

4. ELECTRO MAGNETIC

The phenomena of producing induced in magnetic flux is called electromagnetic

Faraday Law: - (i) change in magnetic flux last till there is change
(ii) $e = -\frac{d\phi}{dt}$

Lenz's Law: - Induced current opposes the factor due to which it is produced.

Method

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

acc. to law of conservation of energy.



Induced current

$$e = -\frac{d\phi}{dt}, i =$$

Motional emf: - The emf induced due to motion of a conductor in M. field.

Motional emf: - $e = -\frac{d\phi}{dt}$
 $= -\frac{dB \cdot A}{dt}$
 $= -\frac{B dA}{dt} = -B \frac{dx}{dt}$
 $e = -Bvl$

Direction = Anticlockwise

Force: - $i = \frac{Bvl}{R}$
 $F = Bil = -B \left(\frac{Bvl}{R} \right) l$
 $F = -\frac{B^2 v l^2}{R}$

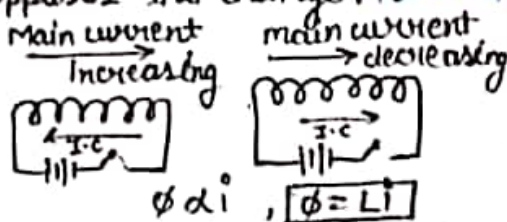
Power: - $P = Fv$
 $P = -\frac{B^2 v^2 l^2}{R}$

Rotating rod: - $e = -\frac{d\phi}{dt}$

$e = -\frac{dB \cdot A}{dt}$
 $e = B \frac{dA}{dt}$
 $e = \frac{B \pi L^2}{2\pi/\omega}$
 $e = \frac{1}{2} B \omega L^2$
 or $e = \frac{1}{2} B \omega R^2$

no. of spokes is increased emf remain same.

Self-Induction: - change in current in a coil, induced current is produced which opposes the change in same coil.



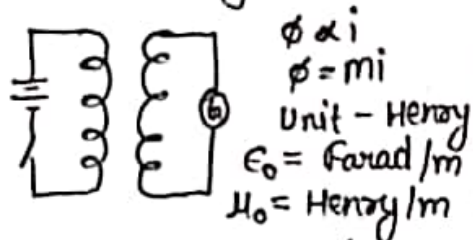
Unit $\rightarrow L = 1 \text{ Henry (H)}$

D. formula $\rightarrow L = [ML^2 T^{-2} A^{-2}]$

Solenoid: $\phi = Li$ [$n = N/L$]

$\phi = BAN = (\mu_0 N^2 i) AN$
 $Li = \mu_0 N^2 AN$

Mutual-Induction: when the change in current in primary coil induces current in secondary coil.



Solenoid: $B_2 = \mu_0 n_2 i_2$

$\phi = B_2 AN_1$
 $\phi = (\mu_0 n_2 i_2) AN_1$
 $\phi = m i_2$
 $m_{12} = \mu_0 n_1 n_2 A l \frac{1}{2}$
 $m = \mu_0 n_1 n_2 A l$

ALTERNATING CURRENT

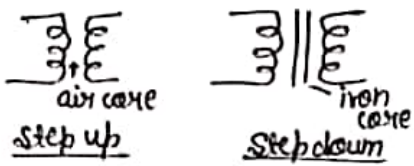
* TRANSFORMER :- It is a device use. to change AC voltage.

Principle: It is based on principle of mutual induction.

Construction:- two coil Primary & secondary

• Step up: Increase voltage ($K > 1$) and decrease current.

• Step down: decrease voltage ($K < 1$) and increases current.



Theory: $\frac{V_s}{V_p} = \frac{N_s}{N_p} = \frac{i_p}{i_s} = K$

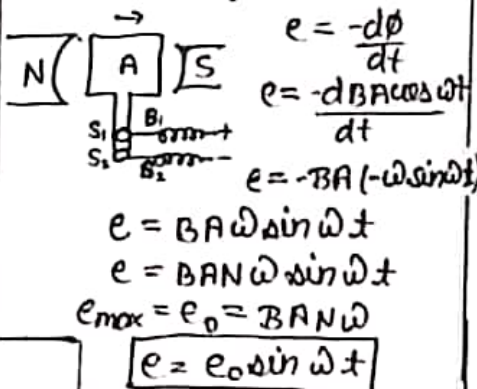
$\eta = \frac{\text{Output}}{\text{Input}} \times 100\%$

* A.C. Generator :- It is a device which convert mechanical energy into electrical energy.

Principle: It is based on principle of electro-magnetic induction.

Construction:-

- (i) Armature coil.
- (ii) Field magnet
- (iii) Slip ring (iv) Brushes.



* Alternating Current :-

D.C - Direction & magnitude are fixed.

A.C - Change in both magnitude and direction.

• HALF-CYCLE :- $V_{\text{avg}} = \frac{\int_0^\pi V}{\pi}$

$V_{\text{avg}} = \frac{1}{\pi} \int_0^\pi V_0 \sin \theta d\theta$

$V_{\text{av}} = \frac{1}{\pi} [-V_0 \cos \theta]_0^\pi$

$V_{\text{av}} = \frac{-V_0}{\pi} [\cos \pi - \cos 0]$

$V_{\text{av}} = \frac{2V_0}{\pi}$ or $I_{\text{av}} = \frac{2I_0}{\pi}$

• Full Cycle :- $V_{\text{av}} = \frac{1}{2\pi} \int_0^{2\pi} V d\theta$

$V_{\text{avg}} = \frac{1}{2\pi} \int_0^{2\pi} V_0 \sin \theta d\theta$

$V_{\text{avg}} = \frac{V_0}{2\pi} [-\cos \theta]_0^{2\pi}$

$V_{\text{avg}} = \frac{V_0}{2\pi} (-\cos 2\pi + \cos 0) = \frac{V_0}{2\pi} (-1+1)$

$\Rightarrow V_{\text{avg}} = 0$ or $I_{\text{avg}} = 0$

• Root mean Square :

$V_{\text{RMS}} = \sqrt{\frac{1}{2\pi} \int_0^{2\pi} V^2 d\theta}$

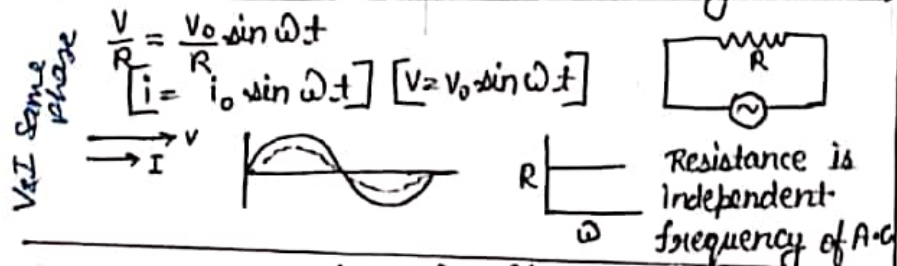
$V_{\text{RMS}}^2 = \frac{1}{2\pi} \int_0^{2\pi} V^2 d\theta = \frac{1}{2\pi} \int_0^{2\pi} V_0^2 \sin^2 \theta d\theta$

$V_{\text{RMS}}^2 = \frac{V_0^2}{2\pi} (\pi) = \frac{V_0^2}{2}$ [$\int \sin^2 \theta = \pi$]

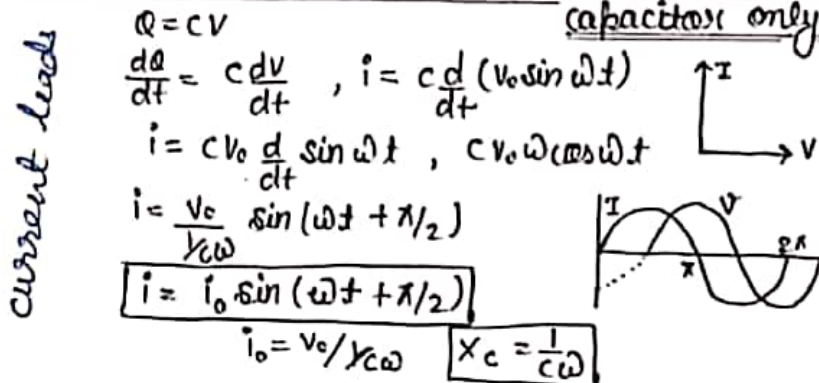
$V_{\text{RMS}} = \frac{V_0}{\sqrt{2}}$ or $I_{\text{RMS}} = \frac{I_0}{\sqrt{2}}$

A.C. Circuit :-

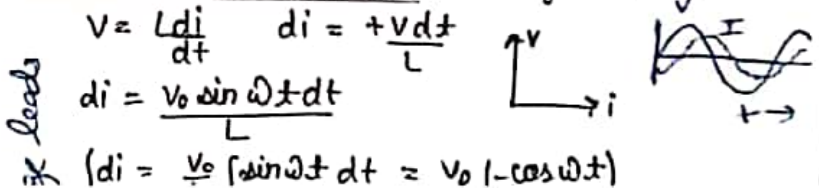
• Pure Resistive Circuit : (circuit containing resistance)



• Pure resistive capacitor circuit (circuit containing capacitor only)



• Pure inductive circuit : $V = V_0 \sin \omega t$



• Series LCR circuit :-

