

M.Sc.(Maths.) Semester - 1 (CBCS) Examination

Nov/Dec-2023

Classical Mechanics 1(Elective (New))

Time: 2:30 Hours

Marks: 70

Instructions:

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

- Que.1(A) Answer any Two out of Three. (10)
- 1) Derive the D' Alembert's Principle.
 - 2) Describe the Lagrange's Equations of Motion.
 - 3) Describe the Lagrange's Equations of Motion in spherical co-ordinate system.
- Que.1(B) Answer any One out of Two. (04)
- 1) Is the force $\mathbf{F} = (2xy - 1, x^2 + z, y)$ conservative? If yes then determine the corresponding potential V such that $\mathbf{F} = -\nabla V$.
 - 2) Classify the Constraints.
- Que.2(A) Answer any Two out of Three. (10)
- 1) Derive the Euler's equation in calculus of variations.
 - 2) Show that the curve between two points in a plane on which the distance is minimum is a straight line joining these points.
 - 3) Derive the energy function of a Lagrange's system.
- Que.2(B) Answer any One out of Two. (04)
- 1) Compute the generalized momentum and energy functions and check whether the following functions are conserved or not.
(A) Simple Harmonic Oscillator
(B) Two-dimensional isotropic Oscillator
 - 2) Describe brachistochrone problem and obtain its solution.
- Que.3(A) Answer any Two out of Three. (10)
- 1) Show that the central force motion of bodies about their centers of mass can always be reduce to an equivalent body problem.
 - 2) Show that the square of the time period is directly proportional to the cube of semi measure axis.
 - 3) Derive the equation of motion for two body.
- Que.3(B) Answer any One out of Two. (04)
- 1) State and prove Kepler's first law of motion.
 - 2) State and prove Kepler's second law of motion.
- Que.4(A) Answer any Two out of Three. (10)
- 1) Derive the properties which satisfies the orthogonal transformation.
 - 2) Derive the Cayley-Klein's parameters in terms of Euler angle.
 - 3) Prove that $\left(\frac{d}{dt}\right)_s = \left(\frac{d}{dt}\right)_r + \omega X$
- Que.4(B) Answer any One out of Two. (04)
- 1) Define Euler angles.
 - 2) Define infinitesimal and derive the formula $d\mathbf{r} = \mathbf{r} \times d\boldsymbol{\Omega}$
- Que.5(A) Answer any Two out of Three. (10)
- 1) State and prove Euler's theorem for the motion of a rigid body.
 - 2) Discuss the finite rotation and obtain the correspondence matrix of the rotation.
 - 3) Derive the curve between two fixed point has minimum surface area of revolution.
- Que.5(B) Answer any One out of Two. (04)
- 1) Show that Geodesics arcs on a sphere of radius "r" are greatest circle
 - 2) Prove that the generalized momentum conjugate to a cyclic coordinate is conserved.
