

B.Sc. F.Y. CBCS Pattern Semester-I  
**USPHT01 - Physics Paper-I (Mechanics and Relativity)**

P. Pages : 3

Time : Three Hours



**GUG/W/23/11560**

Max. Marks : 50

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

**Either:**

1. a) i) Discuss and explain Newton's laws of motion with proper examples. 3
- ii) Distinguish between inertial and non- inertial frame of reference. Explain why earth is not an inertial frame of reference. 3
- iii) Prove that Newton's law of motion is a special case of Newton's second law of motion. 2
- iv) An object of mass 10 kg falling freely to the ground with an acceleration of  $5 \text{ m/s}^2$  downward. Calculate force acting on the body. 2

**OR**

- b) a) Obtain an expression for radial and transverse component of velocity of particle moving in rectangular plane. 2½
- b) Deduce the equation of motion of centre of mass. 2½
- c) What is linear momentum? State and explain the linear momentum about centre of mass. 2½
- d) Consider a projectile moving along a path as  $(3t^2 - t/10) \text{ m}$ . Estimate its velocity and acceleration after the time loses. 2½

**Either:**

2. a) i) Discuss the phenomenon of perfectly elastic collisions in one dimension and derive an equation of velocity of particle in elastic collision. 7
- ii) If two bodies having masses 10 kg and 8 kg and their respective initial velocities are 5m/s and 6m/s. Find the final velocities of the two bodies after elastic collision in one dimension. 3

**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) State principle and working of multistage rocket. 2½

- d) A gun of mass 5kg fires a bullet of 150 gm with a velocity 1500 m/s. find the velocity with which gun is recoiled. 2½

**Either:**

3. a) i) Derive an expression for moment of inertia of a ring about an axis passing through. 3+3  
 a) Its centre.  
 b) One end perpendicular to its diameter.
- ii) Define moment of inertia and its physical significance. 2
- iii) Evaluate the radius of gyration of a solid sphere rotating about its diameter where radius is 5am. 2

**OR**

- b) a) Prove that angular momentum of a particle remains conserved in the absence of an external torque. 2½
- b) Show that torque is the time rate of change of angular momentum. 2½
- c) Discuss isotropy and rotation invariance of space. 2½
- d) Explain homogeneity and isotropy of time. 2½

**Either:**

4. a) i) Derive an expression for Lorentz transformation and inverse form. 4+2
- ii) State and explain postulates of special theory of relativity. 2
- iii) A rocket of rest mass 8000kg is travelling with velocity of  $0.6C^\circ$ . Find relativistic mass. 2

**OR**

- b) a) Derive an expression for length contraction. 2½
- b) Derive an expression for time dilation. 2½
- c) Derive  $E = \sqrt{P^2 C^2 + M_0^2 C^4}$ . 2½
- d) A body of rest mass 100 kg changes its mass by 1kg in a rocket ship. Calculate the speed of rocket. 2½

5. Solve **any ten** from the following.

- a) What is Coriolis force? 1
- b) Explain centripetal force. 1

- c) What is frame of Reference? 1
- d) What is collision? 1
- e) Give two examples of elastic and inelastic collision. 1
- f) What is principle of rocket? 1
- g) State the principle of parallel axis for moment of inertia. 1
- h) What is angular momentum? 1
- i) What is radius of gyration? 1
- j) What is proper length? 1
- k) Explain mass-energy equivalence. 1
- l) What is time dilation? 1

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