

ECE 3600 Exam 1 given: Fall 24

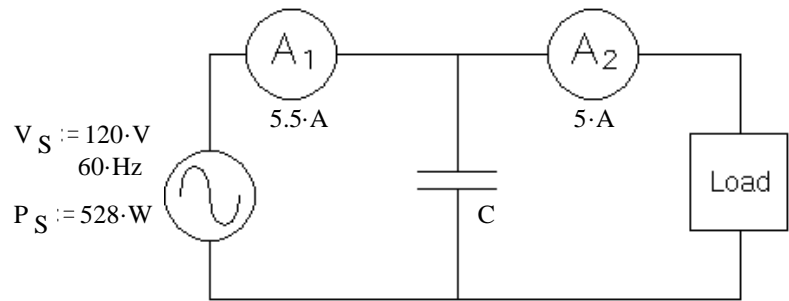
DO NOT use erasable ink

1. (28 pts) A capacitor (C) is placed in parallel with a load. Two ammeters (A_1 and A_2) read the currents shown. The source supplies 528 watts.

Find the following:

- a) The value of the capacitor (C).
As part of your solution, find the P_L and Q_L of the load.

If you have to make any assumptions in order to solve the problem, be sure to indicate or state your assumption in such a way that it shows you know what the alternate assumption is.



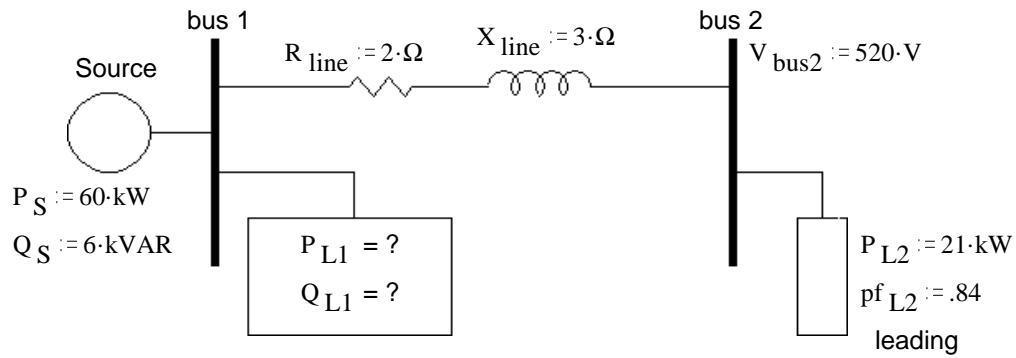
b) How much current flows through the capacitor (magnitude).

c) Add an additional component to the drawing above in order to completely correct the power factor.
Find the value of the component.

2. (40 pts) A one-line drawing of a 3-phase system is shown.

Some 3-phase P_s and Q_s are also shown. Remember that bus and line voltages are the same.

Hints: Work from load 2 back and if you don't use P_s and Q_s to solve this problem it will be VERY HARD!



a) Find the line current.

b) Find the complex power consumed by load 1.

c) What is the line voltage at bus 1?

d) What is the efficiency of this system? $\eta = ?$

3. (32 pts) The parameters of a 375/120-V, 840-VA transformer are shown below.

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Model values: $R_m := 500 \cdot \Omega$ $R_s := 6 \cdot \Omega$ $X_m := 400 \cdot \Omega$ $X_s := 8 \cdot \Omega$ $N := 3$ (NOT 375/120)

The secondary voltage is measured as $V_2 := 93.6 \cdot V$ The secondary current is measured as $I_2 := 7.2 \cdot A$

The transformer is loaded with a resistor, R_L , in series with a capacitive reactance, $X_C := -5 \cdot \Omega$

a) Find the value of the load resistor. $R_L = ?$

If you can't find R_L , use a value between 10Ω and 15Ω , Write that value here: $R_L = \underline{\hspace{2cm}}$ and proceed.

b) Find the primary, source voltage. Magnitude only. $|\mathbf{V}_S| = ?$ As part of your answer, make a useful drawing or schematic and label it with known numbers.

c) Find the efficiency of the transformer.

d) Is this transformer operating within its ratings? Show all evidence and calculations needed to determine this.

Prob 3 _____ / 32

Total _____ / 100

Answers

1. The capacitor makes the power factor WORSE! **Q_S MUST be NEGATIVE!** If Q_L is positive (unlikely):

If Q_L is positive (unlikely): a) $125 \cdot \mu\text{F}$ b) $5.675 \cdot \text{A}$

If Q_S and Q_L are both negative (most likely): a) $20.45 \cdot \mu\text{F}$ b) $0.925 \cdot \text{A}$

c) Add an inductor in parallel with the load and cap. $96.5 \cdot \text{mH}$

2. a) $27.8 \cdot \text{A}$ b) $34.4 + 12.6 \cdot j$ kVA c) $550.5 \cdot \text{V}$ d) $96.3 \cdot \%$

3. a) $12 \cdot \Omega$ b) $287.7 \cdot \text{V}$ c) $75.7 \cdot \%$ d) NO $7.2 \cdot \text{A} > 7 \cdot \text{A}$