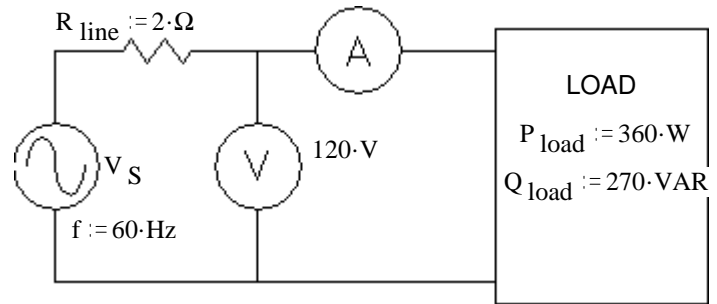


ECE 3600 Exam 1 given: Spring 24

1. (21 pts) The AC load uses 360W and 270VAR.
The voltmeter measures 120 V.

a) Find the apparent power. $|S| = ?$
Give with correct units



b) What does the ammeter measure?

c) Find the power factor of the load. $\text{pf} = ?$

d) The power factor is: i) leading ii) lagging

e) The load in the box consists of two parts in parallel. Draw the parts below and find the values.

f) How much power does R_{line} waste? $P_{R_{\text{line}}} = ?$

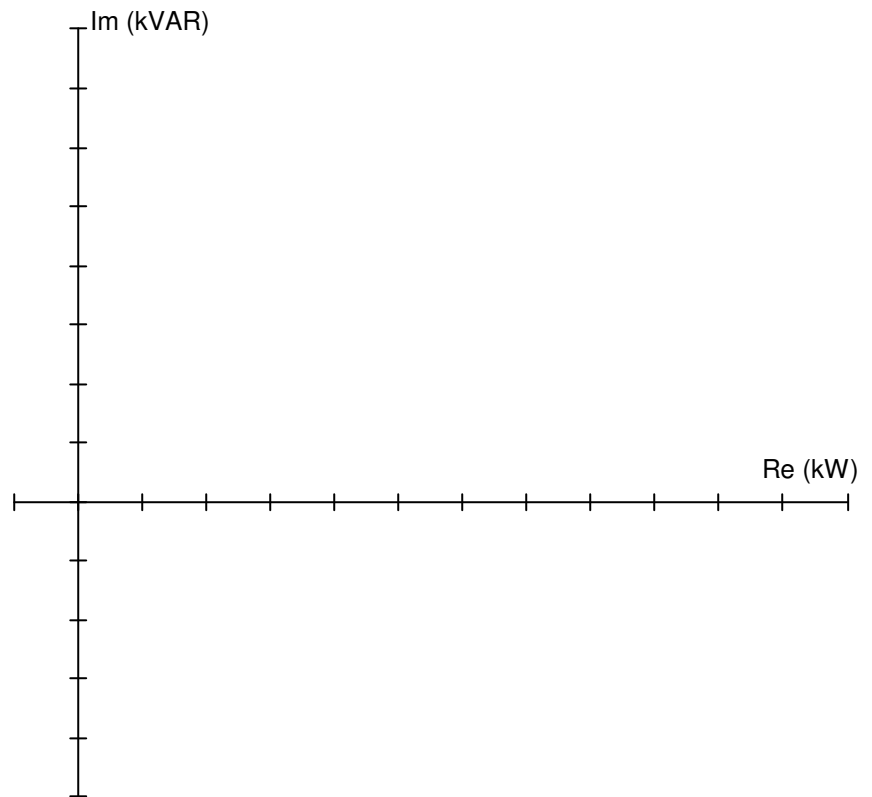
g) Find the complex power provided by the source. $S_S = P_S + j \cdot Q_S = ?$

h) What is the source voltage (magnitude)? $|V_S| = ?$ Remember, you can't add magnitudes of complex numbers.

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2. (19 pts) A load draws 10kVA at 0.75 pf, lagging when hooked to 480V. A capacitor is hooked in parallel with the load and the power factor is corrected to 0.92, lagging. Find the reactive power (VAR) of the capacitor.

Draw a phasor diagram as part of the solution. Include and label ALL the powers, including reactive and complex for both power factors. Be sure to use correct signs & units for each value.



Note: If you can't find the reactive power (VAR) of the capacitor, mark an X : _____ and use -2500VAR for part b).

b) Find the value of the capacitor assuming $f = 60\text{Hz}$.

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3. (38 pts) a) A 3-phase system consists of a generator, 3 lines and a load. At the generator the line voltage is 350-V, the total power is 13.2 kW, and the power factor is 0.80. The overall efficiency of the system is 85%. Each line has the same resistance (R_{line}) and no reactance.

a) Find the magnitude of the line current. $I_L = ?$

b) Find the line resistance. $R_{\text{line}} = ?$

c) What is the line voltage at the load? **Do not** ignore the phase difference between the voltage and the current.
Hint: remember that the line has no reactance and therefore no Q.

- d) Assume that the load is Y-connected and each branch is a resistor (R_{load}) in **parallel** with a reactance (X_{load}).

Find the value of load resistance. $R_{\text{load}} = ?$

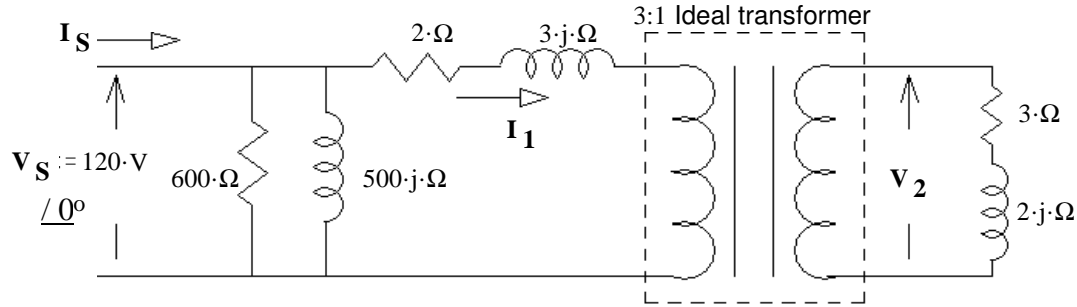
- e) The power factor is corrected to 1 at the load. The generator line voltage remains 350V.
What is the new efficiency?

Hint: You may interpret the power factor correction as though X_{load} has been eliminated.

Beware! The power given above and the I_L calculated above are no longer valid.

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4. (22 pts) A model of a 3:1 step-down transformer is shown below. The transformer is loaded with $\mathbf{Z_L} := (3 + 2 \cdot j) \cdot \Omega$.



a) Find the current shown as $\mathbf{I_1}$, below. Magnitude only. $|\mathbf{I_1}| = ?$ Hint: draw a simpler model first.

b) Find the secondary voltage. Magnitude only. $|\mathbf{V_2}| = ?$

c) Find the efficiency of this transformer.

Prob 4 _____ / 22 Total _____ / 100

Answers

1. a) $450 \cdot \text{VA}$ b) $3.75 \cdot \text{A}$ c) 0.8 d) ii) e) $40 \cdot \Omega$ & $141.5 \cdot \text{mH}$
f) $28.13 \cdot \text{W}$ g) $(388.1 + 270 \cdot j) \cdot \text{VA}$ h) $126.1 \cdot \text{V}$ 2. a) $-3.419 \cdot \text{kVAR}$ b) $39.37 \cdot \mu\text{F}$
3. a) $27.22 \cdot \text{A}$ b) $0.891 \cdot \Omega$ c) $317.4 \cdot \text{V}$ d) $8.98 \cdot \Omega$ e) $90.97 \cdot \%$
4. a) $3.35 \cdot \text{A}$ b) $36.25 \cdot \text{V}$ c) $86.71 \cdot \%$

