Physical Interpretation of Maxwell's Eq^n or Integral form of Maxwell's Eq^n :-

Maxwell's I eq^n :-

From the Maxwell's I eq^n, we know that

$$\text{Div}\, D = \rho$$

Now, taking the volume integral of above eq^n, we get

$$\int \text{Div}\, D\, dv = \int \rho\, dV \quad \text{--- (1)}$$

we have

$$q = \int \rho\, dV$$

then above eq^n converts in the form of

$$\int \text{Div}\, D\, dV = q$$

Applying the Gauss Divergence Theorem

in above eq^n, we get

$$\boxed{\int D \cdot ds = q}$$

This is the integral form of Maxwell I eq^n which can be expressed as the surface integral of electric displacement vector is equal to the total charge flowing in the surface.

Maxwell II eq^n:-

From Maxwell's II eq^n:-

$$\text{Div } B = 0$$

On taking the volume integral, we get

$$\int \text{Div } B \, dV = 0$$

Now using the Gauss Divergence theorem in above eq^n, we get

$$\boxed{\int B \cdot ds = 0}$$

This is the Maxwell's II eq^n

which can be interpreted as the surface integral of magnetic field is continuous, i.e; the magnetic monopole does not exist and magnetic line of force form close loop.

3. **Maxwell's III eqⁿ :-**

From Maxwell III eqⁿ the curl of magnetic field intensity is equal to the sum of conduction current and displacement current density.

$$\text{Curl } H = J + J_d$$

Now taking the surface integral of above eqⁿ, we get

$$\int \text{Curl } H \, ds = \int J \, ds + \int J_d \, ds$$

Also from the definition of current density, we know that

$$I = \int J . ds$$

similarly, $I_d = \int J_d \cdot ds$

$$\int \text{Curl}\, H \cdot ds = I + I_d$$

Now, using the Stoke's theorem of above eqⁿ we get

$$\boxed{\int H \cdot dl = I + I_d}$$

$\because B = \mu_0 H$ $\therefore B = \mu_0 H$

$\therefore \int B \cdot dl = \mu_0 (I + I_d)$

This is the integral form of Maxwell III eqⁿ which shows that the line integral of magnetic field intensity is equal to the sum of conduction current and displacement current.

4. <u>Maxwell IV eqⁿ :-</u>

From Maxwell IV eqⁿ we know that

$$\text{Curl}\, E = -\frac{\delta B}{\delta t}$$

Now taking, the surface integral of above eqⁿ, we get

$$\int \text{Curl}\, E \cdot ds = -\int \frac{\delta B}{\delta t}\, ds$$

$$\int \text{curl } E \, ds = -\frac{\delta}{\delta t} \int B \cdot ds$$

We also know that

$$d\phi = B \cdot ds$$

$$\phi = \int B \cdot ds$$

then from above eq^n, we get

$$\int \text{curl } E \, ds = -\frac{\delta \phi}{\delta t}$$

by using the Stoke's theorem the surface integral can be converted into line integral.

$$\boxed{\int E \cdot dl = -\frac{\delta \phi}{\delta t}}$$

This is the integral form of Maxwell IV eq^n which shows that the line integral of electric field intensity is equal to the negative rate of change of magnetic flux.