IQRA National University, Peshawar
Department of Electrical Engineering

IQRA NATIONAL UNIVERSITY

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 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. 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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~~Example~~

Q1 (a)

L = 55 cm 0.55
A = 150 cm² 0.15 m²
N = 200 Turn
φ = 1.012
H = 115

Then find.

B = ?
μr = ?
R = ?

Solution.

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

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

(B = 67.4 T)

$\mu_r = \frac{\mu}{\mu_0}$ $\quad \mu = \frac{B}{H} = \frac{67.4}{115}$

$\mu_r = \frac{0.586}{4\pi \times 10^{-7}}$ $\quad \mu = 0.586$

$\mu_r = 0.000000046$

$(\mu_r = 4.6 \times 10^{-8})$

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

$\mathcal{T} = Hl$

$\mathcal{T} = 115 \times 0.55$

$\mathcal{T} = 63.25$

$R = \frac{63.25}{1.012}$

$(R = 62.5 \frac{\text{turns}}{\text{weber}})$

Impedance-Turn ratio

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

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

$$V_p = \alpha V_s \quad \text{---} (1)$$

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

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

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

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

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

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

$$Z_P = \alpha V_S \div \frac{I_S}{\alpha}$$

$$Z_P = \alpha V_S \times \frac{\alpha}{I_S}$$

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

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

$$Z_P = \alpha^2 Z_S$$

$$Z_P = \alpha^2 Z_S$$

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

$$\sqrt{\frac{Z_P}{Z_S}} = \alpha \quad \because \alpha \frac{N_P}{N_S}$$

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

voltage - turn ratio

$$v_1 = \frac{d\varphi}{dt} \qquad v_2 = \frac{d\varphi}{dt}$$

$$v_1 = N_1 \frac{d\varphi}{dt} \qquad v_2 = \frac{N d\varphi}{dt}$$

$$\frac{v_1}{v_2} = \frac{N_1 \frac{d\varphi}{dt}}{N_2 \frac{d\varphi}{dt}}$$

$$\frac{v_1}{v_2} = \frac{N_1}{N_2} = a$$ voltage Turn ratio

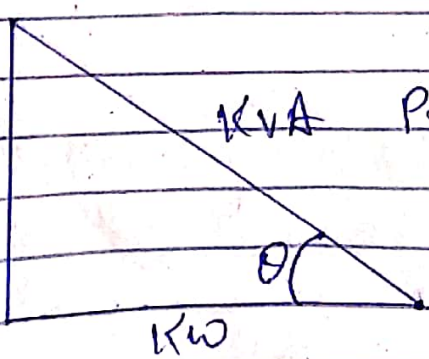
Power factor

Q3 (a)

Power factor is the ratio of working power, measured in Kilowatts (Kw to apparant power measured in Kilovolt Amperes (KVA).

Apparant power also known as Demand is the measure of the Amount of power used to run machinery and equipment during a certain period. it is found by multiplying

(KVA = V x A)



P.F = Actual Power / Apparent Power

or

P.F = Cos θ.

Differentiate b/w, Real, Apparent and reactive.

Reactive:

Reactive loads such as inductors and capacitive dissipate zero power, yet the fact that they drop voltage and draw current gives the decpective impression that they actually do dissipate power.

Fantom power is called reactive power and its measured in a ~~circuit~~ unit called volt-Amps-Reactive (VAR) rather than watts.

Q = reactive power

$Q = I^2 X$

OR

$Q = \frac{E^2}{X}$

$S = P + jQ$

$S = VI\cos\theta + VI\sin\theta$

$P = (Ie^{j\alpha})(Ve^{j\beta})$

$P = VI\, e^{j(\alpha+\beta)}$

measured in units of vol-Amps-Reactive (VAR).

Apparent Power

Combination of reactive power and True power is called Apparent power and its the product of a circuit's voltage and current without reference to phase Angle.

Apparent power is measured in the unit of volt Amps (VA) and is symbolized by the capital letters.

S = Apparent power

$S = I^2 Z$

$OR \quad \frac{E^2}{Z}$

$S = IE$

measured in units (volt-Amp VA)

Real Power

Real power is Actually Consumed the due to the resistive load and Apparent power is the power the grid must be Abale to withstand.

The unit of real power is Watt while Apparent power unit is VA (volt Amper).

$$Z = R + jx$$

$$Z^2 = R^2 + x^2$$