



**Arab Academy for Science & Technology
and Maritime Transport – Cairo Branch
College of Engineering & technology
Electronics & Communication Engineering Department**



EC311 – Electronic Materials

Problem Set No.10: Magnetism I

Duration: Week# 10

Physical Constants:

$$\epsilon_0 = 10^{-9} / (36 \pi) = 8.854 \times 10^{-12} \text{ F/m}$$

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

$$h = 6.63 \times 10^{-34} \text{ J-s}$$

$$\beta = 9.27 \times 10^{-24} \text{ J/T (or A m}^2\text{)}$$

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

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

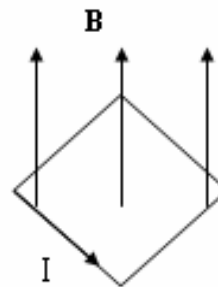
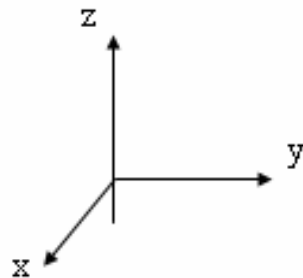
$$c = 3 \times 10^8 \text{ m/s}$$

P1) Using the results of quantum mechanics, calculate the magnetic moments that are possible for an $n = 3$ level.

P2) Consider a rectangular loop of wire carrying current I . From the torque of a homogeneous magnetic field perpendicular to one pair sides, show that the current loop is equivalent to a magnetic dipole $\mu_m = I A$, where A is the area of the loop.

P3) A flat conducting loop carries current I and is located in a uniform magnetic field, B . The field is along the z axis. For what orientation of the loop (in which plane or planes must be the loop) for the torque to be:

- (a) maximum?
- (b) Zero?



The torque is maximum if the loop is in the ----- plane.

The torque is zero if the loop is in the ----- plane.

P4) A rectangular loop of dimensions 5.4 cm x 8.5 cm carries a current of 375 mA.

- (a) Calculate the magnitude of its magnetic moment.
- (b) Suppose a magnetic field, B , of magnitude 0.35 T is applied parallel to the plane of the loop. What is the magnitude of the torque acting on the loop?
- (c) Calculate the magnitude of the torque on the loop when the 0.35 T magnetic field makes angles of (i) 60° and (ii) 0° with μ_m .