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

BTCLEVI/BTMEVI/BTELVI/BTECVI/BTCSVI

Term-End Examination

December, 2013 01850

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**. Assume missing data suitably, if any.*

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

(a) What do you mean by impulse ? An aeroplane weighing 60,000 kg can fly at a maximum velocity of 800 km/h. Its engine develops a total thrust of 75 KN. Ignoring air resistance, fuel consumption and change in altitude, how long does the plane take to reach the maximum velocity starting from rest.

(b) Differentiate between conservative and non-conservative forces giving suitable examples. Show that the force $\vec{F} = \left(y^2 - x^2\right)\hat{i} + 2xy\,\hat{j}$ is a conservative force.

(c) Define angular momentum and give its unit. Show that when a particle is moving under the influence of a central force, its angular momentum remains conserved.

(d) Give the conditions necessary for a oscillatory motion to be called Simple Harmonic Motion. A body of mass 0.2 Kg undergoes SHM given by

$$x = 6 \times 10^{-4} \sin(4t - 0.4)$$

where x is in meter and t is in seconds. Find the potential energy at the end of the swing.

(e) What are coherent sources of light ? Why independent sources of light can not be coherent ?

Name the two methods of obtaining coherent sources in inter ferometers.

(f) Define 'drift velocity'. A current of 1A passes through a copper wire of radius of cross section 1mm. Find the current density and the drift velocity of electron.

(g) What do you mean by crossed electric and magnetic fields ? Electrons are accelerated at an accelerating potential of 150 Volt. At what fraction of the speed of light the electrons are moving ?

(h) State Gauss's Law. Two large metal plates of area 5.0 m^2 face each other. They are 5.0 cm apart and carry equal and opposite charges on their inner surface. If E between the plate is 55 N/C, what is the charges on the plates ? Neglect edge effects, i.e, treat the plates to be infinite.

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

(a) (i) State and explain Hooke's law. Name the factors on which the spring constant is dependent.

(ii) Differentiate between static and kinetic frictions.

(b) A 5 kg block rests on a horizontal surface. A horizontal force of 2gN is necessary to start the block moving on the surface while a force of 1.5 gN is sufficient to keep the ball moving with a uniform speed, once it is set into motion. Calculate the coefficient of kinetic and static friction.

(c) A body of mass m slides down on inclined plane (inclination angle θ) with its coefficient of kinetic friction μ. Show that the acceleration of the body is given by

$$a = g\ (\sin\theta - \mu\cos\theta)$$

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

(a) Obtain an expression for the moment of inertia of a uniform bar of length a, width b and mass m about an axis perpendicular to its plane and passing through its centre.

(b) What is 'Compound pendulum' ? Discuss the motion of a compound pendulum and obtain an expression for its time period.

(c) Show that the total energy of a body undergoing SHM remains constant and is independent of both displacement and time.

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

(a) What do you mean by 'damped oscillations' ? Discuss the motion of a damped oscillator ? What do you mean by over damped oscillations ?

(b) Define 'quality factor' of an oscillator. Quality factor of an oscillator is 1500. On starting the oscillations, it executes 250 vibrations per second. Calculate the time in which the amplitude decreases to $\frac{1}{e^3}$ of the initial value.

(c) What is 'resonance' ? Give any three examples of resonance occurring in our daily life. How the phenomenon of resonance is involved in the tuning of a radio receiver.

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

(a) What is an electric dipole ? Obtain an expression for the potential energy of an electric dipole is an electric field. Hence conclude what is the minimum potential energy configuration of the dipole in the field.

(b) State Gauss's law and Coulomb's laws. Obtain Coulomb's law from Gauss's law.

(c) An electric field in a region is radially outward with magnitude $E = Ax$. Calculate the charge contained in a sphere of radius 20 cm from the origin. (Take $A = 100$ N/cm)

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

(a) State Ampere's law and obtain it for an infinitely long straight current i.

(b) A cyclotron accelerates protons to 10 MeV energy (and hence increases ν to 4.38×10^7 m/s) with a maximum orbital radius of 40 cm. (i) calculate the value of the applied magnetic field and (ii) find the frequency of the applied ac supply.

(c) A solenoid of length 50 cm and 60 turns/cm has cross section area 6 cm^2. Calculate the work done in establishing a current of 100 mA in the solenoid. Also calculate the energy density in the interior volume for this current.

Constants

Mass of an electron $= 9.1 \times 10^{-31}$kg

Charge on an electron $= 1.6 \times 10^{-19}$C

$\epsilon_o = 8.85 \times 10^{-12}\ C^2/N - m^2$

$$\frac{1}{4\pi\epsilon_o} = 9 \times 10^9\ Nm^2/C^2$$

$\mu_o = 4\pi \times 10^{-7} N/A^2$