ECE 3600 Homework 7 Ideal transformers Due: Mon , 2/5/24 c

1. A step-up transformer is designed to have an output voltage of $2200\ \text{V}$ when the primary is connected to 240V.
   a) If there are 150 turns on the primary winding, how many turns are required on the secondary?

   b) If a load resistor across the secondary draws a current of $1.2\ \text{A}$, what is the current in the primary, assuming ideal conditions?

2. An ideal transformer has a turns ratio ($N = N_1/N_2$) of 1.5 . It is desired to operate a $200\ \Omega$ resistive load at $150\ \text{V}$ (rms).

   a) Find the secondary and primary currents.

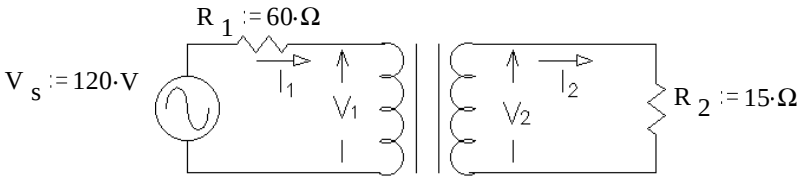
   b) Find the source voltage ($\mathbf{V_1}$).

   c) Find the power dissipated in the load resistor and the power delivered to the primary from the source.

   d) Find the impedance the source sees looking into the primary winding by calculating $\mathbf{Z_{eq}} = N^2\,\mathbf{Z_L}$ and again by calculating $\mathbf{V_1} / \mathbf{I_1}$.

3. The transformer shown in the circuit below is ideal. It is rated at 120/30 V, 80 VA, 60 Hz
   Find the following:

   a) I_1 = ?



   b) V_2 = ?

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c

4. An ideal transformer has a rating of $500/125\ \text{V}$, $10\ \text{kVA}$, $60\ \text{Hz}$. It is loaded with an impedance of 5Ω at $80\%\ \text{pf}\ (0.80)$. The source voltage applied to the primary winding is $440\ \text{V}$ (rms). Find:
   a) the load voltage

   b) the load current

   c) the kVA delivered to load

   d) the power delivered to load

   e) the primary current

   f) the power factor of primary

   g) the impedance the source sees looking into primary.

5. An ideal transformer is rated to deliver $400\ \text{kVA}$ at $460\ \text{V}$ to a customer.
   a) How much current can the transformer supply to the customer?

   b) If the customer's load is purely resistive (i.e. if the $\text{pf} = 1$), what is the maximum power the customer can receive?

   c) If the customer's power factor is 0.8 (lagging), what is the maximum usable power the customer can receive?

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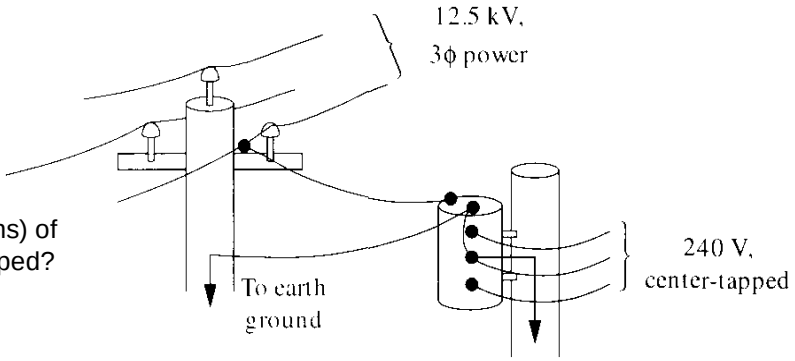
d) What is the maximum power if the power factor is 0.7 (lagging)?

e) If the customer requires 300 kW to operate, what is the minimum allowable power factor given the rating of this transformer?

6. The city of Murray, Utah. distributes power to neighborhoods with a 12.47-kV three-phase system. (12.47 kV is the line voltage.) Each group of houses is served from one phase and ground, and transformed to 240/120 V by a pole transformer, as shown.



a) What is the turns ratio (primary/secondary turns) of the pole transformer to give 240 V, center-tapped?

b) When a 1500-W toaster-oven is turned on, how much does the current increase in the high-voltage wire? Assume the power factor is unity and the transformer is 100% efficient.

c) Repeat b) for a clothes drier that draws 15 A.

Answers

1. a) 1375 turns b) 11 A 2. a) 0.75 A, 0.50 A b) 225 V c) 112.5 W d) 450Ω

3. a) 0.4·A b) 24V 4. a) 110 V b) 22 A c) 2.42 kVA d) 1.94 kW e) 5.5 A f) 0.80 g) 80Ω /36.9° Ω

5. a) 870·A b) 400·kW c) 320·kW d) 280·kW e) 0.75

6. a) 30 b) 208·mA