

Attempt **FIVE** Questions in all, Select at least Two questions from each **Section**.

**SECTION-I**

- 1- a) What is an Electric Dipole? Derive an expression for electric field at a point P due to a dipole. 4  
 b) Calculate magnitude of the electric field; due to an electric dipole of dipole moment  $3.56 \times 10^{-29}$  C.m. at points 25.4nm away along the bisector axis. 3  
 c) A point charge is moving in an electric field at right angle to the lines of force. Does any force act upon it? 1
- 2- a) Define Gauss's Law and apply it to find electric field near an infinite line of charge. 4  
 b) The electric field just above the surface of the charged drum of a photocopying machine has a magnitude E of  $2.3 \times 10^5$  N/C. What is surface charge density on the drum if it is a conductor? 3  
 c) A spherical rubber balloon carries a charge that is uniformly distributed over its surface. As the balloon is blown up, how does E vary for a point inside the balloon? 1
- 3- a) Derive an expression for Absolute Electric Potential at a point in the field of a point charge. 4  
 b) Two protons in the nucleus of a  $U^{238}$  atom are 6.0fm apart. What is the potential energy associated with the electric force that acts between these two particles? 3  
 c) Do electrons tend to go to regions of high potential or of low potential? 1
- 4- a) Derive an expression for capacitance of a cylindrical capacitor. 4  
 b) The space between the conductors of a long coaxial cable, used to transmit TV signals, has an inner radius 0.15mm and outer radius 2.1mm. What is capacitance per unit length of this cable? 3  
 c) Capacitors often are stored with a wire connected across their terminals. Why is this done? 1

**SECTION-II**

- 5- a) Derive an expression for Torque acting on a current carrying coil of wire in a magnetic field. 4  
 b) A galvanometer coil is 2.1cm high and 1.2cm wide having 250 turns, rotates in a uniform radial magnetic field with  $B = 0.23$  Tesla. If a current of  $100\mu A$  produces an angular deflection of  $28^\circ = 0.49$  radian, what must be torsional constant  $\kappa$  of the spring? 3  
 c) Is B uniform for all points within a circular loop of wire carrying a current? Explain. 1
- 6- a) Discuss the behavior of AC in i) A resistive element ii) An inductive element 4  
 b) In an inductive circuit  $L = 230mH$ ,  $\nu = 60Hz$ ,  $(V_L)_{\max} = 36$  volts. Find 3  
 i) Inductive reaction ii) Current amplitude in the circuit  
 c) Why would power distribution system be less effective without alternating current? 1
- 7- a) By using Biot-Savart Law, derive an expression for magnetic field at the center of current carrying circular loop. 4  
 b) In the Bohr model of hydrogen atom, the electron circulates around the nucleus in a path of radius  $5.29 \times 10^{-11}$  m at a frequency of  $6.63 \times 10^{15}$  Hz. 3  
 i) What value of B is set up at the center of the orbit? ii) What is the equivalent magnetic dipole moment?  
 c) Wires that carry equal but opposite current are often twisted. How does this act reduce the magnetic effect at a distant point? 1
- 8- a) State and express mathematically the Faraday's Law of electromagnetic induction for a coil of N turns. Also explain the significance of negative sign. 4  
 b) An automobile having a radio antenna 110cm long enters in a region where Earth's magnetic field is  $55\mu T$ . What must be the minimum speed of the automobile so that maximum emf upto 1.51mV is induced? 3  
 c) Justify that 1 volt = 1 weber / s. 1
- 9- a) Derive an expression to calculate Inductance per unit length of an air cored Solenoid of length 'l' and having n turns per unit length. 4  
 b) A solenoid has its inductance of  $12\mu H$  and carries a current of 3.80A. The current is reduced at constant rate to 3.20A in a time of 15 seconds. What is the resultant emf developed by solenoid? 3  
 c) In an LR circuit, can induced emf ever be larger than batter emf. 1
- 10- Write notes on any two of the following: 4, 4  
 i) Magnetic dipole moment ii) Motional EMF  
 iii) Hysteresis loop in ferromagnetic material iv) Growth of current in RC circuit