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Department of Electrical Engineering

Summers

Course Code:	EEE342			**Course Title:**	Electrical Machines		
Prerequisite:	Circuit Analysis			**Instructor:**	Engr. Sanaullah Ahmad		
Module:	8th	**Program:**	BEE	**Total Marks:**	30	**Time Allowed:**	

Note: 1) Attempt all questions.
2) Calculators borrowing/exchange is prohibited.

	(b)	A square ferromagnetic core has a mean path length of 55cm and a cross-sectional area of $150cm^2$. 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. turns/m. Find: a. How much current is required to produce 0.012 Wb of flux in the core? b. What is the core's relative permeability at that current level? (4π×10-7H/m) c. What is its reluctance?	Marks 10 CLO 2
Q2	(a)	Derive Voltage and Impedance relationship with turn ratio for an ideal transformer?	Marks 10 CLO 1
Q3	(a)	Define power factor? Differentiate between Real, Apparent and reactive powers?	Marks 10 CLO 1

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Subject – Electrical Machine

Teacher: – Eng Sir Sanaullah

Date – 21-08-2020

Q: No: 01

Solution:- The requried flux density in the core is

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

$$= 0.8T$$

- The required megnetizing intensity is $H = 115$ A.turns/m

- The megnetomotive force needed to produce this megnetizing intensity is:

$$F = Ni = Hl_c = 115 \times 0.55$$

$$= 63.25 \text{ A.turns}$$

- So the required current is:

$$i = F/N = \frac{63.25}{200}$$

$= 0.316$ Amp

- The core's permeability at this current is:

$$\mu = \frac{B}{H} = \frac{0.8}{115} =$$

$$= 0.00696 \ H/m$$

- Therefore, the relative permeability is:

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

$$= 5540$$

- The reluctance of the core is:

$$R = F/\phi$$

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

$$= 5270 \ \text{A·turns/Wb}$$

Q : No : 3

Power Factor :-

Power factor is the ratio of the actual electrical power dissapated by an AC circuit to the product of the r.m.s values of current and voltage.

OR

The ratio of the real power observed by The load to the apperent power flowing in the circuit and is a dimentionless number in the close interval of -1 to 1.

Real Power :-

The power which is actually consumed or utilized in on AC. ~~current~~ circuit is called true power or active or real power It is measured in K 10 watt

Active power is the real power consumes by the load

Apparent power:-

The combination of reactive power and true power is called apparent power and it is product of a circuit voltage and current without reference to phase angle

Apparant power measured in unit of volt. Amp (VA)

Reactive Power:-

Reactive power is the product of voltage and current and the sine of the angle between them.

Reactive power is measured in VAR.

Q: NO: 02

Voltage and Impedence relationship with turn ratio for ideal transformer.

Voltage:-

For the ideal transformor ; all the flux is confined to the iron core and thus links the primary and secondary.

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

$$4.44 f N B_{max} A_C$$

$$\downarrow$$

$$E_P = 4.44 f N_P \phi_{max}$$

$$E_S = 4.44 f N_S \phi_{max}.$$

$$\downarrow$$

$$\frac{E_P}{E_S} = \frac{N_P}{N_S} = a$$

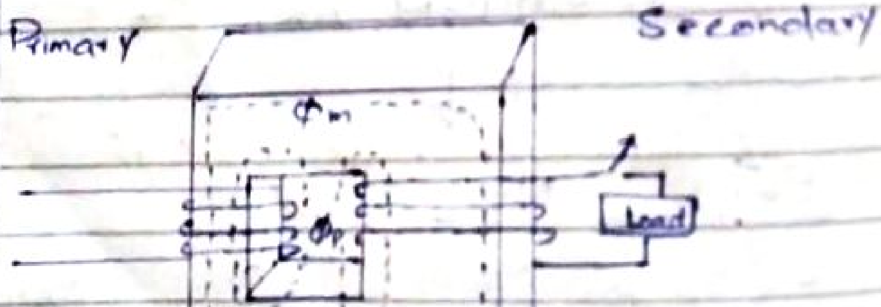
↑ Turn Ratio

For step down transformer, the primary side has more turns 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 changes the voltage and current levels in opposite directions, it also changes the apparent impedance as seen from the two sides of the transformer.



Ohm's law applied at load =

$$Z_L = V/I$$

Recollect : $\frac{I_p}{I_s} = \frac{V_s}{V_p} = \frac{N_s}{N_p}$

$= 1/a$

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

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

→ $Z_{in} = a^2 Z_L$

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

We divide it by the turns ratio Squared.

The process is called refering The impedance to the side we move it, and allow us to use transformer to match impedance between a Source and a load.