ECE 3600 Exam 1 Given Fall 2017 (The space between problems has been removed.)

Closed Book, Closed notes, Calculators OK, Show all work to receive credit

Circle answers, show units, and round off reasonably

Write Legibly! If I can't read what you've written or your answer is ambiguous, I'll assume you don't know.

1. Give the approximate efficiency of a combined-cycle power plant.

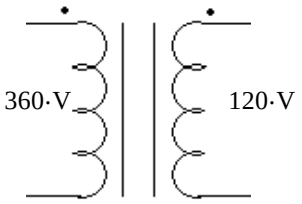
2. We recently visited Gadsby Power Plant.
   a) On the bottom floor of the building, there were some very large water pumps. What was the purpose of these pumps?
   b) Is there anything special about the water used in the steam cycles? If yes, what?

3. At the dispatch center there was a large curved screen in the main room with lots of information projected on it. The most important information was at the very top of the screen.
   a) Other than local time, list one other item displayed at the top of the screen. Describe the meaning of the display item.
   b) List and describe one other item from anywhere on the screen.

a) You have a 360/120-V, 7.2-kVA transformer. Show the necessary connections to use this transformer to transform 120 V to 480 V.

b) Compute the new VA rating.

c) Also show the 120-V source and the load.



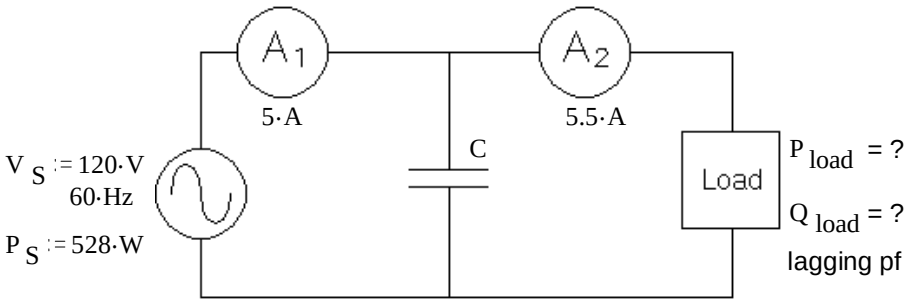
d) Could this transformer also be used to transform 80 V to 320 V ? If yes, what is the maximum real power that could be transformed?

5. A single-phase transformer is rated at 2 kVA, 1000/250 V. The primary is hooked to an 800V source
   a) What is the turns ratio of this transformer?
   b) The primary is hooked to a 800-V source, what is the secondary voltage?
   c) At this voltage (800-V primary), what is the maximum power that transformer should be allowed to transform? (Assuming the right type and value of load.)
   d) In order to actually transform this much power, what should the load impedance value be?
   e) In order to actually transform this much power, what type of load impedance should be used?
   f) A resistor, R_L, hooked to the secondary of this transformer would appear how big from the primary side?

6. A transformer rated at 240/600 V, 1.2kVA , 60Hz is used at 50Hz .
   a) Do any of the other ratings (voltage, current or VA) have to change? If yes, which one(s) and by how much?
   b) Do any ratings stay the same? If yes, which one(s)?

Problems You MUST show work to get credit. Show the correct units for each value. Assume voltage and current values are RMS and $f := 60 \cdot Hz$. Assume normal abc sequence and balanced conditions for all 3ϕ.

1. (22 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) Find the P and Q of the load.



b) The value of the capacitor. C = ?
c) How much current flows through the capacitor (magnitude).
d) In part b) you had to make an assumption in order to calculate the value of the capacitor. Change that assumption and recalculate the value of C. C = ?

2. (16 pts) a) A 3-phase system delivers (at load) 380-V, 3-phase power of 12 kW to a load with a 70% power factor. Each line has a resistance of 0.5 Ω. Find the total power lost in the lines and the overall efficiency of the system.

b) The power factor is corrected and the source voltage is adjusted so that it still delivers 380-V, 3-phase power of 12 kW to a load. What is the new efficiency?

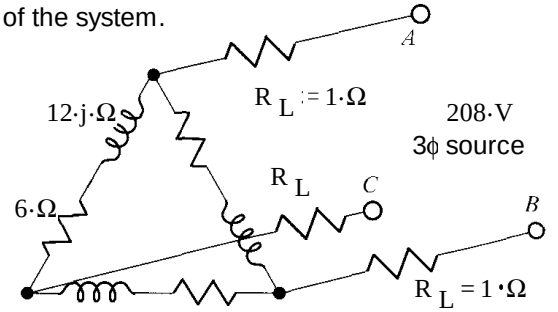
3. (16 pts) Find the following: Hint: Convert to Y & redraw one phase of the system.

a) The line current that would be measured by an ammeter. Hint: Convert to Y

b) The power factor of the load. Don't include the lines.

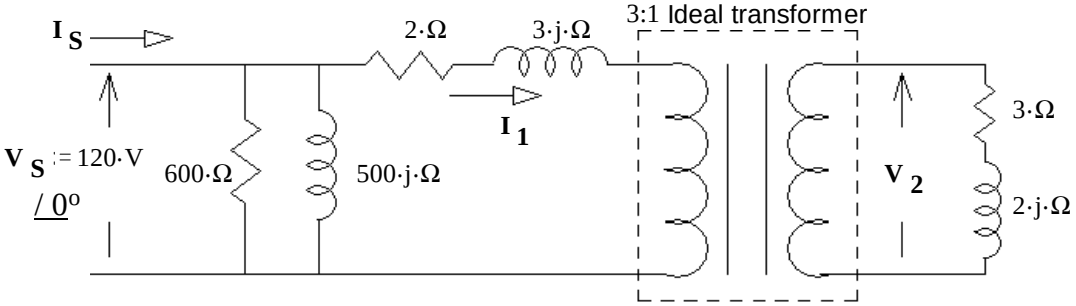
c) The power consumed by the three-phase load. Don't include power lost in the lines.

d) What is the line voltage at the load? Just magnitude.



All $\mathbf{Z} := (6 + 12\cdot j)\cdot\Omega$ load impedance Line resistance

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.

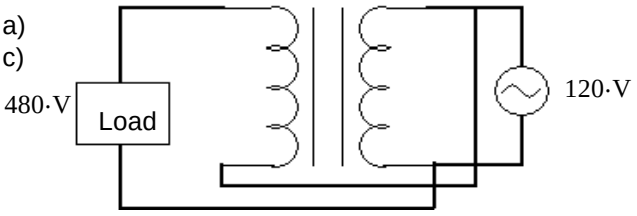
Answers

1. 55 - 60%

2. a) They were boiler feed pumps, they returned the condensed steam to the boiler.
b) This water is very pure and regularly monitored.

3. a) 15:00 DCS Clock: If RMP suffers a problem which would cause them to require power from a neighboring power company, they would have only 15 minutes to make up the deficit.
Frequency: Showed the frequency of the system, used to help balance power production and load.
ACE: Shows power interchanged with neighboring systems. + is outgoing and - is incoming.
b) Many possibilities, including power generation and load figures, map, warnings, etc.

4. a)
c)



b) 9.6·kVA
d) Same connections 6.4·kW

5. a) 4 : 1 b) 200·V c) 1.6·kVA d) 25·Ω
e) Purely resistive, power factor of 1 f)16 times bigger

6. a) 240/500 V, 1kVA b) Current ratings stay the same.

Problems

1. a) 396·VAR b) 20.5·μF c) 0.925·A d) 125.4·μF

2. a) 1.02·kW 92.18·% b) 96.01·%

3. a) 24.0·A b) 0.447 c) 3.46·kW d) 186·V

4. a) 3.35·A b) 36.25·V c) 86.7·%