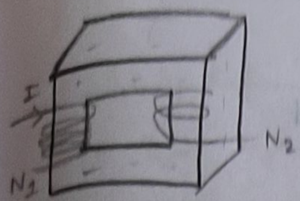
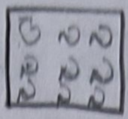
TRANSFORMER :



Since transformer is static, the mechanical loses are nil.



Energy Losses in Transformer :

i) Copper Loss :

ii) Core Loss :

* The core material should conduct magnetic flux (or) greater magnetic permeability (μ_r).
* It should not conduct current.

Eddy Current Loss :

* Eddy currents are formed inside the transformer also due to I^2R energy is dissipiated as heat.
* To overcome this, laminated sheets are used which has air gaps and creates a resistance for the eddy currents and heat loss is reduced.
* To increase resistance, Si is added as alloy to core material. ($\because$ 3% Si is alloyed)

B) Hysteresis Loss :

* In transformer, AC current at 50 Hz is used.
* For every $\frac{1}{50}$ sec, the domains are oriented. polarity changes, the size of magnetic dipole increases & decreases vice
* Due to change in orientations of domains, friction is produced, which generates heat.
* To overcome this, soft-magnetic materials can be used.

For Ideal Transformer : Eddy current Loss & Hysteresis Loss will be ze

Books:

Electrical Technology - A. K. Thereja, B. L. Thereja

Rohit Mehta

Determination of Phase Angle and in LCR Bridge:

$Z = x + iy$ $\qquad$ $z_1 = x_1 + iy_1$

$r = |z| = \sqrt{x^2 + y^2}$ $\qquad$ $z_2 = x_2 + iy_2$

$\theta = \tan^{-1}\left(\frac{y}{x}\right)$

$Z = r\cos\theta + i\sin\theta$

LCR : Two Frequencies:

	100 Hz	1 kHz
C	9.431 μF, $\phi = -87.83$	
L		
R	9.812 kΩ, $\phi = 0.16°$	9.939 kΩ, $\phi = 0.03°$
Z		
ϕ	0.16°	0.03°

100 Hz

$R = 9.812\ k\Omega$

$\phi = 0.16°$

1000 Hz

$R = 9.934\ k\Omega$

$\phi = 0.03°$

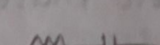
RC:

$C = 9.431\ \mu F$

$\phi = -87.83°$

$R \to 6.32\ \Omega$

$Z \to 168.7\ \Omega$



$Z = R + iX_C$

$X_C = \frac{1}{\omega C} = \frac{1}{2 \times 3.14 \times 100 \times 9.431 \times 10^{-6}}$

$= 1.6884 \times 10^{-4} \times 10^{6} = 168.84$

RC:

$C = 8.726\ \mu F$

$\phi = -83.278°$

$R = 2.151\ \Omega$

$Z = 18.37\ \Omega$

$Z = \sqrt{R^2 + (X_C)^2}$

$= \sqrt{39.94 + 2850...}$

$= 168.11\ \Omega$

$$X_C = \frac{1}{2\times3.14\times1000\times8.726\times10^{-6}}$$

$$= 1.824\times10^{-5}\times10^{6}$$

$$= 18.24$$

$$Z = \sqrt{(R)^2+(X_C)^2} = \sqrt{(2.151)^2+(18.24)^2}$$

$$= \sqrt{4.626+332.69}$$

$$= \sqrt{337.316}$$

$$= 18.36\ \Omega$$

At 100 Hz : Pure Inductor;

$L = 2.187$ mH

$R = 9.859\ \Omega$

$Z = 9.95\ \Omega$

$\phi = 7.96^\circ$

$$X_L = \omega L = 2\pi f L$$

$$= 2\times3.14\times100\times2.187\times10^{-3}$$

$$= 1373.4\times10^{-3}$$

$$= 1.373\ \Omega$$

$$Z = \sqrt{(R)^2+(X_L)^2}$$

$=$

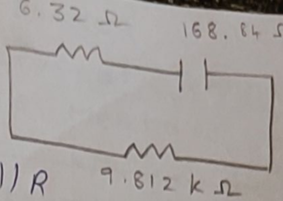
At 1k Hz

$L = 2.213$ mH

$R = \cancel{2.151\ \Omega}\ 9.896\ \Omega$

$Z = 17.07\ \Omega$

$\phi = 54.55^\circ$



$Z_1 = 168.11$ 96.04 -

RC || R

~~RBC~~ : 100 Hz :

$Z_2 = 9.812\times10^3\ \Omega$

$$\left|\frac{1}{Z}\right| = \sqrt{\left(\frac{1}{Z_1}\right)^2 + \left(\frac{1}{Z_2}\right)^2}$$

$$= \sqrt{(5.948\times10^{-3})^2 + (0.1019\times10^{-3})^2}$$

$$= \sqrt{35.37\times10^{-6} + 0.01038\times10^{-6}}$$

$$= \sqrt{35.38\times10^{-6}}$$

$$\left|\frac{1}{Z}\right| = 5.94\times10^{-3}$$

$$Z = \frac{1}{5.94}\times10^3 = 0.16835\times10^3 = 168.35\ \Omega$$

Exp Value

RC:

$Z = 168.5\ \Omega$

$\phi = -86.88°$

RLC:

$Z = 167.8\ \Omega$

$\phi = -83.48$

$Z_1 = 6.32\Omega + i(168)$ $(x_1 + iy_1)($.

$Z_2 = 9.812\ \Omega + i(0)$

$$\frac{1}{Z} = \frac{1}{Z_1} + \frac{1}{Z_2} = \frac{Z_2 Z_1}{Z_1 + Z_2} =$$