Roll No. .....

(12/24)

5157

B.Sc. B.Ed. (4 Years) (For Batch 2011 & Onwards)/B.A./B.Sc. (First Semester) (For Batch 2011 to 2020 Only) EXAMINATION

PHYSICS

Paper–I (PH-101)

Classical Mechanics and Theory of Relativity

Time : Three Hours *Maximum Marks* : 40

Note : Attempt *Five* questions in all, selecting *one* question from each Unit. Q. No. **1** is compulsory. All questions carry equal marks.

1. (a) Give the physical significance of center of mass of a body. 2

   (b) Comment on that 'generalized co-ordinates need not necessarily have dimensions of length'. 2

(c) Is earth an inertial frame ? Justify your answer. 2

(d) What do you mean by relativistic momentum ? 2

Unit I

2. (a) Prove that constraint imposed on a system, reduces the minimum number of co-ordinates required to describe the system. 4

(b) Three particles having masses 1 gm, 2 gm and 4 gm are located at points (3, 2), (4, –1) and (3, 7) in a plane. Find the co-ordinates of the centre of mass. 4

3. (a) Show that kinetic energy can be expressed as the sum of the kinetic energy of motion of the centre of mass and the kinetic energy of motion about the centre of mass. 4

(b) A system of particles consists of three particles of 3 gm, 5 gm and 2 gm located at the points (1, 0, –1), (–2, 1, 3) and (3, –1, 1) respectively. Find the co-ordinates of the centre of mass. 4

Unit II

4. (a) State and explain Hamilton's variational principle. 4

(b) State and prove Hamilton's principle and use it to obtain the equation of motion $ma = -\frac{\partial V}{\partial x}$, for a particle of mass m moving with acceleration a in a potential V. 4

5. (a) A particle of mass m is projected with the initial velocity u at an angle α with the horizontal. Use Lagrange's equation to describe the motion of the projectile. The resistance of the air may be neglected. 4

(b) A particle of mass M is moving in a plane under an inverse square law attractive force. Set up the Lagrangian and hence obtain the equation describing its motion. 4

Unit III

6. (a) Show that law of conservation of energy and momentum are invariant under Galilean transformation. 4

   (b) Discuss the accelerated frame of reference and rotating frame of reference. 4

7. (a) What are Galilean transformations ? Show that under Galilean transformation, velocity is variant and acceleration is invariant. 4

   (b) Find the magnitude and direction of the Coriolis force on a 700 kg automobile that is travelling due to north at 132 km hr^{-1} at a latitude of 60°. 4

Unit IV

8. (a) A given relativistic particle has a kinetic energy equal to its rest mass energy. Calculate the velocity of the particle. 4

   (b) What do you mean by mass-energy equivalence ? Obtain Einstein's mass-energy relation. 4

9. (a) Discuss the transformation of relativistic momentum and energy. Also give the relation between these. 5

   (b) Two particles come towards each other, each with speed 0.9 c with respect to laboratory. What is their relative speed ? 3