Electrical Engineering Department

EE 360-01 **Term 071**

Major Examination 1

Date October 24, 2007

Place 14-108

Time 18:30-19:45

Instructor Name Dr. Ibrahim El-Amin

Section #

Student Id # **Student Name**

Q1 (40)	
Q2 (40)	
Q3 (20)	
Total	

Model

Q1

(a) The load on a 460-V, 60Hz, Y-connected balanced three-phase source consists of three equal Y-connected impedances of 100+j100 Ohms connected in parallel with three Delta connected impedances of 300-j300 Ohms. Compute:

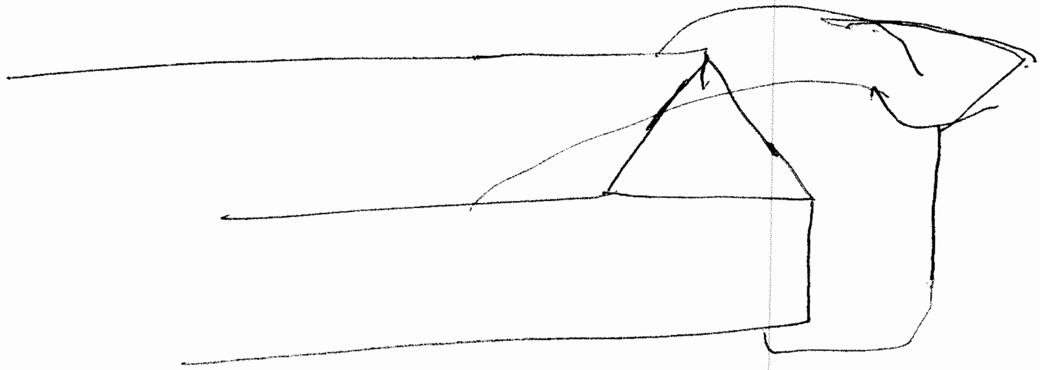
(1) The line current of the total load.

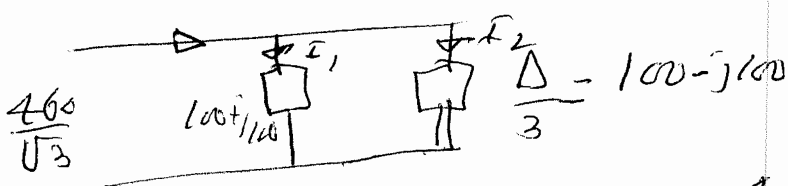
(2) The total load power

(3) The power factor of the total load

(b) Two wattmeters are used measure power in a balanced wye-wye system. The lien voltage is 208-V. Wattmeter A reads 1600 W and wattmeter B reads 840 W. Compute the impedance per phase.

a)





$I_1 = \frac{460}{\sqrt{3}(100+j100)}$; $I_2 = \frac{460}{\sqrt{3}(100-j100)}$

(i) $I_T = I_1 + I_2 = \frac{265.6}{100} = 2.656A$

(ii) $P_T = \sqrt{3}(460)(2.656) = 2116W$

(iii) $pf = 1.0$

(b)

$P_T = P_A + P_B = 1600 + 840 = 2440W$

$\theta = \tan^{-1}\left[\frac{P_A - P_B}{P_A + P_B}\right]\sqrt{3} = \tan^{-1}\frac{[760]\cdot\sqrt{3}}{2440} = 28.32^\circ$

$pf = 0.8803$ $P_T = \sqrt{3}V_L I_L pf$; $I_L = 7.694$; $Z = \frac{V_P}{I_P} = \frac{208}{\sqrt{3}(7.69)}$

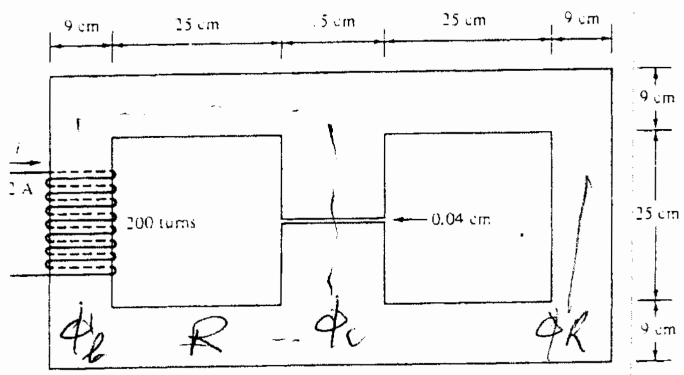
$= 15.61\angle 28.35$

Q2 (a) A magnetic core is shown in the figure below. Its depth is 5 cm and there are 200 turns on the leftmost leg. The relative permeability of the core is 1200.

Calculate:

(i) The flux in each of the three legs.

(ii) The flux density in each of the three legs..



(b) The eddy current loss of a given solid core is 80 W at 50Hz. What would be the loss at 60 Hz if the maximum flux density remained the same at the two frequencies.

a) a] R_1 = reluctance of left. R_3: center; R_4 = airgap

R_2 = reluctance of Right.

$R_T = R_1 + \frac{R_2(R_3+R_4)}{R_2+R_3+R_4}$; $R_1 = \frac{l_1}{\mu_0 \mu_r A} = \frac{1.08}{1200(4\pi\times10^{-7})(.09\times0.05)} = 159\,KAT$

$R_2 = 159\,KAT/Wb$

$R_3 = \frac{0.34}{1200(4\pi\times10^{-7})0.15(0.05)} = 30.0\,KA\text{-}T/wb.$

$R_4 = 0.0004/4\pi\times10^{-7}(0.15)(0.05\times1.0) = 42.4\,KA\text{-}T/wb$

$R_T = 209\,KAT/wb$; $\Phi_T = \frac{Ni}{R} = 0.0019\,wb$

CDR; $\phi_c = 0.0013$; $\phi_l = 0.0019$; $\phi_R = 0.0006$

$B_L = \frac{\phi_l}{A} = 0.42\,T$; $B_c = 0.17$; $B_r = 0.13$

b) $E_{eddy} = K.\,f^2.\,B_{max}^2$

$80 = K.(50)^2.\,B_{max}^2$;

$E_2 = K(60)^2.\,B_{max}^2$

$E_2(60) = 80\left(\frac{60}{50}\right)^2 = 115.2\,W$

Q3

(a) Choose the correct answer

A transformer having 1000 primary turns is connected to a 250-V AC supply. For a secondary voltage of 400 V, the number of secondary turns should be:

5

a. **250** | **B. 1600**
c. **400** | d. **1250**

(b) The secondary voltage of a transformer is $V_2(t) = 282.8 \sin 377t$. The turns ratio is 50:200. If the secondary current is $I_2(t) = 7.07 \sin(377t-36.8)$.

(i) What is the primary voltage of the transformer? 5

(ii) What is the primary current of the transformer? 5

(iii) What is the power rating of the transformer? 5

$$V_2 = \frac{282.8}{\sqrt{2}} = 200\ V$$

$$I_2 = \frac{7.07}{\sqrt{2}} = 5$$

(i) $\frac{V_1}{V_2} = \frac{N_1}{N_2} = \frac{50}{200}$; $V_1 = 50\ V$

$v_1(t) = 70.7 \sin 377t$

(ii) $\frac{I_1}{I_2} = \frac{N_2}{N_1}$; $I_1 = 20\ A$; $i_1(t) = 28.28 \sin(377t - 36.8)$

(iii) $V_1 I_1 = 50 * 20 = 1000\ VA =$ 800 Watt