$$\boxed{\int_S (\nabla \times E) \cdot dS = -\int_S \frac{\partial B}{\partial t} \cdot dS}$$

where the surface integrals may be taken over identical surfaces,

Differential form →

$$(\nabla \times E) \cdot dS = -\frac{\partial B}{\partial t} \cdot dS$$

and

$$\boxed{\nabla \times E = -\frac{\partial B}{\partial t}}$$

DISPLACEMENT CURRENT →

By Faraday's law, We use one of of Maxwell's equations in differential form,

$$\nabla \times E = -\frac{\partial B}{\partial t} \quad \text{—(1)}$$

Now, point form of Ampere's circuital law as it applies to steady magnetic fields,

$$\nabla \times H = J \quad \text{—(2)}$$

By taking the divergence of each side,

$$\nabla \cdot \nabla \times H = 0 = \nabla \cdot J \quad \text{—(3)}$$

The divergence of the curl is identically zero, so $\nabla \cdot J = 0$,

By continuity Equation,

$$\nabla \cdot J = -\frac{\partial \rho_v}{\partial t}$$

Eqn (2) can be true only if $\frac{\partial \rho_v}{\partial t} = 0$,

Suppose we add an unknown term G to (2)

$$\nabla \times H = J + G$$

Again taking the divergence,

$$0 = \nabla \cdot J + \nabla \cdot G$$

Thus,

$$\nabla \cdot G = \frac{\partial \rho_v}{\partial t}$$

Replacing ρ_v by $\nabla \cdot D$

$$\nabla \cdot G = \frac{\partial}{\partial t}(\nabla \cdot D) = \nabla \cdot \frac{\partial D}{\partial t}$$

Now, $G = \frac{\partial D}{\partial t}$

Ampere's circuital law in point form therefore becomes

$$\boxed{\nabla \times H = J + \frac{\partial D}{\partial t}} \quad — (4)$$

Maxwell equation is termed a displacement current density. (denoted by J_d)

$$\nabla \times H = J + J_d$$

$$J_d = \frac{\partial D}{\partial t}$$

Conduction current density,

$$J = \sigma E$$

is the motion of volume charge density. and convection current density,

$$J = \rho_v V$$

is the motion of volume charge density,

In Nonconducting medium in which no volume charge density is present, $J=0$, & then from Eq^n (4)

$$\nabla \times H = \frac{\partial D}{\partial t} \quad (\text{if } J = 0) \quad — (5)$$

The total displacement current crossing any given surface is expressed by the surface integral.