C 32340 (Pages : 2) Name.....

Reg. No.....

FIRST SEMESTER M.Sc. DEGREE EXAMINATION, DECEMBER 2017

(CUCSS)

Physics

PHY 1C 01—CLASSICAL MECHANICS

(2012 Admissions)

Time : Three Hours Maximum : 36 Weightage

Part A

Answer **all** *questions.*

Each question carries 1.

1. What are inertial and non-inertial frames ? Show that if a frame is an inertial frame, then a frame moving with constant velocity relative to it is also inertial.
2. Explain principle of virtual work.
3. Briefly explain Kepler's laws of planetary motion.
4. State and discuss the principle of least action.
5. Explain general properties of centre force motion.
6. If q_j and p_j do not depend on time explicitly, show that $\dot{q}_j = \left[q_j, H\right]$ and $\dot{p}_j = \left[p_j, H\right]$.
7. Find the condition for a transformation to be canonical.
8. What are body and space co-ordinate systems in relation to the motion of a rigid body.
9. Find the relation between the angular momentum vector, the inertia tensor and angular velocity vector ?
10. What do you mean by stable, unstable and neutral equilibrium ?
11. Explain Feigenbaum diagram in chaos.
12. Explain with example the period doubling route in chaos.

(12 × 1 = 12 weightage)

Turn over

Part B

Answer any **two** *questions.*
Each question carries 6.

1. State and explain Hamilton's principle. Derive Lagrange's equations of motion using Hamilton's principle. Comment on the extension of the principle to non-holonomic system.
2. Explain action- angle variable ? Explain the role of action-angle variable in obtaining frequency of a periodic system.
3. What are normal modes of vibration and normal co-ordinates. Express the kinetic and potential energy of a system in terms of normal co-ordinates.
4. Explain bifurcation in chaotic system with the help of a diagram. What is logistic map and fixed point of an iterated map ?

(2 × 6 = 12 weightage)

Part C

Answer any **four** *questions.*
Each question carries 3.

1. A particle of mass m can move without friction on the inside surface of a paraboloid of revolution $\phi = x^2 + y^2 - z = 0$ under the action of a uniform gravitational field in the negative z direction. Obtain the equation of motion using D'Alembert's principle.
2. Consider a particle of mass m suspended from a weightless cord of length 'l' . The motion of the particle takes place in a plane. Obtain the Lagrangian and equation of motion.
3. For the Lagrangian $L = \frac{1}{2} m \left(\dot{x}^2 + \dot{y}^2 + \dot{z}^2\right) + \frac{\omega}{2} L_z$ where L_z is the 'z' component of angular momentum. Obtain the Hamiltonian.
4. The kinetic energy of a system is $T = \frac{1}{2} m \left(\dot{x}^2 + \dot{y}^2 + \dot{z}^2\right)$ and potential energy is $V = \frac{1}{2}\left(k_1 x^2 + k_2 y^2 + k_3 z^2\right)$. Obtain the eigen frequencies.
5. Show that the transformation $Q = 2^{1/2} q \exp(k) \cos p$ $P =$
6. $2^{1/2} q \exp(-k) \sin p$ is canonical.
7. Show that the curve of minimum length joining a pair of points in the plane is a straight line.

(4 × 3 = 12 weightage)