[\frac{\partial u}{\partial t}, v\right] + \left[u, \frac{\partial g}{\partial t}\right]$, the notations being usual.

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