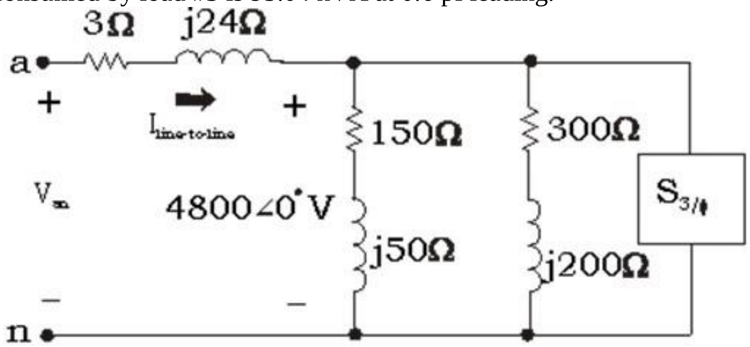
Name:____

EE 303, Quiz 5, Spring 2019, Dr. McCalley, Closed book, closed notes, no calculator

1. (30 pts) Consider the following circuit which is exactly the same as one discussed in class. It is a per-phase circuit of a three-phase system. The three phase power consumed by load #3 is 95.04 kVA at 0.6 pf leading.



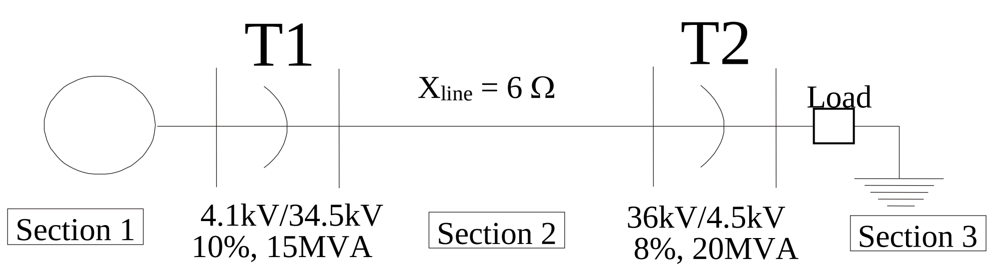
Choose your base line-to-neutral voltage as 5000volts and your base per-phase power as 100,000volt-amperes.

a. Compute the base line current.
b. Compute the base impedance for Y-connected loads.
c. Compute the per-unit voltage applied at load.
d. Compute the per-unit power consumed by load #3.
e. Compute the per-unit impedances for the impedance of the two constant impedance loads.

<u>Solution</u>:

a. $I_{base}=S_{1,base}/V_{LN, base}$=100,000/5000=20 or $I_{base}=S_{3,base}/(\text{sqrt}(3)V_{LL, base})$=300,000/sqrt(3)sqrt(3)5000=20amps.
b. $Z_{base}=V_{LN,base}/I_{base}$=5000/20=250ohms or $Z_{base}=(V_{LL,base})^2/S_{3,base}=(\text{sqrt}(3)*5000)^2/300{,}000$=250ohms
c. $V_{pu,load}$=4800/5000=0.96pu
d. $S_{3,pu}$=95,040(0.6-j0.8)/300,000=0.3168(0.6-j0.8)
e. $Z_{1,pu}$=(150+j50)/250=(0.6+j0.2)pu; $Z_{2,pu}$=300+j200//250=(1.2+j0.8)pu.

2. Choose a system MVA base of 100 MVA and a voltage base of 4.0 kV for the load portion of the system. Find per-unit values of impedances for both transformers and the transmission line.



Solution:

$$V_{base2}=(4.0kV)\cdot\left(\frac{36kV}{4.5kV}\right)=32kV$$

$$V_{base2}=(32kV)\cdot\left(\frac{4.1kV}{34.5kV}\right)=3.803kV$$

$$T1: X_{T1}=X_{puT1}\cdot\left[\frac{V_{baseold}}{V_{basenew}}\right]^2\cdot\left[\frac{S_{basenew}}{S_{baseold}}\right]=0.10\cdot\left[\frac{4.1kV}{3.803kV}\right]^2\cdot\left[\frac{100MVA}{15MVA}\right]=0.7749$$

$$T2: X_{T2}=X_{puT2}\cdot\left[\frac{V_{baseold}}{V_{basenew}}\right]^2\cdot\left[\frac{S_{basenew}}{S_{baseold}}\right]=0.08\cdot\left[\frac{4.5kV}{4.0kV}\right]^2\cdot\left[\frac{100MVA}{20MVA}\right]=0.506$$

$$Line: Z_{base}=\frac{(32kV)^2}{100MVA}=10.24\Omega\Rightarrow Z_{pu}=\frac{6\Omega}{10.24\Omega}=0.586$$