Roll No. | | | | | | | | | | | | **Total No. of Pages : 02**

Total No. of Questions : 09

M.Sc. (Physics) (Sem.–1)

CLASSICAL MECHANICS

Subject Code : MSPH-412-21

M.Code : 91410

Date of Examination : 14-01-2023

Time : 3 Hrs. **Max. Marks : 60**

INSTRUCTIONS TO CANDIDATES :

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

SECTION-A

1. Write briefly:

a) Explain the principle of virtual work.

b) If a coordinate is cyclic for Lagrangian, will it be so for Hamiltonian also? Justify your answer.

c) Write down the Lagrange's equation of motion for a particle of mass m falling freely under gravity.

d) A particle slide down an inclined plane under the influence of gravity? Justify the type of constraint.

e) Give the advantage of using variational principle formulation over the Lagrangian mechanics.

f) Discuss the Brachistochrone curve problem.

g) Show that the transformation $P = \log(\sin p) : Q = q \tan p$, is canonical.

h) Write a note on Infinitesimal Canonical transformation.

i) What do you mean by the conservative and non-conservative force?

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

SECTION-B

2. What do you understand by holonomic and non-holonomic constraints? Obtain differential equation of constraints in case of disc of radius R, rolling on horizontal *xy* plane and constrained to move so that the plane of the disc is always vertical.

3. Using Hamilton's Principle, show that the angular momentum is conserved in a central force problem.

4. If F and G are two functions of position coordinate q_1, and momentum coordinate p_1. Show that the Poisson bracket of F and G follows the relation:

$$[F, G] = -[G, F]$$

5. Give an account of Hamilton Jacobi theory by applying it to problem of Simple harmonic oscillator.

6. Find the expression for rotational kinetic energy in the torque free motion of a rigid body.

SECTION-C

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

   b) Set up the Lagrangian for a mass m attached to a spring of force constant K and hence obtain the Euler Lagrange equation of Motion.

8. a) What are the advantages of using Hamiltonian mechanics over Lagrangian mechanics.

   b) Obtain Hamiltonian and Hamilton's equation of motion for a compound pendulum from it's Lagrangian. Also calculate the period of oscillation.

9. What are canonical transformations? Show that the transformation $P = 2(1+\sqrt{q}\cos p)\sqrt{q}\sin p$ and Q = $\log(1+\sqrt{q}\cos p)$ is canonical. Also find out the generating function F_2 of this transformation.

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.