Name:_____

EE 303 Quiz 2, Spring 2019, Dr. McCalley, February 7, 2019
20 minutes, Closed book, Closed Notes, No calculator allowed, Write all answers on this sheet.

1. (24 pts) Consider the relation $S=(\sqrt{3})|\mathbf{V_{LL}}||\mathbf{I_L}|[\cos\theta+j\sin\theta]$, where $\mathbf{V_{LL}}$ is the line-to-line voltage phasor and $\mathbf{I_L}$ is the line current phasor, and | | indicates magnitude. Answer true/false for the below statements:
   F____a) S is the per-phase complex power.
   T____b) This relation can be used for both Y- and Δ-connected loads.
   F____c) The power factor angle θ is the angle by which $\mathbf{V_{LL}}$ leads $\mathbf{I_L}$.

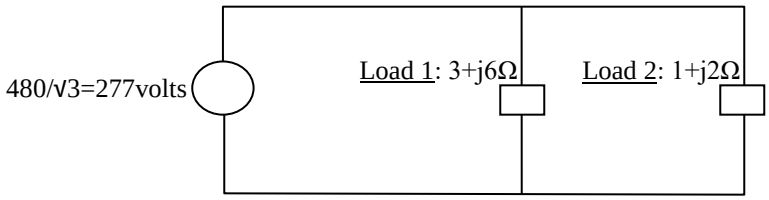
2. (24) A Delta-connected load, with a-b-c phase sequence, has a line current magnitude of 10 amperes. Assume the a-phase line current is reference. Identify the following phasors (**magnitude and angle**).

   $\mathbf{I}_a$=_10∠0° _____ $\mathbf{I}_{ab}$=_(10/√3) ∠30° _

   $\mathbf{I}_b$=__10 ∠-120_____ $\mathbf{I}_{bc}$=_(10/√3) ∠-90° _

   $\mathbf{I}_c$=__10 ∠-240_____ $\mathbf{I}_{ca}$=_(10//√3) ∠-210° _

3. (24) Two three-phase loads are in parallel, directly-connected to a three-phase balanced source. Load 1 is Wye-connected with impedance 3+j6 ohms/phase. Load 2 is delta-connected with impedance 3+j6 ohms/phase. The line-to-line voltage at the source is 480 volts. Draw the per-phase equivalent circuit, indicating on the circuit the values of impedances, which load they represent, and the value of the source voltage.
   Solution:



4. (28) A 3-phase line has an impedance of 0.4+j2.7 ohms/phase. The line feeds 2 balanced 3-phase loads that are connected in parallel. The first load is consuming 560.1kVA at 0.707 power factor lagging. The second load consumes 132 kW at unity power factor. The line-to-neutral voltage at the load end of the line is 2200 volts. Write down the calculation steps you would take to determine the total real and reactive power loss in the line. In each step, you should express the appropriate formula, and then express it using the numerical values that you would use in the computation; you need not actually make the computation.
   Solution:
   The total complex power consumed by the load is

$$S_{R(3\phi)} = 560.1(0.707 + j0.707) + 132 = 528 + j396 = 660\angle 36.87^\circ \text{ kVA}$$

   With the phase voltage $\mathbf{V}_2$ as reference, i.e., $\mathbf{V}_2$=2200/_0°, the current in the line is

$$I = \frac{S^*_{R(3\phi)}}{3V_2^*} = \frac{660{,}000\angle -36.87^\circ}{3(2200\angle 0^\circ)} = 100\angle -36.87^\circ \text{ A}$$

   The three-phase power loss in the line is

$$S_{L(3\phi)} = 3R|I|^2 + j3X|I|^2 = 3(0.4)(100)^2 + j3(2.7)(100)^2 = 12\,\text{kW} + j81\,\text{kvar}$$