MODULE - 3

10 mrks min
2 short que
1 prob

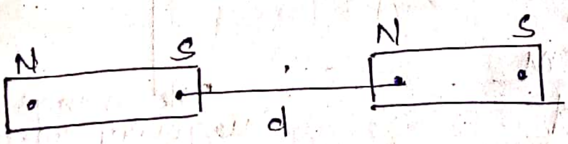
Magnet :-

Properties :-

- A magnet has 2 poles i.e north and south pole and the pole strengths of 2 poles are same.
- The ~~2~~ poles of a magnet cannot be isolated.
- Between magnets, like poles repel and unlike poles attract
- Magnet always attract ~~on~~ iron and its alloys.
- Magnetic field exerts force on moving charge and current carrying conductor.
- Magnet can be magnetically saturated.
- Magnet can be demagnetised by beating, heating, mechanical jerks and with lapse of time.
- ~~It~~ produces magnetism in other magterials by induction.
- The magnetism of materials mainly due to spin motion of electrons.
- On bending a magnet, its pole strength remains unchanged, ~~by~~ but its magnetic moment changes.

$\boxed{\text{magnetic moment} = (m)(2l)}$

Coulomb's law :-



$F \propto m_1 m_2$

$\propto \frac{1}{d^2}$

$F \propto \frac{m_1 m_2}{d^2}$

$F = K \frac{m_1 m_2}{d^2}$

$F = \frac{1}{4\pi\mu_0} \frac{m_1 m_2}{d^2} = \frac{1}{4\pi\mu_0\mu_r} \frac{m_1 m_2}{d^2}$

μ = Permeability of the md.

$\mu = \mu_0 \mu_r$

μ_0 = absolute permeability.

$= 4\pi \times 10^{-7}$

μ_r = relative permeability

Magnetic Field :-

Magnetic flux (ϕ) :-

It is the no. of magnetic lines of force come out of the north pole or enter south pole of a magnets. It is represented by ϕ.

SI unit = weber = 10^8 maxwell

Magnet flux density :-

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

It is defined as the flux passing per unit area through a plane at right angles to the flux.

→ It is presented by B.

$$B = \phi/A$$

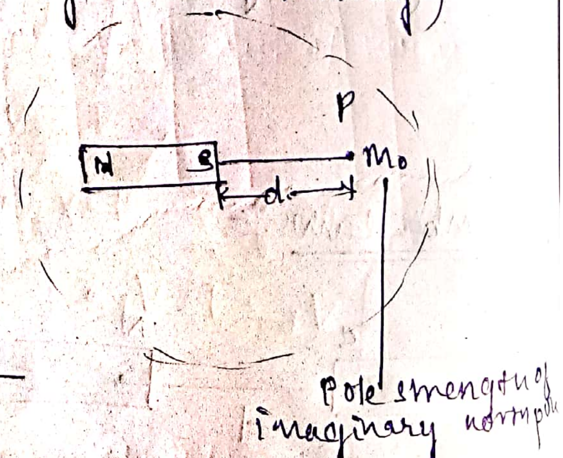
→ SI unit = weber/m^2
or
= tesla

$$\boxed{1 \text{ tesla} = 10^4 \text{ gauss}}$$

Magnetising force :- (or Magnetic Intensity)

Force acting on 'm_0' is

$$F = \frac{k M m_0}{d^2}$$



$$\text{mangnetising force}(H) = \frac{F}{m_0}$$
$$= \frac{kM}{d^2}$$

Magnetic intensity at any point in a magnetic field is defined as the force acting on a unit north pole placed at that point.

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Relation between 'B' and 'H' :-

→ B = magnetic flux density
H = magnetising force (or magnetic intensity)

→ $B \propto H$

$B = \text{const.} \times H$

$B = \mu H$

μ = permeability of the material

μ_0 = absolute permeability.
= permeability of air or vaccum
= $4\pi \times 10^{-7}$ H/m

μ_r = relative permeability

Permeability :-

→ $\mu = B/H$

It is the ratio of magnetic flux density to magnetising force.

→ Permeability of a material is defined as its conducting power for magnetic lines of force. Greater the permiability, greater is the conducting power for magnetic lines of force.

→ Permeability of soft iron (pure iron) is high i.e $\mu_r = 8000$.
Due to high μ_r of soft iron, it is used for electrical equipment.

→ μ_r is not const. for a given magnetic material. It varies with flux density in the material.

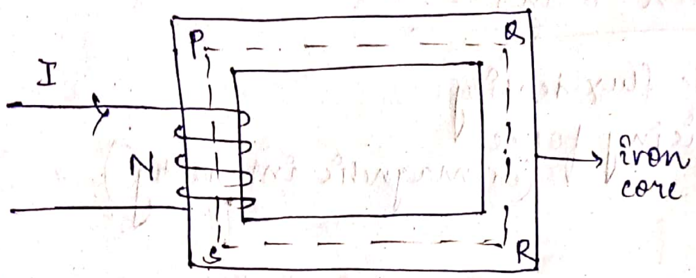
pole strength (magnetic ckt)

analogue

current

magnetic flux

Magnetic circuit –



→ The closed path follow by magnetic flux is called magnetic ckt.

→ Let us consider a coil of N turns wound on an iron core as shown. When current I passes through the coil, magnetic flux ϕ is setup in the core. The flux follow the close path PQRS, this path is called magnetic ckt.

Magneto-motive force :- (mmf)

work done

pole strength

→ The amount of workdone required to carry a unit magnetic pole once through the entire magnetic field called mmf.

→ It drives magnetic flux through magnetic ckt.

good magnetic mate...

$S \uparrow$

$\mu \downarrow$

→ It is the product of current and no. of turns of the coil.

$$mmf = NI$$

→ unit – Ampere turn (AT)

Analysis of magnetic ckt –

Let us consider a magnetic ckt of area of cross section 'a' and mean length 'l'. A coil of N turns wound on the core as shown.

We know that –

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

$$B = \mu H \Rightarrow H = \frac{B}{\mu} \rightarrow (1)$$

$$H = NI/l \rightarrow (2)$$

From eqn ① and ②

$$\frac{B}{\mu} = \frac{NI}{l}$$

$$\Rightarrow \frac{\phi/a}{\mu} = \frac{NI}{l}$$

$$\Rightarrow \frac{\phi}{a\mu} = \frac{NI}{l}$$

$$\Rightarrow \phi l = NIa\mu$$

$$\Rightarrow \phi = \frac{NI}{l/a\mu}$$

$$\Rightarrow \boxed{\phi = \frac{NI}{S}}$$

$$\therefore S = \frac{l}{a\mu} = \frac{l}{a\mu_0\mu_r}$$ = reluctance of magnetic ckt.

R = emf/current

$$S = \frac{NI}{\phi} = \frac{mmf}{flux}$$

$$\boxed{S = \frac{AT}{Wb}}$$

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Reluctance :-

→ It is the opposition possessed by the magnetic ckt to the flow of magnetic flux.

→ It is represented by 'S'

→ $S = \frac{l}{a\mu_0\mu_r}$

Its unit is AT/wb

$$S = \frac{NI}{\phi} = \frac{mmf}{\text{magnetic flux}}$$

Factors affecting on reluctance :-

It depends -

- directly length of the magnetic ckt
- inversely area of cross section of magnetic ckt.
- inversely permeability of the medium.

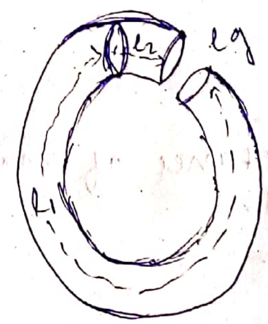
Permeance (Λ)

→ Reciprocal of reluctance is called permeance.

~~prey~~ ~~∓~~ Permeance $= \frac{1}{S} = \frac{a\mu_0\mu_r}{l}$

Its unit is $\frac{Wb}{AT}$

Series magnetic field -



→ In series magnetic ~~fi~~ ckt, magnetic flux through each part is same.

→ Total reluctance, $(S = S_1 + S_2 + S_g)$

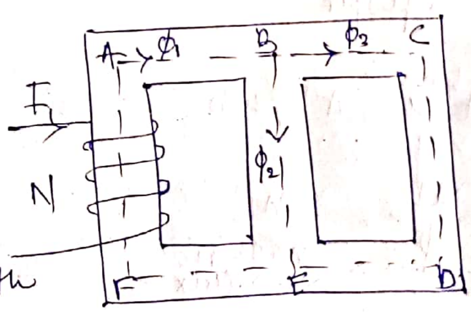
$S_g = \frac{l_1}{a_1\mu_0\mu_{r_1}} + \frac{l_2}{a_2\mu_0\mu_{r_2}} + \frac{l_g}{a_g\mu_0}$

{∵ a_1 = area of cross section of l_1

a_2 = area of cross section of l_2

a_3 = area of cross section of gap}

Parallel magnetic ckt -



→ In parallel magnetic ckt, mmf across each path is same.

→ a magnetic ckt, which has more than one path for flux is called parallel magnetic ckt.

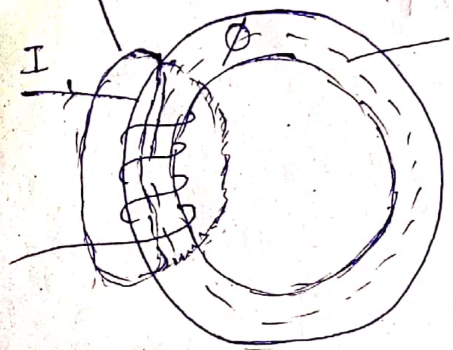
→ From fig, I produces magnetic flux ϕ_1. This flux ϕ_1 is divided into 2 parts ϕ_2 and ϕ_3 along two magnetic paths BE and BCDE.

→ The two paths BE and BCDE are parallel, so mmf of BE = mmf of BCDE.

Total mmf = mmf of EFAB + mmf of BE (or mmf of BCDE)

Total mmf $= NI = \phi_1 S_1 + \phi_2 S_2$

Leakage flux :-



→ The total magnetic flux is the sum of useful flux and leakage flux.

→ The part of total flux which has its path within magnetic ckt, called as useful flux.

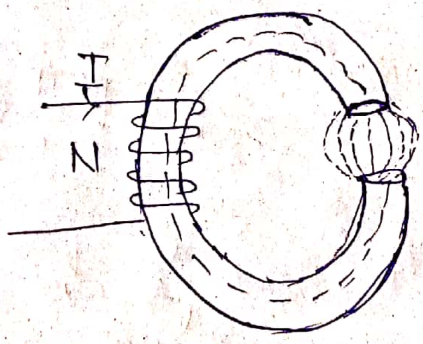
→ The part of total flux having its ~~path~~ partly in magnetic ckt and partly in air is called as leakage flux.

→ The ratio of total flux to useful flux is called leakage factor or leakage coefficient (λ)

$$\text{Leakage coefficient } (\lambda) = \frac{\text{Total flux}}{\text{useful flux}}$$

→ Value of $\lambda > 1$ always.

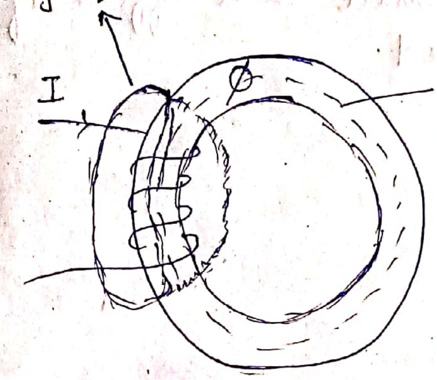
Magnetic fringing :-



→ Consider a ring provided with an air gap. When flux lines cross the gap, they tend to [illegible] out across the edges of air gap. This effect [illegible] called fringing.

$$\text{Total mmf} = NI = \phi_1 S_1 + \phi_2 S_2$$

Leakage flux :-



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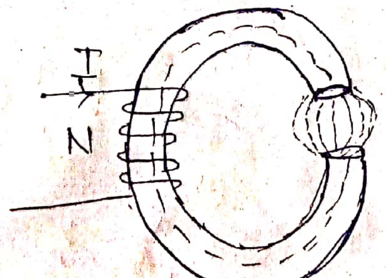
Magnetic fringing :-



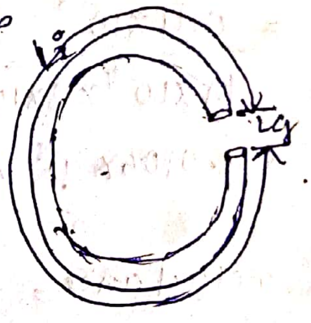
→ Consider a ring provided with an air gap, when flux lines cross the gap, they out across the edges of air gap. called fringing.

→ Fringing increases the gap area of the ring
→ so flux density in the gap decreases.
→ If the gap length is small then effect of fringing will be reduced.

A ring has cross sectional area $3 cm^2$ and mean diameter 25cm. An air gap 0.4mm has been cut across the ring. The ring wound with a coil of 200 turns through which current of 2A flows. If flux is 0.24mWb. Calculate μ.

$D = 25\ cm = 25 \times 10^{-2} m$, $\phi = 0.24 \times 10^{-3} wb$

$N = 200$, $I = 2A$



Length of ring $= \pi D$

$= \pi \times 25 \times 10^{-2} m$

$= 78.5 \times 10^{-2}$

Length of airgap $= 0.4mm$

$= 0.4 \times 10^{-3} m$

length of iron $= Li = \pi D - lg$

$= 78.5 \times 10^{-2} \times 0.4 \times 10^{-3}$

$= 78.46 \times 10^{-2} m$

Area of cross section $= (a) = 3 cm^2$

$= 3 \times 10^{-4} m^2$

97.68

Total reluctance $(S) = S_i + S_g$

$= \frac{Li}{a \mu_0 \mu_r} + \frac{lg}{\mu_0 a}$

$\frac{l}{a\mu}$

$= 2.74\ 77$

$\cancel{78.5 \times 10^{-2}} \Rightarrow S = \frac{78.46 \times 10^{-2}}{3 \times 10^{-4} \times 4\pi \times 10^{-7} \times \mu_r} + \frac{0.4 \times 10^{-3} m}{3 \times 10^{-4} \times 4\pi \times 10^{-7}}$

$\Rightarrow S = \frac{2.08 \times 10^{9}}{\mu_r} + \cancel{0.0106 \times 10^{4}}\ 0.0106 \times 10^{8}$ → (1)

But we know, $\phi = \frac{NI}{S}$

$S = \frac{NI}{\phi} = \frac{200 \times 2}{0.24 \times 10^{-3}} = 1.66 \times 10^{6} \frac{AT}{wb}$ — (2)

From eqn (1) and (2), we get

$1.6 \times 10^{6} - 0.0106 \times 10^{8} = \frac{2.08 \times 10^{9}}{\mu_r}$

$\mu_r = \frac{2.08 \times 10^{9}}{1.66 \times 10^{6} - 0.0106 \times 10^{8}} = 3466.6 \times 10$

≈ 3467

0.54 0.6

0.4 $\times 10^{8}$

1.06×10^{6}

Alternative method.

In series magnetic ckt, magnetic flux ~~no~~ remains same.

$$S_g = \frac{l_g}{\mu_0 a}$$

$$= \frac{0.4\times10^{-3}}{4\pi\times10^{-7}\times3\times10^{-4}}$$

$$= 0.0106\times10^{8} \text{ AT/wb}$$

Total reluctance, $S = \frac{\cancel{N}I}{\phi} = \frac{\overset{200}{\cancel{78.5\times10^{-2}}}\times2}{0.24\times10^{-3}}$

$= 1666.6\times10^{3}$

$= 1$

$$S_i = S - S_g$$

$$= 0.60\times10^{6}$$

606666.667 2.544×10⁵

$$S_i = \frac{L_i}{\mu_0\mu_r a}$$

$$0.60\times10^{6} = \frac{78.46\times10^{-2}}{4\pi\times10^{-7}\times\mu_r\times3\times10^{-4}}$$ 3.768×10⁻¹⁰

$$\mu_r = \frac{2.08\times10^{9}}{0.60\times10^{6}}$$ 254.7

1666666.667
1060000

Total mmf = AT = 400

mmf of gap = $AT_g = \phi S_g$

$= 0.24\times10^{-3}\times S$

$= 2.547\times10^{2}$

$= 254.7$

mmf of iron = $AT_i = AT - AT_g$

$= 145.3$

$$\phi = \frac{\text{mmf}}{S_i} = \frac{AT_i}{S_i}$$

$$S_i = \frac{AT_i}{\phi} = \frac{145.3}{0.24\times10^{-3}} = 605416.666 \text{ AT/wb}$$

Scanned by CamScanner

$$\frac{l_i}{\mu_0 \mu_r a} = 6054166.66$$

$$\mu_r = \frac{78.46 \times 10^{-2}}{37.68 \times 6054166.66}$$

22812099.97

$$\approx 3439$$

Q. A iron ~~beaming~~ ring of Diameter 15cm and area of cross section 10 cm^2 is wound with 200 turns. There is a gap of 2mm cut in the ring. For B = 1 wb/M^2 and $\mu_r = 500$, Find exciting current.

$D = 15cm = 0.15 m$

$A = 10 cm^2 = 10 \times 10^{-4} m^2 = 10^{-3} m^2$

$N = 200$

$l_g = 2 \times 10^{-3} m$

$B = 1 wb/m^2$

$\mu_r = 500$

~~So~~ Length of ring $= \pi D = 3.14 \times 0.15 = 0.471 m$

~~Length of~~ $l_i = \pi D - l_g$

$= 0.471 - 0.002$

$= 0.469 m$

$\frac{NI}{\phi} = S$

$I = \frac{S\phi}{N}$

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

$\phi = Ba = 1 \times 10^{-3}$

~~$NI = S\phi$~~

$S = S_i + S_g$

$$= \frac{0.469}{4\pi \times 10^{-7} \times 10^{-3} \times 500} + \frac{2 \times 10^{-3}}{4\pi \times 10^{-7} \times 10^{-3}}$$

$$= \frac{0.0469}{6280 \times 10^{-10}} + \frac{2 \times 10^{-3}}{12.56 \times 10^{-10}}$$

$$= \frac{5.89 \times 10^{-10} + 12.56 \times 10^{-10}}{78876.8 \times 10^{-10}}$$

$$= \frac{18.45 \times 10^{-10}}{78876.8 \times 10^{-10}}$$

$= 2.33$

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Q The inductance of a coil is 0.15H. The coil has 100 turns. Find —

(a) Flux through the coil when current is 4A.

(b) Energy stored in the magnetic field

(c) Voltage induced in the coil when current reduced to zero in 0.01 sec.

$$emf = L\frac{dI}{dt}$$

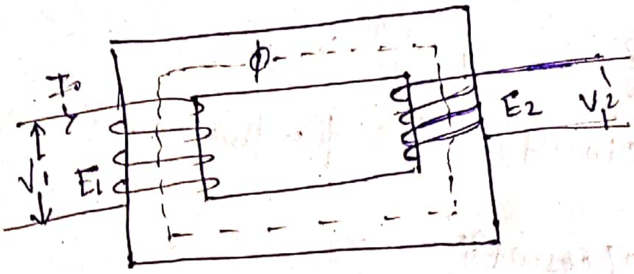
$$L = \frac{N\phi}{I}$$

$$\text{Energy stored} = \frac{1}{2}LI^2$$

22.10.19

15 mrks

TRANSFORMER



→ Transformer is a static device which consist of two or more stationary electric ckts. interlinked by common magnetic ckt, for transfering electric energy from one ckt to another at same frequency but with changed voltage (or current)

$V = V_m \sin \omega t$ (freq)

→ In transformer, frequency and apparent power is always const.

→ Principle —
It is based on the principle of mutual induction i.e whenever magnetic flux linkages with a coil changes an emf is induced in the coil.

Working —
→ when alt. voltage V_1 is applied to primary of a transformer then a current I_o flows through it. This I_o is called exciting current which produces alt. magnetizing flux. (ϕ) in the core. This flux links both primary and secondary windings. so emf(E_1) induced in primary and emf (E_2) induced in secondary.

→ Acc. to Lenz's law, Emf E_1 will oppose V_1 so we can write $\boxed{E_1 = -V_1}$

→ when load is connected to secondary then current will start flowing in sec. winding. The voltage induced in 2ndary winding is responsible to deliver power to the load conn-ected to it.

→ If secondary is open then secondary current is zero and $\boxed{E_2 = V_2}$

Emf eqn –

We know that,

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

$$\Rightarrow e = -N\frac{d(\phi_m \sin\omega t)}{dt} \quad \{\because \phi = \phi_m \sin\omega t\}$$

$$= -N\phi_m \omega(\cos\omega t)$$

$$= -N\phi_m \omega[\sin(90 - \omega t)]$$

$$= N\phi_m \omega[\sin(\omega t - 90)]$$

$$= E_m[\sin(\omega t - 90°)]$$

$$\therefore \quad E_m = N\phi_m \omega = \text{max}^m \text{ emf}$$

Rms value of emf –

$$E_{rms} = \frac{E_m}{\sqrt{2}} = \frac{N\phi_m \omega}{\sqrt{2}}$$

$$= \frac{N\phi_m(2\pi f)}{\sqrt{2}}$$

$$= 4.44 N\phi_m f$$

1.414×3.14

This is the exp. of emf eqn

→ For primary coil emf induced,

$$E_1 = 4.44 N_1 \phi_m f$$

similarly, for secondary coil emf induced,

$$E_2 = 4.44 N_2 \phi_m f$$

Voltage transformation ratio –

It is defined as the ratio of secondary voltage to primary voltage. It is represented by K.

so, $K = \frac{E_2}{E_1} = \frac{N_2}{N_1}$

Also, it is defined as the ratio of 2ndary turns to primary turns.

V. Imp

Turn ratio — The ratio of primary to 2ndary turns called as turn ratio.

Turn ratio = $\frac{N_1}{N_2}$

NOTE - (i) If $N_2 > N_1$ then $E_2 > E_1$. It is the condn for step-up transformer.

(ii) If $N_2 < N_1$ then $E_2 < E_1$. It is the condn for step down transformer.

Ideal transformer :-

→ Primary and secondary winding resistance are negligible ~~hav~~ hence there is no resistive voltage drop and no resistive heat loss.

→ The leakage flux and inductances are zero, so there is no reactive voltage drawn in the winding.

→ The efficiency is 100% i.e there are no high hysteresis loss and heat losses due to resistance

→ The permeability of the core is infinity.

The power (VA) in primary = the secondary (power in VA)

$V_2/V_1 = I_1/I_2 \rightarrow (1)$ Also $E_1 I_1 = E_2 I_2$

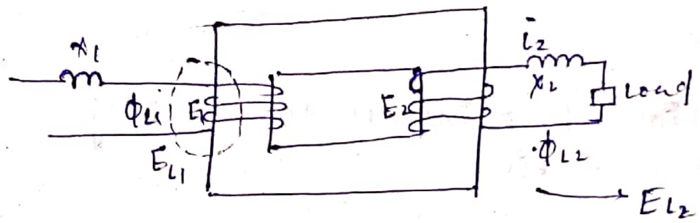
$\Rightarrow E_2/E_1 = I_1/I_2 \longrightarrow (2)$

Thus, $E_2/E_1 = K = V_2/V_1 = I_1/I_2$

Practical transformer :-

(1) Winding resistance —

(ii) Leakage Reactance —



(iii) Iron loss :— (core loss)

Eddy current loss | Hysteresis loss

P.T → Practical transformer are far diff. from ideal transformer. It has winding resistance, leakage reactance and iron losses.

→ In practical transformer 1° and 2° winding consist of copper conductors so it posses resistance.

$R_1 \rightarrow$ 1° resistance
$R_2 \rightarrow$ 2° resistance } → connected in series as shown in fig.

L.R → In ideal transformer all flux produced by 1° links in both 1° and 2° winding. but in practical transformer a portion of this flux ~~oriented~~ diverted to the surroundings. It is because surrounding (air) has a permeability. This small portion of flux called as leakage flux (ϕ_{L1}). This ϕ_{L1} links only in 1° and induces emf E_{L1} in 1°

→ The 2° current I_2 produces flux ϕ_2. A portion of ϕ_2 diverted to the surrounding. This leakage flux is called 2° leakage flux (ϕ_{L2}).
It links in 2° turns and induces emf E_{L2}.
E_{L1} and E_{L2} are diff. from E_1 and E_2.

→ As the leakage flux linking with each winding produces self induced emf in that winding hence the effect of leakage flux equivalent to an inductance in series with each winding.

$X_1 \longrightarrow 1^{\circ}$ reactance

$X_2 \longrightarrow 2^{\circ}$ "

I.L → As core of the transformer subjected to alternating flux, there occurs AD current and hysteresis loss. These 2 losses are called iron losses.

→ Its value is less in practical transformer.

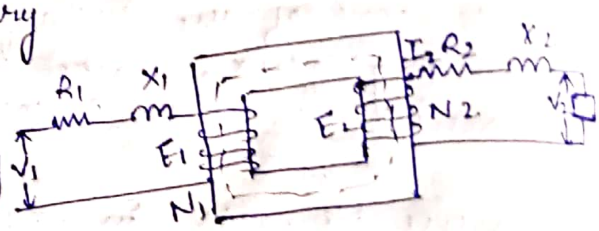
Impedence Reflections and Power transform :-

→ To make transformer calculation simpler, it is preferrable to transfer voltage, current and impedence either to primary or 2 secondary.

→ Equivalent values prefeected to primary :-

Let R_2 = Resistance of secondary

R_2' = Resistance of 2ndary refleeted to primary



The resistance R_2' should produce same effect in 1° as it produces in 2°.

So, $(I_2')^2 R_2' = I_2^2 R_2 \longrightarrow ①$

where, I_2' = current of 2° winding reflected to 1° winding - this I_2' is used to counteract the demagnetising effect of 2° current I_2. Therefore -

$$N_1 I_2' = N_2 I_2$$

$$\Rightarrow I_2' = \frac{N_2}{N_1} I_2$$

$$\Rightarrow I_2' = K I_2$$

eqn ① becomes

$$(I_2')^2 R_2' = I_2^2 R_2$$

$$\Rightarrow R_2' = \frac{I_2^2 R_2}{(I_2')^2}$$

$$= \frac{I_2^2 R_2}{K^2 I_2^2}$$

$$\Rightarrow R_2' = \frac{R_2}{K^2}$$

Similarly -

$$X_2' = \frac{X_2}{K^2}$$

where X_2 = reactance of $2°$ winding

X_2' = reactance of $2°$ winding reflected to $1°$.

let R_{01} = Effective resistance of the whole transformer referred to $1°$.

$= R_1 + R_2'$

$= R_1 + \frac{R_2}{K^2}$

X_{01} = Effective reactance of the whole transformer referred to $1°$

$= X_1 + X_2'$

$= X_1 + \frac{X_2}{K^2}$

Z_{01} = Effective impedence of whole transformer referred to $1°$

$= R_{01} + j X_{01}$

$$|Z_{01}| = \sqrt{R_{01}^2 + X_{01}^2}$$

→ Equivalent values reflected to secondary :-

let R_{02} = Effective resistance of the whole transformer referred to $2°$.

$= R_2 + R_1'$

$= R_2 + K^2 R_1$

let X_{02} = Effective reactance of the whole transformer referred to $2°$.

$= X_2 + X_1'$

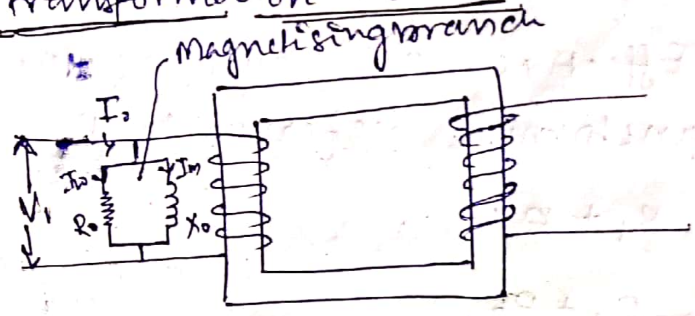
$= X_2 + K^2 X_1$

let Z_{02} = Effective impedence of the whole transformer referred to $2°$

$= R_{02} + j X_{02}$ $\Rightarrow |Z_{02}| = \sqrt{R_{02}^2 + X_{02}^2}$

Practical transformer :-

(i) Practical transformer on no load :-

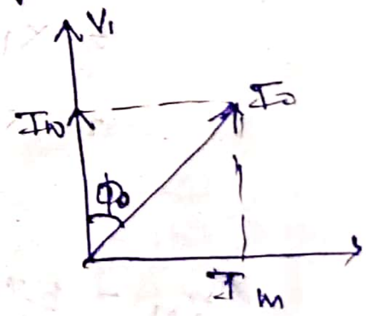


→ I_0 = no load current

I_0 resolves into two components.

I_m = magnetising current (Wattless current)

I_w = current flows through the coil



→ $I_w = I_0 \cos\phi_0$

$I_m = I_0 \sin\phi_0$

$\therefore \phi_0 = \tan^{-1}\left(\frac{I_m}{I_w}\right)$

$I_0 = \sqrt{I_w^2 + I_m^2}$

→ No load primary input power is equal to iron loss of the core $= V_1 I_0 \cos\phi_0$

Q A distribution transformer x no load primary current one ampere at 0.24 power factor lagging. Find magnetising current.

$I_0 = 1$ Amp $\quad \cos\phi_0 = 0.24$

$I_m = I_0 \sin\phi_0 \quad \phi_0 = \cos^{-1}(0.24)$

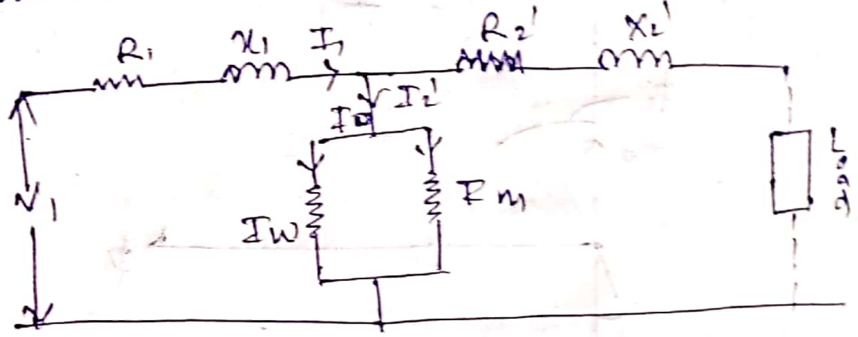
$= 1 \times 0.97$ Amp $\quad = 76.11$

or

$I_0 - I$

(ii) Practical transformer on Load :-

Imp Equivalent circuit :-



→ When 2ndary is loaded, 2'dry current I_2 is setup.

→ The secondary current setup its own mmf $N_2 I_2$ and hence its own flux ϕ_2. This ϕ_2 opposes main primary flux ϕ_1 which is due to I_0.

→ The secondary ampere turns $N_2 I_2$ are called demagnetising ampere turns.

→ The secondary flux ϕ_2 ~~oppo~~ weakens the primary flux ϕ_1 momentarily. Hence primary emf E_1 ~~re~~ decreases. For a moment, V_1 increases over E_1 and hence ~~purchase~~ causes more current to flow primary. Let the additional primary current be I_2'.

→ The additional primary mmf $N_1 I_2'$ balances $N_2 I_2$. As a result magnetiz effects of secondary current I_2 are immediately neutralized by current I_2'.

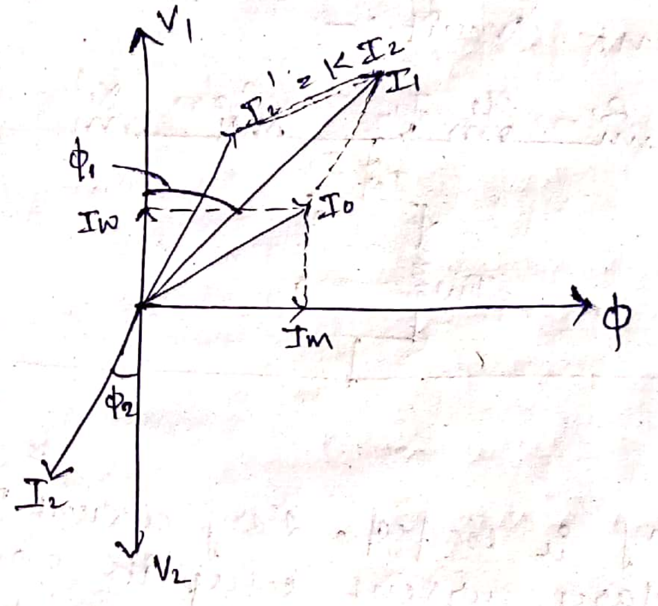
→ so we can write -

$$N_1 I_2' = N_2 I_2$$

$$\Rightarrow I_2' = \frac{N_2 I_2}{N_1}$$

$$\Rightarrow I_2' = K I_2$$

Draw the phasor diagram of practical transformer under inductive load.



30.10.19 :-

Losses of Transformers :-

These are the following losses of a transformer:-

(i) Cu loss

(ii) Iron loss (or core loss)

Cu loss :-

- These losses occur due to resistance of the windings.
- If I_1 and I_2 are primary and secondary currents respectively and R_1 and R_2 are the respective resistances of 2 windings then copper losses occuring in 2 windings are - $I_1^2 R_1$ and $I_2^2 R_2$ respectively.
- Total copper loss of the transformer -

$I_1^2 R_1 + I_2^2 R_2$

- The Cu loss vary with a square of load current.

Iron Loss -

It is of 2 types -

1) hysteresis Loss

2) Eddy current loss

~~Hysteresis Loss~~ -

Voltage regulation -

$$\text{Voltage reg.} = \frac{\text{2ndary no load voltage} - \text{2ndary full load voltage}}{\text{2ndary no load voltage}}$$

$$= \frac{E_2 - V_2}{E_2} \times 100$$

Efficiency of the transformer :-

It is defined as the ratio of output power to input power.

It is represented by $\% \eta = \frac{\text{Output power in KW}}{\text{input power in KW}} \times 100$

$$= \frac{\text{Output power}}{\text{output power + losses}} \times 100$$

Condition for max^m efficiency of transformer?

When variable Cu loss is equal to constant iron loss then efficiency will be max^m.

Why transformer will not work on DC?

If we feed DC supply to the 1° winding of a transformer then the magnetic flux produce will not vary but remains const in magnitude. Therefore no emf will be induced in the secondary winding except at the moment of switching on.

Thus the transformer cannot be employed for rising or lowering the DC voltage.

Also there will be no back induced emf in the 1° winding. and therefore a heavy current will be drawn from the supply means. which may result in the burning out of in the transformer windings.

Q. Why transformer related to KVA?

The size of a transformer determined by KVA of the load the current that passes through the windings ~~which~~ will determine cu loss. whereas iron losses, insulation losses depend on voltage that's why the transformer rating may be expressed in KVL.

Isolation transformer —

→ When the transformer receives energy at 1V and delivering it at the same voltage then the transformer is called one to one transformer.

→ For one to one transformer, $N_1 = N_2$ and $E_1 = E_2$. Such a transformer is used to isolate ~~the 2 currents~~ the ckt. and is known as isolation transformer.

* Frequency and Apparent power const in transformer.