Enrollment No: _____ Exam Seat No:_____

C. U. SHAH UNIVERSITY

Winter Examination-2022

Subject Name: Classical Mechanics

Subject Code: 5SC04CLM1 **Branch: M.Sc. (Mathematics)**

Semester: 4 **Date: 23/09/2022** **Time: 02:30 To 05:30** **Marks: 70**

Instructions:

(1) Use of Programmable calculator and any other electronic instrument is prohibited.
(2) Instructions written on main answer book are strictly to be obeyed.
(3) Draw neat diagrams and figures (if necessary) at right places.
(4) Assume suitable data if needed.

SECTION – I

Q-1 **Attempt the following questions** **(07)**

a. Define degree of freedom **01**
b. Define: Center of system. **01**
c. State Hamilton's principle for a system **01**
d. What do you mean by ignorable coordinates? **01**
e. Write the difference between Lagrangian and Hamiltonian of mechanical system. **01**
f. What is virtual displacement? **01**
g. Define: Linear momentum. **01**

Q-2 **Attempt all questions** **(14)**

A State and prove conservation theorem of linear momentum. **04**
B State and prove Lagrange's equation of motion. **10**

OR

Q-2 **Attempt all questions** **(14)**

A State and prove D'Alembert's principle **07**
B Obtain Lagrange's equation of motion for simple pendulum. **07**

Q-3 **Attempt all questions** **(14)**

A Show that Lagrange's equation of motion is invariant under co-ordinate transformation. **07**
B Derive Euler Lagrange's equation using Hamilton's principal **07**

OR

Q-3 A State and prove conservation theorem of angular momentum. **07**
B Show that the bead sliding on a uniform rotating wire follows the exponential curve. **07**

SECTION – II

Q-4 **Attempt the following questions** **(07)**

a. What is dual transformation? **01**

b. Define cyclic coordinates. **01**

c. Define: Phase space. **01**

d. State analog of the Jacobi's identity for Lagrange's bracket **02**

e. Define: Lagrange's bracket. **02**

Q-5 **Attempt all questions** **(14)**

A Let a spring attached to a fixed point, on the other hand a particle of mass m is attached. Find Hamilton's equation of motion of particle. **06**

B State and prove Hamilton's equation of motion. **06**

C Define cyclic coordinates. **02**

OR

Q-5 **Attempt all questions**

A Write any three properties of Hamiltonian function also justify it. **07**

B Find Hamiltonian and Hamilton's equation of motion for simple pendulum. Find Hamiltonian for the following Lagrangian. Hamilton's equation of motion **07**

$$L = a\dot{x}^2 + b\dot{y}yx + c\dot{x}\dot{y} + fy^2\dot{x}\dot{z} + g\,\dot{y} - k\sqrt{\dot{x}^2 + y^2}.$$

Q-6 **Attempt all questions** **(14)**

A State and prove the necessary and sufficient condition for canonical transformation. **07**

B State and prove Fermat's Postulate in optics. **07**

OR

Q-6 **Attempt all Questions**

A Obtain Hamilton's equation of motion using variational principal. **05**

B State and prove Poisson's theorem. **05**

C In usual notation prove that $[u, v, w]q,p + [v, w, u\ ]q,p + [w, u, v\ ]q,p = 0$ **04**