D 72978 (Pages : 2) Name.....

Reg. No.....

FIRST SEMESTER M.A./M.Sc./M.Com. DEGREE EXAMINATION DECEMBER 2019

(CBCSS)

Physics

PHY 1C 01—CLASSICAL MECHANICS

(2019 Admissions)

Time : Three Hours Maximum : 30 Weightage

Section A

Answer **all** *questions, each carry weightage* 1.

1. State d'Alembert's principle.
2. Show that the transformation ; (q, p) to (Q, P) defined by $Q = -p$, $P = q$ is an example of canonical transformation.
3. Show that Schrödinger equation reduces to Hamilton-Jacobi equation in the appropriate limit.
4. Find the Hamiltonian corresponding to the Lagrangian,

$$L = \frac{1}{2} m\dot{q}^2 - c\dot{q}$$

where c is a constant.

5. What is meant by Coriolis force ?
6. What do you mean by precession and nutation ?
7. What are generalised co-ordinates ?
8. Explain the concept of universality.

(8 × 1 = 8 weightage)

Section B

Answer any **two** *questions, each carry weightage* 5.

9. Explain Hamilton's principle and use that to derive the Lagrange's equations.
10. Explain the concept of action-angle variables with an example.
11. Find the frequencies of free-vibrations of a linear triatomic symmetric molecule.

Turn over

12. Discuss the case of logistic map, find the fixed points and describe the onset of chaos through period doubling.

(2 × 5 = 10 weightage)

Section C

Answer any **four** *questions, each carry weightage* 3.

13. Taking the case of a simple harmonic oscillator in one dimension show how do we obtain the Hamiltonian from the Lagrangian.

14. By calculating the Poisson bracket show that the following transformation is a canonical transformation :

$$Q = \tan^{-1}\left(mw\frac{q}{p}\right), P = \frac{1}{w}\left(\frac{p^2}{2m} + \frac{1}{2}mw^2q^2\right).$$

15. Find the generating function for the infinitesimal transformation;

$$Q = q + c, P = p.$$

16. Solve the harmonic oscillator problem via the Hamiltonian formulation.

17. Prove the Poisson bracket relation between angular momentum components given by

$$\left[L_x, L_y\right] = L_z.$$

18. Show that the definition of moment of inertia as :

$$I = \sum_i m_i \left(\vec{r}_i \times \vec{n}\right) \cdot \left(\vec{r}_i \times \vec{n}\right)$$

reduces to

$$I = \sum_i m_i \left(\vec{r}_i^{\,2} = \cdot \left(\vec{r}_i \cdot \vec{n}\right)^2\right).$$

19. Find the maximum values possible for the centrifugal force acting on a body of mass m = 20 kg. due to the spin of the Earth as the equator, given that the radius of the Earth is R = 6400 km.

(4 × 3 = 12 weightage)