Introduction of Electrical Machine

Comprehensive Course on Electrical Machines

Ajay Gupta • Lesson 1 • Dec 10, 2020

Know your educator:

- EX-IES Officer
- ESE 2002---AIR2
- GATE 2002---AIR5
- CRACKED ESE WITH EE AND ECE BOTH BRANCH
- QUALIFIED CSE(MAIN)
- SELECTED IN ALL PUBLIC SECTOR LIKE IOCL,BPCL,HPCL,POWERGRID,BHEL,NTPC,NHPC,BARC,ISRO,IIFCO ETC
- 15+ TEACHING EXPEREINCE.

Books : →
- P. S. Bhimra (Electrical Machinery).
- P. S. Bhimra (Generalised theory of electrical M/c)
- Nagrath kotari
- J. B. Gupta.

Electric ckt

1> The close path follow by electrical current is called electrical ckt

2> Source : E.M.F.

Magnetic ckt

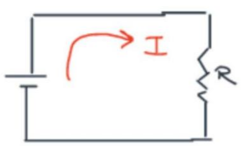
1> The close path follow by magnetic flux is called the Magnetic ckt.

2> Source : MMF

- Permanent Magnating.
- Electro magnet.

3>

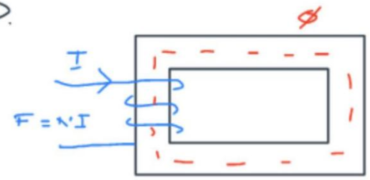
E



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

$F = MMF = NI$ AT.

3>



$\phi = \frac{F}{R_l} = \frac{NI}{R_l}$

4> Resistance oppose flow of current.

$R = \frac{\rho l}{a} = \frac{l}{\sigma a}$

ρ = resistivity

σ = conductivity.

Best electrical Material

$= \sigma \uparrow$

$= R \downarrow$

4> Reluctance oppose the flux

$R_l = \frac{l}{\mu . a}$

μ = Permeability.

Best Magnetic material $= \mu \uparrow$

$= R_l \downarrow$

5> Current density

$J = \frac{I}{a}$

6> Electrical field Intensity

$\epsilon = \frac{E}{l} = \frac{IR}{l}$

$= \frac{I}{l} \cdot \frac{\rho l}{a}$

$\epsilon = J \rho$

$\epsilon = \frac{J}{\sigma}$

$\boxed{J = \sigma \epsilon}$

5> flux density.

$B = \frac{\phi}{a}$

6> Magnetic field Intensity.

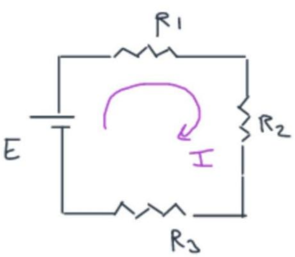
$H = \frac{MMF}{l} = \frac{\phi R_l}{l}$

$H = \frac{\phi}{l} \cdot \frac{l}{\mu a}$

$H = \frac{B}{\mu}$

$\boxed{B = \mu H}$

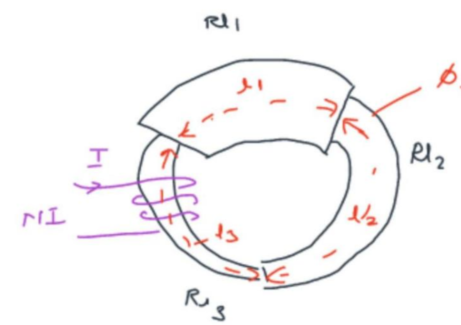
7> Series electrical ckt (KVL).



$E = IR_1 + IR_2 + IR_3$

$= I(R_1 + R_2 + R_3)$

7> Series Magnetic ckt (Kirchoff MMF Law).



$NI = \phi . R_{l1} + \phi R_{l2} + \phi R_{l3}$

$NI = \phi (R_{l1} + R_{l2} + R_{l3})$

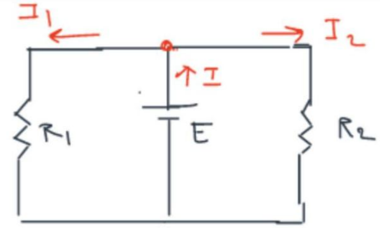
8> Parallel Magnetic ckt
(KCL)

or

$NI = H_1 l_1 + H_2 l_2 + H_3 l_3$

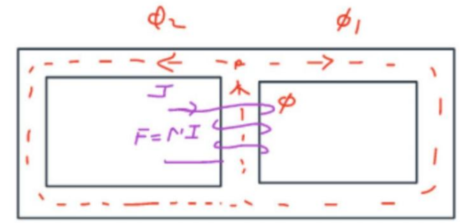
is called KML.

8> Parallel Magnetic ckt
(Kirchoff flux law).



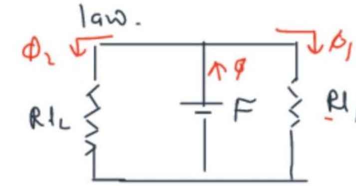
KCL $I = I_1 + I_2$

KCL



$\phi = \phi_1 + \phi_2$

is called kirchoff flux law.



Difference between electrical & Magnetic ckt. →

1> Electrical Insulator exist in this world but Magnetic Insulator does not exist. Even through High Reluctance air gap flux can complete its path.

2> In electrical ckt "electrical current" actually flows in ckt, so it is continuously drawing energy from source.

But in Magnetic ckt flux is actually "established". The energy is required for establishment of flux but energy is not require to maintain it.

Faraday law. :→ As per this law the emf is Induced in a coil if flux linkage of coil change w.r.t. time

flux linkage → The flux which is passing through the coil.

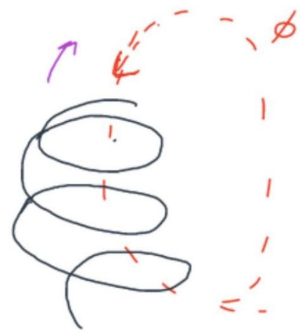
Flux linkage = $N\phi$

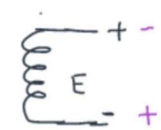
$\psi = N\phi$

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

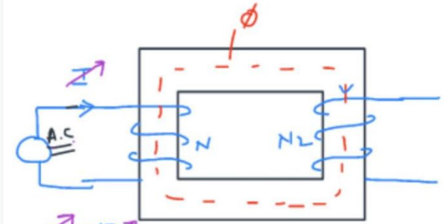
↳ Lenz law

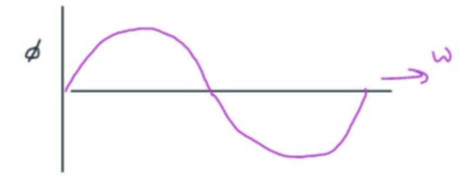
→ As per Lenz law the "effect" oppose it "cause"





(i) Statically Induced EMF / Transformer emf. →





$\psi = N\phi$

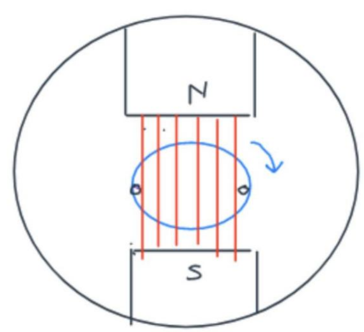
$e = \frac{d\psi}{dt} = \frac{d}{dt}(N\phi)$

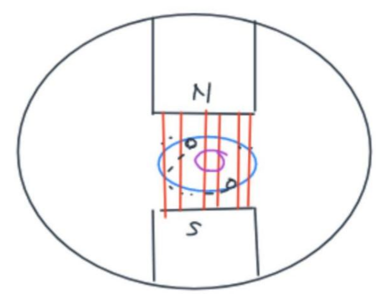
$e = -N\frac{d\phi}{dt}$

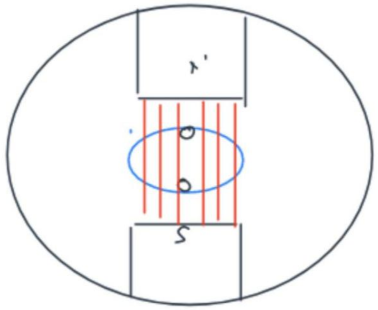
→ Transformer emf is induced becoz Mag. of flux is changing w.r.t time.

→ In developement of X-mer emf, No motion is involve, so x-mer emf is not associate with energy conversion.

(ii) Dynamically induced EMF, Motional emf, Rotational emf.

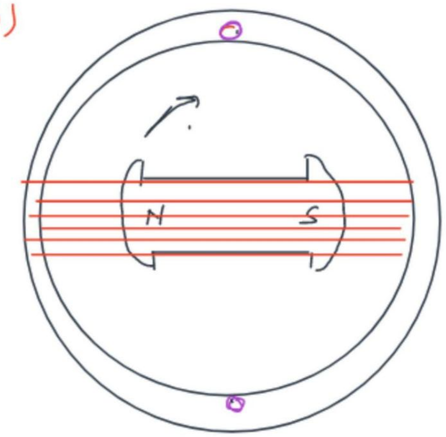


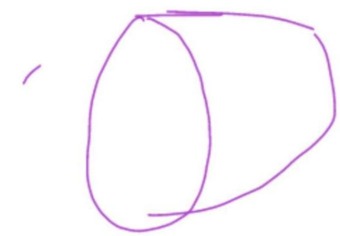


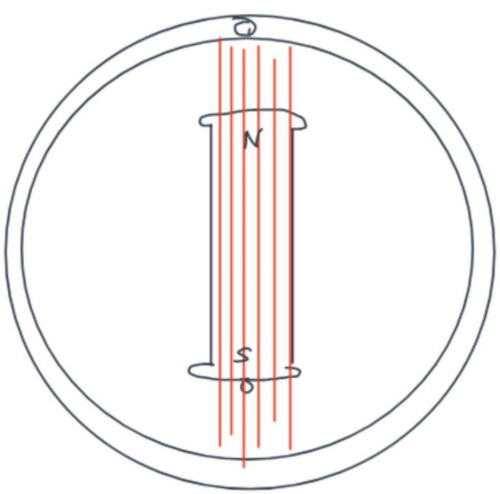


(1) flux is stationary but coil is moving.

(ii)

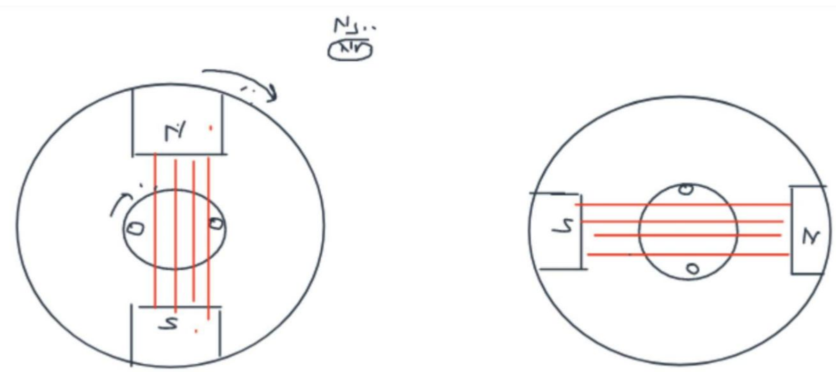






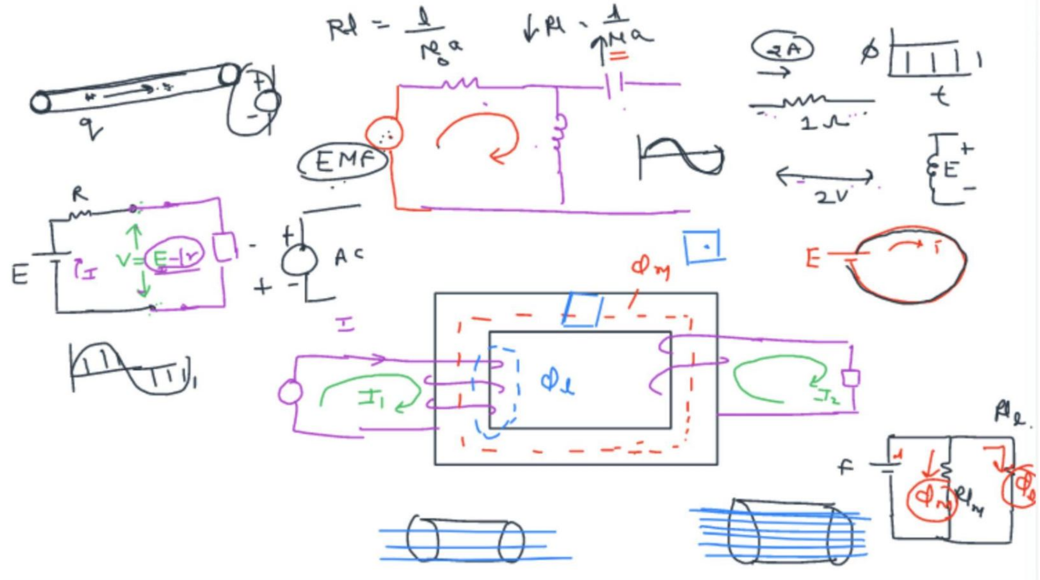
(ii) Coil is stationary but flux is rotating.

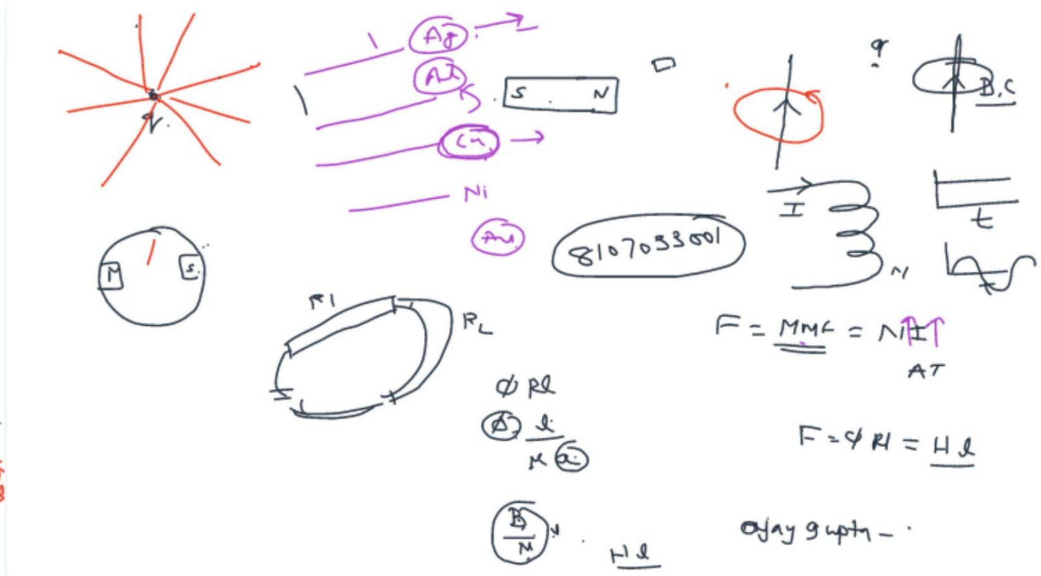
(iii)

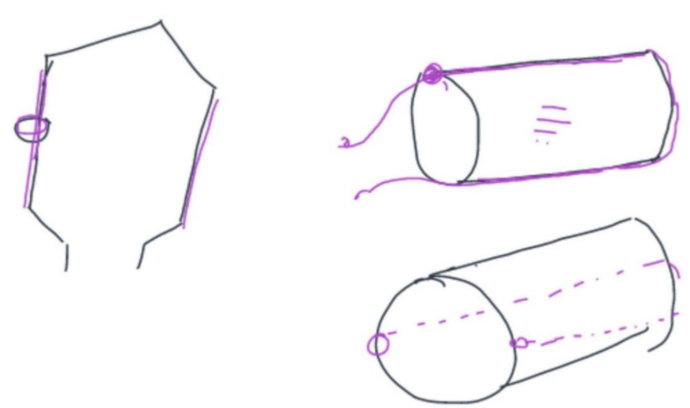


(iii) Both field & coil Rotating at same speed. flux linkage is not changing with respect to time

$E = 0$







Construction of Transformer

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