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Q2 (a)(b)(c)

A square ferromagnetic core has a mean path length off 55cm & a cross-sectional area of 150cm². A 200 turn coil of wire is wrapped around one leg of the core. The core is made of a material having magnetization intensity (H) 115 A. turn/m Find:

(a) How much current is required to produce 0.012 Wb of flux in the core?

(b) What is the core relative permeability at that current level?

(c) What is it reluctance?

Solution:-

The required flux density in the core is:

$$B = \frac{\Phi}{A} = \frac{1.012}{0.015}$$

$$= 0.8T$$

- The required magnetizing intensity is $H = 115$ A. turns/m.
- The magnetomotive force needed to produce this magnetizing intensity is

$$F = Ni = Hl_c = 115 \times 0.55 = 63.25 \text{ A turns.}$$

(a) So the required current is

$$i = \frac{F}{N}$$

$$= \frac{63.25}{200}$$

$$= 0.316 \text{ Amp}$$

(b) The core permability at this current is

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

$$= \frac{0.8}{115}$$

$$= 0.00696 \text{ H/m.}$$

(c) Therefore the relative permeability is

$$\mu_r = \frac{\mu}{\mu_0} = \frac{0.00696}{4\pi \times 10^{-7}}$$

$$= 5540$$

(c) The reluctance of the core is

$$R_o = \frac{F}{\Phi}$$

$$= \frac{63.25}{0.012}$$

$$= 5270 \text{ A.turn/wb}$$

Q2(a) Derive voltage & Impedence relationship with turn ratio for an ideal transformer?

Ans **Voltage :-**

For an ideal transformer all the flux is confined to the iron core & thus links the primary & secondary.

$$E_{RMS} = 4.44 f N \phi_{max} = 4.44 f N B_{max} A_e$$

$$E_p = 4.44 f N_p \phi_{max}$$

$$E_s = 4.44 f N_s \phi_{max}$$

$$\frac{E_p}{E_s} = \frac{N_p}{N_s} = a$$ (Turn ratio)

For step down transformer the primary side has more turn than secondary therefore $a > 1$;

For step up transformer the primary side has fewer turns than secondary therefore $a < 1$;

Impedance

Due to the fact that the transformer charges the voltage & current levels in opposite directions. It also changes the apparent impedance as seen from the two side of the transformer.

ohm's law applied at load:

$$Z_L = \frac{V_s}{I_s}$$

Re collected:

$$\frac{I_p}{I_s} = \frac{V_s}{V_p} = \frac{N_s}{N_p} = \frac{1}{a}$$

When we move an impedance from the secondary to the primary side of transformer we multiply by the turns ratio squared.

When moving the impedance from the primary to the secondary. We divide it by turns ratio squared.

This process is called referring the impedance to side we move it & allow us to use transformer to match impedance b/w a source & a load.

$$Z_L = \frac{\frac{V_p}{a}}{aI_p} = \frac{V_p}{a^2 I_p} = \frac{Z_{in}}{a^2}$$

$$\underset{\uparrow}{Z_{in}} = a^2 Z_L$$

The reflected impedance.
(the impedance looking into the primary side of the transformer).

Q3M1 Define Power factor? Differentiate between Real, Apparent & reactive powers?

Ans:- **Power Factor :-**

Power factor is the ratio of the actual electrical power dissipated by an AC circuit to the product of the rms values of current & voltage.

OR

The ratio of the real power absorbed by the load to the apparent power flowing in the circuit & is a dimensionless number in the closed interval of -1 to 1.

Real Power:-

The power which is actually consumed or utilised in an AC circuit is called true power or active or real power. It is measured in W (watt). It is denoted by P.
Active power is the real power consumes by the load.

Apparent Power:-

The combination of reactive power & true power is called apparent power. and it is the product of a circuit voltage & current without reference to phase angle. Apparent power measured in unit of volt-Amp(V_A). It symbolized by capital S.

Reactive Power:-

Reactive Power is the product of voltage & current and the sine of the angle between them

Reactive Power is measured in VAR.

The mathematically symbol for reactive power is the capital letter Q.