No. of Printed Pages : 4

5-SEMS-Phy-DSE-I(R&B)

2023

Time - 3 hours

Full Marks - 80

*Answer **all groups** as per instructions.*
Figures in the right hand margin indicate marks.

GROUP – A

1. Fill in the blanks. (all) [1 × 12

(a) Lagrangian is a _____ function.

(b) The constraint of a pendulum with variable length is _____.

(c) $\oint \vec{F} \cdot d\vec{r} = 0$ does not hold for _____ forces.

(d) Shortest distance between two points in a plane is known as _____.

(e) The dimension of action integral of Hamilton's principle is _____.

(f) Fermat's principle of least time is one example of _____ principle.

(g) According to Minkowski, the fourth coordinate is _____.

(h) The square of four velocity vector is _____ invariant.

P.T.O.

(i) The relativistic Doppler effect holds good for _____ wave.

(j) Dimension of Hamiltonian is equal to the dimension of _____.

(k) Time dilation leads to the principle of _____.

(l) For space-like interval, the square of the interval is _____ than zero.

GROUP – B

2. Answer any eight of the following questions within two to three sentences each. [2 × 8

(a) What is the cyclic coordinate if a particle is moving in a central-force field ?

(b) Define Scleronomic constraints.

(c) A body moves with 0.2 c velocity. Find the ratio of moving mass to rest mass.

(d) A rocket has velocity 0.6 c. Find the velocity of light with respect to rocket.

(e) Explain Minkowski space.

(f) Write Lorentz transformation equation.

(g) Prove that rest mass of photon is zero.

(h) State principle of virtual work.

(i) Define generalised coordinates.

(j) Explain Lagrangian of a charged particle.

GROUP – C

3. Answer any eight of the following questions within 75 words each. [3 × 8

(a) Explain the physical significance of Lagrangian.

(b) Explain Hamilton's principle.

(c) Explain D' Alembert's principle.

(d) Write the rules for framing Lagrange's equation.

(e) Explain central force motion.

(f) Explain four velocity and acceleration.

(g) What are time-like light-like ?

(h) Explain Brachistochrone problem with one example.

(i) The rest mass of electron is 0.928×10^{-31} kg. Calculate the energy equivalent in eV.

(j) Calculate the velocity of a watch when it seems to be slowed down by 1 minute in one hour.

GROUP – D

*Answer **all** questions within 500 words each.*

4. Using D' Alembert's principle, derive Lagrange's equation of motion of a particle moving under the action of conservative force. [7

OR

Using Lagrange's equation, derive the equation of motion of a one dimensional harmonic oscillator.

5. Derive Lagrange's equation of motion from Hamilton's principle. [7

OR

Derive an expression for Hamiloton's Canonical equations of motion.

6. Derive an expression for Lorentz transformation equations. [7

OR

Using Lorentz transformation equation, derive an expression for relativistic variation of mass with velocity.

7. Derive an expression for relativistic Doppler effect using four vector concept. [7

OR

Explain conservation of four momentum and give its application to two body decay of an unstable particle.