Bachelor of Science (F.Y.BSc.) (CBCS Pattern) First Semester

USPHT01 - Physics Paper-I (Mechanics and Relativity)

P. Pages : 3 **GUG/W/18/11560**

Time : Three Hours * 3 6 3 5 * Max. Marks : 50

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1. Either:

A) i) State Newton's laws of motion. **3**

ii) Show that Newton's first law of motion is simply a special case of the second law. Discuss the limitations of Newton's laws of motion. **3**

iii) Distinguish between inertial and non-inertial frames of reference. **2**

iv) Two bodies of masses 2gm and 10gm have position vectors $\left(3\vec{i}+2\vec{j}-\vec{k}\right)$ and $\left(\vec{i}+\vec{j}+3\vec{k}\right)$. **2**

Find the position vectors and the distance of centre of mass from the origin.

OR

B) a) Derive equation of motion of centre of mass. **2½**

b) Two particles of masses m_1 and m_2 and positions vectors $\vec{r}_1$ and $\vec{r}_2$ are moving with velocities $\vec{v}_1$ and $\vec{v}_2$ respectively. Obtain expression for velocity and acceleration. **2½**

c) Obtain expression for radial and transverse component of velocity. **2½**

d) The path of projectile is given by an equation $3t^2-\frac{t^2}{20}$ Meter. Find the velocity and acceleration after the time of 10 sec. **2½**

2. Either:

A) i) Discuss the phenomenon of Collision in one dimension between two particles when the Collision is elastic. Hence find velocities after collision. **6**

ii) When masses of colliding particle are same and when one of the particle is initially at rest. **2**

iii) A gun of mass 10kg fires a bullet of 100gm with a velocity 1500cm/s. Find the velocity with which gun is recoiled. **2**

OR

B) a) State and prove law of conservation of linear momentum. **2½**

b) State and prove the work-energy principle. **2½**

c) Explain the terms elastic and inelastic collision. With examples. **2½**

d) If the two bodies having masses 10kg and 8kg and their respective initial velocities are 5 m/sec. and 6m/sec. Find the final velocities of the two bodies after elastic collision in one dimension. **2½**

3. Either:

A) i) Derive an expression for moment of inertia of a rod about an axis passing through: **6**
i) its centre ii) One end perpendicular to its length

ii) Explain the terms: **2**
a) Angular Velocity b) Angular momentum
State its SI Units.

iii) Calculate the radius of gyration of a solid sphere rotating about its diameter where radius is 5cm. **2**

OR

B) a) Explain isotropy and rotational invariance of space. **2½**

b) Show that angular momentum of a particle remains conserved in the absence of an external torque. **2½**

c) State the principle of perpendicular and parallel axes for moment of inertia. Give their mathematical equations. **2½**

d) A thin uniform rod of mass 1Kg and length 1m is rotating about an axis passing through its centre and perpendicular to its length. **2½**
Calculate M. I. Also calculate radius of Gyration.

4. Either:

A) i) Derive Einstein's relativistic velocity addition formula. **6**

ii) Prove that it is in confirmly with the principle of constancy of speed of light. **2**

iii) A Rocket of rest mass 8000kg is travelling with a velocity of 0.6C. Find the relativistic mass. **2**

OR

B) a) Derive an expression for time dilation. **2½**

b) Obtain the relation, $E = \sqrt{p^2c^2 + m_0^2c^4}$. **2½**

c) Derive an expression for length construction. **2½**

d) An object in motion has a mass of a 12kg and travels in air with velocity 0.82C. What would be its rest mass? **2½**

5. Attempt **any ten** questions from the followings.

a) What is frame of reference? **1**

b) Define centripetal force **1**

c) Write the names of forces acting on a moving particle in rotating frame. **1**

d) Name the fuel used in the rocket. **1**

e) What are the applications of elastic collision. **1**

f) State the principle of multistage rocket. **1**

g) What is torque. **1**

h) Define angular impulse. **1**

i) Write the relation between τ and L. **1**

j) Write the Lorentz transformation equations. **1**

k) What is meant by proper time? **1**

l) What are the postulates of special theory of relativity. **1**

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