

This question paper contains 3 printed pages].

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S. No. of Question Paper : 6202

Unique Paper Code : 222103

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Name of the Paper : Mechanics (PHHT-102)

Name of the Course : B.Sc. (Hons.) Physics

Semester : I

Duration : 3 Hours

Maximum Marks : 75

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt five questions in all including Q. No. 1 which is compulsory.

1. Attempt any five of the following :

- (a) What is meant by radius of gyration and centre of mass of a rigid body ?
- (b) Check if the force $\vec{F} = 3xy\hat{i} - y\hat{j}$ is conservative or not.
- (c) Show that the intensity of the field can be expressed in the form $E = -\text{grad } V$, where V is the potential.
- (d) Show that in an elastic one-dimensional collision, the relative velocity with which the two particles approach each other before collision is equal to the relative velocity with which they recede from each other after collision.
- (e) A solid spherical ball rolls on a horizontal table. What fraction of its total kinetic energy is rotational ?

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- (f) What do you understand by inertial and gravitational mass ?
- (g) What are the different types of energies a liquid in streamline flow may possess ?
- (h) Draw a graph between mass of an object having rest mass m_0 moving with velocity v . 5×3=15
2. (a) Establish the relation for the velocity of a rocket taking into account the weight of the fuel. 10
- (b) Find the impulse developed by a force $\vec{F} = 4t\hat{i} + (6t^2 - 2)\hat{j} + 12\hat{k}$ from time $t = 0$ to $t = 2$ sec. 5
3. (a) Obtain an expression for the acceleration of a body rolling down an inclined plane. 7
- (b) A sphere and a cylinder are allowed to roll down simultaneously on an inclined plane from the same height without slipping. Explain which one reaches down first. 8
4. (a) Show that the gravitational potential at the centre of a solid sphere is one and a half times the potential at the surface. 8
- (b) When a particle moves under a central force, prove that the angular momentum is conserved and the particle moves in a fixed plane. 7
5. (a) Derive an expression for the twisting couple per unit twist for a solid cylinder as well as a hollow one. 10
- (b) Show that a hollow cylinder is stronger than a solid one of same material, mass and length. 5

6. (a) What is Coriolis force ? Show that the total Coriolis force acting on a body of mass m in a rotating frame is $-2m\vec{\omega} \times \vec{v}_r$, where $\vec{\omega}$ is the angular velocity of rotating frame and \vec{v}_r is the velocity of the body in rotating frame. 7
- (b) Explain the basic postulates of Einstein's special theory of relativity. Derive the Lorentz space-time transformation formulae. 8
7. (a) Describe the Michelson-Morley experiment and explain the physical significance of the negative results. 10
- (b) What is length contraction ? Obtain the volume of a cube, the proper length of each edge of which is L_0 , when it is moving with a velocity v along one of its edges. 5