ET-105(A)

B.Tech. Civil (Construction Management) / B.Tech. Civil (Water Resources Engineering) / BTCLEVI / BTMEVI / BTELVI / BTECVI / BTCSVI

Term-End Examination

□□592   **June, 2018**

ET-105(A) : PHYSICS

Time : 3 hours   *Maximum Marks : 70*

Note : *Attempt* **all** *questions. Internal choices are provided. Assume missing data suitably, if any. Symbols have their usual meanings. Use of scientific calculator is permitted.*

1. (a) A ball is launched vertically upwards with a speed of 40 m/s. What is its velocity at a height of 35 m from the ground ? How much time does it take to reach this height ? $(g = 10 \text{ m/s}^2)$ 6

OR

A coin is sitting at the bottom of a glass tumbler filled with a liquid of refractive index μ. If the height of the water column is t, calculate the apparent shift in the position of the coin.   6

(b) Find the force between the two parallel current carrying conductors of the same length and carrying current of the same magnitude. *4*

(c) Find the moment of inertia of a square of side A about its diagonal. *4*

OR

A particle is under the influence of two SHMs along x and y directions. If their amplitudes are equal, show that the particle moves along a circle when the phase difference between the oscillations is $\pi/2$. *4*

2. (a) The position coordinates of two particles are $\vec{r_1}$ and $\vec{r_2}$. Write down the expression for the gravitational force between them. Is gravitational force a conservative force ? Why ? *6*

OR

A 10 kg block rests on a horizontal surface. A horizontal force of 4g N is necessary to start the block moving on the surface while a force of 2g N is sufficient to keep it moving with constant speed. Find the coefficients of kinetic and static friction. *6*

(b) Obtain the expression for the energy of a parallel plate capacitor. Show that this energy is due to the electric field within the plates of the capacitor. *4*

(c) Find the equation of the path of the resulting motion of two perpendicular SHM whose equations are x = 5 cos ωt and x = 4 cos (ωt + φ), where φ takes following values : (i) π/2, and (ii) π. In each case draw the Lissajous figure. *4*

OR

A particle is moving in a circular orbit. Show that its velocity is changing at each point of the orbit. Find the expression for the force responsible for keeping the particle in the circular orbit. *4*

3. (a) Sketch how a pulse travelling along a string gets reflected from (i) a rigid boundary, and (ii) a free boundary. What is the phase relation between the incident and reflected pulses in the two cases ? *4*

OR

State Ampere's law. Use it to get an expression for the magnetic field due to a long straight current carrier at a distance r from it. *4*

(b) Two identical metal spheres have charges q_1 and q_2. They are separated by a distance r. They are made to touch each other and then separated by the same distance r. Show that the force between them is now greater than before. *6*

(c) Define a wavefront. Prove laws of refraction using Huygens principle. 4

OR

2N + 1 number of sheets are stacked together, each with its axis rotated by $\pi/4$ N with respect to the preceding one. The first and last sheets are polarizers; the remaining are half-wave plates. If the incident light on the first sheet is unpolarized, find the ratio of the intensity of the emergent light to the incident light. 4

4. (a) An electron moves in a circular orbit with a uniform speed v. It produces a magnetic field of magnitude B at the centre of the circle. Show that the radius of the circle is proportional to $\sqrt{v/B}$. 4

OR

Define an elastic collision. A particle collides with another particle at rest. The two stick together. If the collision is elastic and masses of the particles are equal, find the velocity of the sticking particles. 4

(b) Define a magnetic dipole. Derive an expression for the field at a point on the axis of the dipole in terms of its magnetic moment. *4*
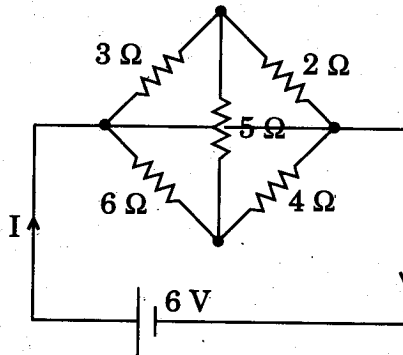
(c) Find the capacitance between points A and B in the following network of capacitors :

Each capacitor is of capacity 2 μF. *6*
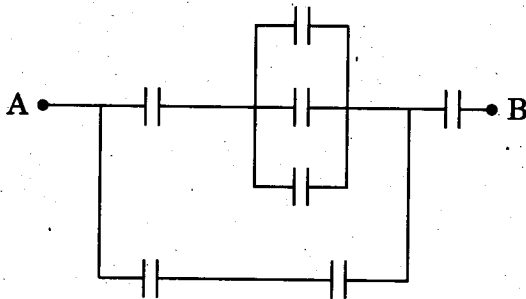
OR

In the following network, find I. *6*

5. (a) Define moment of inertia and its physical meaning. Derive an expression for the moment of inertia of a cylinder about an axis along the axis of the cylinder. *6*

OR

Distinguish between diamagnetic, paramagnetic and ferromagnetic materials. Explain why ferromagnetic materials can be strongly magnetized. What happens when a ferromagnetic material is heated ? *6*

(b) Explain coherent sources. Derive an expression for the spacing between fringes in a double-slit interference pattern. *4*

(c) Define a wave. Distinguish between transverse and longitudinal waves. Why is it that only transverse waves can be polarized ? *4*

OR

Find the acceleration due to gravity at a height of 100 km from the surface of the Earth. *4*