End Semester Examination, 2021

Semester - V

Physics

PAPER - DSE1T

Full Marks : 20

Time : 2 Hours

Group - A

Answer any Ten Question :- **10x2=20**

1.a) Explain Hamilton's principal function (s). 2

b) Distinguish between stable and unstable equilibrium. 2

c) What is central force ? 2

d) Write the equations of motion in poisson Bracket form. 2

e) Find out the nature of the force, conservative or Nonconservative, $\vec{F} = x^2yz\hat{i} - xyz^2\hat{k}$ 2

f) Determine - [Px, Lz] 2

g) Is the constraint given by, $x\dot{x} + y\dot{y} + x\dot{y} + \dot{x}y = k$ (a constant), a holonomic constraint ? Give reasons to your answer. 2

h) For a lagrangian $L(x,\dot{x}) = \frac{1}{2}x\dot{x}^2 - V(x)$, calculate the Hamiltonian. 2

i) What are configuration space and phase space ? 2

j) What are ideal fluid and real fluid ? 2

k) What is meant by Newtorian fluid ? Give an example. 2

l) Water flows through a Horizontal fube having variable corss section. Calculate the increase or decrease in pressure when the velocity of flow changes from 10cm/sec to 20cm/sec. 2

m) A particle of unit mass moves in a potential $V(x) = x^3 - 3x + 2$. Find the angular frequency of small oscillation about the minimum of the potential. 2

n) If q_1 and q_2 are the generatised coordinates and p_1 and p_2 are the comesponding generalised momenta, then find the poisson brocket $\{q_1^2 + q_2^2,\ 2p_1 + p_2\}$ 2

o) A particle in constrained to move in a plance under the influence of an attractive central force which proportional to the distance from the origin. Find the Lagrangian of this pusticle of mass m. 2

Group - B

Answer any four from the following :- **4x5=20**

2) Compare Newtorian, Lagrangian and Hamiltomian formulation and discuss the advantages and disadvantages of each. 5

3) Deduce poiseuille's formula for the flow of a viscous fhid through a narrow harozontal fube mentioning the terms. 5

4) Derive and explain continuity equation. Justify the statement "two streamline can not intersed."3+2

5) Deduce an expression for the viscous drag (stokes law) by the method of dimension in the case of a small sphere falling through a viscous siquid. State the assumptions clearly. 5

6) State and explain the virial theorem. 5

7.a) Consider the Lagrangian, $L = a\left(\frac{dx}{dt}\right)^2 + b\left(\frac{dy}{dt}\right)^2 + cxy$

Where *a*, b, c are constants. If p_x and p_y are the momenta conjugate to the co-ordinates *x* and y respectively. Find the expression of Hamiltomian in $H\left(p_x,\ p_y,\ x,\ y\right)$ form.

b) An inextensible string of nyligible mass hamging over a smooth peg β connects one mass m_1 on a frietionless inclined plane of any be θ to another mass m_2. Find the eqnilibrium condition using DAlembert's principle. 2+3

8.a) Using Hamiltoris equation of motion, show that Hamiltonian,

$$H = \frac{p^2}{2m}e^{-\gamma t} + \tfrac{1}{2}m\omega^2 x^2 e^{-\gamma t}$$

leads to the equation of motion of a damped harmonic oscillator.

$$\ddot{x} + \gamma\dot{x} + \omega^2 x = 0$$

b) Write down the Hamiltorien and equation of motion for a simple pendulum. 3+2

Group - C

Answer any <u>two</u> from the following :- **2x10=20**

9.a) Derive the Lagrangian for a charged particle moving in an electromagnetic field.

b) Applying the theory of small oscillations, determine the eigen values and eigenvectors. For a linear triatomic molecule.

Discuss the different modes of vibrations of the molecule. 4+6

10) What are Laminar and turbulent flow ? Define streamline motion and stream line for fluid flow.

"Cocfficient of viscocity of glycerine is 8.4 poise" – Explain.

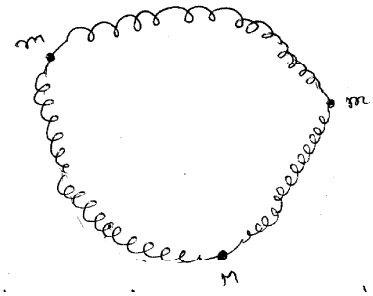
A plate of area 200cm^2 rests on a layer. of eastor oil of thickness 1mm.

The coefficient of viscocity of castor oil is 15.5 poise. Calculate the force requried to move the plate horizontally with a speed of 4cm/sec. 3+2+2+3

11.a) Derive Hamiltoris cannonical equations of mothion and hence define cyclic condinate.

b) A bead is stiding on a uniform rolating wire in a foce-free space, find its equation of motion.

12. Three point particles, two of mass m and one of mass M are connected to lie on a horizontal circle of radius r. They are mutually connected by springs, each of Constark K, that follow the are of the circle and that are of equal length when the system is at rest as shown in the following fig. Assume that stretches the springs only by a



Small amont from the equlibrium length $\left(\frac{2\pi r}{3}\right)$,

a) Describe qualitatively the modes of motion that are simple harmonic in time (the nromal modes).

b) find a precise set of normal coordinates, one corresponding to each mode.

c) find the frequency of each mode. 3+5+2