Magnetizing field(H)

Quantity which has the ability to magnetise a material

H = ni

H = N/l i N = no of turns, n = no of turns per unit length

Solenoid

B = mu\_{0}ni

Air medium

B\_{0} = mu\_{0}H B = muH

mu\_{r} = (mu) /mu\_{0} = B/ B\_{0}

intensity of magnetization

I = M/V M = moment V = volume

Magnetic susceptibility

How easily a material get magnetized

Ki = I/H

Diamagnetic – ki small and –ve

Paramagnetic – ki small and +ve

Ferromagnetic – ki large and +ve

Field due to material B\_{m} = mu\_{o}I

mu\_{r} = 1 + ki

coercivity = B/mu\_{0}

electromagnet : low retentivity , low coercivity

magnetic flux

total field lines passing normally through unit area phi = int(B.ds) = 0

gauss theorem

magnetic flux through any closed surface is always zero

phi = oint(B\*ds) = 0

**magnetic dipole**

consists of two unlike poles of equal strength and separated by small distance. Eg bar magnet

**magnetic dipole moment of a bar magnet**

M = m\*2l l = distance from pole to centre of magnet

When magnet cut into n equal parts then

Moment = M/n

Magnetic field strength (B) = F/m\_{0}

B = mu\_{0}/(4pi) m/r^2

Magnetic field strength due to magnetic dipole/ bar magnet

1. Along the axial line of dipole

r

P

B\_{s}

B\_{n}

m

N

S

B\_{axial} = mu\_{0}/(4pi) 2MR/((r^2- l^2))^2

L<<<r

B\_{axial} = mu\_{0}/(4pi) (2M)/r^3

1. Along the equatorial line of a dipole

B\_{n}

θ

2Bcosθ

P

m

r

B\_{net} = 2Bcostheta

B\_{s}

S

N

B\_{net} = mu\_{0}/(4pi) M/((r^2 + l^2)^(3/2))

B

α

1. At any point around the magnetic dipole

B\_{n}

B\_{s}

tanalpha = ½ tantheta

Mcosθ

B = mu\_{0}/(4pi) M/r^3sqrt(3cos^2theta +1)

M

θ

S

N

Msinθ

Circular current loop as magnetic dipole

B\_{axial} = mu\_{0}/(4pi) (2M)/((R^2 + x^2)(3/2))

R

x

I

Electric dipole in a uniform manetic field

Tau = MBsintheta (restoring force)

Tau = -MBsintheta

Due to inertia magnet oscillates simple harmonically

Tau = -MBtheta = Ialpha alpha = omega^2theta

Alpha = (-MBtheta)/I T = (2pi)/omega

T = 2pisqrt(I/(MB))

Magnet cut to n parts(vertically)

T’ = T/n

Horizontally

T’ = T

Work done to rotate the dipole in uniform magnetic field against restoring torque from theta\_{1} to theta\_{2}

W = MB[costheta\_{1} – costheta\_{2}]

Potential energy of dipole

U = W

Minimum potential energy(stable eqbm)

Magnet is parallel to field

U= -MB tau = 0

maximum potential energy(unstable eqbm)

U = MB tau = 0

Force between two magnets

One magnet(M\_{1}) is in axial position of another magnet M\_{2}

Field due to M\_{1} at a distance r

B\_{1} = mu\_{0}/(4pi) (2M\_{1})/r^3

U = mu\_{0}/(4pi) (2M\_{1}M\_{2})/r^3

F = mu\_{0}/(4pi) (6M\_{1}M\_{2})/r^4

One magnet is placed at equatorial line of another

Filed Due to M\_{1}

B\_{1} = mu\_{0}/(4pi) (M\_{1})/r^3

U = mu\_{0}/(4pi) (M\_{1}M\_{2})/r^3

F = mu\_{0}/(4pi) (3M\_{1}M\_{2})/r^4