

Roll No.

Total Pages : 03

GSE/D-21

789

PHYSICS

Paper I

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. Non-programmable calculator is allowed.

(Compulsory Question)

1. (a) How the concept of center of mass is useful in the dynamics of rigid bodies ? 2
- (b) What are Generalized coordinates ? 2
- (c) Give the postulates of Special Theory of Relativity. 2
- (d) Why is compensating plate used in Michelson-Morley's experiment ? 2

Unit I

2. State and prove the conservation theorem of energy for a system of particles. 8

3. (a) What are Holonomic and Non-Holonomic Constraints ? Explain with examples. 4
- (b) State and prove the law of conservation of angular momentum for n -particles system. 4

Unit II

4. (a) Find the time period for simple pendulum with the help of Lagrange's equation of motion. 4
- (b) Discuss configurational space and degree of freedom. 4
5. (a) Explain the following terms : 4
Generalized displacement, velocity and acceleration.
- (b) Deduce Lagrange's equation of motion from Hamilton's principle. 4

Unit III

6. (a) Derive an expression for force acting on a particle in a uniformly rotating frame of reference. Explain the physical significance of various terms obtained. 6
- (b) Whether earth is an inertial or non-inertial frame of reference ? Explain. 2
7. (a) Explain the effect of centrifugal force on the surface of the earth. 5

- (b) Compare and contrast inertial and non-inertial frame of reference. **3**

Unit IV

8. (a) Derive the formula for variation of mass of a particle with its velocity. **6**
- (b) What is the velocity of a meter stick moving parallel to its length, when its mass is 1.5 times of its rest mass ? **2**
9. (a) What is relativity of length ? Find the expression for Fitzgerald length contraction. **5**
- (b) An electron moves with velocity of $0.6 \times 10^8 \text{ ms}^{-1}$. Calculate its mass, when $m_e = 9 \times 10^{-31} \text{ kg}$. **3**