Maxwell's Fourth Eqn :-

This is also known as Faraday's Law. According to which time-variable magnetic field produce an electric field which create an induced emf and can be expressed as

$$e = -\frac{d\phi}{dt} \quad \text{--- (1)}$$

where ϕ is the magnetic flux.

Also from the definition of induced electromotive force, we know that the time rate of change of magnetic flux is known as induced emf. Here '−ve' sign shows the Lenz Law, which told about the induced current which opposes that cause due to it was produced.

Again from the definition of magnetic flux

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

$$\phi = \int B \cdot ds \quad \text{--- (2)}$$

Also from the old definition of induced emf the work done to carry a unit charge from a closed surface

$$dW = F \cdot dl$$

$$dW = qE \cdot dl$$

$$W = q\int E \cdot dl$$

$$\frac{W}{q} = \int E \cdot dl$$

$$e = \int E \cdot dl \quad \text{---} \quad (3)$$

Now, from eq^n (1), (2) & (3) we get

$$\int E \cdot dl = \frac{-d}{dt}\int B \cdot ds$$

$$\int E \cdot dl = -\int \frac{dB}{dt} ds$$

Applying the Stoke's theorem, the line integral can be converted into surface integral.

$$\int \text{curl } E \cdot ds = -\int \frac{dB}{dt} ds$$

$$\int \text{curl } E ds + \int \frac{\partial B}{\partial t} ds = 0$$

$$\int \left[\text{curl } E + \frac{\partial B}{\partial t} \right] ds = 0$$

here, $\int ds \neq 0$

$$\boxed{\text{curl } E = -\frac{\partial B}{\partial t}}$$

or

$$\boxed{\text{curl } E = -\mu_0 \frac{\partial H}{\partial t}}$$

This is the required expression for Maxwell's fourth eq^n.