

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

P. Pages : 3

Time : Three Hours

**GUG/W/22/11561**

Max. Marks : 50

- Notes : 1. All questions are compulsory.
2. Draw neat and well labelled diagram wherever necessary.

Either:

1. a) i) Derive an expression for the gravitational potential due to thin spherical shell at a point: **6**
i) Outside ii) On the surface and iii) Inside the shell
- ii) Explain the term 'Global Positioning System' (GPS) **2**
- iii) Find the mass of sun from the following data: Radius of earth's orbit **2**
 $r = 1.5 \times 10^8 \text{ km. } (G = 6.67 \times 10^{-11} \text{ Nm}^2 \text{ Kg}^{-2})$

OR

- b) i) Explain the terms: Gravitational field and Gravitational potential. **2½**
- ii) Derive an expression for critical velocity required to set a satellite in a circular orbit. **2½**
- iii) Deduce an expression for gravitational self – energy of any uniform solid sphere. **2½**
- iv) Calculate the gravitational self – energy of the earth assuming its radius **2½**
 $6.37 \times 10^6 \text{ m. and mass to be } 5.98 \times 10^{24} \text{ kg. Given : } (G = 6.67 \times 10^{-11} \text{ Nm}^2 \text{ Kg}^{-2})$

Either:

2. a) i) Derive the differential equation of linear S. H. M. and solve it to show **5**
 $x = a \sin(wt + \phi)$
- ii) States Damped and force harmonic oscillations. **3**
- iii) A particle of mass 5 kg lies in a potential field $V = 8x^2 + 200$ Joules / kg. **2**
Calculate its time period.

OR

- b) i) Obtain an expression for the power dissipation in damped harmonic motion. **2½**
- ii) If the amplitude of a simple harmonic oscillator is doubled, then how does this affect **2½**
the time period, total energy and maximum velocity of the oscillator?
- c) Explain free, damped and forced harmonic oscillations. **2½**

- d) A man stands on a platform which vibrates simple harmonically in a vertical directions at a frequency of 5 Hertz. Show that mass loses contact with the platform when the displacement exceeds 10^{-2} meters 2½

Either:

3. a) i) What is torsion of cylinder? Derive an expression for the torque required to twist a given cylindrical wire through Q radian. 5
- ii) Show that for homogeneous isotropic medium: $Y = 3K(1 - 2\sigma)$ 3
- iii) A sphere of mass 0.8 kg and radius 3 cm is suspended by a wire 1.0m long of radius 0.5m. If the time for one torsional vibration 1.23 sec. Determine the modulus of rigidity of wire. 2

OR

- b) i) Find the expression for work done in stretching a wire under the load. 2½
- ii) Explain the behavior of wire under action of load with Stress – Strain diagram. 2½
- iii) State Poisson's ratio what are limiting values of Poisson's ratio, 2½
- iv) What couple is required to twist the wire of length 1 m and diameter 1 mm through an angle 90° . Modulus of rigidity = $2.8 \times 10^{10} \text{ N/m}^2$ 2½

Either:

4. a) i) Describe with necessary theory Poiseuille's method of determining the coefficient of viscosity of a liquid. State clearly the assumptions made. 6
- ii) Distinguish between stream line flow and turbulent flow of a liquid. 2
- iii) Water flows through a horizontal pipe line of varying cross – section. At a point where the pressure of water is 0.05 m of mercury the velocity of flow is 0.25 m/s. Calculate the pressure at another point where velocity of flow is 0.4 m/s. (Density of water = 10^3 kg/m^3) 2

OR

- b) i) Give an account of molecular theory of surface tension. 2½
- ii) Deduce an expression for the difference of pressure on the two side of a spherical drop. 2½
- iii) Derive an expression for the excess pressure inside a soap bubble in air. 2½
- iv) Calculate the excess pressure inside a soap bubble of radius $3 \times 10^{-3} \text{ m}$. Surface tension of soap solution $20 \times 10^{-3} \text{ N/m}$. Calculate the surface energy. 2½

5. Attempt **any ten** from following.

- a) State Kepler's laws of planetary motion. 1
- b) State Newton's law of Universal Gravitation. 1
- c) What is central force? Give at least one examples. 1
- d) Define Quality factor. 1
- e) What is resonance? Explain sharpness of resonance. 1
- f) What is damping coefficient? 1
- g) State Hooke's law 1
- h) Define Poisson's ratio. 1
- i) Define modulus of Rigidity. 1
- j) State any two applications of Bernolli's theorem. 1
- k) Explain wetting of a solid with a liquid 1
- l) Define Reynold's Number (K). 1
