Name: _____ (please print)

Signature: _____

ECE 2202 – Quiz 7

November 30, 2023

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 40 minutes to work on this quiz.

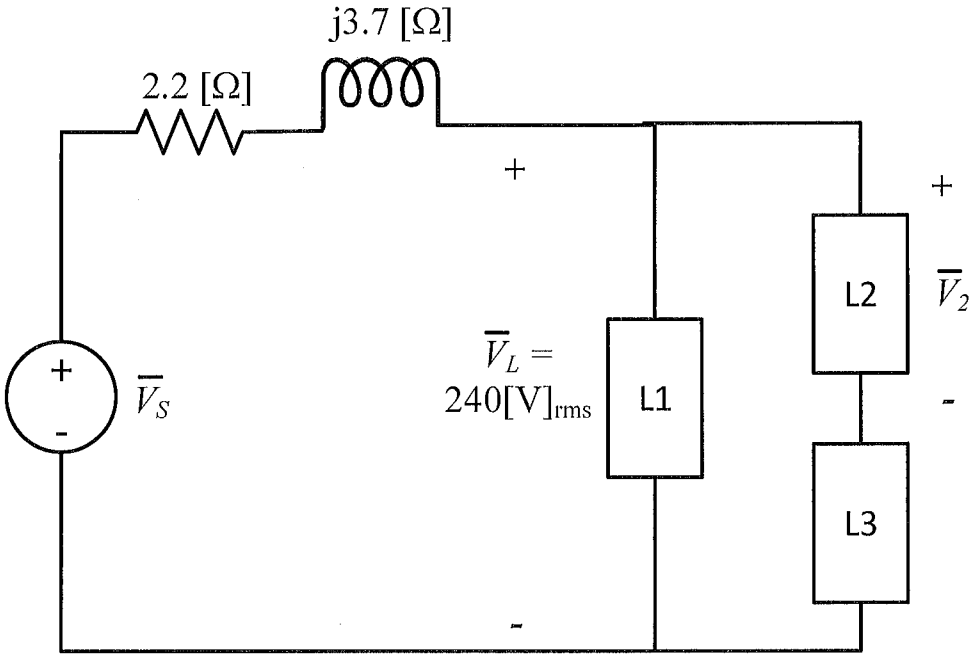
_____/20

Room for extra work

The circuit is operating in steady state. The load voltage $\bar{V}_L$ is known, as shown in the figure.

Load 1 (L1) absorbs 25[kW] at 0.72 power factor lagging. Load 2 (L2) absorbs 12 [kW] and delivers 10 [kVAR]. Load 3 (L3) absorbs 16 [kVA] at 0.8 power factor leading.

- Find the complex power delivered by the source $\bar{V}_S$.
- Find the voltage $\bar{V}_2$.



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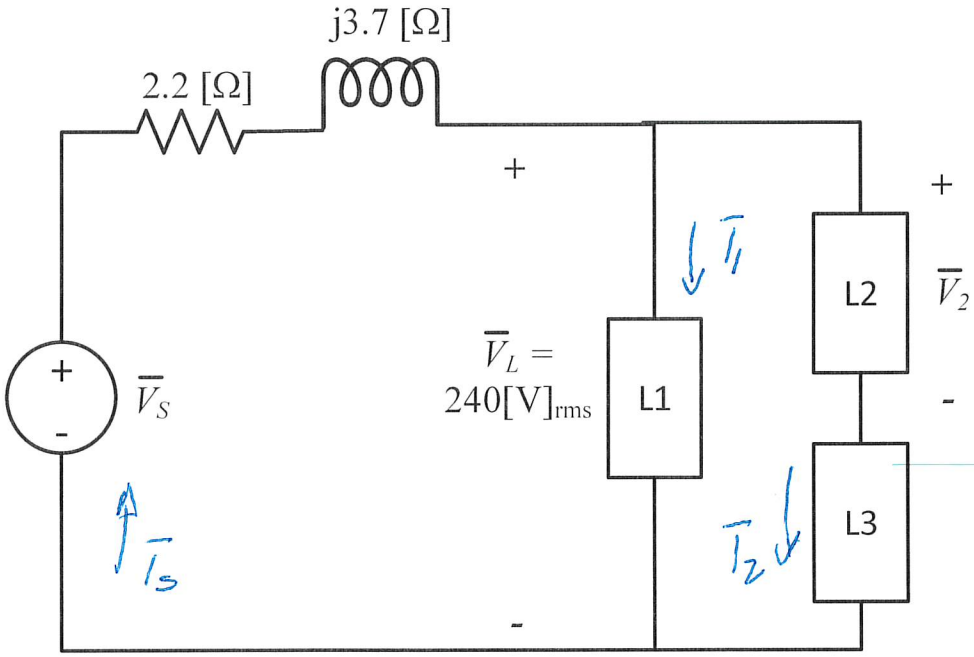

S1: $pf = 0.72 \Rightarrow rf = \sqrt{1-0.72^2} = 0.694$

$S1 = |S1| \cdot pf + j|S1| \cdot rf = P + jQ$

$\Rightarrow |S_1| = \frac{25000}{0.72} = 34,722$ [VA]

$S_1 = 34,722(0.72) + j(34,722)(0.694)$

$S_1 = 25000 + j\ 24,097$ [VA]

(lagging $\Rightarrow$ '+')

Room for extra work

S_2: $S_2 = 12000 - j10000$ [VA]

S_3: $S_3 = 16000(0.8) - j16000(0.6)$

$pf = 0.8 \Rightarrow rf = \sqrt{1-0.8^2} = 0.6$

$\Rightarrow S_3 = 12800 - j9600$ [VA]

$S_{TOTAL} = S_1 + S_2 + S_3 = 49{,}800 + j4497$ [VA] $= \bar{V}_L \bar{I}_S^*$

$$\bar{I}_S = \left(\frac{49800 + j4497}{240}\right)^* = 208.34 \angle -5.16^\circ \text{ [A]}_{rms}$$

$$\therefore \boxed{\bar{V}_S = \bar{I}_S(2.2 + j3.7) + 240 = 1023.6 \angle 2.22^\circ \text{ [V]}_{rms}}$$

$$\bar{I}_1 = \left(\frac{S_1}{\bar{V}_L}\right)^* = \left(\frac{25000 + j24097}{240}\right)^* = 144.68 \angle -43.95^\circ \text{ [A]}_{rms}$$

$$\bar{I}_2 = \bar{I}_S - \bar{I}_1 = 131.71 \angle 38.32^\circ \text{ [A]}_{rms}$$

$$\therefore \boxed{\bar{V}_2 = \frac{S_2}{\bar{I}_2^*} = \frac{(12 - j10) \times 10^3}{131.71 \angle -38.32^\circ} = 118.6 \angle -1.48^\circ \text{ [V]}_{rms}}$$