

EMI

① Magnetic Flux (Φ)

$$\Phi = \vec{B} \cdot \vec{A} \quad [\Phi = BA \cos \theta]$$

$\theta \rightarrow$ Angle b/w B and A not coil
for N turns $[\Phi = NBA \cos \theta]$

(1 weber = 10^8 Maxwell)

$$[\Phi = ML^2 T^{-2} A^{-1}]$$

② Faraday law

$$e = -\frac{d\Phi}{dt}$$

$$e = -N \frac{d\Phi}{dt}$$

$$I = \frac{1}{R} \frac{\Delta \Phi}{\Delta t}$$

$$Q = \frac{\Delta \Phi}{R}$$

do not depend on time.

$$e = -[\text{slope of } \Phi-t \text{ curve}]$$

$\theta = 180^\circ$ rotated $\rightarrow |\epsilon| = \frac{2NBA}{\Delta t}$

$\theta = 90^\circ$ rotated $\rightarrow |\epsilon| = \frac{NBA}{\Delta t}$

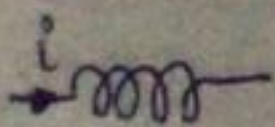
③ Lenz law

To nora hai use oppose
 $\rightarrow$ energy conservation.

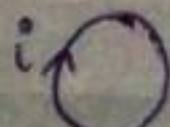
[south $\rightarrow$ clockwise
North $\rightarrow$ Anticlockwise]

④ Self induction (L) (Henry)

$\rightarrow$ property of coil/conductor
which opposes any change
in the current itself.



$$B = \mu_0 \left[\frac{N}{l} \right] I$$



$$B = \frac{\mu_0 I}{2R}$$

Toroid

$$B = \mu_0 \left(\frac{N}{2\pi r} \right) I$$

$$B \propto I$$

$$\Phi \propto I$$

$$\Phi = LI$$

$$\Phi_{\text{Total}} = N\Phi$$

$$[\Phi_{\text{Total}} = LI]$$

weber/amp

Faraday:-

$$e = -L \frac{dI}{dt}$$

⑤ Self inductance of a solenoid

$$L = \mu_0 \frac{N^2 A}{l}$$

$$L = \mu_0 n^2 (Al)$$

Volume

$$L \propto \frac{1}{l}$$

Area const

$n \rightarrow$ Turn density

$$L \propto l$$

If volume constant

$$L \propto \frac{1}{l^2}$$

⑥ Self inductance of a circular coil

If material filled

$$L = \frac{\mu_0 N^2 \pi R}{2}$$

$$L = \frac{\mu_0 \mu_r N^2 A}{l}$$

Do not depend on Φ and I
 $\rightarrow$ depend on dimensional parameter
like R, A, V, L and material.

⑦ L-R circuit

① Growth

$$I = I_0 [1 - e^{-t/\tau}]$$

Just after the switch closed

$$t = 0$$

inductor = open wire

$$I = 0$$

$$t \rightarrow \infty$$

inductor = simple wire

$$I = \frac{E}{R}$$

$$\tau = \frac{L}{R} \rightarrow \text{time constant}$$

$$I = 0.63 \frac{E}{R}$$

time at which current become 63% of its maximum value

Rate of change of current

$$\frac{dI}{dt} = \frac{E}{L} e^{-\frac{Rt}{L}}$$

For initial rate
put $t = 0$