Name: _____ (please print)

Signature: _____

ECE 2202 – Quiz 6
April 28, 2022

1. This quiz is closed book, closed notes. You may have one 8.5 x 11" crib sheet.
2. Show all work necessary to complete the problem. A solution without the appropriate work shown will receive no credit. A solution which is not given in a reasonable order will lose credit.
3. Show all units in solutions, intermediate results, and figures. Units in the quiz will be included between square brackets.
4. If the grader has difficulty following your work because it is messy or disorganized, you will lose credit.
5. Do not use red ink. Do not use red pencil.
6. You will have 30 minutes to work on this quiz.

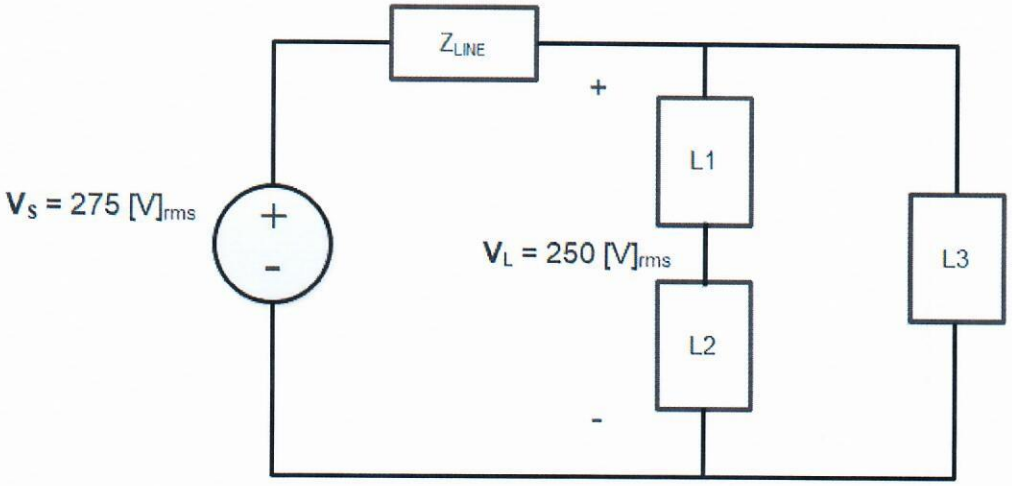
_____/25

Room for extra work

In the circuit below, Z_{Line} represents a line impedance, and L1, L2, and L3 are loads.

L1 absorbs $4750\angle 20°$ [VA].
L2 absorbs 3100 [W] at a power factor of 0.5 leading.
The impedance of L3 is $5 + j7.5$ [Ω].

a. Find the line impedance Z_{Line}.
b. Find the impedance of the load L1.
c. What impedance should be connected in series with L3 to make the power factor of L3 unity?



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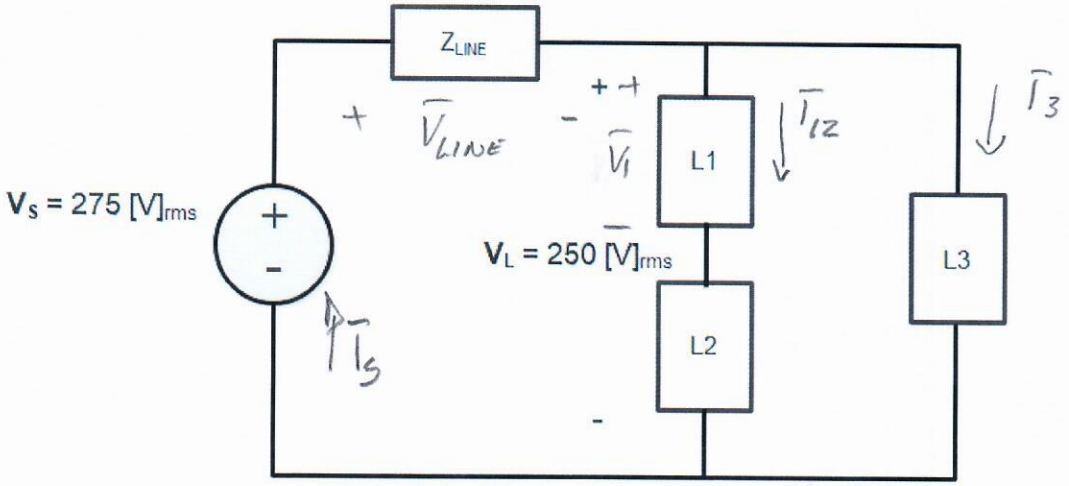

a) $\bar{V}_{LINE} = \bar{V}_S - \bar{V}_L = 25\ [V]_{rms}$ $\quad Z_{LINE} = \dfrac{\bar{V}_{LINE}}{\bar{I}_S}$

$\bar{I}_S = \bar{I}_{12} + \bar{I}_3$ $\quad \bar{I}_{12}^{*} = \dfrac{S_1 + S_2}{\bar{V}_L}$

L2: $S_2 = |S_2|\cos(\theta) + j|S_2|\sin(\theta)$ $\quad \cos(\theta) = 0.5$ $\quad \theta = \theta_v - \theta_i$

$|S_2|\cos(\theta) = 3100 \Rightarrow |S_2| = \dfrac{3100\ [W]}{0.5} = 6200\ [VA]$

$\theta = \cos^{-1}(0.5) = 60°$ leading $\Rightarrow \theta_v - \theta_i = -60°$

$\therefore S_2 = 6200\angle -60°\ [VA]$ $\quad S_1 = 4750\angle 20°\ [VA]$

Room for extra work

So $\bar{I}_{12}^* = \dfrac{6200\angle -60^\circ + 4750\angle 20^\circ}{250} = 33.759\angle -26.34^\circ \ [A]_{rms}$

$\bar{I}_3 = \dfrac{250}{5+j7.5} = 27.73\angle -56.31^\circ \ [A]_{rms}$

$\bar{I}_s = \bar{I}_{12} + \bar{I}_3 = 33.759\angle 26.34^\circ + 27.73\angle -56.31^\circ = 46.348\angle -10.06^\circ \ [A]_{rms}$

$Z_{LINE} = \dfrac{\bar{V}_{LINE}}{\bar{I}_s} = \dfrac{25}{46.348\angle -10.06^\circ} = 0.5311 + j0.0942 \ [\Omega]$

b) $S_1 = \hat{V}_1 \bar{I}_{12}^* = Z_1 \bar{I}_{12} \cdot \bar{I}_{12}^* = Z_1 |I_{12}|^2$

$Z_1 = \dfrac{S_1}{|\bar{I}_{12}|^2} = \dfrac{4950\angle 20^\circ}{(33.759)^2} = 3.916 + j1.45 \ [\Omega]$

c) $pf = 1 \Rightarrow Im\{Z_3\} = 0 \Rightarrow Z_{add} = -j7.5 \ [\Omega]$