Roll No. | | | | | | | | | | | | | **Total No. of Pages : 03**

Total No. of Questions : 11

M.Sc.(Physics) (Sem.-1)

CLASSICAL MECHANICS

Subject Code : MSPH-412-18

M.Code : 75123

Date of Examination : 10-01-2023

Time : 3 Hrs. **Max. Marks : 70**

INSTRUCTIONS TO CANDIDATES :

1. **SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.**
2. **SECTION-B contains SEVEN questions carrying FIVE marks each and students have to attempt any SIX questions.**
3. **SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.**

SECTION-A

1. Answer briefly :

a) Explain the terms: (i) Holonomic and (ii) Non-Holonomic constraints.

b) Define generalized coordinates and their advantages.

c) Write Lagrangian equations for a simple pendulum.

d) Explain the physical significance of Hamiltonian.

e) What is Δ-variation? How it is different from δ-variation?

f) Write a note on Infinitesimal Canonical transformation.

g) What is Jacobi's identity?

h) "*Lagrangian mechanics is superior to Newtonian mechanics*". Explain how?

i) Define action angle variable in one dimension.

j) How many generalized coordinates are needed to specify the motion of a rigid body?

SECTION-B

2. State the D'Alembert Principle. Derive Lagrange's equation of motion from it for conservative system. How results will be modified for non-conservative system.

3. Obtain Hamiltonian and Hamilton's equation of motion for a compound pendulum from its Lagrangian. Deduce the Lagrange function and Lagrange equation of motion for a compound pendulum. Also calculate the period of oscillation.

4. State and prove the principle of least action. Deduce the principle of least action in the following form:

$$\Delta\int_{t1}^{t2} p_1 \dot{q}_1 dt = 0$$

5. What is a Poisson bracket? If H is the Hamiltonian and F is a function, depending upon position, momenta and time, show that, where symbols have their usual meaning.

$$\frac{dF}{dt} = \frac{\partial F}{\partial t} + [F, H]q, p"$$

6. Show that the transformation $P = 1/2(p^2 + q^2)$ and $Q = \tan^{-1}(q/p)$ is canonical.

7. Show that the kinetic energy for a system of particles can be written as the sum of three homogeneous functions of the generalized velocities : $T = T_0 + T_1 + T_2$, where T_0 is independent of generalized velocities, T_1 is linear in velocities, and T_2 is quadratic in velocities.

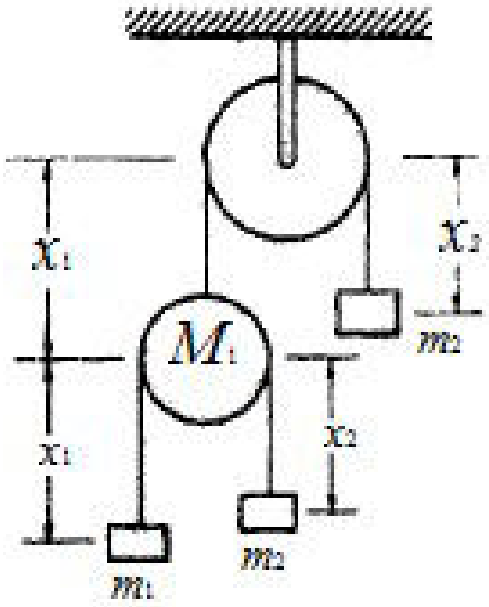
8. Find the equations of motion of a pendulum bob suspended by a spring and allowed to swing in a vertical plane.

SECTION-C

9. Give an account of Hamilton Jacobi theory and illustrate it by applying it to the problem of simple harmonic oscillator.

10. Discuss Euler angles as the generalized coordinates for a rigid body motion and obtain an expression for the angular velocity of a rigid body in terms of Euler's angles.

11. A mass M_2 hangs at one end of the string which passes over the frictionless non-rotating pulley (see figure). At the end of this string there is a non-rotating pulley of mass M_1 over which there is a string carrying mass m_1 and m_2. Setup the Lagrangian of the system and find the acceleration of mass M_2.



NOTE : Disclosure of Identity by writing Mobile No. or Making of passing request on any page of Answer Sheet will lead to UMC against the Student.