D1APH2201 **(2 Pages)** **Name.....**
Reg.No.....

FIRST SEMESTER M.Sc. DEGREE EXAMINATION, NOVEMBER 2022
(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. Distinguish between Holonomic and Non-holonomic constraints with examples.
2. State and explain the Principle of virtual work.
3. Obtain Hamilton's equations from the relationship between Lagrangian and Hamiltonion.
4. Explain the concept of action angle variables.
5. Define moment of inertia tensor. Give its physical significance.
6. Explain Centrifugal and Coriolis forces.
7. Obtain the Lagrangian of an oscillating simple pendulum.
8. What do you understand by universality of chaos?

(8 × 1 = 8 weightage)

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

9. a) Define Poisson's bracket. Outline any six properties of Poisson bracket.

   b) Show that Poisson bracket is invariant under canonical transformation.

10. a) Obtain the Normal frequencies of vibrations of a linear triatomic molecule.

    b) Obtain Euler's equations of motion of a rigid body rotating about a fixed point using Lagrange method.

11. Discuss scattering in a central force field. Derive Rutherford expression for differential scattering cross section.
12. Derive Lagrange's equations from:

    i) D' Alembert's principle.

    ii) Hamilton's principle

(2 × 5 = 10 weightage)

(P.T.O.)

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

13. Consider a diatomic molecule consisting of masses m1 and m2 connected by a spring of spring constant k vibrating along the line joining the two masses. Obtain its normal frequencies.

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 three particles of each of mass m located at points (1,0,0), (0,0,1) , and (0,1,0). Determine the moment of inertia tensor of the body.

16. Show that the total energy of a particle moving along a circular orbit under the action of an inverse square law central force is $\frac{-K}{2r}$. Where 'r' is the radius of circular path and 'K' is the force constant (assume equation of orbit).

17. Show that the transformation $P = \frac{1}{2}(p^2 + q^2)$ and $Q = tan^{-1}\left(\frac{q}{p}\right)$ is caonical.

18. Obtain the relationship between the angular momentum and angular velocity of a rotating rigid body.

19. Write brief notes on:

    i) Logistic map; ii) Bifurcation iii) Period doubling.

(4 × 3 = 12 weightage)