Roll No. ..... Total Pages : 3

238102

December, 2019

M.Sc. (Physics)- I SEMESTER

Classical Mechanics (PHL-102)

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) State Hamilton's Principle. (1.5)

(b) Define Poincare maps. (1.5)

(c) Show that angular momentum is conserved in motion under central force. (1.5)

(d) State Kepler's laws. (1.5)

(e) Prove that for Poisson brackets

$$[X, YZ] = Y[X, Z] + [X, Y]Z.$$ (1.5)

(f) What do you mean by Principal axis transformation? (1.5)

(g) Write in brief how Liapunov exponent explain chaos. (1.5)

(h) Deduce the expression of Hamiltonian for one-dimensional harmonic oscillator. (1.5)

(i) 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)

(j) State Poisson Theorem. (1.5)

PART - B

2. (a) Set up the Hamiltonian and hence find the equations of motion for a simple pendulum

(i) Prove or disprove that H represents a constant of motion.

(ii) Whether H represents total energy. (8)

(b) What is Routhian Function? How it is used to eliminate cyclic coordinates? (7)

3. (a) Show that Poisson bracket is invariant under canonical transformation. (10)

(b) Determine frequencies of vibration of a system of linear triatomic molecule. (5)

4. (a) How can a two body problem under central force be reduced to one body problem? (8)

(b) Derive the differential equation of the orbit in polar co-ordinates under a central force. (7)

5. (a) For the motion of a particle under central attractive force inversely proportional to the square of the distance from the centre of force, find the conditions under which the orbit will be an ellipse, parabola or hyperbola. (7)

(b) Discuss one dimensional harmonic oscillator problem using Hamilton Jacobi method. (8)

6. (a) State and prove Jacobi's identity. (5)

(b) Find the law of force if a particle under central force moves along a curve $r = a(1 + \cos \theta)$. (5)

(c) What are cyclic coordinates? (5)

7. What is linear stability analysis? Discuss the classification of fixed points in brief. Draw phase portrait of an undamped pendulum. (2+7+6)
