11121

B.Sc. I Semester Degree Examination, November/December 2016
PHYSICS
Paper – 1.1 : Mechanics and Properties of Matter

Time : 3 Hours Max. Marks : 80

Instructions : 1) *Section – **I** is **compulsory**.*
2) *Answer **any four** questions from Section – **II** and **any four** from Section – **III**.*

SECTION – I

1. Answer **any twelve** of the following : **(12×1=12)**

A) Choose the correct answer :

i) Newton's laws of motion are valid in
   a) Inertial frame of reference
   b) Non-inertial frame of reference
   c) Both a and b
   d) None of these

ii) The bar pendulum is used to find
   a) The acceleration due to gravity
   b) Radius of gyration
   c) Moment of inertia of the bar
   d) All the above

iii) In an inelastic collision
   a) Momentum is conserved
   b) Energy is conserved
   c) Both a and b
   d) None of these

iv) The sucking of oil in a wick of a oil lamp is due to
   a) Viscosity
   b) Adhesion
   c) Gravitation
   d) Surface tension

B) Fill in the blanks :

i) Length is _____ under Galilean transformation.

ii) Centrifugal force is _____ force.

iii) For an elliptical orbit, the eccentricity is

C) State **true** or **false** :

i) The angular momentum of rigid body about an axis is the product of moment of inertia and the angular velocity of the body about that axis.

ii) The motion of the rocket can be explained on the basis of Newton's third law of motion and the momentum principle.

iii) A line obtained by the inter-section of neutral surface and plane of bending is called neutral axis.

D) Answer the following in **one** or **two** sentences :

i) What is centrifugal force ?

ii) What is central force ?

iii) State Newton's law of gravitation.

iv) State Stoke's law of viscosity.

SECTION – II

Answer **any four** of the following : **(4×4=16)**

2. Show that the law of conservation of linear momentum is invariant to Galilean transformation.

3. State and prove perpendicular axes theorem.

4. What is centripetal force ? Derive an expression for centripetal force.

5. State and derive Kepler's III law of planetary motion.

6. Derive an expression for twisting couple per unit twist of the wire or cylinder.

7. Derive the expression for gravitational potential at a point due to unit mass.

SECTION – III

Answer **any four** of the following : **(4×13=52)**

8. a) What is Coriolis force ? Derive an expression for Coriolis force acting on a body.

b) Calculate the fictitious force and the observed force on a body of mass 5 kg

9. a) Obtain an expression for the moment of inertia of a solid cylinder about
   i) an axis through its centre and perpendicular to its length
   ii) its own axis parallel to the length.

   b) A circular ring of mass 4 kg and radius 0.02 m rotates about an axis passing through its centre and perpendicular to its plane. Calculate its moment of inertia and radius of gyration. **(9+4=13)**

10. a) Derive the expression for the radial and transverse component of velocity and acceleration of a particle executing uniform circular motion.

    b) An aircraft of mass 18×10^3 kg flies in a horizontal circle of radius 0.5 km with a speed of 83.33 m/s. Find the horizontal thrust of the air upon the aircraft. **(9+4=13)**

11. a) What is inelastic collision ? Derive equations for velocities of two particles in inelastic collision in one dimension with respect to laboratory and centre of mass frame of reference.

    b) An empty rocket weighs 5000 kg and contains 40000 kg of fuel. If the exhaust velocity of the fuel is 2 km/sec, find the maximum velocity gained by the rocket.

    [Ignore the effect of gravity] **(9+4=13)**

12. a) Deduce the relation between Young's modulus, Bulk modulus, Rigidity modulus and Poisson's ratio.

    b) Calculate the twisting couple on a solid shaft of length 1.5 m and diameter 120 mm when it is twisted through an angle 0.6°. The rigidity modulus for the material of the shaft may be taken to be 9.3×10^{10} N/m^2. **(9+4=13)**

13. a) Define co-efficient of viscosity. Derive Poiseulle's equation for the flow of liquid through capillary tube.

    b) Calculate the excess pressure inside a soap bubble of radius 3×10^{-3} m. Surface tension of soap solution is 20×10^{-3} Nm^{-1}. **(9+4=13)**
