Sl. No. of Ques. Paper	**: 8309 C**
Unique Paper Code	**: 222161**
Name of Paper	**: PHPT–101 : Physics – I Mechanics**
Name of Course	**: B.Sc. Physical Science / Applied Physical Science Part I**
Semester	**: I**
Duration : 3 hours	*Maximum Marks : 75*

Attempt five questions in all. Question No. 1 is compulsory.

Attempt four questions from the rest of the paper.

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

    (a) If $\vec{A} = 3xyz^2 \hat{i} + 2xy^3 \hat{j} - x^2 yz \hat{k}$ and $\emptyset = 3x^2 - yz$, find the value of $\vec{\nabla}.(\emptyset \vec{A})$.

    (b) The potential energy of a particle is described by $U = A \log_e(x^2 + y^2 + z^2)$. What will be the force acting on the particle?

    (c) Explain the physical significance of the negative results of the Michelson-Morley experiment.

    (d) How fast should a spaceship move relative to an observer on earth, in order that one year on it may correspond to two years on earth?

    (e) The maximum and minimum distances of a planet from the sun are 2.8×10^8 km and 1.4×10^8 km, respectively. Calculate the magnitude of its velocity when the planet is nearest to the sun, if the velocity when it is farthest is 3×10^3 m/s.

    (f) Define impulse. A cricket ball of mass 100 g moving with a velocity of 12 m/s is hit by a bat, so that it is turned back with a velocity of 20 m/s. The force of the blow acts for 0.01 second on the ball. Find the average force exerted by the bat on the ball.

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

2. (a) What is centre of mass? Show that in the absence of external forces, the velocity of the centre of mass remains constant.   **10**

    (b) Show that law of conservation of momentum is invariant to Galilean transformation.   **5**

3. (a) Define moment of inertia for a rigid body. A flywheel of mass 500 kg, radius 1 m makes 500 revolutions per minute. Assuming the mass to be concentrated along the rim, calculate the energy of the flywheel. **5**

   (b) Calculate the moment of inertia for a solid cylinder of mass M, length L and radius R about an axis passing through its centre and perpendicular to its length. **10**

4. (a) Explain what is meant by modulus of rigidity of a material. Obtain an expression for the couple per unit twist for a wire having circular cross-section. **10**

   (b) Show that under the influence of a central force, angular momentum of a particle is conserved and its motion is confined to a fixed plane. **5**

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

   (b) Prove $\iint_{S} r^{5} \hat{n}\, ds = \iiint_{V} 5 r^{3} \vec{r}\, dV$ **5**

6. (a) Deduce an expression for relativistic variation of mass with velocity. **10**

   (b) What are massless particles? Show that they exist only if they move with the speed of light. **5**

7. (a) Write Lorentz transformation equations and use them to derive an expression for length contraction. **10**

   (b) Determine the length of a rod of proper length 1 m with respect to an observer moving with a velocity 0.8 c in a direction inclined at 30^{0} to its length. **5**

8. (a) Show that $\vec{\nabla}\phi$ is a vector perpendicular to the surface $\phi(x,y,z)=c$, where c is a constant. **5**

   (b) In what direction from the point (1, 3, 2) is the directional derivative of $\phi=2xz-y^{2}$ a maximum? What is the magnitude of this maximum? **5**

   (c) Evaluate $\oint(y-2x)dx + (3x+2y)dy$ around the boundary of a circle of unit radius centered at origin. **5**