Roll No. .....

Total Pages : 3

321604

May, 2023

B.Sc. (Physics) VI SEMESTER

Classical Dynamics (DECP-606)

Time : 3 Hours]

[Max. Marks : 75

Instructions :

1. *It is compulsory to answer all the questions (1.5 marks each) of Part -A in short.*
2. *Answer any four questions from Part -B in detail.*
3. *Different sub-parts of a question are to be attempted adjacent to each other.*

PART–A

1. (a) Compare briefly Newtonian, Lagrangian and Hamiltonian mechanics. (1.5)

(b) Find the Poisson bracket of $[L_x, L_y]$ where L_x and L_y are angular momentum components. (1.5)

(c) State principle of least action. (1.5)

(d) Define normal coordinates. Name the transformation to obtain normal coordinates. (1.5)

(e) The Lagrangian for anharmonic oscillator is given by $L(x,\dot{x}) = \frac{1}{2}\dot{x}^2 - \frac{1}{2}\omega^2 x^2 - \alpha x^3$ Find the Hamiltonian. (1.5)

(f) State Jacobi's identity. Give its physical significance. (1.5)

(g) Show that the following transformation is canonical

$Q = (2q)^{1/2} e^a \cos p$

$P = (2q)^{1/2} e^{-a} \sin p$ where 'a' is a constant. (1.5)

(h) Set up the Hamiltonian for the motion of a particle in central force. (1.5)

(i) A particle of mass m is observed to move in a spiral orbit given by the equation $r = C\theta$, where C is a constant. Find the force law. (1.5)

(j) Define pressure and density of a fluid. (1.5)

PART–B

2. (a) Derive Lagrange's equation of motion using Hamilton's principle for a conservative system. (10)

(b) Define the Hamiltonian. What is its physical significance? (5)

3. (a) Define cyclic coordinates. Explain with an example. (5)

(b) Establish the relation between Lagrange and Poisson brackets. (10)

4. Determine the frequencies of vibration and all the normal coordinates for a system of linear triatomic molecule. (15)

5. (a) State and prove integrals of motion under central force. (7)

(b) A particle of mass m moves under the action of central force whose potential is $V(r) = Kmr^3 (K > 0)$, then.

(i) For what kinetic energy and angular momentum will the orbit be a circle of radius R about the origin?

(ii) Calculate the period of circular motion. (8)

6. (a) Consider the motion of a particle under a central attractive force inversely proportional to square of the distance from the center. Classify the orbits on the basis of energy. (7)

(b) Write Hamilton-Jacobi equation and its solution for a one-dimensional harmonic 'Oscillator. (8)

7. Write short notes on the following :

(a) Motion of a charged particle in uniform electric field.

(b) Kepler's laws.

(c) Poiseuille's equation for flow of a liquid through a pipe. (15)
