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Subject — Electrical Machine
Exam — Summer

Question # 1

Answer :-

Given Data :-

$L = 55cm = 0.55$

$A = 150\ cm^2 = 0.015\ m^2$

$N = 200$ Turn

$\phi = 1.012$

$H = 115$ A.turns/m

Required Data :-

$B = ?$

$\mu_r = ?$

$R = ?$

Solution :-

formula :-

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

The required flux density in the core is :

$$B = \frac{\phi}{A} = \frac{1.012}{0.015} = 0.8\ T$$

→ From figure, the required magnetizing intensity is : $H = 115$ A.turns/m

→ The magnetomotive force needed to Produce this magnetizing intensity is:

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

→ So the required current is :

$$i = F/N = \frac{63.25}{200} = 0.316\ Amp$$

→ The core's permeability at this current is:

$$\mu = B/H = \frac{0.8}{115} = 0.00696 \text{ H/m}$$

→ Therefore, the relative permeability is:

$$\mu_r = \frac{\mu}{\mu_0} = \frac{0.00696}{4\pi \times 10^{-7}} = 5540$$

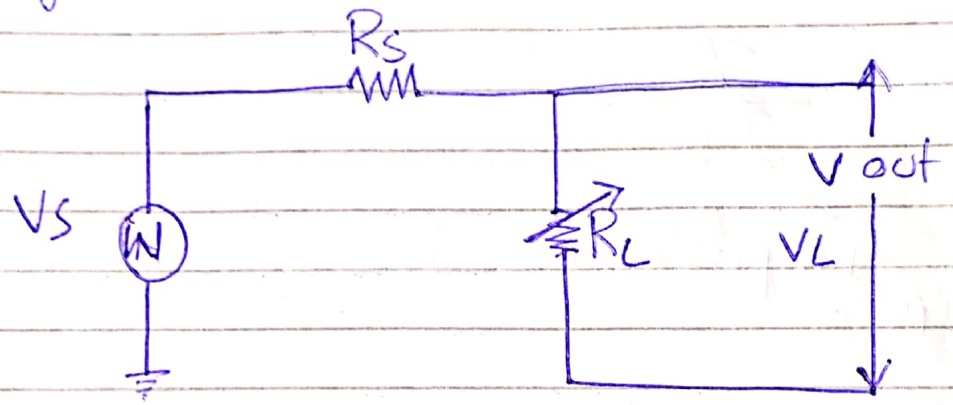
→ The reluctance of the core is:

$$R = F/\phi = \frac{63.25}{0.012} = 5270 \text{ A-turns/wb}$$

Question # 2

Voltage and Impedence relation-ship with turn ratio:-

The important thing for transferring maximum power from source (battery) to the load (motor). is impedence matching.
forexample we will explain it diagram



we know that

$$V_{out} = \frac{R_L}{R_L + R_S} \times V_S$$

as

$$P = \frac{V^2}{R}$$

so here

$$P_{out} = \frac{(V_{out})^2}{R_L}$$

⇒ Putting the value of V(out)

$$\Rightarrow P_{(out)} = \frac{\left(\frac{R_L}{R_S+R_L}\right)^2 (V_S)^2}{R_L}$$

$$\Rightarrow P_{(out)} = \frac{R_L}{(R_S+R_L)^2}(V_S)^2$$

Now Impedence of Primary side :.

$$Z_p = \frac{V_p}{I_p}$$

and Impedence of secondary side is :.

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

we Know that

$$\frac{V_p}{V_s} = \frac{N_p}{N_s} = \alpha \text{ (turn ratio)}$$

So

$$\frac{V_p}{V_s} = \alpha$$

$$V_p = \alpha \times V_s \Rightarrow \alpha V_s \longrightarrow ①$$

$$\frac{I_p}{I_s} = \frac{N_s}{N_p} = \frac{1}{\alpha}$$

$$\Rightarrow 1/\alpha = \frac{I_p}{I_s}$$

$$I_p = I_s/\alpha \longrightarrow (2)$$

Primary Impidance.

$$Z_p = \frac{V_p}{I_p}$$

Putting the value of V_p and I_p :

$$Z_p = \frac{\alpha V_s}{I_s/\alpha}$$

$$\Rightarrow Z_p = \frac{\alpha V_s}{I_s}$$

$$Z_p = \alpha^2 \frac{V_s}{I_s}$$

So

$$Z_p = \alpha^2 Z_s$$

$$\frac{Z_p}{Z_s} = \alpha^2$$

$$\Rightarrow \sqrt{\frac{Z_P}{Z_S}} = \sqrt{\alpha^2}$$

$$= \sqrt{\frac{Z_P}{Z_S}} = \frac{N_P}{N_S}$$

as $\alpha = \frac{N_P}{N_S}$

So

$$\alpha = \sqrt{\frac{Z_P}{Z_S}}$$

Question # 3

Answer:

Power factor:

It is an expressing efficiency of energy. It is expressed as a percentage when the percentage is low the efficient power use is low and high the percentage, higher will be the use of power.

Definition

It is the ratio of working power or real power used of doing work which is measured in Kilowatts (Kw) to apparent power that is measured in Kilo volt amperes (KVA).

Apparent power, also known as demand, is the measure of amount of power used to run machinary and equipment during a certain period. It is found multiplying (KVA = VxA). The result is expressed as KVA units.

Its values range from 0 to 1

When there is no real power supplied and only reactive power is supplied the power factor is 0.

When all the power supplied is real power and there is no resistive load or reactive power the power factor is 1.

If there is 100 percent efficient circuit demand is always equal to supplied power when demand is higher then supply a strain occures, that is placed on using the power.

Calculating Power factor:

Power factor is calculated by Power quality analyzer that measure both working power and apparent power.

The power factor formula can be expressed in this ways

$$PF = (\text{True Power})/(\text{Apparent Power})$$

OR

$$PF = W/VA$$

watts measure useful power while VA measures supplied Power. The ratio of the two is essentially useful Power to supplied power.

Differences b/w real reactive and apparent Power

There is always a difference in Phase of Power of grid and Power of load, so there are various terms used for Power that are.

* real Power
* reactive Power and
* apparent Power.

Real Power / Active Power:

① It is the power which is actually utilized in an AC circuit is called True Power or Active Power or Real Power.

② It is measured in Kilowatt(KW) or (MW).

③ It is the actual outcomes of the electrical system which runs the electric circuits or load.

Reactive Power:

① It is the Power which flows back and forth that means it moves in both the directions in the circuit or reacts upon itself, is called reactive power.

② The reactive power is measured in kilo volt-ampere reactive(KVAR) or MVAR.

③ This reactive Power does not perform any useful work in the circuit.

Apparent Power:-

① Apparent power, also known is demand, is the measur of the amount of power used to run machinery and equipment during a certain perjod.

② It is found by multiplying (KVA = V X A).

③ The result is expressed as KVA units.

Diagram:-