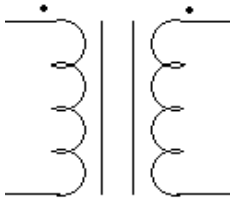
ECE 3600 Exam 2 given: Fall 21

1. (13 pts) You have a 100/250-V, 500-VA transformer.
   a) Can you use this transformer to transform 100 V to 150 V? If yes, show the connections and compute the new VA rating.



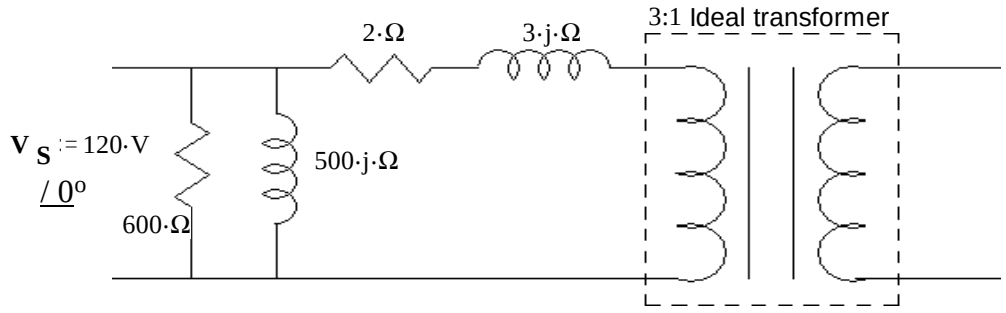
   b) Indicate or show the source and the load on your drawing.

   c) Can you use this transformer to transform 80 V to 120 V?
   If yes, compute the maximum power that can be transformed at these voltages.

   d) What must the load be to transform this maximum power? Give part(s) and value(s).

_____/ 13

2. (27 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 from the source, including complex part or phase angle. $\mathbf{I}_S$ = ?



b) Find the secondary voltage. Magnitude only. $|\mathbf{V}_2|$ = ?

c) If this load were considered "full load", find the voltage regulation as defined in your notes. %VR = ?

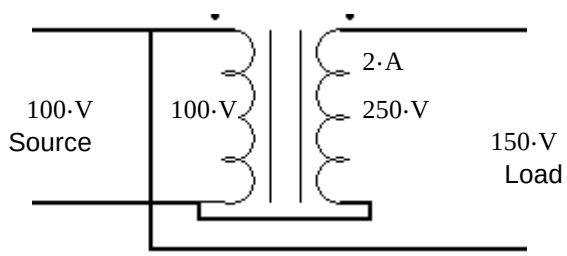
d) Find the efficiency of the transformer.

_____/ 27

Answers

1. a) 300·VA

b)



c) 240·W

d) 60·Ω Just a resistor

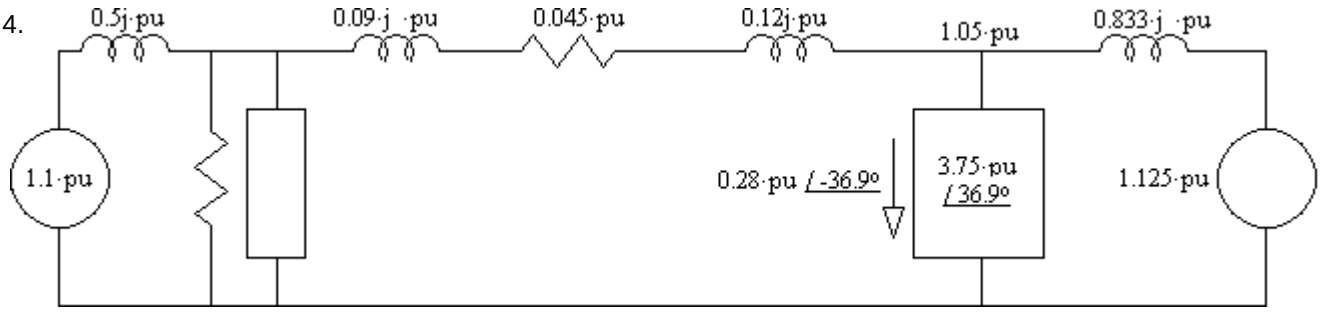
2. a) $\mathbf{I_S}$ = 3.655 A /-37.12° b) 36.25·V

c) 10.34·% d) 86.7·%

3. a) 0·deg 0·W b) 31.58·Ω c) 17.15·kVAR

d) 188.5·kW e) 31.38·deg f) - 35.81·kVAR g) 2.259·kV h) Change I_f to 22.6·A i) decreased

4.



3. (35 pts) A 3-phase, synchronous generator is not electrically connected to anything. The prime mover is spinning the generator at $3600\ \text{rpm}$. The input torque is $25\ \text{Nm}$. When the field current is $10\ \text{A}$, DC, the terminal voltage is $1000\ \text{V}$.

   The field current is raised to $20\ \text{A}$, and the terminal voltage goes up to $2000\ \text{V}$.
   The generator is now Y-connected to a $3.3\ \text{kV}$, $60\ \text{Hz}$, bus. The line current is measured at $3\ \text{A}$.
   The input torque is still $25\ \text{Nm}$, just enough to overcome rotational losses.

   a) What is the power angle and/or how much power is being generated?

   b) Find the synchronous reactance. X_S = ?

   If you can't find X_S, or doubt your value, mark here ____ and use $X_S = 30\ \Omega$ for the rest of the problem.
   If it still doesn't seem like you have enough information to answer the following parts, Ask. I will answer questions for points.

   c) Find the total reactive power generated.

   d) The prime mover torque is increased to $\tau_{in} := 525 \cdot \text{N} \cdot \text{m}$ Find the generated electrical power P = ?

   The prime mover torque is held at this value for the rest of the problem.

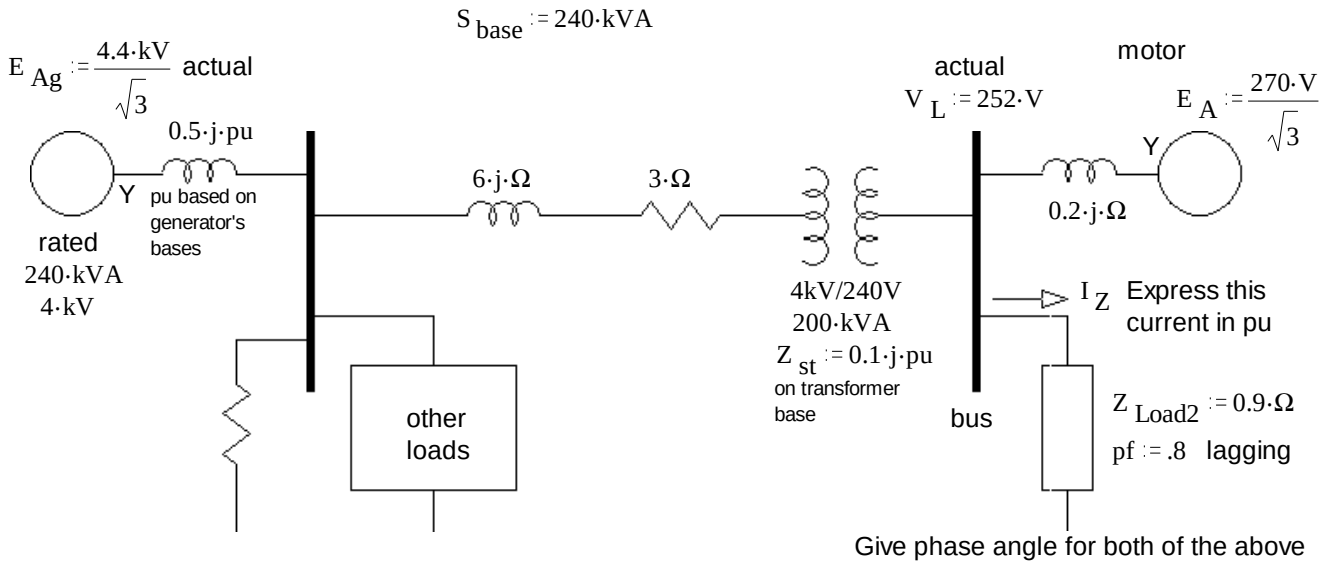
   e) Find the power angle. δ = ?

g) The generator operator is told to produce $18\ \mathrm{kVAR}$, no change in real power. Find the required $\mathrm{E_A}$.

h) What does the operator change to get this new $\mathrm{E_A}$, and to what new value.
Hint: reread the initial problem statement.

i) Did the power angle change with the the previous change?
If yes, say whether it increased or decreased. No calculation is required.

4. (25 pts) A one-line, per-phase diagram is shown below. Using the S_{base} given, draw a per-phase, per-unit diagram. Include pu values for all the values given in the drawing below. E_A voltages are line-to-neutral. **ECE 3600 E2 F21 p5**



_____/ 25