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

P. Pages : 3

Time : Three Hours

GUG/W/23/11561

Max. Marks : 50

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Notes : 1. All questions are compulsory.
          2. Draw neat, well labelled diagrams wherever necessary.

Either

1. a) i)   Define gravitational field and gravitational potential. **2**

        ii) Obtain an expression for gravitational potential outside the spherical shell. **5**

        iii) The radius of earth is 6.4×10^6 m and acceleration due to gravity is $9.8 \, \text{m}/\text{s}^2$ Find the gravitational potential at a point. **3**
             1) On the surface of the earth.
             2) At a distance of SR from the surface of the earth.

OR

    b) a) 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**

        b) State Kepler's law of planetary motion. **2½**

        c) State the characteristics of central force. **2½**

        d) Explain in brief basic segment of GPS. **2½**

Either

2. a) i)   What is simple harmonic motion? **1**

        ii) Derive differential equation of S.H.M. **2**

        iii) Derive an expression for the total energy of a hormonic oscillator and show that the mechanical energy remains conserved. **4**

        iv) A particle performs SHM of period 10sec and amplitude 5cm. Calculate the maximum velocity and maximum acceleration. **3**

OR

    b) a) What are Damped and Force Harmonic oscillator? **2½**

        b) Derive an differential equation of damped harmonic oscillator. **2½**

        c) Derive an expression for power dissipation due to damping. **2½**

d) A mass of 25×10^{-2} kg is suspended from the lower end of a vertical spring having a force constant 25N/m. What should be the mechanical resistance of the system so that the motion of the mass is critically damped? **2½**

Either

3. a) i) Explain the behavior of strtching wire, with the help of stress-strain diagram. **3**

ii) What is Torsional pendulum? Obtain an expression for modulus of rigidity using Torsional pendulum. **4**

iii) What force is required to stretch a steel wire $\frac{1}{2}$ cm^2 in cross-section to double its length? $[y = 2 \times 10^{11} \text{N/m}^2]$ **3**

OR

b) a) Define Poisson's ratio: show that the theoretically values of σ lies between 0.5 to -1. **2½**

b) Define : **2½**
   i) Young Modulus
   ii) Bulk Modulus
   iii) Modulus of Rigidity

c) Obtain the relation **2½**
   $$\frac{9}{y} = \frac{1}{k} + \frac{3}{\eta}$$

d) Calculate the value of σ for brass given that for brass, **2½**
   $Y = 10 \times 10^{10} \text{N/m}^2$ and $K = 10 \times 10^{10} \text{N/m}^2$

Either

4. a) i) Distinguish between streamline flow and turbulent flow of a liquid? **2**

ii) Define viscosity and coefficient of viscosity. Write their units. **2**

iii) State and prove Bernoulli's theorem. **4**

iv) A pipe line 5kg long and diameter 4cm delivers water at the rate of 20lt/sec calculate the pressure to maintain the flow. (for water $\eta = 0.001 \text{Ns/m}^2$) **2**

OR

b) a) Derive equation of continuity. **2½**

b) Explain surface tension on the basis of molecular interpretation. **2½**

c) Explain any one application of Bernoulli's theorem. **2½**

d) Derive an expression for excess pressure inside the spherical bubble in air. **2½**

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

      a)   What is weightlessness?   **1**

      b)   Write the condition to set a satellite into circular orbit.   **1**

      c)   What is GPS?   **1**

      d)   Explain free hormonic oscillations.   **1**

      e)   What is Sharpness of resonance.   **1**

      f)   What is band width?   **1**

      g)   What is stress?   **1**

      h)   State Hooke's law.   **1**

      i)   What is Elastic Fatigue?   **1**

      j)   What is surface tension? State it's unit.   **1**

      k)   Define angle of contact.   **1**

      l)   What is Reynold number?   **1**

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