

Total number of printed pages - 7

63 (FY)SEM-1/MIN/PHYMIN1014

2025

**PHYSICS**

(MINOR)

Paper : PHYMIN1014

*(Mechanics)*

Full Marks : 50

Pass Marks : 20

Time : Two hours

***The figures in the margin indicate full marks for the questions.***

1. Choose the correct answer :  $1 \times 5 = 5$

(a) If  $\vec{A} \cdot \vec{B} = \vec{A} \times \vec{B}$  then the angle between  $\vec{A}$  and  $\vec{B}$  will be

(i)  $180^\circ$

(ii)  $90^\circ$

(iii)  $60^\circ$

(iv)  $45^\circ$

- (b) In physics, frames of reference are classified by two main types. These are
- (i) True and Frictional
  - (ii) Inertial and Non-Inertial
  - (iii) Fast and Slow
  - (iv) Real and Imagined
- (c) The time rate of change of momentum of a body is equal to
- (i) Displacement
  - (ii) Applied Force
  - (iii) Speed
  - (iv) Velocity
- (d) The modulus of elasticity is dimensionally equivalent to
- (i) Strain
  - (ii) Stress
  - (iii) Surface Tension
  - (iv) Poisson's Ratio

- (e) The relative velocity of Geo-stationary satellite with respect to Earth is

(i) 10 m/s

(ii) 15 m/s

(iii) zero

(iv) 1 m/s

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

- (a) Find the value of  $\lambda$  for which the two vectors  $2\hat{i} - \hat{j} - 2\hat{k}$  and  $3\hat{i} + \lambda\hat{j} + \hat{k}$  are perpendicular.

- (b) Define with examples

(i) Homogeneous differential Equation,

(ii) Non-homogeneous differential Equation.

- (c) In case of rotational motion of a particle, show that

Power = Torque × angular velocity.

- (d) What is 'Acceleration due to gravity'? Find the expression of it.
- (e) Deduce the expression for velocity of a particle executing simple harmonic motion (S.H.M) is given by

$$v = \pm w\sqrt{A^2 - x^2}$$

where  $y \rightarrow$  Displacement,  $w$  - Angular frequency  $A \rightarrow$  Amplitude.

- (f) Define Hook's law. Which co-efficient of elasticity deals with extension?
- (g) Show that, for a massless loaded spring the Potential Energy is

$$W_p = \frac{1}{2} kx^2$$

where  $k$  = force constant of spring

$x$  = displacement.

3. Answer **any five** of the following questions :  
5×5=25

- (a) Two vectors are given by

$$\vec{A} = 3\hat{i} + 4\hat{j} - 5\hat{k} \text{ and}$$

$$\vec{B} = -\hat{i} + 2\hat{j} - 6\hat{k}$$

Then find the following :

- (i) Length of  $\vec{A}$  and  $\vec{B}$ .
- (ii) Angle between  $\vec{A}$  and  $\vec{B}$ .
- (iii) Unit vectors along  $\vec{A}$  and  $\vec{B}$ .  
1+2+2=5
- (b) Define Frame of reference. Obtain Galilean Transformation equations.  
1+4=5
- (c) Write short notes on :  
(i) Global positioning System (GPS)  
(ii) Central Force
- (d) Deduce the expression for time period of a satellite around the earth is given  
by  $T = \frac{2\pi}{R} \sqrt{(R+h)^3/g}$   
R = Radius of Earth  
h = Height of the satellite from Earth surface  
g = Acceleration due to gravity
- (e) Define centre of mass. Find the expression for position vector of a system of N-particles. 1+4=5

(f) Define Angular Momentum. What is its dimensional formula? Establish the expression of Newton's second Law in rotational motion. 1+1+3=5

(g) What is Mechanical Energy? Find the Expression for Work-Energy Theorem. 1+4=5

(h) What is Mass-Energy Equivalence? Derive the relation of it and mention its significance. 1+2+2=5

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

(a) (i) Write down the characteristics of Simple Harmonic motion. (SHM) 2

(ii) Show that in case of a particle executing simple harmonic motion the average value of kinetic and potential Energy is same and it is given by,

$$(K.E)_{av} = (P.E)_{av} = \frac{1}{2} \times \text{Total Energy.} \quad 8$$

(b) (i) Write short note on 'Poisson's Ratio.' 2

(ii) Establish the relation connecting  $Y$ ,  $K$  and  $\sigma$ . i.e.

$$Y = 3K(1 - 2\sigma) \quad 8$$

where  $Y$  = Young's Modulus of Elasticity,

$K$  = Bulk Modulus of Elasticity,

$\sigma$  = Poisson's Ratio.