Bachelor of Science (B.Sc.) First Semester

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

P. Pages : 3 **GUG/W/18/1218**

Time : Three Hours * 0 9 3 1 * Max. Marks : 50

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

1. Either

a) i) State Newton's laws of motion. Show that Newton's first law of motion is simply a special case of second law. Also discuss the limitations of Newton's laws of motion. **5**

ii) A particle is moving along a curve in a plane. Derive an expression for the radial and transverse components of velocity. **3**

iii) A point moving in a plane has co-ordinates x=3, y=4 and has components of speed $\dot{x} = 5\,\text{m/sec}$. and $\dot{y} = 8\,\text{m/sec}$. at some instant of time. Find the components of speed in polar co-ordinators r, θ along directions $\hat{r}$ and $\hat{\theta}$. **2**

OR

b) i) Explain the terms **3**
a) Gravitational field.
b) Gravitational intensity
c) Gravitational potential

ii) Derive an expression for gravitational potential and intensity due to thin spherical shell at a point, **5**
a) Outside the shell
b) On the surface of shell
c) Inside the shell.

iii) What will be the gravitational potential and intensity of a thin spherical shell of mass 10 kg and radius 0.1m at a point 0.2m outside its surface **2**
Given : $G = 6.67 \times 10^{-11}\,\text{Nm}^2/\text{kg}^2$.

2. Either

a) i) Define simple harmonic motion. Derive general differential equation of a simple harmonic oscillator and also obtain its solution. **6**

ii) Obtain the resultant of two S.H.M.s of same period executing in the same direction but differing in phase and amplitude. **2**

iii) Show that the number of beats produced is equal to the difference in the frequencies of the two sounding bodies. **2**

OR

b) i) What are damped vibrations. Establish the differential equation of motion for a damped harmonic oscillator and obtain an expression for displacement Discuss the case of underdamping $(k < w_o)$. **6**

ii) Obtain an expression for quality factor of damped harmonic oscillator. **2**

iii) Calculate the band width of an acoustic system having Q=1.75 and resonant frequency 280 Hz. **2**

3. Either

a) Distinguish between inertial and non-inertial frame of reference. Give the example of each. Is earth inertial frame? Why? **2½**

b) What is linear momentum. State and explain the principle of conservation of linear momentum with examples. **2½**

c) Find the expression for resultant motion of a particle subjected simultaneously to two S.H.M.s of same period but of different amplitudes and phases in perpendicular directions. **2½**

d) What is sharpness of resonance? Explain the effect of damping on sharpness of resonance. **2½**

OR

e) State kepler's laws of planetary motion. **2½**

f) Show that velocity of centre of mass of a system remains constant if no external force is applied on it. **2½**

g) Calculate the radius of guration of a solid sphere rotating about its diameter if its radius is 5cm. **2½**

h) Show that in driven oscillator, the maximum power is absorbed at the frequency of velocity resonance and not at the frequency of amplitude resonance. **2½**

4. Either

a) Find the maximum speed of a body of mass 2kg revolving in a circular path of radius 2m, if the centripetal force of 400N applied towards the centre of Girde. **2½**

b) Show that torque is the time rate of change of angular momentum. **2½**

c) Obtain an expression for the resultant of two S.H.M.s perpendicular to each other having different amplitudes and phases and having frequencies in the ratio 1:2. **2½**

d) What is forced harmonic oscillator. Derive differential equation of forced harmonic oscillator. **2½**

OR

e) What are central and non-central forces? Give three characteristics of each. **2½**

f) Two bodies of masses 2g and 10g have position vectors $3\hat{i}+2\hat{j}+\hat{k}$ and $\hat{i}-\hat{j}+3\hat{k}$ respectively. Find the position vectors and distance of centre of mass from the origin. **2½**

g) Give physical significance of moment of inertia. **2½**

h) Show that average power dissipation in damped harmonic oscillator is 2bE. **2½**

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

a) Give two examples each of central and non-central force. **1**

b) What is conservative force. **1**

c) Define centripetal force. **1**

d) Define centre of mass. **1**

e) What is radius of gyration. **1**

f) State law of conservation of angular momentum. **1**

g) What are Lissajous figures. **1**

h) What are beats. **1**

i) State principle of perpendicular axes for M.I. **1**

j) Define quality factor of damped harmonic oscillator. **1**

k) Give two examples each of damped and forced harmonic oscillator. **1**

l) Define band width. **1**

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