

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

P. Pages : 2

Time : Three Hours



GUG/S/23/11560

Max. Marks : 50

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

Either:

1. i) State Newton's laws of motion and write the limitations. 4
ii) Derive an expression for radial and transverse components of velocity. 3
iii) 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. 3

OR

- a) Distinguish between inertial and Non - inertial frame of reference. 2½
b) What is centripetal force? Write its characteristics. 2½
c) Derive the equation of motion of Centre of mass. 2½
d) Two bodies of masses 10 gm and 20 gm constrained to move in horizontal plane collide. If their velocities are $v_1 = 6\text{ cm/sec}$ and $v_2 = 7\text{ cm/sec}$ respectively, then find the velocity of Centre of mass. 2½

Either:

2. i) Explain the terms elastic and inelastic collisions with examples. 3
ii) Derive an expression for velocity after collision in one dimension when the two bodies have elastic collision between them. 4
iii) If the two bodies having masses 10 kg and 8 kg and their respective velocities are 6 m/sec and 5 m/sec. Find its final velocities of two bodies - after elastic collision between them. 3

OR

- a) Explain the working principle of single stage rocket. 2½
b) State and prove the law of conservation of momentum. 2½
c) Derive an expression for velocity of rocket at any instant of time t. 2½
d) A rocket of mass 20kg has 180 kg of fuel. The exhaust velocity of fuel is 1.60km/s. Calculate the ultimate vertical speed gained by the rocket when the rate of consumption of fuel is 20 kg/s. 2½

Either:

3. i) Explain the moment of inertia and radius of gyration. 3
ii) Derive an expression for moment of energy of solid sphere about its diameter. 4
iii) Assuming earth to be solid sphere of uniform density 5520 kg/m^3 and radius 6400 km, calculate the moment of inertia about its axis of rotation. 3

OR

- a) State the principle of perpendicular and parallel axes about M. I. of body. Give their Mathematical equations. 2½
- b) State and prove law of conservation of angular momentum. 2½
- c) Derive an expression for moment of inertia of thin ring about an axis passing through its Centre and perpendicular to its plane. 2½
- d) A thin uniform rod has a length 2m and mass 3kg. Find its moment of inertia about a axis passing through. 2½
 - i) One end of the rod.
 - ii) Centre of mass of the rod, which is perpendicular to its length.

Either:

- 4. i) Derive Lorentz space - time transformation equations and write its inverse transformation formulae. 4
- ii) Derive an expression for time dilation and discuss the result in special theory of relativity. 3
- iii) A rocket of rest mass 10^4 kg is travelling at a velocity of $(0.6) C$. Find its relativistic mass. What would be the mass when it travels with speed of light? 3

OR

- a) Obtain the relation. 2½

$$E = m_0^2 C^4 + p^2 c^2$$
- b) Obtain an expression for length contraction in case of special theory of relativity. 2½
- c) The total energy of particle is exactly twice of its rest mass energy. What is the velocity of particle. 2½
- d) Deduce the formula for relativistic variation of mass with velocity. 2½

- 5. Attempt **any ten** from following.
 - a) What is Centre of mass? 1
 - b) What is meant by frame of reference? 1
 - c) show that Newton's second law is a special case of first law. 1
 - d) State the principle of rocket. 1
 - e) State the principle of conservation of energy. 1
 - f) What is jet propulsion in rocket? 1
 - g) What is torque? 1
 - h) Explain the isotropy and rotational invariance of space. 1
 - i) What is angular momentum? 1
 - j) Write the postulates of special theory of relativity. 1
 - k) Define proper time. 1
 - l) State the physical significance of $E = mc^2$ 1
