Qus.1> Explain Different type of Magnetic Material

Ans.> Magnetic Materials are basically three types

(i) Paramagnetic Material

(ii) Diamagnetic Material

(iii) Ferromagnetic Material

(i) Promagnetic Materials> The materials which are not strongly attracted by a magnet are known as Paramagnetic material.

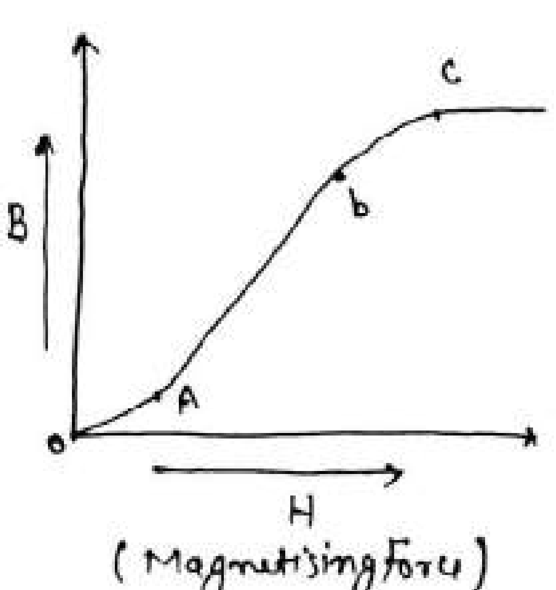
Ex.> aluminium, platinum, magnesium.

(ii) Diamagnetic Materials> The materials which are repelled by a magnet such as Zinc, mercury, lead are known as Diamagnetic materials.

(iii) Ferromagnetic Materials> The material which are strongely attracted by a magnet such as Iron, steel, Nichel are known as ferromagnetic materials.

Qus.2> Explain B-H curve in detail>

Ans.> The Curve Drawn b/w Induction density B and Magnetising Force H is known as B-H curve or Magnetising curve.



* in region 0A Increase in flux density is very small
* in region ab flux density is Directly proportional to Magnetising Force
* in Region bc again Increase in flux density is very Small.
* beyond c there is no change in flux density on Increasing the Magnetising Force this Region is known as Magnetic Saturation.

Que.3 > Explain Ideal & Practical Transformer.

Ans. > For a Ideal Transformer we take following assumption's →

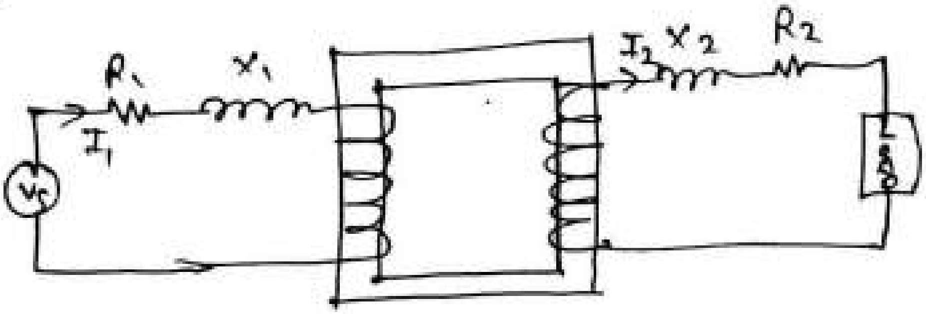
(i) No winding resistance → The primary & Secondary winding's have No resistance.

(ii) No magnetic leakage → There is No leakage flux all the flux setup is confined to the core.

(iii) No Iron loss → There is No Hysteresis and eddy current loss

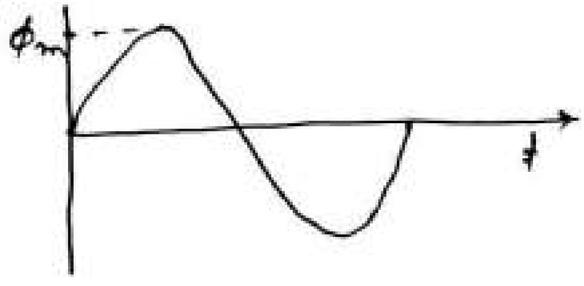
(iv) Zero magnetising current → The Core has Infinite Permeability and zero reluctance.

Practical Transformer > The Transformer which Not follow the assumption of Ideal Transformer is known as practical Transformer



Que.4 > Write down E.m.f. Equation of transformer

Ans. >



* let flux associated with the Core is
$$\phi = \phi_m \sin \omega t$$

* N_1 & N_2 no of turn in Primary and Secondary winding.

* Now Induced e.m.f in Primary winding

$$e_1 = -N_1 \frac{d\phi}{dt} = -N_1 \omega \phi_m \cos \omega t$$
$$= N_1 \omega \phi_m \sin(\omega t - \pi/2)$$

Similarly

$$E_2 = -N_2 \frac{d\phi}{dt}$$

$$= -N_2 \frac{d}{dt}(\phi_m \sin \omega t)$$

$$= N_2 \omega \phi_m \sin(\omega t - \pi/2)$$

Now ~~average~~ r.m.s. value of Induced e.m.f

$$E_1 = \frac{N_1 \phi_m \omega}{\sqrt{2}}$$

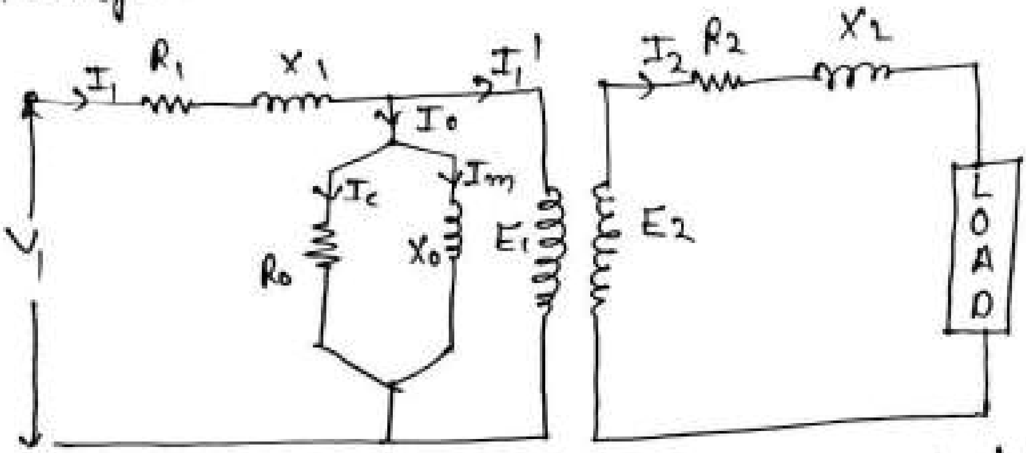
$$= \frac{N_1 \phi_m 2\pi f}{\sqrt{2}}$$

$$\boxed{E_1 = 4.44 f \phi_m N_1 \text{ Volt}}$$

$$\boxed{E_2 = 4.44 f \phi_m N_2 \text{ Volt}}$$

Ques 5> Draw and Explain Equivalent Circuit of Transformer.

Ans.>



Equivalent ckt of any device can be quite helpful in Predetermination of the behavior of the device under various condition of operation.

$R_1, X_1 \rightarrow$ Primary Resistance and Reactance

$R_2, X_2 \rightarrow$ Secondary Resistance and Reactance.

$I_1, I_2 \rightarrow$ Primary & Secondary current

$R_0, X_0 \rightarrow$ No-load Parameter of Transformer.

$I_0 \rightarrow$ No load Current

I_1' → Counter balancing current which Neutralized the flux produced by Secondary current.

$$I_1 = I_0 + I_1'$$

$$\boxed{N_1 I_1 = N_2 I_2}$$

Que 6 → Explain Different type of losses Present in Transformer.

Ans. → There are two type of losses present in Transformer

(i) Copper loss

(ii) Iron loss

Copper loss → Copper loss is basically due to Resistance and It takes place in primary & Secondary winding.

$$\boxed{P_c = I_1^2 R_1 + I_2^2 R_2}$$

Iron loss → Iron loss is also two types.

(i) Hysteresis loss

(ii) Eddy current loss.

(i) Hysteresis loss > When alternating flux Setup in the Core the Hysteresis loop is Traced out and area under Hysteresis loop represent Hysteresis loss. and it is given by

$$\boxed{P_h = \eta (B_{max})^{x} f V \text{ Joule}}$$

where η → Hysteresis Cofficient

B_{max} → Max. flux density

f → Supply frequency

V → Volume of Core.

(ii) Eddy current loss > When Variable flux Setup in the Core the flux linkage with Iron core is change due to which a current is

Induced in the Core this current is known as Eddy Current and result heating loss which is known as Eddy current loss. And is given by

$$P_e = K_e (B_{max})^2 f^2 t^2 v \text{ Watt}$$

Ques. 7 → What is the efficiency of Transformer. Derive the expression for max. efficiency.

Ans. 7 The efficiency of any Machine is given by

$$\eta = \frac{\text{output}}{\text{Input}} = \frac{\text{output}}{\text{output} + \text{losses}}$$

for a fixed Input Voltage Iron-loss is constant but Copper loss is depend upon Load current

$$\eta = \frac{\text{output}}{\text{output} + \text{Copper-loss} + \text{Iron-loss}}$$

let $P_o \rightarrow$ output Power at full load

$P_i \rightarrow$ Iron-loss

$P_c \rightarrow$ Copper-loss at full load

then efficiency at x load where x is fraction of full load →

$$\eta = \frac{x P_o}{x P_o + P_i + x^2 P_c}$$

for max. efficiency

$$\frac{d\eta}{dx} = 0 \quad \text{now} \quad \frac{d\eta}{dx} = \frac{(xP + x^2 P_c + P_i)P - xP(P + 2xP_c)}{(xP + P_i + x^2 P_c)^2}$$

$$P_i - x^2 P_c = 0$$

$$x = \sqrt{\frac{P_i}{P_c}}$$

Que. 8 → In a 25 KVA 2000V/200V Transformer The Iron and Copper losses are 200 W and 400 W respectively calculate the efficiency at half load 0.8 Power Factor lagging. also determine max. efficiency and corresponding load.

Ans. → $P_c = 400\,W = 0.4\,KW$

$P_i = 200\,W$

$P_o = \frac{1}{2} \times V \times I \times \cos\phi$

$= \frac{1}{2} \times 25 \times 0.8$

$= 10\,KW$

* Copper loss at half load $= \left(\frac{1}{2}\right)^2 \times 400 = 0.1\,KW$
* efficiency at half load →

$$\%\eta = \frac{10}{10 + 0.1 + 0.2} \times 100 = 97.08\%$$

* for max efficiency $x = \sqrt{\frac{P_i}{P_c}}$ ⇒

Corresponding load $= 25 \times \sqrt{\frac{P_i}{P_c}} = 17.68\,KVA$

So max. efficiency $= \frac{17.68}{17.68 + 0.2 + 0.2} = 97.788\%$

Que. 9 > What is Auto Transformer. How Conducting Material Saved in Auto Transformer.

Ans. > The Auto Transformer has same principal as like Conventional two winding transformer the only difference is that in auto transformer primary and Secondary windings are Interrelated.

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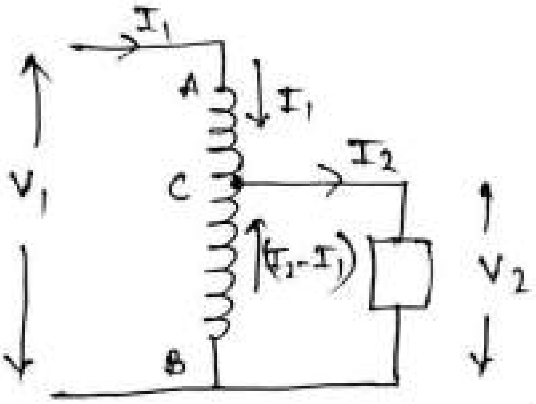

$$\frac{V_2}{V_1} = \frac{E_{BC}}{E_{AB}} = \frac{N_2}{N_1} = \frac{I_1}{I_2} = K$$

Conducting Material → Conducting Material required is Directly Proportional to cross sectional area and length of Conductor so.

Conducting Material in ordinary Transformer

$$C_0 \propto (N_1 I_1 + N_2 I_2)$$

$$C_0 \propto 2 N_1 I_1 \quad \text{because } N_1 I_1 = N_2 I_2$$

In auto Transformer

$$C_A \propto I_1 (N_1 - N_2) + N_2 (I_2 - I_1)$$

$$C_A \propto 2 (N_1 - N_2) I_1$$

now

$$\frac{C_A}{C_0} = \frac{2(N_1 - N_2) I_1}{2 N_1 I_1} = 1 - \frac{N_2}{N_1} = 1 - K$$

$$\boxed{C_A = C_0 (1-K)}$$

Conducting Material Saved.

$$C_0 - C_A = C_0 - C_0 (1-K)$$

$$= C_0 K$$

Saving = K × Conducting Material in Ordinary