	IQRA National University, Peshawar Department of Electrical Engineering Summers						
Course Code:	EEE342			Course Title:	Electrical Machines		
Prerequisite:	Circuit Analysis			Instructor:	Engr. Sanaullah Ahmad		
Module:		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? ($4\pi \times 10\text{-}7H/m$) c. What is its reluctance?	
Q2	(a)	Derive Voltage and Impedance relationship with turn ratio for an ideal transformer?	
Q3	(a)	Define power factor? Differentiate between Real, Apparent and reactive powers?	

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Electrical Machine Paper:

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Q1: Given Data:

$L = 55\,cm = 0.55\,m$

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

$\varphi = 0.012$ web

$H = .115$ A.Turns/meter.

Required: $B = ?$, $\mu_r = ?$ $R = ?$

Sol:

$$B = \frac{\varphi}{A} = \varphi = A \cdot B$$

$$B = \frac{0.012}{0.015} \Rightarrow \boxed{B = 0.8\,T}$$

$$\mu_r = \frac{\mu}{\mu_0} \Rightarrow \mu = \frac{B}{H}$$

$$\left(\mu = 0.006956521\overline{74} \right)$$

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$$\mu_r = \frac{0.006956217 4}{4\pi \times 10^{-7}}$$

$$\mu_r = 5.46 \cdot 0869562 2 \times 10^{-12}$$

$$R = T/\phi$$

$$T = HL$$

$$T = 115 \times 0.55$$

$$T = 63.25 \text{ A-Turns}$$

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

$$R = 5270.833333333333$$

$$R = 5.270833333333333 \times 10^{3} \frac{\text{A Turn}}{\text{Weber}}$$

Q2. (3)

Impedence Turn ratio:

Impedence = $Z = R + jx$

$V = IR$. ohm Law

$V = IZ$

$Z_p = \frac{V_p}{I_p} \Rightarrow Z_s = \frac{V_s}{I_s}$

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

$V_p = \alpha V_s \rightarrow (1)$

$\frac{I_s}{I_p} = \alpha$

$I_p = \frac{I_s}{\alpha} \quad -(2)$

$Z_p = \frac{V_p}{I_p} \quad -(3)$

Now put eq (1) and eq (2) in eq (3)

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

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

$$Z_P = \alpha V * \frac{\alpha}{I_S}$$

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

$$Z_P = \alpha^2 Z_S$$

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

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

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

Voltage Turn ratio

$$V_1 = \frac{d\phi}{dt}, \quad V_2 = \frac{d\phi}{dt}$$

$$\frac{V_1}{V_2} = \frac{N_1 \frac{d\phi}{dt}}{N_2 \frac{d\phi}{dt}} =$$

$$\frac{V_1}{V_2} = \frac{N_1}{N_2} = \alpha$$ Voltage Turn ratio

$$\boxed{\frac{V_1}{V_2} = \frac{N_1}{N_2} = \alpha}$$

31/8/2020

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Q3 @

Power factor Diffiniation:

Ans: Power factor (P.F) is the ratio between actual power and apparent Power

P.F = kW/kVA

for a purely resistive load the power factor (P.F) is unity. Active and reactive power are designated by P & Q respectively the average 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: or Real Power:

Also known as "real power" Active power is the rate of producing, transferring, or using electrical energy it is measured in watts and often MW expressed in kilowatts (kW) or Mega watt(MW) The Term "active" or "real" power are used in place of the term "power" alone to differentiate it from "reactive power".

Apparent power:

the product of the voltage in (volts) and the current (in amperes). it comprises both active and reactive power. it is measured in "volt-amperes

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and often expressed in "kilovolt-amperes" (KVA) or megvolt-amperes" (MVA)

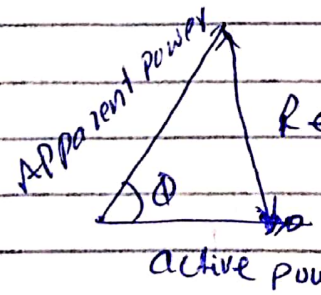
The combination of reactive power and True Power is called apparent power and it is the product of a Circuit's voltage and current with out reference to phase angle.

~~Reactive Power:~~

~~The product of root mean Squre (Rms) value value of voltage and current is known~~

Reactive Power:

The power which flows back and forth That means it moves in both the directions in the circuit or reacts upon it self is called reactive power. The reactive power is measured in Kilo-Volt-ampere reactive (KVAR) or MVAR



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