

B.Sc. First Year (CBCS Pattern) Semester-I
USPHT01 - Physics Paper-I - Mechanics and Relativity

P. Pages : 3

Time : Three Hours



GUG/W/24/11560

Max. Marks : 50

- Notes :
1. All questions are compulsory.
 2. Draw neat, well labelled diagram wherever necessary.

Either:

1. A) i) State Newton's laws of motion and write its limitations. 4
- ii) Distinguish between inertial and non-inertial frame of reference. 3
- iii) The motion of a particle is described by the equation $x = 4\sin 2t$, $y = 4\cos t$ and $z = 6t$ 3
Find velocity and acceleration of the particle.

OR

- B) a) Derive equation of motion of centre of mass. 2½
- b) What is linear momentum? State and explain the linear momentum about centre of mass. 2½
- c) What is centripetal force? Write its characteristics. 2½
- d) The distance between carbon and oxygen atom in CO molecule is 1.12\AA . Find the centre of mass of CO molecules with respect to C atom. 2½

Either:

2. A) i) Explain the term elastic and inelastic collision. 2
- ii) Discuss the phenomenon of collision in one dimension between two particles when the collision is elastic. 6
- iii) Two objects of mass $m_1 = 2\text{g}$ and $m_2 = 5\text{g}$ possess velocity $u_1 = 10\text{ cm/sec}$ and $u_2 = 5\text{ cm/sec}$. They suffer an elastic collision. Find the velocities of both after collision. 2

OR

- B) a) State and explain the law of conservation of linear momentum with examples. 2½
- b) State law of conservation of energy? Prove work-energy theorem. 2½
- c) Explain the principle and working of multistage rocket. 2½

- d) A rocket of mass 20kg has 180kg of fuel. The exhaust velocity of fuel is 1.60 km/s calculate the ultimate vertical speed gained by the rocket when the rate of consumption of fuel is 2kg/s 2½

Either:

3. A) i) Derive an expression for moment of inertia of a rod about an axis passing through 6
 a) Its centre
 b) One end perpendicular to its length.
- ii) Define moment of Inertia and give its physical significance. 2
- iii) Assuming the earth to be solid sphere of uniform density 5520kg/m³ and radius 6400km calculate the moment of inertia about its axis of rotation. 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) Define torque: obtain the relation between torque and moment of inertia. 2½
- d) Calculate the radius of gyration of a solid sphere rotating about its diameter where radius is 5cm. 2½

Either:

4. A) i) Derive an expression for Lorentz transformation and inverse form. 5
- ii) Derive an expression for length contraction. 3
- iii) The total energy of a particle is exactly is twice of its rest mass energy. What is the velocity of particle ($C = 3 \times 10^8$ m/s) 2

OR

- B) a) Derive an expression for time dilation. 2½
- b) Obtain the Einstein relation $E = MC^2$. 2½
- c) Derive $E = \sqrt{P^2 C^2 + m_0^2 c^4}$. 2½
- d) Find the percentage contraction in the length of rod, in a frame of reference moving with a velocity 0.8C in a direction parallel to its length. 2½

5. Solve **any ten** from the following.
- a) What is Coriolis force? 1
 - b) Explain centripetal force. 1
 - c) Define frame of reference. 1
 - d) Define collision. 1
 - e) Why rocket called as a system of variable mass. 1
 - f) Write drawback of single stage rocket. 1
 - g) State the principle of parallel axis for moment of inertia. 1
 - h) Define angular impulse. 1
 - i) A thin ring has a mass 0.35kg and radius 0.75m. Calculate its moment of inertia about any of its diameter. 1
 - j) State the postulates of special theory of relativity. 1
 - k) What is meant by proper time. 1
 - l) What is constancy of speed of light? 1
