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# SARDAR PATEL UNIVERSITY

**B.Sc. (Sem.- 5)EXAMINATION**
**Tuesday, 12th November2013**
**10:30 a.m. to 01:30 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 potential due to dipole falls off as _____
(a) $1/r^2$ (b) $1/r^3$
(c) $r^2$ (d) $1/r$

(2) For elliptical orbit the values of energy E and eccentricity Є are _____
(a) E=0 and Є =1 (b) E=0 and Є >1
(c) E< 0 and Є < 1 (d) E>0 and Є =0

(3) The areal velocity of the particle in a central force field is _____
(a) zero (b) conserved
(c) infinity (d) Not conserved

(4) The Lagrangian equations of motion are _____order differential equations
(a) first (b) second
(c) forth (d) zero

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

(6) All the frames of reference that are rotating relative to a fixed frame of reference are the _____ frame of reference
(a) real (b) imaginary
(c) non inertial (d) inertial

(7) The term $2\vec{\omega} \times \left(\frac{d\vec{r}}{dt}\right)_{rot}$ is called _____
(a) linear acceleration (b) angular acceleration
(c) centripetal acceleration (d) coriolis acceleration

(8) _____ must be applied to maintain the rotation of the system about given axis
(a) force (b) torque
(c) velocity (d) momentum

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

(10) The angle of flies off for a particle moving on spherical surface is

(a) $\phi_c = cos^{-1}\left(\frac{2}{3}\right)$ (b) $\phi_c = sin^{-1}\left(\frac{3}{2}\right)$

(c) $\phi_c = cos^{-1}\left(\frac{3}{2}\right)$ (d) $\phi_c = sin^{-1}\left(\frac{3}{2}\right)$

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

(1) Write the Poisson's equation in Cartesian coordinate system
(2) Write the equation of motion for two body moving under the action of internal forces
(3) Define elliptical orbit
(4) Define Holonomic and non-holonomic constraints
(5) Define Scleronomous and Rheonomous constraints
(6) Define cyclic coordinates
(7) State the Euler's theorem
(8) Define precessional velocity
(9) Show that the directions of the angular velocity and the angular momentum are different
(10) Define geodesic line
(11) Write the Lagrangian of simple pendulum in terms of spherical polar coordinates
(12) State the Hamilton's principle

**Q-3** (a) State and prove the Gauss' law for electrostatic fields **(6)**

(b) Using the Gauss' law obtain the expression of Laplace equation **(4)**

**OR**

**Q-3** (a) Derive the equation of motion of equivalent one body **(6)**

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

**Q-4** (a) Discuss the virtual work done for motion of a system and derive the mathematical statement of D'Alembert's statement

(b) Define the Hamiltonian. When is it equal to the total energy of the system? When is it conserved? **(4)**

**OR**

**Q-4** (a) Derive the general expression of kinetic energy and find the kinetic energy of double pendulum from it **(6)**

(b) Construct the Lagrangian of spherical pendulum and derive its the equation of motion **(4)**

**Q-5** Derive the expressions of angular momentum and kinetic energy and also derive the Euler's equations of the motion **(10)**

**OR**

**Q-5** Discuss the motion of a symmetrical top and derive the expressions of its total energy and precessional velocity **(10)**

**Q-6** (a) Derive the Euler's equation using $\delta$- notation **(5)**

(b) Show that the extremum value of the distance between the two points on the surface of a sphere is an arc of a circle whose centre lies at the centre of the sphere **(5)**

**OR**

5 (a) Derive the equation of motion for a simple pendulum using undetermined multiplier **(5)**

(b) Derive the Schrodinger wave equation using variational principle **(5)**

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