No. of Printed Pages : **6** | **ET-105(A)**

B.Tech. Civil (Construction Management) / B.Tech. Civil (Water Resources Engineering)

BTCLEVI/BTMEVI/BTELVI/BTECVI/BTCSVI

Term-End Examination

June, 2013

01364

ET-105(A) : PHYSICS

Time : 3 Hours | *Maximum Marks : 70*

Note : *All questions are **compulsory**. Symbols have their usual meanings. Use of scientific calculator is **permitted**.*

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1. Attempt *any five* of the following : 5x4=20

(a) Explain how the first law of motion may be said to be contained in the second law of motion.

(b) Show that the position vector $\vec{r}_{cm}$ of the centre of mass of a system of particles is independent of the choice of the origin.

(c) In the case of a rigid body rotating about an axis fixed in space, show that

$$\vec{v} = \vec{w} \times \vec{r}$$

(d) A pendulum clock has a time period of 2s. If its length decreases by 2%, how fast would the clock be in 24 hours ?

(e) Light from a point source passes through slits of various sizes. Sketch how light appears on a screen kept at some distance from the slits as the slit width decreases.

(f) Define an electric dipole. Sketch the electric field lines due to a dipole.

(g) A point charge 8 μC is placed at the origin. Find the potential differences between the points A(0, 0.6, 0) and B(0, 0, −0.8).

(h) Investigate if vector

$\vec{A} = \hat{i}\ x^2 y - \hat{j}\ yza + \hat{k} a^2 z$ can represent a field of magnetic induction.

2. Attempt **any two** of the following : **2x5=10**

(a) A car is travelling with a constant speed of 60 km/hr. It has to negotiate a turn of radius 50 m. If the coefficient of friction between the car tyres and the road is 0.4, would the car be able to negotiate the turn without sliding. (Take $g = 10\ m/s^2$).

(b) Define gravitational potential energy. Calculate the gravitational potential energy of a particle of mass m located in the vicinity of the earth's surface. How can you find gravitational force on the particle from this expression ?

(c) State Kepler's laws of planetary motion. Prove the second law.

3. Attempt **any two** of the following : **2x5=10**

(a) Define moment of inertia of a body and discuss its physical significance.

Calculate the moment of inertia of a uniform solid sphere about an axis which is tangential to the sphere.

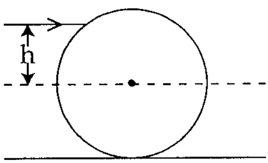
(b) Show that for a system of particles

$$\vec{\tau}_c = \frac{d\vec{L}_c}{dt}$$

Where the subscript c refers to the centre of mass of the system.

(c) A billiard hall of mass m and radius R is hit by a cue at a distance h above the centre (see figure).

As a result the hall acquires a speed v_0 immediately after the impact. Describe its subsequent motion. What happens if h>2R/5 ?



figure

4. Attempt **any two** of the following : **2x5=10**

(a) Write down the equation of motion of a damped oscillator and solve it. Explain when the oscillator is under - damped and when it is over - damped.

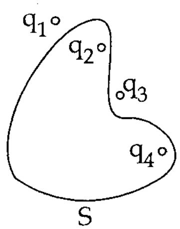
(b) Describe Young's double slit experiment. Get an expression for the intensity of light on the screen as a function of the distance from the centre of the screen.

(c) Explain what is meant by the polarization of light.

Calculate the thickness of a half - wave calcite plate for light of wavelength 589 nm, given that $\mu_o = 1.658$ and $\mu_e = 1.486$.

5. Attempt **any two** of the following : **2x5=10**

(a) State Gauss' law in electrostatics. Find the flux through the surface S in the following figure with charges as shown.

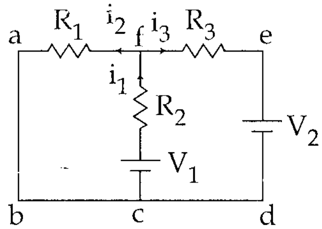


Show that the magnitude of the electric field due to a point charge q at a distance r from it is

$$E = \frac{q}{4\pi\epsilon_0 r^2}$$

(b) Define electric potential at a point. Derive an expression for the electric potential due to a spherical shell of surface charge density σ.

(c) State Kirchoff's rules. Calculate currents i_1, i_2 and i_3 in the circuit given below :



Take $R_1 = \frac{10}{3}\ \Omega$, $R_2 = 20\ \Omega$, $R_3 = 10\ \Omega$, $V_1 = 25$ V and $V_2 = 10$ V. Neglect the internal resistance of the cells.

6. Attempt **any two** of the following : **2x5=10**

(a) State Biot - Savart law. Derive an expression for the $\vec{B}$ - field due to a straight current. Sketch the lines of force of this $\vec{B}$ - field.

(b) Write down the expression for the force acting on a charged particle moving in an electric and magnetic field.
A particle of mass m and charge q is projected with an arbitrary velocity $\vec{v}$ in a uniform $\vec{B}$ field. Sketch the motion of the particle.

(c) Derive an equation governing the propagation of an electromagnetic wave. What is the velocity of the wave ? Sketch a plane electromagnetic wave propagating along the z - axis.

Constants :

$$\frac{1}{4\pi\epsilon_0} = 9.0 \times 10^{9} \ \mathrm{Nm^2C^{-2}}$$

$$\mu_0 = 4\pi \times 10^{-7} \ \mathrm{Hm^{-1}}$$
