[This question paper contains 2 printed pages.]

**Sr. No. of Question Paper : 6848** **D** **Your Roll No.....**

Unique Paper Code : 222161

Name of the Course : **B.Sc. Physical Science / Applied Physical Sciences**

Name of the Paper : PHYSICS – I : Mechanics (PHPT-101)

Semester : I (Three year course)

Time : 3 Hours Maximum Marks : 75

**Instructions for Candidates**

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **five** questions in all.
3. Question No. **1** is compulsory.
4. Attempt **four** questions from the rest of the paper.

1. Attempt any **5** of the following : (5×3=15)

   (a) For the position vector $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$, find the value of gradient $\vec{r}$.

   (b) Determine the constant 'a' so that the divergence of vector $\vec{V} = (x + 3y)\hat{i} + (y - 2z)\hat{j} + (z + az)\hat{k}$ is zero.

   (c) A steel wire 4m long and 5mm in diameter is stretched by a weight 5 kg. Find the elongation of wire (Young's modulus of wire = $23.2 \times 10^{10}\,Nm^{-2}$).

   (d) The edge of the cube as measured by an observer in a stationary frame S is L. What is the volume of the cube as observed in a frame S′, moving with uniform velocity v with respect to S along one of the sides of the cube ?

   (e) State the theorem of parallel axis for a plane laminar body.

   (f) State Kepler's laws of planetary motion.

   (g) Calculate Poisson's ratio for silver from the following data : $Y = 7.25 \times 10^{10}\,Nm^{-2}$, $K = 11 \times 10^{10}\,Nm^{-2}$.

2. (a) Show that in a central force field, the angular momentum of a particle remains conserved. (5)

*P.T.O.*

(b) What do you understand by the center of mass of a system of n particles ? (5)

(c) State and prove work energy theorem. (5)

3. (a) Define modulus of rigidity and bulk modulus of elasticity. What are their SI units ? (5)

(b) Derive an expression for the couple required to twist one end of the cylindrical wire when its other end is fixed. (10)

4. (a) Define the terms 'moment of inertia' & 'radius of gyration'. Give dimensions and SI units. (5)

(b) Determine moment of inertia of a solid sphere about its :

(i) Diameter

(ii) A tangent (10)

5. (a) State and prove Green's theorem in a plane. (10)

(b) Using Green's theorem in the plane, evaluate the integral

$\oint_C [(x^2 + xy)dx + (x^2 + y^2)dy]$

where C is the square formed by the line $y = \pm 1$, $x = \pm 1$. (5)

6. (a) Write Lorentz's transformation equations and use them to drive an expression for time dilation. (10)

(b) A certain star is 20 light years away. How long would it take a spaceship travelling 0.95c to reach that star from earth as measured by an observer (i) on earth, and (ii) on the spaceship, (c is the velocity of light). (5)

7. (a) Describe Michelson-Morley experiment and discuss the importance of its negative results. (12)

(b) Find the energy equivalent to a mass of 5 mg.

8. (a) If $\vec{A}$ is a constant vector, then prove that, $\vec{\nabla}\left(\vec{r}.\vec{A}\right) = \vec{A}$. (5)

(b) If $\vec{A} = \frac{\vec{r}}{r}$, find grad div $\vec{A}$. (5)

(c) Prove $\vec{\nabla}.\left(\vec{\nabla}\times\vec{A}\right) = 0$, where $\vec{A}$ is a vector. (5)

(200)