Magnetic Field (Magnetic Effect of Current): Assignment-2081

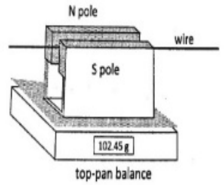
Day-1

1. Fundamental nature of magnetism is the interaction of moving charge.
   a) What is Lorentz force. Write the vector representation of Lorentz force?
   b) Derive the expression for force on a moving charge due to magnetic field.
   c) Can a charged particle move through a magnetic field without experiencing any force?
   d) Can a constant magnetic field set an electron at rest into motion? Explain.
   e) An electron experiences a magnetic force of magnitude $4.60 \times 10^{-15} N$ when moving at an angle of 60^0 with respect to a magnetic field of magnitude $3.50 \times 10^{-3} T$. Find speed of the electron. $(9.47 \times 10^6 m/s)$
   f) An electron of KE $10eV$ is moving in a circular orbit of radius $11cm$, in a plane at right angles to a uniform magnetic field. Determine the value of flux density. $(Ans: 9.7 \times 10^{-5} T)$

Day-2

2. When a current carrying conductor placed in magnetic field, the conductor experiences magnetic force, derive an expression for force experienced by conductor placed in magnetic field.
   a) A straight conductor of length 5 cm carries current of 1.5A. The conductor experiences a magnetic force of 4.5×10^{-3}N when it is placed in a magnetic field of 0.9 T. What angle the conductor makes with magnetic field?
   b) A copper wire has 10^{29} free electrons per cubic meter, a cross-sectional area of $2mm^2$ and carries a current of $5A$. Calculate the force acting on each electron if the wire is now placed in a magnetic field of flux density $0.15T$ which is perpendicular to the wire. $(Ans: 3.75 \times 10^{-24} N)$
   c) A straight horizontal rod of length 20 cm and mass 30 gm is placed in a uniform horizontal magnetic field perpendicular to the rod. If a current of 2A through the rod makes it self-supporting in the magnetic field, calculate the magnetic field. $(Ans: 0.75T)$
   d) A horizontal straight wire 5 cm long weighing 1.2 gm^{-1} is placed perpendicular to a uniform horizontal magnetic field of flux density of 0.6 T. IF the resistance per unit length of the wire is 3.8 Ωm^{-1}, calculate the p.d. that has to be applied between the ends of the wire to make it just self-supporting. $(Ans: 3.7 \times 10^{-3} V)$

3. Figure shows a fixed horizontal wire passing centrally between the poles of a permanent magnet that is placed on a top- pan balance. With no current flowing, the balance records a mass of 102.45 g. When a current of 4.0 A flows in the wire, the balance records a mass of 101.06 g. $(0.0696T)$
   a) Explain why the reading on the top-pan balance decreases when the current is switched on.
   b) State and explain the direction of the current flow in the wire.
   c) The length of the wire in the magnetic field is 5.0 cm. Calculate the average magnetic flux density between the poles of the magnet.



Day-3 & 4

4. a) Discuss the torque produced on a rectangular current carrying coil placed in a uniform magnetic field.
   b) Discuss the cases when the torque is maximum and minimum.
   c) The plane of a $5cm \times 8cm$ rectangular loop of wire is parallel to a $0.19T$ magnetic field. The loop carries a current of $6.2A$. What torque acts on the loop?
5. What is the principle of moving coil galvanometer? In moving coil galvanometer,
   a) Cylindrical magnets are used, why?
   b) What is the use of soft iron core?
   c) The coil of a moving coil galvanometer has 50 turns and its resistance is 10Ω. It is replaced by a coil having 100 turns and resistance 50Ω. Find the factor by which voltage sensitivity changes.
   d) Two galvanometers, which are otherwise identical, are fitted with different coils. One has a coil of 50 turns and resistance 10 ohm while the other has 500 turns and a resistance of 600 ohm. What is the ratio of the deflection when each is connected in turns to a cell of emf 25 V and internal resistance 50 ohms? [13:12]

Day-5 & 6

6. The Hall effect in metal offered the first real proof that electric currents in metals are carried by moving electrons, not by protons.
   a) What is Hall effect? Deduce the expression for hall voltage.
   b) Hall voltage in a semiconductor is more than that in metals, why
   c) A strip of metal is $10\ mm$ wide and $2\ mm$ thick. It carries a current of $6\ A$, and is placed so that a magnetic field of $0.09\ T$ is passing at right angles through it surface. The metal has 8×10^{28} charge carriers per cubic meter. Calculate the velocity of the charge carriers, and the Hall voltage that would be produced.

Day-7, 8 & 9

7. Biot-Savart Law Is used to find magnitude of magnetic field due to a current carrying conductor of any shape and size.