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GSE/D-18 782

PHYSICS

Paper I

PH-101

Classical Mechanics and Theory of Relativity

Time : Three Hours] [Maximum Marks : 40

Note : Q. No. 1 is compulsory. Attempt *Four* more questions, selecting at least *one* question from each Unit.

(Compulsory Question)

1. (a) Explain conservative and non-conservative force. **2**

(b) Explain that it is not necessary for the generalized force Q_j to have the dimensions of force but it is necessary that the product $Q_j . \delta q_j$ must have the dimension of work. **2**

(c) What are the postulates of special theory of relativity ? **2**

(d) Show that it is impossible for a body to move in free space with a velocity equal to that of light or greater than it. **2**

Unit I

2. (a) What are Constraints ? Explain various types of constraints with examples. **5**

(b) Show that for a conservative force $\vec{F}$, we have : **3**

$$\nabla \times \vec{F} = 0$$

3. (a) State and prove that law of conservation of energy for a system of particles. **5**

(b) Two particles are connected by a rod of variable length $l = f(t)$. What is the nature of the system ? **3**

Unit II

4. (a) What are degrees of freedom of a system ? How are the generalized coordinates related to degrees of freedom ? **4**

(b) Use Hamilton's principle, find the equation of motion of one-dimensional harmonic oscillator and find expression for its time period. **4**

5. (a) What do you understand by generalised coordinates ? How do you transform them into Cartesian coordinates ? **5**

(b) Write down the Lagrange's equations when the Lagrangian function has the form : 3

$$L = q_K \dot{q}_K - \sqrt{1 - \dot{q}_K^2}$$

Unit III

6. What are Galilean Transformations ? Show that under Galilean transformations, velocity is variant and acceleration is invariants. 8

7. Describe the Michelson Morley experiment and discuss the negative results. 8

Unit IV

8. (a) What is Lorentz Fitzgerald contraction ? Derive its formula. 5

   (b) Calculate the percentage contraction of a rod moving with a velocity 0.8 times the velocity of light in a direction inclined at 60° to its length. 3

9. (a) Describe the relativistic variation of mass with velocity. 5

   (b) Find the energy of each photon produced during annihilation of an electron and position if the two annihilation particles were at rest. 3