

**1S-PHY 101 - Physics Paper-I (Mechanics And Oscillations)**

P. Pages : 2

GUG/S/19/1218

Time : Three Hours



Max. Marks : 50

- Notes : 1. All questions are compulsory.  
2. Draw neat labelled diagram whenever necessary.

- 1.** Either
- a) i) What is meant by frame of reference? Distinguish between inertial and non-inertial frame of reference. Give one example of each. **3**
- ii) A reference frame rotating with respect to another frame with an angular velocity  $\bar{\omega}$ . Find the relation for acceleration. **4**
- iii) The motion of a particle is described by the equations  $x = 4 \sin 2t$  ;  $y = 4 \cos 2t$  and  $z = 6t$ . Find velocity and acceleration of the particle. **3**
- OR**
- b) i) What is gravitational self energy of a body? Why it has a negative value? **2**
- ii) Derive an expression for gravitational self energy of a uniform solid sphere. **5**
- iii) Find the gravitational self energy of sun if mass of sun =  $2 \times 10^{30}$  kg, radius of sun =  $7 \times 10^8$  m and  $G = 6.67 \times 10^{-11}$  Nm<sup>2</sup>/kg<sup>2</sup>. **3**
- 2.** Either
- a) i) What are Lissajou's figure? State any two application of it. **2**
- ii) A particle is subjected simultaneous to two SHM at different amplitude and same frequency acting right angle to each other. Find the general expression for the resultant motion. **5**
- iii) Obtain the expression for the resultant motion for the phase difference **3**
- a)  $0^\circ$                       b)  $\frac{\pi}{4}$                       c)  $\frac{\pi}{2}$
- OR**
- b) i) Define damped oscillation. **1**
- ii) Obtain differential equation and its solution for damped harmonic oscillator. **7**
- iii) A mass of  $25 \times 10^{-3}$  kg is suspended from the lower end of a vertical spring having a force constant 25 N/m. What should be the mechanical resistance of a system so that the motion of the mass is critically damped. **2**
- 3.** Either
- a) State Newton's law of motion and explain their limitation. **2½**
- b) Show that when no external force act on a body, the velocity of centre of mass is constant. **2½**
- c) Derive differential equation of linear simple harmonic motion. **2½**
- d) In an oscillatory circuit  $L = 0.5$  H  $C = 1.8 \mu$  F. What is the maximum value of resistance to be connected so that the circuit may produce oscillation. **2½**

**OR**

- e) State and explain Kepler's law of Planetary motion. 2½
- f) Define centre of mass and derive an equation of motion of centre of mass. 2½
- g) A torque of 400 Nm acting on a body of mass 40 kg produces an angular acceleration of 20 rad/sec<sup>2</sup>. Calculate moment of inertia and radius of gyration. 2½
- h) Derive an expression for the power dissipated in damped harmonic oscillation. 2½

4. Either

- a) A particle is moving along a curve in a plane. Derive an expression for its radial and transverse components of velocity. 2½
- b) The radius of earth is  $6.637 \times 10^6$  m and its mean density is  $5.57 \times 10^3$  kg/m<sup>3</sup>. Calculate the gravitational potential on the surface of earth. 2½
- $(G = 6.67 \times 10^{-11} \text{ Nm}^2 / \text{kg}^2)$
- c) Calculate the moment of inertia of a annular ring about an axis passing through its centre and perpendicular to its plane. 2½
- d) Derive differential equation of force harmonic oscillation. 2½

**OR**

- e) Find the maximum speed of a body of mass 2kg revolving in a circular path of radius 2m, if the centripetal force acting on it is 400 N. 2½
- f) Show that the rate of change of angular momentum of body is equal to torque acting on it. 2½
- g) Discuss the necessary condition for the interference of sound waves. 2½
- h) Explain the term 2½
- i) Quality factor ii) Band Width

5. Attempt **any ten** from the followings.

- a) Newton's first law of motion simply a special case of Newton's second law. Explain. 1
- b) Define frame of reference. 1
- c) Define centripetal force. 1
- d) State Newton's law of gravitation. 1
- e) Define torque. 1
- f) State principle of conservation of energy. 1
- g) What is beats? 1
- h) State the theorem of perpendicular axes for the moment of inertia. 1
- i) Define radius of gyration. 1
- j) Define resonance in oscillation. 1
- k) What is mean by dead beat motion? 1
- l) Define free oscillation. 1

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