

**USPHT02 - Physics Paper-II - Gravitation, Oscillation and Properties of Matter**

P. Pages : 2

Time : Three Hours

**GUG/S/25/11561**

Max. Marks : 50

**Either :**

1. a) i) Derive the expression of gravitational potential at a distance  $r$  outside the thin spherical shell. 5
- ii) Derive the expression for gravitational self energy of a body. 3
- iii) Calculate the gravitational potential of a spherical shell of mass 10 kg of radius 0.1m at a point 0.1m outside from the surface.  $\left(G = 6.67 \times 10^{-11} \text{ Nm}^2 / \text{kg}^2\right)$  2

**OR**

- b) a) State and explain Newton's law of gravitation. State its characteristics. 2½
- b) Define Gravitational field. Find the expression of gravitational field at a distance  $r$ . 2½
- c) Define angular momentum. Show that angular momentum is conserved under central force. 2½
- d) State and explain Kepler's law of planetary motion. 2½

**Either :**

2. a) i) Define simple harmonic motion. Obtain its differential equation of SHM and obtain its solution. 6
- ii) Obtain expression for period of simple harmonic oscillator. 2
- iii) Obtain an expression for total energy of a Particle performing SHM. 2

**OR**

- b) a) Obtain the differential equation of damped harmonic oscillator. 2½
- b) Explain free and damped oscillation with diagram. 2½
- c) Define quality factor. Obtain its expression in damped oscillation. 2½
- d) In an oscillatory circuit  $L = 0.5\text{H}$ ,  $C = 1.8\mu\text{F}$  what is maximum value of resistance to be connected so that the circuit may produce oscillations. 2½

**Either :**

3. a) i) Derive an expression for work done in stretching a wire. 4
- ii) Obtain an expression for Poisson's ratio in terms of elastic constants. 3

- iii) Find torque required to twist the wire of length 1m and diameter 1mm through an angle  $90^\circ$  [modulus of rigidity  $\eta = 2.8 \times 10^{10} \text{ N/m}^2$ ] 3

**OR**

- b) a) State and explain the Hooke's Law of elasticity. 2½
- b) Explain the types of modulus of elasticity. 2½
- c) Prove that  $\frac{9}{y} = \frac{1}{k} + \frac{3}{\eta}$  2½
- d) Find the stress and force required to double the length of wire of cross-sectional area  $0.5 \times 10^{-4} \text{ m}^2$  and  $y = 2 \times 10^{11} \text{ N/m}^2$  2½

**Either :**

4. a) i) What is surface tension? Give its molecular interpretation. 3
- ii) Derive Poiseuille's equation for the steady flow of liquid. 5
- iii) A pipe line 5 km long and diameter 4cm delivers water at the rate of 20 lit/sec. Calculate the pressure required to maintain the flow. 2

**OR**

- b) a) Distinguish between streamline and turbulent flow. 2½
- b) Obtain the equation of continuity for a flow of liquid. 2½
- c) Derive an equation for excess pressure inside a liquid drop. 2½
- d) A soap bubble of radius 10 cm is blown calculate the work done in blowing a soap bubble having surface tension 30 dyne/cm. 2½

5. Solve **any ten** of the following

- a) Define gravitational potential. Give its unit 1
- b) Define gravitational self energy. 1
- c) Define geosynchronous satellite. 1
- d) Define forced harmonic oscillation. 1
- e) Define resonant frequency. 1
- f) Define bandwidth. 1
- g) State the types of strain. 1
- h) State Poisson's ratio. 1
- i) Define elastic limit. 1
- j) Define critical velocity. 1
- k) Write statement of Bernoulli's theorem. 1
- l) Define surface energy. 1

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