

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

P. Pages : 3

Time : Three Hours

**GUG/W/23/11561 (S)**

Max. Marks : 50

**EITHER**

1. A) i) Obtain an expression for the gravitational potential due to a thin uniform spherical shell at a point outside, inside and on the surface of the shell. **7**
- ii) Calculate gravitational potential and intensity of thin spherical shell of mass 10 kg and radius 0.1 m at a point 0.2 m outside the surface. **3**

**OR**

- B) a) State the Kepler's laws of planetary motion. **2½**
- b) Obtain an expression for gravitational self energy of uniform solid sphere. **2½**
- c) What is Global Positioning System (GPS)? Give the basic idea of GPS. **2½**
- d) Find the gravitational self energy of the sun. Given  $G = 6.67 \times 10^{-11} \text{ Nm}^2 / \text{kg}^2$ , mass of the sun =  $2 \times 10^{30} \text{ kg}$ ; radius of the sun =  $7 \times 10^8 \text{ m}$ . **2½**

**EITHER**

2. A) i) Write differential equation for simple harmonic motion. **1**
- ii) Obtain the solution of SHM for displacement, velocity and acceleration. **4**
- iii) Show that total energy is constant in SHM. **3**
- iv) A mass of 1 kg is attached to a spring of stiffness constant  $16 \text{ Nm}^{-1}$ . Find the natural frequency. **2**

**OR**

- B) a) Derive expression for power absorbed by damped oscillator. **2½**
- b) Explain free oscillation, damped oscillation and forced oscillation. **2½**
- c) What is resonance? Explain sharpness of resonance. **2½**
- d) If the resonant frequency of the acoustic system is 280 Hz and half power frequencies are 200 Hz and 360 Hz respectively, calculate the quality factor. **2½**

**EITHER**

3. A) i) State Hooks law. Explain the terms Elastic limit, Yield point and Elastic fatigue. 3
- ii) Derive the relation between angle of twist and angle of shear. 2
- iii) Obtain an expression torque required for twisting of cylinder. 3
- iv) A wire of 0.5 m long and 1 sq mm in cross section area has Young's modulus of  $1.24 \times 10^{11} \text{ N/m}^2$ . How much work done in stretching it through 1 mm? 2

**OR**

- B) a) Derive the expression work done in stretching the wire.  $2\frac{1}{2}$
- b) What is Poisson's ratio? Write its expression and its limiting values.  $2\frac{1}{2}$
- c) Prove that  $\frac{9}{Y} = \frac{1}{K} + \frac{3}{\eta}$ .  $2\frac{1}{2}$
- d) Calculus rigidity of modulus for a given  $Y = 11.7 \times 10^{10} \text{ N/m}^2$  and Poisson's ratio  $\sigma = 0.35$ .  $2\frac{1}{2}$

**EITHER**

4. A) i) Define streamline and turbulent flow. 2
- ii) State and prove Bernoulli's theorem for a liquid along a stream line. 5
- iii) A pipe is running full of water. At a certain point A it tapers from 0.6 m diameter to 0.2 m diameter at B. The pressure difference between A and B is 1 m of water column. Find the rate of flow of water through the pipe. 3

**OR**

- B) a) Derive the equation of continuity.  $2\frac{1}{2}$
- b) Derive an equation for excess pressure inside a liquid drop.  $2\frac{1}{2}$
- c) Define angle of contact. Under what condition wetting is possible.  $2\frac{1}{2}$
- d) Calculus the excess pressure inside a soap bubble of radius  $3 \times 10^{-3} \text{ m}$ . Calculate surface energy if surface tension is  $20 \times 10^{-3} \text{ N/m}$ .  $2\frac{1}{2}$

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

- a) What is central force? 1
- b) Write any two characteristics Gravitational Force. 1

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| c) Define gravitational potential.                                 | 1 |
| d) Write unit and dimension of force constant.                     | 1 |
| e) Write the differential equation for damped harmonic oscillator. | 1 |
| f) Define quality factor and write the expression.                 | 1 |
| g) Define Young's modulus.   | 1 |
| h) Define stress and write its types.                              | 1 |
| i) Define angle of twist and angle of shear.                       | 1 |
| j) Define surface tension and give its SI unit.                    | 1 |
| k) What is critical velocity?                                      | 1 |
| l) Write the Poiseuilles flow equation                             | 1 |

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