B.Tech. 2nd Semester Examination, March-2015

UNIVERSITY PHYSICS: ELECTRICITY and MAGNETISM (UPEM)

Full Mark: 30 **Time: 2 Hours**

All the questions are compulsory.
Answer all parts of a question at one place only.
The figures in the right hand margin indicate marks.

Group- A

1. [1x6]
   (a) A charged rod is brought close to an uncharged metallic bob without touching it. Will they attract or repel each other & why?
   (b) A point charge of **20μC** is at the center of a cubic surface of **5** cm edge. Find the net electric flux through the surface.
   (c) Would the shape of an equipotential surface change if the sign of each charge were reversed? Explain.
   (d) If a copper wire is replaced by another copper wire of dimensions: twice in length and twice in diameter, what change do you expect in its resistivity and resistance?
   (e) emf of a cell in the circuit is always greater than its terminal voltage, why?
   (f) Explain why the total magnetic flux through a closed surface is always zero.

Group- B

2. (a) Using Gauss's law, calculate electric field due to uniformly charged infinitely long straight wire in term of its linear charge density **λ** at a distance ***r*** from its axis [4]
   (b) A dipole, with dipole moment $\vec{p}$, is in stable equilibrium in an electrostatic field of magnitude E. Find out work done in rotating this dipole to its position of unstable equilibrium. [2]

OR

   (a) Using Gauss's law, calculate electric field due to uniformly charged sphere of radius **R** at any point inside and outside the sphere. [4]
   (b) Two point charges **+9e** and **–e** are separated by **12** cm in air. Find the position where the resultant electric field is zero. [2]

Group- C

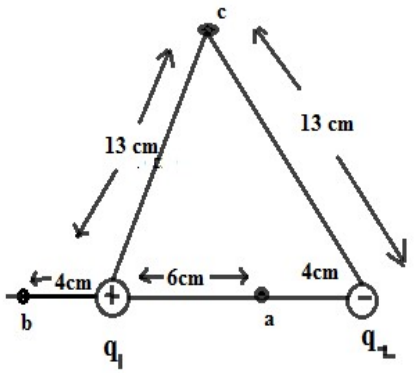
3. (a) Find an expression for the energy stored in a parallel plate capacitor of capacitance **C** when it is charged to the final charge $\mathbf{Q_f}$ & hence find energy density in between the plates. [4]

(b) The combination of two capacitors of capacitance **6μF** & **12μF** in series is connected to a battery. If the voltage across the 6-μF capacitance is **2V**, find the terminal voltage across the battery. [2]

OR

(a) A particle with charge ***q*** moves with velocity $\vec{v}$ in a region of space where both the electric field ($\vec{E}$) and magnetic field ($\vec{B}$) are present. Find the expression for the resultant force experienced by the particle in motion. [3]

(b) An electric dipole consists of point charges $q_1 = +11\,nC$ and $q_2 = -11\,nC$ placed **10** cm apart as shown in the figure. Find the electric potentials at the points ***a, b*** and ***c***. [3]



Group- D

4. (a) What is drift velocity of free electrons in a metal? Using the concept of drift velocity, find an expression for current density ($\vec{J}$) at a point across any cross section of the conducting medium. [3]

(b) A beam of electrons moves at 3.00×10^5 m/s through a uniform **2.0** T magnetic field directed along the positive **z**-axis. The velocity of each electron lies in the **xz**-plane and is directed at 30^0 to the **+z** axis. Find the force on an electron. [3]

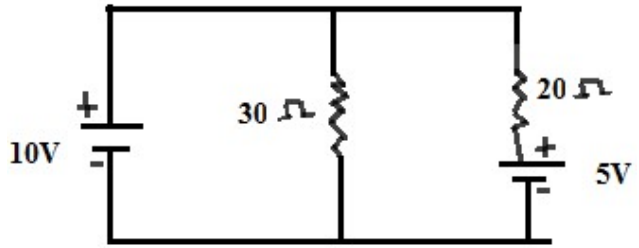
OR

(a) Derive expression for instantaneous charge and current in a **R-C** circuit when the capacitor is being charged and discuss graphically the growth of charge and decay of current in the process. [4]

(b) A **12.0-μF** capacitor is connected in series with **0.5-MΩ** resistor to a constant potential difference of **12 V**. Find (i) the time constant of the circuit and (ii) the fraction of final charge $\mathbf{Q_f}$ on the capacitor at the time $t = 3$ **s**. [2]

Group- E

5. (a) The batteries shown in the circuit have negligibly small internal resistance. Find out current through (a) the **30 Ω** resistor (b) the **20 Ω** resistor (c) the **10 V** battery. [3]



(b) A small particle with charge **-5μC** and mass 2.00×10^{-4} kg. It moves from point **A**, where the electric potential is $V_A = +200\,V$, to point **B**, where the electric potential is $V_B = +800\,V$. The electric force is the only force acting on the particle. The particle has speed **5.00 m/s** at point **A**. What is its speed at point **B**? [3]

End of the questions