[96]   **SARDAR PATEL UNIVERSITY**
B.Sc. EXAMINATION (Semester- 5)
Monday, 9ᵗʰ April 2018
2:00 p.m. to 05:00 p.m.
Subject: PHYSICS
Course: US05CPHY01
Title: Classical Mechanics

Total Marks:70

N.B: *(i) All the symbol have their usual meanings*
(ii) Figures at the right side of questions indicate full marks

Q-1   Multiple Choice Questions (Attempt All)   (10)

(1)   The areal velocity of the particle in a central force field is _____
    (a) Conserved   (b) not conserved
    (c) Zero   (d) infinity

(2)   At the turning point in an arbitrary potential field the radial velocity is
    (a) 1   (b) -1
    (c) 0   (d) 0.5

(3)   All the planet moves around the Sun in _____ orbit
    (a) Circular   (b) elliptical
    (c) hyperbolic   (d) parabolic

(4)   The degree of freedom for a free particle in space are _____
    (a) 3   (b) 2
    (c) 1   (d) 0

(5)   The number of independent variable for a free particle in space are ___
    (a) N   (b) 2N
    (c) 3N   (d) 0

(6)   The Hamiltonian function is define by _____
    (a) $H = F + V$ (b) $H = F - V$
    (c) $H = T - V$ (d) $H = T + V$

(7)   A frame of reference moving with a constant velocity relative to a fixed frame is called _____ frame
    (a) real   (b) imaginary
    (c) inertial   (d) Non inertial

(8)   The term $\vec{\omega} \times (\vec{\omega} \times \vec{r})$ is called _____
    (a) linear acceleration   (b) centripetal acceleration
    (c) angular acceleration   (d) coriolis acceleration

(9)   The shortest distance between two points in a plane is _____
    (a) circular   (b) hyperbolic
    (c) parabolic   (d) Straight line

(10)   In variational principle the line integral of some function between two end points is _____
    (a) zero   (b) infinite
    (c) extremum   (d) one

Q-2   Short Questions (Attempt any Ten)   (20)

(1)   State the Coulomb's inverse square law
(2)   State the Kepler's first law of planetary motion
(3)   Define parabolic orbit

(P.T.O.)

(4)   What is degree of freedom?
(5)   Define Scleronomous and Rheonomous constraints
(6)   Construct the Lagrangian for Spherical pendulum
(7)   Define inertial and non-inertial frame of reference
(8)   Define spherical top and asymmetric top
(9)   Define symmetrical top and rigid rotator
(10)   State the variational principle
(11)   State the Hamilton's principle
(12)   Define geodesic line

Q-3 (a) Explain the laws of gravitational and electromagnetic forces and show   (6)
          that electromagnetic forces are much stronger than the gravitational
          forces in the interaction of atomic and subatomic particles.

     (b) Derive the Gauss' law for electrostatic fields   (4)
                                    OR
Q-3 (a) Derive the equation of motion of equivalent one body and explain why   (6)
          apple falls toward the earth and not the earth towards the apple?

     (b) State and prove Kepler's third law of planetary motion   (4)

Q-4 (a) What are constraints? Explain, giving examples, the meaning of   (6)
          holonomic and nonholonomic constraints

     (b) Discuss the virtual work done for motion of a system and derive the   (4)
          mathematical statement of D'Alembert's statement
                                    OR
Q-4 (a) Derive the Lagrange's equation of motion for a conservative system   (6)
          from D'Alembert's principle

     (b) Construct the Lagrangian of Atwood machine and derive its the equation (4)
          of motion

Q-5 (a) Discuss the rotating coordinate system and derive necessary expressions (6)

     (b) State and prove Euler's theorem   (4)
                                    OR
Q-5 (a) Derive the expression of angular momentum and kinetic energy   (6)

     (b) Discuss the Coriolis force   (4)

Q-6   Discuss the technique of calculus of variation and derive the Euler's   (10)
          equation. Also derive second form of it.
                                    OR
Q-6   Find the Lagrangian for series and parallel connection of inductance L, (10)
          resistance R and capacitor C with an external electromotive force $\varepsilon(t)$

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