- In a Conduction Current, where +ve & -ve charges are present in Equal density the macro scopic Electric field is zero, but the magnetic field of moving charges is not.
- In gaussian units, where $\epsilon_0 = 1/4\pi$ by defination $\mu_0/4\pi = 1/c^2$ is an Experimental value. The difference between two systems of units is that in gaussian units the two C's are split up with the two V's i-e

$$B = \frac{q_1}{r^2}\frac{v_1}{c} \times \frac{\vec{r}}{|r|} \quad ; \quad F_m = q\frac{v}{c} \times B$$

$\vec{B}$ is dimensionally the same as $\vec{E}$ (and the relativistic form v/c appears explic

Stated clearly in Detail.

Forces On a Current Carrying Conductor

Force on a current carrying conductor depends upon following factors

(1) Area

(2) Lenght

(3) No of Turns

$V = L \times A$

The product of or cross of lenght & area is known as 'volume'.

To determine force on a current carrying conductor we take the element 'dl' which is the element of conductor with its sense taken in the direction of the current 'I' that it carries. If there are 'N' charge carriers per unit volume in the conductor, then the force on the element 'dl' is

$$dF = NA\,|dl|\,q\,\vec{V} \times \vec{B}$$

where 'A' is the cross-sectional area of the conductor & 'q' is the charge per charge carrier. If several kinds of charge carriers are involved. then we take small area to find force and summation sign must be included. however final result is unchanged. Since 'v' and 'dl' are parallel. then q is

$$dF = NqA\,|\vec{v}|\,\vec{dl} \times \vec{B}$$

However, $Nq|v|A$ is just the

current for a single species of
Therefore expression becomes.

$$dF = I\,\vec{dl} \times \vec{B}$$

This is $\because NqA|\vec{v}| = I$
written for the force o
infinitesimal element of charge car
conductor.
For the total contour force we
integerated.

$$F = \oint_c I\,\vec{dl} \times \vec{B}$$

$\vec{B}$ depends upon position, the only
simplification we take 'I' out of the
integral, however $\vec{B}$ is uniform, i-e
$\vec{B}$ Independent of position. Therefore it
Can be removed under integral. to
give.

$$\vec{F} = I \left\{ \oint_c dl \right\} \times \vec{B}$$

The remaining Integral is Easy to
Evaluate. The sum of infinitesimal
vectors forming a complete circuit
It must be zero

$$F = \oint_C I\,dl \times B = 0 \quad (B = \text{uniform})$$

Force Exist when $\vec{B}$ changes and magnetic field induce.

$$F = I\,\vec{L} \times \vec{B}$$

Torque:-

Torque is a measure of how much force acting on an object causes that object to rotate. The object rotates about an axis, which we will call the pivot point, and will label 'O'. It is also known as moment of force. It is represented by $d\tau$

$$d\tau = \vec{r} \times d\vec{F}$$

$$d\tau = \vec{r} \times I\,d\vec{l} \times \vec{B}$$

$$d\tau = I\vec{r} \times (d\vec{l} \times \vec{B})$$

The torque on a complete circuit is

$$\tau = I \oint_C \vec{r} \times (d\vec{l} \times \vec{B})$$

$$\tau = I\vec{A} \times \vec{B}$$

$$\because \vec{A} = \oint \vec{r},$$