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paper : Electrical Machine

Q1 (a)

Given Data:

Core length = 55 cm = 0.5 m

Cross area = 150 cm^2 = 1.5 m^2

N = 200 Turns

ϕ = 0.012 webers.

Required = B = ?

μ_r = ?

R = ?

Solution :

$$\phi = B \cdot A$$

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

$$= \frac{0.012}{0.015}$$

$$\boxed{B = 0.8 \text{ Tesla}}$$

$$B = \mu H$$

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

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

$$\mu = 0.0069 \, H/m$$

Scanned with CamScanner

Now

$$Ur = \frac{\mu}{\mu_0}$$

$$Ur = \frac{0.0069}{3.14 \times 4 \times 10^{-7}} \quad \therefore ur = 4\pi \times 10^{-7}$$

$$\boxed{Ur = 5540}$$

$$T = HL$$

$$= 115 \times 0.55$$

$$T = R\phi$$

$$R = \frac{T}{\phi}$$

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

$R = 5270$ Aturns/Wb

Now current

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

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

$$\boxed{I = 0.316 \text{ amps}}$$

Q2(a)

Solution:-

Turn Ratio

$$\frac{NP}{NS} = \frac{VP}{VS} = \frac{IS}{IP}$$

$$\alpha = \frac{NP}{NS}$$

for Impedence

impedence = Z

$$Z = R + jX$$

$$V = IZ$$

$$ZP = VP/IP$$

$$ZS = VS/IS$$

$$\alpha = \frac{NP}{NS} = \frac{VP}{VS}$$

$$\alpha = \frac{VP}{VS}$$

$$\boxed{\alpha VS = VP} \quad (1)$$

$$\alpha = IS/IP$$

$$\frac{1}{\alpha} = IP/IS$$

$$I_P = I_S/\alpha \quad \text{—} (2)$$

$$Z_P = \frac{V_P}{I_P} \quad \text{—} (A)$$

put values in (A)

$$Z_P = \frac{\alpha V_S}{I_S/\alpha} = \frac{V_S}{I_S}\alpha^2$$

$$Z_P = \alpha^2 \frac{V_S}{I_S} \qquad \because Z_S = \frac{V_S}{I_S}$$

$$Z_P = \alpha^2 Z_S$$

$$\frac{Z_P}{Z_S} = \left(\frac{N_P}{N_S}\right)^2$$

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

For voltage

EMF equation of T/F

$$e_P = -N_P \frac{d\Phi}{dt}$$

$$\because V_m = V_m \sin\omega t$$

$$\because \Phi_m = \Phi_m \sin\omega t$$

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

$= -N_P \omega \cos\omega t \, \phi_m + \sin\omega t$

$= -2\pi f N_P \cos\omega t \, \phi_m + \sin\omega t$

$= -2\pi f N_P \sin(\omega t - 90°) \phi_m + \sin\omega t$

$= 2\pi f N_P \sin(90° - \omega t) + \sin\omega t$.

$e_p = 2\pi f N_P (1) + (0)$

main Value $e_p = 2\pi f N_P \phi_m$

$$\frac{V_{max}}{\sqrt{2}} = V_{rms}$$

$e_{Prms} = 4.44 f N_P \phi_m$

$e_{Prms} = 4.44 f N_S \phi_m$

$$\frac{e_{Prms}}{e_{Srms}} = \frac{4.44 f N_P \phi_m}{4.44 f N_S \phi_m}$$

$$\boxed{\frac{e_P}{e_S} = \frac{N_P}{N_S}}$$

Q3(a): Define power factor? Differentiate b/w Real. Apparent and reactive powers? (6)

Ans:- power factor: (P.F)

power factor is the ratio between actual power and apperent power.

$$P.F = KW/Kva$$

for a purely resistive load the power factor is unity. Active and reactive power are designated by P & Q respectively the current-power in a circuit is called active power and the power that supplies the stored energy in reactive elements is called reactive power.

Active power:=>

Active power is also know as real power. Active power is the rate producing, Transfaring or using electrical Energy. it is measured in watts and often MW expressed in Killowatts (Kw) or mega watt (MW) The Term "active" or "Real" are used in place of term "power" alone to differentiate it from reactive power;

Apparent power: The product of the voltage in (volts) and the current (in ampers). it comprises both active and reactive power. it is measured in "volt-ampers and often expressed in "kilovolt" "ampst" (KVA) or meg volt-ampers' (MVA) The combination of reactive power and true power is called apparent circuit voltage and current without reference to phase angle.

Reactive power:-

The power which flows back and forth that means it moves in both direction in the circuit or reacts upon it self is called reactive power is measured in kilo-volt-ampere reactive (KVAR) or (MVAR)