B.Sc. 5th Semester (Honours) Examination, 2020-21

PHYSICS

Course ID: 52416 **Course Code: SH/PHS/503/DSE-1**

Course Title: Classical dynamics

Time: 2 Hours **Full Marks: 40**

The figures in the margin indicate full marks

Candidates are required to give their answers in their own words as far as practicable.

Section - I

1. **Answer *any five* of the following:** 2×5 =10

a) what is the advantage of using the generalized coordinate? Write down the generalized coordinate for the particle moving on a sphere.

b) A proton, with initial velocity of 5×10^6 m/sec, passes through an electric field (transverse) of 200 volts/cm. Calculate the transverse deflection in travelling a distance of 1 meter.

c) What are gyroradius and gyro-frequency?

d)What do you mean by interval between two events in four dimensional spaces?

e)The potential energy function of a particle is $V(x) = \frac{1}{2}kx^2 - \frac{\lambda x^3}{3}$,Find out its stable and unstable equilibrium points. K and λ are constant

f) What is time dilation?

g) If photons have a speed c in one reference frame ,can they be found at rest in any other frame ? Can photon have a speed other than c?

h) State the condition when the Hamiltonian equals the total energy.

Please Turn Over

Section - II

Answer *any four* of the following: 5x4=20

2. a) Write down the Lorentz transformation equations for two frames of reference S and S'.

b) Calculate the percentage of length contraction in length of a rod in a frame of reference, moving with a velocity 0.8c, in the direction at an angle 30 degree with its length.

c) What is the momentum of a proton moving with a velocity 0.86c? Proton mass is 1.67×10^{-27}Kg. (1+2+2 =5)

3. Define four-velocity and four-momentum for a particle. Show that they are time like. (1+1+3=5)

4. Derive Navier-Stokes equation for fluid. 5

5. a) What is reduced mass?

b) A particle moves under the influence of attractive central force and describes a conic

$r = \frac{p}{(1+\varepsilon \cos\theta)}$ where p and θ are constants. Find out the law of force. (2+3=5)

6.a) Prove that Sum of kinetic energy and the potential energy remains constant when a charge particle moves in an external electric field.

b) A particle of charge q is projected with a speed v along x axis in a region of space having a magnetic field $\vec{B} = c_1\hat{j} + c_2\hat{k}$, *where* c_1 and c_2 are constant. Find the force on the particle. (2+3=5)

7. Deduce the Lagrange's equation of motion from Hamilton's principle for conservative system. 5

Please Turn Over

Section - III

Answer *any one* of the following: 10×1=10

8. a) Derive an equation for a particle moving in constant magnetic field. Find out the radius of the circular orbit.

b) What are normal frequency, normal modes of vibration, and normal co-ordinate?

c) Two identical blocks of mass m, are connected to each other by a spring of spring constant k such that they can slide freely on a smooth horizontal surface. The other sides of the blocks are attached to the rigid walls on both sides by springs of spring constant 2k. Find out the normal frequencies for small oscillations of the system.

(3+3+4=10)

9. a) What are the advantages of Lagrangian and Hamiltonian approaches over the Newtonian mechanics.

b) Consider a simple pendulum of mass m and length ℓ. Find its Lagrangian.

c) Find out Hamilton's equations of motion for the case in (b).

(2+3+5=10)