I Semester B.Sc. Examination, November/December 2015
(Semester Scheme) (CBCS/NS) (2011-12 and Onwards)
PHYSICS – I
Mechanics, Oscillations and Properties of Matter

Time : 3 Hours

Max. Marks : 70

Instruction : *Answer five questions from each Part.*

PART – A

Answer **any five** questions. **Each** question carries **eight** marks. (5×8=40)

1. a) State and explain Newton's second law of motion.
   b) What is meant by static friction ? Explain derive the relation between coefficient of static friction and angle of repose. (2+6)

2. a) State the postulates of special theory of relativity.
   b) Using Lorentz transformation equations, explain. (1) Length contraction (2) Time dilation. (2+6)

3. a) State Kepler's laws of planetary motion.
   b) What is a geostationary satellite ? Arrive at an expression for orbital velocity of a satellite orbiting round the earth in a circular orbit at a height h above the surface of the earth. (3+5)

4. a) State and explain work energy theorem.
   b) Derive an expression for the pressure difference across a curved liquid surface. (3+5)

5. a) Define centre of mass of a system of particles. Arrive at an expression for the position vector of the centre of mass of a system of particles.
   b) Show that the linear momentum of a system of particles is equal to the product of the mass of the system and the velocity of the centre of mass. (4+4)

6. a) Derive an expression for the moment of inertia of a circular disc about an axis passing through its centre and perpendicular to its plane.
   b) State and explain the principle of conservation of angular momentum. Mention two examples to illustrate the conservation of angular momentum. (4+4)

7. a) What is a compound pendulum ? Derive expressions for its time period and the length of the equivalent simple pendulum.
   b) What is a coupled oscillator ? Mention the two normal modes of a coupled oscillator. (6+2)

8. a) Distinguish between elastic and plastic bodies.
   b) Derive an expression for the couple per unit twist of the material of a wire fixed at one end and twisted at the other. (2+6)

P.T.O.

PART – B

Solve **any five** of the following problems. **Each** problem carries **four** marks.   (5×4=20)

9. A block slides down an inclined plane, inclined at an angle 30° to the horizontal with an acceleration 0.3 g. Calculate the coefficient of kinetic friction.

10. An electron of rest mass 9.1×10^{-31} kg moves with a velocity of 0.99 C where $C = 3 \times 10^8$ ms^{-1}. Calculate its total energy.

11. A constant force $(4\hat{i} + 2\hat{j} + 3\hat{k})$ N acts on a particle and displaces it from a position $(3\hat{i} + 2\hat{j} - 6\hat{k})$ m to a position $(15\hat{i} + 13\hat{j} + 9\hat{k})$m. Calculate the work done by the force.

12. The radius of a soap bubble is increased from 0.01 m to 0.03 m by blowing air. Calculate the increase in surface energy of the soap film. Given surface tension of soap solution is 0.026 Nm^{-1}.

13. A body of mass 10 kg moves with a velocity 32 ms^{-1}. It collides with another body of mass 80 kg moving in the same direction with a velocity of 4 ms^{-1}. After collision, the first body moves with a velocity of 17.8 ms^{-1} in the opposite direction. What is the velocity of the second body after collision ?

14. Calculate the moment of inertia of the earth about its diameter. Given that the earth is a sphere of uniform density 5520 kgm^{-3} and its radius is 6.4×10^6 m.

15. Calculate the total energy of a simple harmonic oscillator of mass 0.025 kg having an amplitude 0.2 m and frequency of oscillation 10 Hz.

16. A steel wire of length 2m and radius 0.4 mm stretches by 0.5 mm when a mass of 2.5 kg is hung from its lower end. Calculate the Young's modulus of steel. Assume g = 9.8 ms^{-2}.

PART – C

Answer **any five** of the following. **Each** question carries **two** marks.   (5×2=10)

17. a) Can action and reaction pair of forces cancel each other ? Explain.

    b) A moving clock ticks slowly. Explain.

    c) Two artificial satellites of the earth having masses M and 2 M have the same orbital radius. Which one will have a greater orbital velocity ? Why ?

    d) Small insects are able to freely move on the surface of water. Justify.

    e) A light body and a heavy body have the same kinetic energy. Which one has a larger linear momentum ? Why ?

    f) What is the torque on a body when the force is applied in the direction of the radius vector ?

    g) A body executes simple harmonic motion about an equilibrium position. At which position is its velocity maximum ? Why ?

    h) Springs are made of steel and not of copper ? Why ?

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