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

Total No. of Questions : 09

M.Sc.(Physics) (2015 to 2017) (Sem.–1)

CLASSICAL MECHANICS

Subject Code : MPH-102

Paper ID : [A2711]

Time : 3 Hrs. **Max. Marks :100**

INSTRUCTION TO CANDIDATES :

1. **Attempt FIVE Questions in all including the compulsory question No.-9.**

Q1. a) State D'Alembert's principle. Derive Langrange's equations for a non-conservative system from it. (10)

b) Derive an expression for Kinetic energy in term of generalised velocity. (4)

c) Find out equations of motion for a bead sliding on a rotating wire. (6)

Q2. a) Derive Lagrange's equations from Hamilton's variational principle. (10)

b) Using Hamilton's variational principle get the equation of motion for brachistochrone problem. (10)

Q3. a) Define Euler's angles. Find transformation matrix for transforming the space set co-ordinates into body set of axis. Show that this matrix is orthogonal. (14)

b) Derive Euler's equations of motion for a rigid body. (6)

Q4. a) Find out general solutions for a system of two coupled oscillators. Also derive equations of motion for it. (10)

b) Formulate the small oscillations using Lagrange's equations. (10)

Q5. a) Derive Hamilton's equations of motion by Legendre transformations. (8)

b) Derive Principle of least action. Also obtain Fermat's principle from it. (12)

Q6. a) Obtain the fourth form generating function (F_4) from F_1. Discuss different variables included and obtain q_j, Q_j and K from F_4. (6)

b) Discuss infinitesimal contact transformations in detail. "*Hamiltonian is the generator of the system motion*" justify this statement. (8)

c) Show that the following transformation is canonical : (6)

$$q = \sqrt{2P}\ sinQ \ and \ \ p = \sqrt{2P}\ cosQ$$

Q7. a) Find out equations of motion using Poisson's brackets. (6)

b) Derive the conservation theorem for angular momentum using concept cyclic co-ordinates. Also write down which symmetry leads to it? (10)

c) Define Rayleigh's dissipation function. What is its physical significance? (4)

Q8. a) Find equation of motion of a hoop of radius r, rolling down an inclined plane having an angle of inclination φ and length I. Also find its velocity at the bottom of the inclined plane. Comment on its acceleration compared that if there would only be sliding motion. (10)

b) Explain principal axis transformation. (3)

c) Explain in brief what do you understand by (i) fast top (ii) sleeping top? (4)

d) Are energy function and Hamiltonian the same variable? Justify your answer. (3)

Q9. Answer briefly :

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

b) Write down the formula for canonical momentum. What can you say about its units?

c) Compare Lagrangian and Hamiltonian formulation. Does the one make it easy to solve the given problem than the other?

d) Write down the conditions under which energy of the system is conserved.

e) How Coriolis force affects tropical winds?

f) What do you understand by normal modes of vibration?

g) Out of two types of variations δ and Δ, for which the condition of energy conservation is satisfied for actual and varied paths? Justify your answer.

h) Give two examples of canonical transformations, justify why they are canonical.

(8×2.5=20)