December 2023

B.Sc. (Physics) Ist SEMESTER

Mechanics (BPH23-102T)

Time : 3 Hours]   [Max. Marks : 75

Instructions :

1. *It is compulsory to answer all the questions (1.5 marks each) of Part-A in short*
2. *Answer any four questions from Part-B in detail.*
3. *Different sub-parts of a question are to be attempted adjacent to each other.*

PART–A

1. (a) Differentiate between Elastic and Inelastic Collision.
               (1.5)

   (b) Discuss the concept of Moment of inertia and Radius of Gyration.   (1.5)

   (c) If angular momentum is conserved in a system whose moment of inertia is decreased, Will its rotational K.E. be also conserved?   (1.5)

   (d) State and prove Theorem of Perpendicular axis.
               (1.5)

   (e) Compute the mass of the sun from the Period and Radius of earth's orbit.   (1.5)

(f) Explain why particles cannot move faster than light. (1.5)

(g) Both Venus and Earth have approximately circular orbits around the Sun. The period of orbital motion of Venus is 0.615 years and period of Earth is I year. By what factor do the sizes of the two orbits differ? (1.5)

(h) Explain Inverse Square Law of force. (1.5)

(i) Why don't we observe the effect of Time Dilation in every day's life? (1.5)

(j) What is the relation between energy and momentum for a relativistic particle? (1.5)

PART–B

2. (a) State and Prove Work-Energy Theorem. (5)

(b) Prove that conservative force is equal to negative gradient of potential energy. (5)

(c) Define Potential Energy Curve for a particle. What significant information can does it give about the behaviour of the particle? (5)

3. (a) State and prove the Theorem of Parallel Axis for moment of Inertia. (5)

(b) Calculate the moment of Inertia of a solid cylinder

(i) About its own axis,

(ii) About an axis passing through its center of mass but perpendicular to its length. (10)

4. (a) Derive an expression for moment of Inertia of a Circular Disc. (5)

(b) How two body problems can be reduced to one body problem? Also discuss the concept of reduced mass. (10)

5. (a) How Newton's Law of gravitation can be derived from Kepler's Law of Planetary motion? (5)

(b) Derive an expression for Differential equation of motion under central force. (10)

6. (a) Prove that Differential interval between two events.
$$ds^2 = dx^2 + dy^2 + dz^2 - c^2dt^2$$
is invariant under Lorentz Transformation. (5)

(b) Derive an expression for Relativistic Kinetic Energy and establish Mass-Energy Equivalence. Also give some examples of Mass-Energy Equivalence. (10)

7. (a) On her 16th birthday, Priya decides that she will like to remain 16 for atleast 10 years. What will be the minimum speed she must move relative to the laboratory frame of reference so that when she returns after 10 years she can still say that she is only 16. **(Assume 1 year = approx. 360 days).** (5)

(b) What do you mean by Time-Dilation? Discuss the variation of Mass with velocity according to the Special theory of Relativity. (10)