D1APH2101 **(2 Pages)** **Name.....**
Reg.No.....

FIRST SEMESTER M.Sc. DEGREE EXAMINATION, NOVEMBER 2021
(Regular/Improvement/Supplementary)

PHYSICS
FPHY1C01- CLASSICAL MECHANICS

Time: 3 Hours **Maximum Weightage: 30**

Part A: Short answer questions. Answer *all* questions. Each carries *one* weightage.

1. Explain Holonomic constraints with examples. How does it affect the degree of freedom.
2. What do you mean by phase space? Draw the phase space of a classical one dimensional harmonic oscillator
3. Write the relationship between Lagrangian and Hamiltonion. Obtain Hamilton's equations from this relation
4. Obtain the Lagrangian of the vibrations of a linear triatomic molecule.
5. Discuss the Lagrange's equations of motion in the presence of generalized potentials.
6. Obtain the Lagrangian of an oscillating simple pendulum.
7. Define moment of inertia tensor. Give its physical significance.
8. Explain period doubling bifurcation.

(8 × 1 = 8 weightage)

Part B: Essay questions. Answer any *two* questions. Each carries *five* weightage.

9. a) Derive Lagrange's equations from D' Alembert's principle.
   b) Derive Lagrange's equations from Hamilton's principle.
10. Discuss scattering in a central force field. Derive Rutherford expression for differential scattering cross section.
11. Obtain Euler's equations of motion of a rigid body rotating about a fixed point using Lagrange method. Explain principal axis and principal moment of inertia.
12. Obtain the solution of one dimensional harmonic oscillator using Hamilton Jacobi method.

(2 × 5 = 10 weightage)

(P.T.O.)

Part C: Problems. Answer any *four* questions. Each carries *three* weightage.

13. A particle of unit mass moves in a potential $V(x) = 2x + \frac{1}{x}$. Find the angular frequency of small oscillations of the particle about the minimum of the potential.
14. By using the method of action angle variables show that the angular frequency of a simple pendulum is $\sqrt{(\frac{g}{l})}$
15. A rigid body consists of four particles of each of mass m located at points (1,0), (0,1) , (2,0) and (0,2). Determine the moment of inertia tensor of the body.
16. Show that the total energy of a particle moving along an elliptical orbit under the action of an inverse square law central force is $\frac{-K}{2a}$, where 'a' is the semi major axis and 'K' is the force constant (assume equation of orbit).
17. Show that the transformation $Q = \sqrt{2p}\sin q$ and $P = \sqrt{2p}\cos q$ is canonical using Poisson bracket.
18. Define Poisson's bracket. Outline any six the properties of Poisson bracket.
19. What is a logistic map? What are the fixed points on an iterated map?

(4 × 3 = 12 weightage)