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ET-105(A)

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

**Term-End Examination**

**December, 2015**

**ET-105(A) : PHYSICS**

*Time : 3 hours*

*Maximum Marks : 70*

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*Note : Attempt all questions. Internal choices are provided. Assume missing data suitably, if any. Use of scientific calculator is allowed.*

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1. (a) Compare the electric and gravitational forces that exist between an electron and a proton. 6

**OR**

Explain Gauss law. A uniformly charged sphere has a total charge of  $300 \mu\text{C}$  and a radius of 8 cm. Find the electric field at 6

- (i) a point 16 cm from the centre of the sphere.
- (ii) a point on the surface of the sphere.
- (iii) a point 4 cm from the centre of the sphere i.e. at a point inside the sphere.

(b) Three capacitors are connected in series across a 75 volts supply. The voltage across them are 20, 25 and 30 volts respectively. The charge on each capacitor is  $3 \times 10^{-3}$  C. Find the capacitance of each capacitor and also of the combination.

4

(c) A current of 1 A passes through a copper wire of radius of cross-section 1 mm. Find the current density and the drift velocity of electron. The atomic weight of copper is 63.55, density 8.96 gm/cc. Avogadro's number is  $6.022 \times 10^{26}$  atoms.

4

**OR**

State and explain Kirchhoff's rule for electrical circuits.

4

2. (a) A particle of mass 0.5 kg is executing Simple Harmonic Motion. The period of oscillation is 0.1 s and the amplitude is 0.1 m. Calculate

- (i) the force
- (ii) spring constant
- (iii) potential energy

6

**OR**

Explain the theory of diffraction grating and derive expressions for maxima and minima.

6

(b) The critical angle ( $\theta_c$ ) for the total internal reflection in case of water is  $48^\circ$ . What is its polarization angle? What is the angle of refraction corresponding to this polarization angle? 4

(c) A thin film has a refractive index 1.45. Determine its minimum thickness if it appears black on reflection.  
( $\lambda = 6 \times 10^{-7}$  m) 4

**OR**

Explain ordinary ray (O-ray) and extraordinary ray (E-ray). 4

3. (a) Define moment of inertia. Find the moment of inertia of a solid cylinder about an axis which is normal to the axis of the cylinder and passes through the centre of mass. 6

**OR**

State and prove the parallel axis theorem and perpendicular axis theorem. 6

(b) A wheel with moment of inertia  $I = 10 \text{ kg-m}^2$  is spinning at 2 rev/s on its axis. How large is the frictional torque, if the wheel makes 40 revolutions before it comes to a stop? 4

- (c) A sphere of mass 0.5 kg and diameter 1 m rolls without slipping with a constant velocity of 5 m/s. Calculate its total energy. Take moment of inertia of sphere about one of its diameters as  $\frac{2}{5}MR^2$ . 4

**OR**

State and prove Work–Energy Theorem. 4

4. (a) State and explain Newton's law of motion. When two bodies interact only through mutual forces, show that the net momentum of the bodies does not change with time. 6

**OR**

Discuss one-dimensional elastic collisions between two bodies. 6

- (b) A particle is projected with an initial speed  $V_0$  at an angle  $\theta$  to the horizontal. Determine its angular momentum about the origin as a function of time. 4

- (c) In a nuclear fusion reaction, a deuteron of mass 2.01355 u and a triton of mass 3.01550 u combine to give a neutron of mass 1.00867 u and an alpha particle of mass 4.00150 u. Calculate the energy released in the process.

One atomic mass =  $931.5 \text{ MeV}/c^2$ .

4

**OR**

State Kepler's law of planetary motion.

4

5. (a) State and prove Ampere's law. What is the magnitude of force per 110 cm length of each of a pair of conductors of a direct current line carrying 10 Amperes and spaced 10 cm apart ?

6

**OR**

State and explain Faraday's law.

6

- (b) Two square loops of sides 1 cm and 2 cm are kept in the same plane with their centres 40 cm apart. Calculate the mutual inductance.

4

- (c) What is displacement current ? A parallel plate capacitor with circular plates of radius 10 cm separated by 5 mm is being charged by an external source. The charging current is 0.2 A. Find the displacement current and rate of change of potential difference between the plates. 4

**OR**

Discuss energy density in electromagnetic waves. Also define Poynting vector. 4

**Physical Constants :**

$$e = 1.6 \times 10^{-19} \text{ C}$$

$$\epsilon_0 = 8.854 \times 10^{-12} \text{ F/m}$$

$$\mu_0 = 4\pi \times 10^{-7} \text{ Wb/A-m}$$

$$G = 6.67 \times 10^{-11} \text{ N-m}^2/\text{kg}^2$$

$$\text{Avogadro's number} = 6.022 \times 10^{26} \text{ atoms}$$

$$m_e = 9.1 \times 10^{-31} \text{ kg}$$

$$m_p = 1.7 \times 10^{-27} \text{ kg}$$