

Roll No. ....

Total Pages : 3

**321102**

**January 2023**

**B.Sc. (Physics) - Ist SEMESTER**

**Mechanics (BPH-102A)**

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) Define reference frames. What are its two types? (1.5)
- (b) Define elastic potential energy. (1.5)
- (c) State Kepler's laws. (1.5)
- (d) Show that the force  $F = yz \mathbf{i} + zx \mathbf{j} + xy \mathbf{k}$  is conservative force. (1.5)
- (e) Define fictitious forces. (1.5)
- (f) Two masses constrained to move in a horizontal plane collide. Given initially  $m_1 = 85 \text{ gm}$ ,  $m_2 = 200 \text{ gm}$ ;  $u_1 = 6.48 \text{ cm/s}$  and  $u_2 = -6.78 \text{ cm/s}$ , find the velocity of centre of mass. (1.5)

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- (g) Differentiate between elastic and inelastic collision. (1.5)
- (h) The potential energy of a body is given by  $U = 40 + 6x^2 - 7xy + 8y^2 + 32z$  where  $U$  is in joules and  $x, y, z$  are in meters. Deduce the  $x, y$  and  $z$  components of the force when it is in a position  $(-2, 0, 5)$ . (1.5)
- (i) Define massless particles. Give an example. (1.5)
- (j) A friend of yours travels by you in his rocket car at a speed of  $0.6c$ . It appears to be 5 m long. What will be its length at rest? (1.5)

### PART-B

2. (a) What are Galilean transformations? Show that conservation of momentum is invariant under Galilean transformations. (7)
- (b) What do you understand by potential energy curve? Discuss position of equilibrium, unstable equilibrium, stable equilibrium, neutral equilibrium and bounded region in P.E. curve. (8)
3. (a) How can a two-body problem under central force be reduced to one body problem? (5)
- (b) Define Gravitational potential. Derive the expression of Gravitational potential due to a solid sphere at a point  
(i) Outside the sphere (ii) Inside the sphere. Show graphical representation also. (10)

4. Define moment of inertia. Derive the expression of moment of inertia of a hollow circular cylinder about its own axis. Calculate the radius of gyration of a solid sphere rotating about the diameter, if its radius is 5 cm. (15)
5. (a) Define simple harmonic motion. Obtain the differential equation of motion and solution for simple harmonic motion. Write the expressions of kinetic energy, potential energy and total energy. Also show the labeled graphical representation of energies. (10)
- (b) A particle vibrates with SHM of amplitude 0.06 m and time period 31.4 seconds. Calculate its maximum velocity. (5)
6. (a) Describe the Michelson-Morley experiment and explain the physical significance of the negative results. State the postulates of Einstein's special theory of relativity. (12)
- (b) Compute the speed of a particle at which its mass will become 8 times of its rest mass. (3)
- Write short notes on the following :
- (a) Elastic constants and relation between them.
- (b) Time dilation.
- (c) Rotating coordinate system: Coriolis and centrifugal force. (15)