

B.Sc. First Year (NEP Pattern) Semester-I
BSCPH501 / STUG01PHY001 - (Core) - Physics - Mechanics

P. Pages : 3

Time : Two Hours



GUG/W/24/15916(S)

Max. Marks : 40

- Notes :
1. Draw neat, well labelled diagrams wherever necessary.
 2. All questions are compulsory.
 3. Scientific calculator allowed in exam.

Either:

1. a) i) Find the expression for work done in stretching a wire under the load. 2
- ii) What is torsion of cylinder? Derive an expression for the torque required to twist a given cylindrical wire through an angle θ . 4
- iii) One end of a steel wire of length 0.2 m and radius 2×10^{-3} m is fixed. If the work done in twisting the free end of the wire is 3.85×10^{-2} J. Calculate the angle through which the wire is twisted. Given rigidity modulus of steel $= 8.075 \times 10^{11} \text{ Nm}^{-2}$. 2

OR

- b) a) Explain Poisson's ratio. 2
- b) Assuming the relations between k and η in terms of y and G . Prove that $\frac{9}{y} = \frac{3}{\eta} + \frac{1}{k}$. 2
- c) Obtain the relation : $y = 3k(1 - 2\nu)$ 2
- d) Calculate the value of Poisson's Ratio for brass, from the following data : 2
 $y = 10 \times 10^{10} \text{ N/m}^2$ and $k = 10 \times 10^{10} \text{ N/m}^2$.

Either:

2. a) i) Derive a differential equation of motion of a simple harmonic and obtain its solutions. 5
- ii) A body of mass 2kg is suspended from spring of negligible mass and is found stretch the spring 0.1 m. What is its force constant and time period? 3

OR

- b) a) Differentiate between elastic and inelastic collision. 2
- b) Consider two bodies of masses 10 kg and 8 kg and their respective velocities are 5 m/s and 6 m/s. Find the final velocity after elastic collision. 2

- c) Write the application of elastic collision. 2
- d) Explain the phenomenon of perfectly inelastic collision in one dimension between two particles. 2

Either:

- 3. a) i) Define Gravitational field and gravitational potential. 2
- ii) Derive an expression for gravitational potential due to uniform thin hollow spherical shell at a point. 6
 - a) Outside the shell
 - b) On the surface of the shell
 - c) Inside the shell

OR

- b) a) State Newton's Law of gravitation. What is meant by gravitational constant? 2
- b) Deduce the equation of motion of the centre of mass. 2
- c) State the principle of conservation of linear momentum. 2
- d) Two bodies of masses 2g and 10g have position vectors $(3\vec{i} + 2\vec{j} - \vec{k})$ and $(\vec{i} - \vec{j} + 3\vec{k})$ respectively. Find the position vectors and the distance of centre of mass from the origin. 2

Either:

- 4. a) i) Derive in Lorentz space-time transformation equations and write its inverse transformation equations. 6
- ii) As measured by a stationary observer a flash bulb goes off at $x = 100\text{ km}$, $y = 10\text{ km}$, $z = 1\text{ km}$ at $t = 5 \times 10^{-4}$. What are the coordinates of this event as determined by another observer moving relative to the stationary observer with a velocity $0.8 C$ along the common $x - x'$ axis. 2

OR

- b) a) Establish the Einstein's mass energy relation $E = mc^2$. 2
- b) Differentiate between Inertial and non-inertial frame of reference. 2
- c) Explain postulates of special theory of relativity. 2
- d) A rocket of rest mass 8000 kg is travelling at a velocity of $0.6 C$. Find its relativistic mass. 2

5. Attempt **any eight** questions from the followings.

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|---|---|
| a) What is Torsional Pendulum? | 1 |
| b) Define Young's Modulus. | 1 |
| c) Define Modulus of rigidity. | 1 |
| d) Define perfectly elastic collision. | 1 |
| e) What is Simple Harmonic motion? | 1 |
| f) Define Collisions. | 1 |
| g) What is Gravitational self energy of a body? | 1 |
| h) Define central force. | 1 |
| i) State moment of Inertia. | 1 |
| j) Define frame of Reference. | 1 |
| k) What is proper length? | 1 |
| l) State constancy of speed of light. | 1 |
