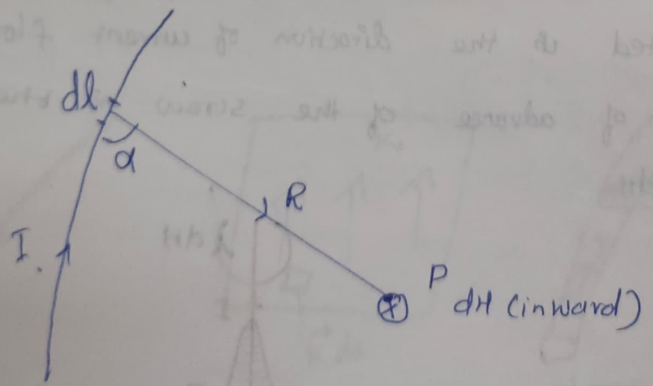
Flux	$\psi = \int \vec{D}\cdot d\vec{s}$	$\psi = \int \vec{B}\cdot d\vec{s}$
	$\psi = Q = CV$	$\psi = LI$
	$I = C\frac{dV}{dt}$	$V = L\frac{dI}{dt}$
Energy density	$W_E = \frac{1}{2} D\cdot E$	$W_m = \frac{1}{2} B\cdot H$
Poisson's equation	$\nabla^2 V = -\frac{\rho_v}{\varepsilon}$	$\nabla^2 A = -\mu J$

Biot - Savart's law :-

Biot - Savart's law states that differential magnetic field intensity dH produced at a point P, by the differential current element Idl is proportional to the product Idl and the sine of the angle α between the element and the line joining P to the element and is inversely proportional to the square of the distance R.



Magnetic field at P due to current element Idl.

$$dH \propto \frac{I dl \sin\alpha}{R^2}$$

or $$dH = \frac{k I dl \sin\alpha}{R^2}$$

Constant of proportionality:

$k = 1/4\pi$

$$\therefore dH = \frac{I dl \sin\alpha}{4\pi R^2}$$

In vector form

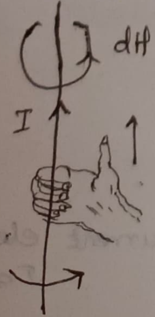
$$dH = \frac{I d\vec{l} \times \hat{a_R}}{4\pi R^2}$$

$$dH = \frac{I d\vec{l} \times \vec{R}}{4\pi R^3}$$

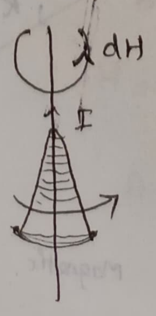
Direction of $d\vec{H}$

1) Right-hand rule: Right-hand thumb pointing in the direction of current and the right-hand fingers encircling the wire in the direction of dH.

2) Right-handed screw rule: The screw placed along the wire and pointed in the direction of current flow, the direction of advance of the screw is the direction of dH.



Right-hand rule



Right handed screw rule

$\odot$ H or I is out $\otimes$ H or I is in

Conventional representation of H — out of the page, • into the page

Different current distributions

line current,

surface current

volume current.

$K \rightarrow$ surface current density, (Amperes per meter)

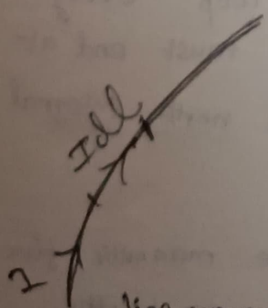
$J \rightarrow$ volume current density (Amperes per meter squared)

Biot Savart's law

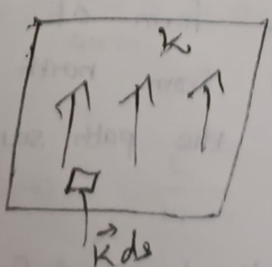
$$\vec{H} = \int_L \frac{I\, d\vec{l} \times \hat{a}_R}{4\pi R^2} \quad \text{(line current)}$$

$$\vec{H} = \int_S \frac{\vec{K}\, ds \times \hat{a}_R}{4\pi R^2} \quad \text{(surface current)}$$

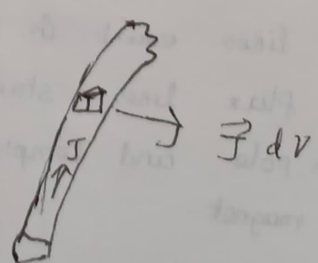
$$\vec{H} = \int_V \frac{\vec{J}\, dv \times \hat{a}_R}{4\pi R^2} \quad \text{(volume current)}$$



line current



Surface current



volume current

→ current distributions