

B.Sc. First Year (CBCS)-Regular-Semester 2017 Sem I
USPHT01 - Physics Paper - I (Mechanics and Relativity)

P. Pages : 2

Time : Three Hours



GUG/S/18/10099

Max. Marks : 50

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

Either :

1. a) State Newton's laws of motion. 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. 6
- b) Distinguish between inertial and non - inertial frame of reference. 2
- c) Find the maximum speed of a body of mass 2 kg revolving in a circular path of radius 2m, if the centripetal force of 400 N applied towards the centre of circle. 2

OR

- e) Two particles of masses m_1 and m_2 and position vectors \vec{r}_1 and \vec{r}_2 are moving with velocities \vec{v}_1 and \vec{v}_2 respectively.
- i) What is the position vector of centre of mass? 2
- ii) What is the velocity and acceleration of centre of mass? 4
- f) Derive the equation of motion of centre of mass. 2
- g) Two bodies of masses 2g and 10g have position vectors $(3\hat{i} + 2\hat{j} - \hat{k})$ and $(\hat{i} - \hat{j} + 3\hat{k})$ respectively. Find the position vectors and the distance of centre of mass from the origin. 2

Either :

2. a) Define linear momentum and write its unit. 2
- b) State and explain principle of conservation of linear momentum. 2
- c) What is rocket? Explain its principle. 3
- d) Explain conservation of energy. 3

OR

- e) Discuss the phenomenon of collision in one dimension between two particles when the collision is elastic. 6
- f) Explain applications of elastic collision. 2
- g) Two objects of mass $m_1 = 2\text{gm}$ and $m_2 = 5\text{gm}$ passes velocity $u_1 = 2\text{cm/s}$ and $u_2 = 4\text{cm/s}$. They suffer elastic collision. Find the velocities of both objects after collision. 2

Either :

3. a) Define moment of inertia and radius of gyration. 2
b) Calculate the moment of inertia of a rectangular lamina. 5
c) A flywheel of mass 500 kg, radius of gyration 1 metre makes 500 revolution per minute. Calculate the energy of the flywheel. 3

OR

- e) Define angular velocity and angular momentum. 2
f) Explain isotropy and rotational invariance of space. 2
g) Prove that the homogeneity of the time and Newton's second laws of motion lead to the principle of conservation of energy. 6

Either :

4. a) Explain relativistic addition of velocities. Also write inverse transformation equation of it. 6
b) Explain constancy of speed of light. 2
c) In the laboratory two particles are observed to travel in opposite direction each with velocity of 2.8×10^8 m/sec. Find their relative velocity. 2

OR

- e) Derive an expression for time dilation and discuss the result. 4
f) Deduce the formula for relativistic variation of mass with velocity. 4
g) A body of rest mass 100 kg changes its mass by 1 kg in a rocket ship. Calculate the speed of rocket. 2

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

- a) Define centripetal force. 1
b) Write application of Coriolis force. 1
c) Write one example each of inertial and non - inertial frame. 1
d) Define collision. 1
e) Write any two difference between elastic and inelastic collision. 1
f) Give two examples of conservation of linear momentum. 1
g) Define Torque. 1
h) Calculate the moment of inertia of circular disc of mass 2 kg and radius 0.17 m. 1
i) State the principle of parallel axes for moment of inertia. 1
j) State the postulates of special theory of relativity. 1
k) What is proper length? 1
l) Calculate the effective mass of a photon of wavelength 1 \AA . 1
($h = 6.63 \times 10^{-34}$ J.s)
