647510 **MSC1MatE101x** **Seat No :_____**

M.Sc.(Maths.) Semester - 1 (*CBCS*) Examination
Oct/Nov. -2019 - [NEW COURSE]
Classical Mechanics 1(Elective (New))

Time: 2:30 Hours **Marks: 70**

Instructions:

1. All questions are compulsory.
2. Figures to the right indicate marks.

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

(1) Define and give an example of a holonomic constraint.

(2) Describe constraints in simple pendulum.

(3) What are geodesics on plane?

(4) Show that generalized momentum conjugate to a cyclic coordinate is conserved.

(5) For the Lagrangian $\frac{1}{2}\left(\dot{r}^2 + r^2\dot{\theta}^2\right) + \frac{1}{r^2}$, obtain all generalized momenta.

(6) Define reduced mass in a two-body problem.

(7) What is meant by inverse square law of force?

(8) Describe constraints in a rigid body.

(9) State Euler's theorem on the motion of a rigid body.

(10) Define infinitesimal rotation.

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

(a) State and prove law of conservation of total energy for a system of particles.

(b) State Lagrange's equations of motion in general for and derive the form in the case of conservative system.

(c) Giving all details obtain Lagrange's equations of motion for Atwood's machine.

Q-3 Answer the following.

(a) State Hamilton's principle and derive Lagrange's equations from it. (5)

(b) Describe the brachistochrone problem and formulate it in the calculus of variations. (5)

(c) State Kepler's laws of planetary motion. (4)

OR

Q-3 Answer the following.

(a) Prove the law of conservation of linear momentum of a system in Lagrangian formalism. (07)

(b) Using calculus of variations obtain geodesics on the surface of a sphere. (07)

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

(a) State differential equation of orbit. Solve it to find orbit in Kepler's problem.

(b) Explain how a central force two-body problem can be solved in terms of formal integrals.

(c) Obtain degrees of freedom of a rigid body.

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

(a) Find force law for the following orbits

$$(i) r = 1 + cos\theta \; (ii) x = acost, y = asint$$

(b) Giving all details discuss Eulerian angles.

(c) Is it true that infinitesimal rotations commute? Justify your answer.

(d) Derive Euler's equations of motion for a rigid body with one point fixed.

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