KING FAHD UNIVERSITY OF PETROLEUM & MINERALS

ELECTRICAL ENGINEERING DEPARTMENT

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EE 360

MAJOR EXAM # 1

October 24, 2007

6:30 – 7:30 pm

Key Solution

Section: **4**

Student Name:

Student I.D.#

Serial #

Question # 1	
Question # 2	
Total	

Q. 1-I) A 345-kV, three-phase transmission line delivers 500 MVA, 0.866 power factor lagging, to a three-phase load connected to its receiving-end terminals. Assume that the load is wye connected and the voltage at the receiving end is 345 kV.

a. Calculate the line and phase currents.

b. Find the complex load impedance per phase.

c. Find the total real and reactive power.

(40 Marks)

a)

$S = 500\ MVA$, $V_L = 345\ kV$, wye - load , $PF = 0.866$ lagging

$$I_{ph} = \frac{500{,}000}{\sqrt{3}\,(345)} \angle -\cos^{-1} 0.866 = 836.74 \angle -30^\circ \ A$$

$$V_{ph} = \frac{345}{\sqrt{3}} \angle 0^\circ = 199.2 \angle 0^\circ \ V$$

$$I_L = I_{ph} = 836.74 \angle -30^\circ \ A$$

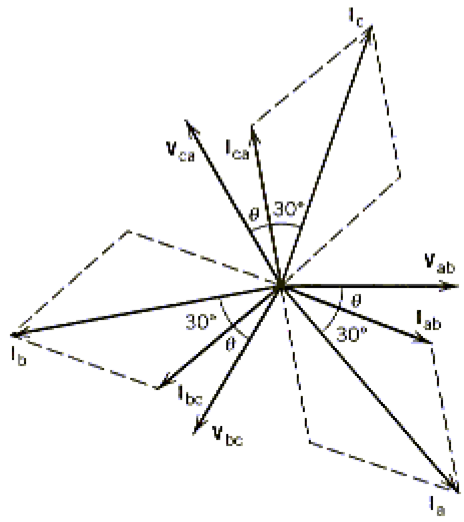
b)

$$Z_{Y,ph} = \frac{199.2 \angle 0^\circ}{836.74 \angle -30^\circ} = 238 \angle 30^\circ \ \Omega$$

c)

$P_T = 433\ MW$; $Q_T = 250\ MVAR$

Q. 1-II) The phasor diagram shown below is for (select the correct answer)



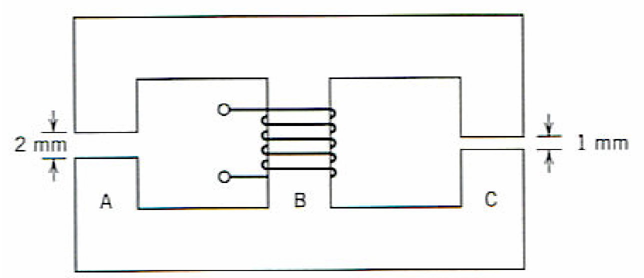
a) wye-connected load with lagging power factor.
b) delta-connected load with leading power factor.
c) delta-connected load with lagging power factor.
d) wye-connected load with leading power factor.

(10 Marks)

Q. 2) A ferromagnetic circuit has a magnetic core with infinitely high relative permeability. It has three legs, and air gaps of 2 mm and 1 mm are cut from sections A and C, respectively, as shown below. A coil is wound on the center leg B, and it has 200 turns and a resistance of 2.5 Ohm. The magnetic core has a 5 x 5 cm uniform cross-sectional area. A DC voltage is applied to the coil.

a. Determine the voltage that will produce a flux density of 0.75 T in the right leg C, which contains the 1-mm air gap.

b. Find the magnetic flux in the other two legs of the core.



(50 Marks)

(a)

$$\mathcal{R}_c = \frac{g_c}{\mu_0 A} = \frac{1\times10^{-3}}{(4\pi\times10^{-7})(25\times10^{-4})} = 318{,}310 \ At/Wb$$

$$\phi_c = BA = (0.75)(25\times10^{-4}) = 1.875\times10^{-3} \ Wb$$

$$NI = \mathcal{R}_c \phi_c = (318{,}310)(1.875\times10^{-3}) = 596.83 \ At$$

$$I = \frac{596.83}{200} = 2.984 \ A$$

$$V = RI = (2.5)(2.984) = 7.46 \ V$$

(b)

$$\mathcal{R}_A = \frac{g_A}{\mu_0 A} = \frac{2\times10^{-3}}{(4\pi\times10^{-7})(25\times10^{-4})} = 636{,}620 \ At/Wb$$

$$\phi_A = \frac{NI}{\mathcal{R}_A} = \frac{596.83}{636{,}620} = 9.375\times10^{-4} \ Wb$$

$$\phi_B = \phi_A + \phi_c = 9.375\times10^{-4} + 18.75\times10^{-4} = 28.125\times10^{-4}$$

$$= 2.8125\times10^{-3} \ Wb$$