King Fahd University of Petroleum & Minerals
Electrical Engineering Department
EE205: Electric Circuits II (031)
Quiz 2

Name: KEY ID# Sec. 02

A balanced three-phase distribution line has an impedance of $1+j5\ \Omega/\Phi$. This line is used to supply two balanced three-phase loads that are connected in parallel. The two loads are L_1= 150 kVA at 0.8 pf lead, and L_2= 336 kW and 72 kVAR (magnetizing). The magnitude of the line voltage at the terminals of the load is $2800\sqrt{3}$ V.

a) What is the magnitude of the line voltage at the sending end of the line?

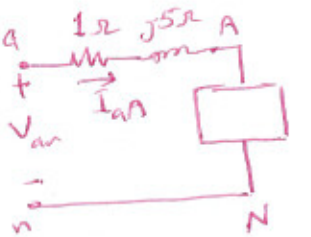
$S_1 = |S|\cos\theta_\phi + j|S|\sin\theta_\phi = 120 - j90$ kVA

$S_2 = 336 + j72$ kVA

$S_T = S_1 + S_2 = 456 - j18$ kVA

$S_{T/\phi} = 152 - j6$ kVA

Single-phase equivalent circuit



$S = VI^*_{aA}$

$\Rightarrow I^*_{aA} = \dfrac{152 - j6\ K}{2800} = 54.29 - j2.14$

$I_{aA} = 54.33\ \angle -2.26^\circ$

$V_{an} = 2800 + (1+j5)(54.29 + j2.14) = 2843.59 + j273.59$

$= 2856.7\ \angle 5.5^\circ$

$\therefore |V_{ab}| = \sqrt{3}(2856.7) = 4947.95$ V

b) What is the percentage of efficiency of the distribution line with respect to average power?

$P_{load/\phi} = 152$ kW

$P_{line/\phi} = |I^2|R = (54.33)^2(1) = 2951.75$ watts

$\eta = \left(\dfrac{152}{152 + 2.95175}\right) * 100 = 98.1\ \%$

Good Luck,
Dr. Ali Muqaibel