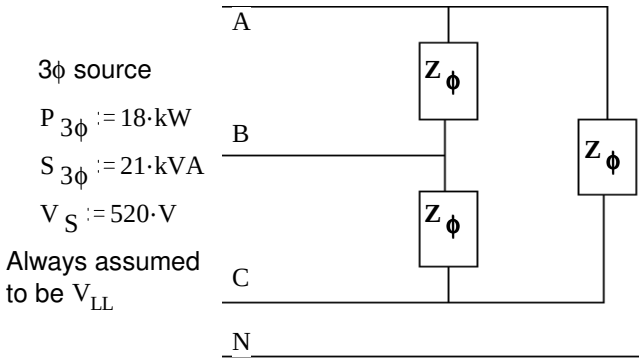
Name_____ ECE 3600 Homework 5 3 Phase a

1. A 3-phase circuit is connected as shown. Find the following:

a) The load power factor, assume lagging.



b) The line current.

c) The value of Y-connected impedances that would result in exactly the same line currents and same pf. $\mathbf{Z}_Y$

d) The phase impedance, $\mathbf{Z}_\phi$

e) The reactive power of each $\mathbf{Z}_\phi$

f) Correct the power factor with capacitors connected in a wye configuration.

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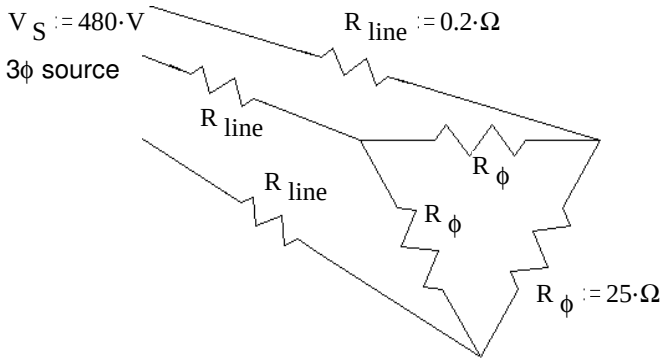
2. For the three-phase circuit shown, the R_{line} resistors represent the resistance of the distribution system. Find the following:
   a) Total power out of the source, including line and load.



   b) Line losses.

   c) Distribution system efficiency. η =

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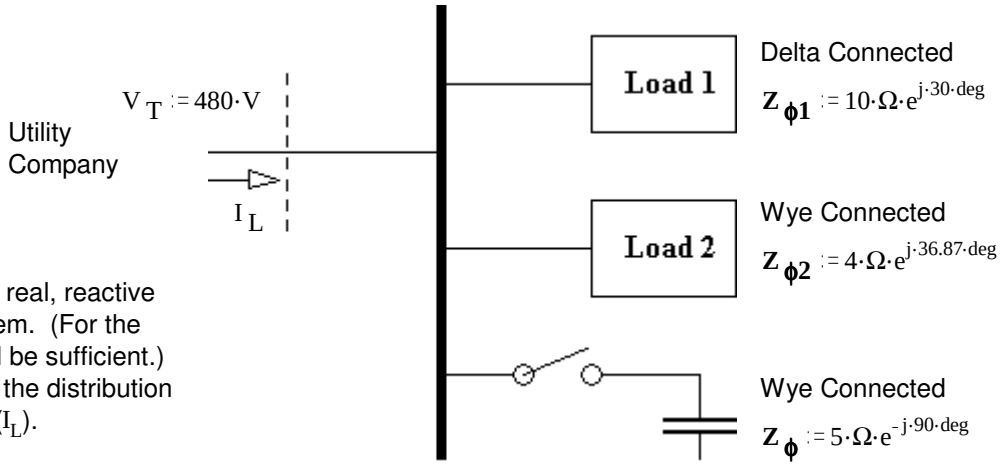
3. Textbook 2-6, modified.
   The figure shows a one-line diagram of a small 480-V distribution system in an industrial plant. For parts a) and b), assume all the lines have zero impedance.



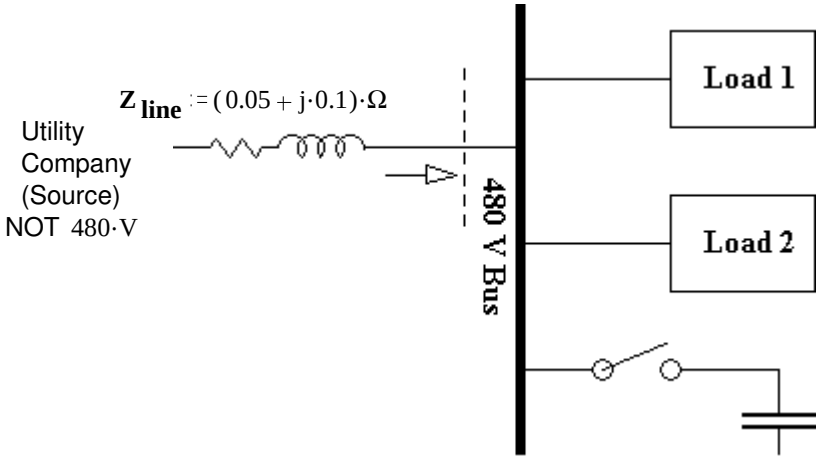
   a) With the switch open, find all the real, reactive and apparent powers in the system. (For the apparent power, just the total will be sufficient.) Find the total current supplied to the distribution system from the utility company (I_L).

b) Repeat a) with the switch closed.

c) What happened to the total current supplied by the utility when the switch closed? Why?

Current is less by more than 20A because caps supply most of the VARs to loads 1 & 2.

d) and e) New configuration.
For the parts d) and e) below, the lines from the utility each have an impedance of $\mathbf{Z_{line}}$. Assume the source voltage is adjusted so that the bus voltage at the plant remains 480V. (This makes it possible to use most of the numbers you've already calculated.)



d) With the switch open, find the magnitude of the source voltage and the efficiency of the system.

e) With the switch closed, find the magnitude of the source voltage and the efficiency of the system.

Answers

1. a) 0.857
   b) 23.3·A
   c) 12.9·Ω ∠31·deg
   d) 38.6·Ω ∠31·deg
   e) 3.61·kVAR
   f) 106·μF

2. a) 27·kW
   b) 632.8·W
   c) 97.7%

3. a) 59.86·kW
   34.56·kVAR

   46.04·kW
   34.53·kVAR

   input:
   105.9·kW
   69.09·kVAR
   126.4·kVA
   152·A

   b) Loads 1 & 2 are the same
   Caps
   0·W -46.06·kVAR

   input:
   105.9·kW
   23.03·kVAR
   108.4·kVA
   130.4·A

   c) Current is less by more than 20A because caps supply most of the VARs to loads 1 & 2.

   d) 505.4·V 96.8·%

   e) 496.0·V 97.6·%

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