Name: _____ (please print)

Signature: _____

ECE 2202 – Quiz 7
December 1, 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.

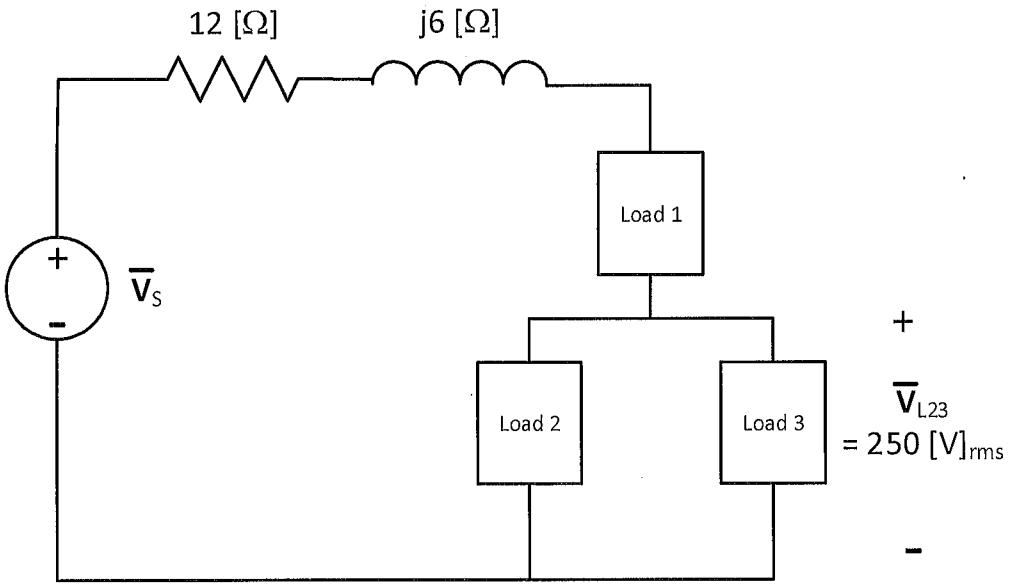
_____/20

Room for extra work

The circuit below is operating in steady state.

Load 1 absorbs 20 [kW] at 0.86 pf lagging.
Load 2 absorbs 5.1 [kVA] at 0.91 pf lagging.
Load 3 is a 17 [Ω] resistor in series with a reactance of -12 [Ω].

a) Find the source voltage $\overline{\mathbf{V}}_S$.
b) Find the power factor for the combined load (Loads 1, 2, and 3 together).



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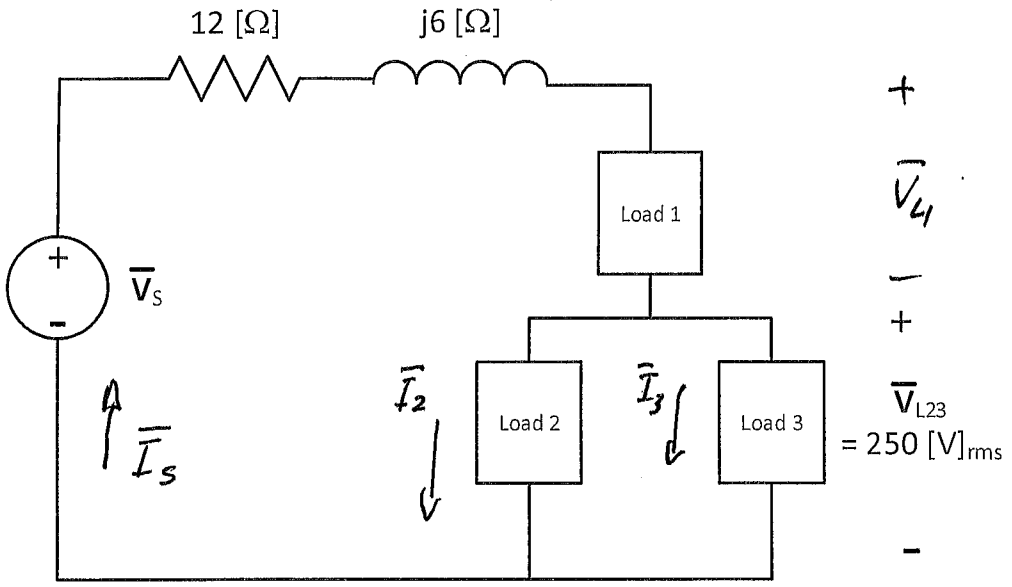

we can find $\bar{I}_s$ with the information given for loads 2 and 3. We can then find $\bar{V}_L$ and do a KVL.

$P_{abs,L1} = 20000\ [W] = |S_{abs,L1}|\cdot(0.86)$

$\Rightarrow |S_{abs,L1}| = \frac{20000}{0.86} = 23256\ [VA]$

So $S_{abs,L1} = 23256(0.86) + j\,23256\cdot\sqrt{1-0.86^2}$

$= 20000\ [W] + j\,11869\ [VAR] = 26109\angle 27.03^\circ\ [VA]$

Room for extra work

$$S_{abs,L2} = 5100(0.91) + j5100\sqrt{1-0.91^2}$$

$$= 4641.0 + j2114.5\ [VAR] = 5100\angle 24.50^\circ\ [VA]$$

$$\bar{I}_2^* = \frac{S_{abs,L2}}{\bar{V}_{L23}} = \frac{5100\angle 24.50^\circ}{250}$$

$$= 18.56 + j8.458\ [A]_{rms}$$

$$\bar{I}_2 = 18.56 - j8.458\ [A]_{rms} = 20.40\angle -25^\circ\ [A]_{rms}$$

$$\bar{I}_3 = \frac{\bar{V}_{L23}}{Z_{L3}} = \frac{250}{17 - j12} = 9.815 + j6.928\ [A]_{rms} = 12.01\angle 35.22^\circ\ [A]_{rms}$$

$$\bar{I}_s = \bar{I}_2 + \bar{I}_3 = 28.38 + j15.39\ [A]_{rms} = 32.28\angle 28.46^\circ\ [A]_{rms}$$

$$\bar{V}_{L1} = \frac{S_{abs,L1}}{\bar{I}_s^*} = \frac{26109\angle 27.05^\circ}{32.28\angle -28.46^\circ} = 808.5 - j20.26\ [V]_{rms}$$

a)

$$\bar{V}_s = \bar{I}_s(12 + j6) + \bar{V}_{L1} + \bar{V}_{L23}$$

$$= 1306.8 + j334.6\ [V]_{rms} = 1348.9\angle 14.36^\circ\ [V]_{rms}$$

b)

$$Z_{L123} = \frac{\bar{V}_{L1} + \bar{V}_{L23}}{\bar{I}_s} = 28.53 - j16.18\ [\Omega] = 32.80\angle -29.56^\circ\ [\Omega]$$

This is the impedance of the three loads combined.

$$\theta_V - \theta_I = -29.56^\circ \Rightarrow pf = 0.8695$$