Roll No. .....

(01/22-II)

5157

B.Sc. EXAMINATION

(First Semester)

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.

1. (a) Define center of mass of a body and discuss its importance. 2

   (b) Write the Lagrange's equation for non-conservative system. 2

(c) Comment on the statement that velocity of light is absolute. 2

(d) What do you mean by rest mass of a body ? 2

Unit I

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

(b) Prove that angular momentum is conserved in motion under central force. 4

3. (a) Dfine potential energy and conservative force. Show that a conservative force is equal to the negative gradient of potential energy. 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

Unit II

4. (a) Discuss the motion of a bead sliding on an uniformly rotating wire on a force free surface. 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) Set up the Lagrangian function for a simple pendulum and hence obtain the equation describing its motion. 5

(b) Define generalized co-ordinates and obtain the expression for generalized velocity. 3

Unit III

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

(b) Explain Newton's relativity principle and show that Newton's law of motion are invariant. 4

7. (a) Discuss the effect of coriolis force on a freely falling particle. 5

(b) A ball has a velocity $(3\hat{i} + 6\hat{j} - 9\hat{k})\ \text{ms}^{-1}$ relative to train. The train is moving with velocity of $(8\hat{i} + 2\hat{j})\ \text{ms}^{-1}$ relative to an observer on the ground. Find the velocity of ball relative to the ground. 3

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. Discuss the variation of mass, length and time with velocity, according to special theory of relativity. 8