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

M.Sc. (Maths) Semester - 2 (*CBCS*) Examination
August/September -2020 [NEW COURSE]
Classical Mechanics – 2 (Elective)

Time: 2:00 Hours **Marks: 56**

Instructions:

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

Q-1 Answer any **Seven** of the following questions in short. (14)

(1) State the expression of total angular momentum of a rigid body with one point stationary.

(2) What is Lagrangian of a heavy symmetrical top with one point fixed?

(3) State the vector form of Lorentz transformation.

(4) What is meant by an event?

(5) Define Minkowski force.

(6) Define Legendre transformation.

(7) State principle of least action.

(8) Define Posson bracket.

(9) Sate Jacobi identity for Poisson brackets.

(10) For a system of n-degrees of freedom evaluate $[q_1, p_2]$, notations being usual.

Q-2 Answer any **Two**. (14)

(a) In usual notations derive the relation $T = \frac{1}{2} I\omega^2$.

(b) Obtain all constants of motion for a heavy symmetrical top with one point fixed.

(c) 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. Also find a set of principal axes.

Q-3 Answer the following.

(a) Using Legendre transformation derive Hamilton's equations of motion from Lagrange's equations of motion. (7)

(b) Lagrangian of a system is given by L $= \dot{q}_1^2 + \frac{\dot{q}_2^2}{a+\mathrm{b}q_1^2} + k_1 q_1^2 + k_2 \dot{q}_1 \dot{q}_2$, (7)

where a, b, k_1, k_2 are constants. Find Hamiltonian.

OR

Q-3 Answer the following.

(a) State Hamilton's modified principle and hence derive Hamilton's equations of motion. (5)

(b) Show that a coordinate cyclic in Lagrangian is also cyclic in Hamiltonian. (4)

(c) Lagrangian for a system is given by $L = \frac{m}{2}(\dot{r}^2 + r^2\dot{\theta}^2) - \frac{k}{r}$. Obtain Routhian. (5)

Q-4 Answer any **Two.** (14)

(a) State Lorentz transformation and hence show that
$x^2 + y^2 + z^2 - c^2t^2 = 0 \Rightarrow x'^2 + y'^2 + z'^2 - c^2t'^2 = 0$.

(b) Show that Lorentz transformation can be regarded as a rotation.

(c) Write a note on covariant formulation.

Q-5 Answer any **Two.** (14)

(a) Define Poisson brackets. Obtain expressions of all type of fundamental Poisson brackets.

(b) Describe Hamilton-Jacobi theory for solving the problem of simple harmonic oscillator.

(c) If $A = q_1 + q_2$, B $= \frac{p_1 - p_2}{q_2 - q_1}$ compute [A, B], [A,[A,B]].

(d) Define canonical transformation. What is meant by a generating function? Describe canonical transformation generated by a function of F_3 type.

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