ECE 3600 Exam 1 given: Fall 11

(The space between problems has been removed.)

Write Legibly! This part of the exam is Closed book, Closed notes, No Calculator.

(28 pts) Questions If I can't read what you've written or you answer is ambiguous, I'll assume you don't know.

1. List the three largest sources of energy used to produce electricity in the US.

   a) largest source: b) 2nd largest source: c) 3rd largest source:

2. Which of of the sources you listed in question 1 is best from a global-warming perspective?

3. Which of of the sources you listed in question 1 can be used in a significantly more efficient way? How?

4. a) The Gadsby power plant (the subject of the first field trip) is used to supply: base load or peak load (circle one)

   b) The Intermountain Power Plant (A large coal-fired power plant near Delta, Utah) is used to supply:

   base load or peak load

5. Name two significant problems with photo-voltaic solar power.

6. What does it mean when a 3-phase system is "balanced"?

7. Express the VARs of a leading-pf load in terms of V, I and P (all magnitudes).

8. Express power lost using the following: P_{in} and η

9. A single-phase transformer is rated at $120\ \text{kVA}$, $12\text{kV}/200\text{V}$. The transformer primary is operated at 6k.

   a) What is the turns ratio of this transformer? (Two possible answers, only need one)

   b) What is the secondary voltage?

   c) What is the rated current in the primary?

   d) What is the rated current in the secondary?

The following problems were handed out to the student after finishing the closed-book part.

This part of the exam is open book, open notes. You MUST show work to get credit. Show the correct units for each value. Assume voltage and current values are RMS and $f := 60\cdot\text{Hz}$. Assume normal abc sequence and balanced conditions for all 3ϕ.

1. (20 pts) A single-phase, 240-V source is connected to two loads. The source provides 3000W and 13A. Load 1 consumes 1800W at a power factor of 0.8.

   In order to find the following, you may have to make some assumptions. If you do, be sure to clearly state your assumption in such a way that I can tell that you know what the other assumption might be.

   a) Find the complex power (both P and Q) consumed by load 2.

   b) Load 2 can be modeled as 2 parts. Draw a model and find the values of the parts.

2. (25 pts) A 3-phase system delivers 480-V, 60-Hz 3-phase power of $10\ \text{kW}$ to a load with a 70% lagging power factor. Each line has a resistance of $2\ \Omega$. ("delivers" means those are the values at the load.)

   a) Three Y-connected sources supply the power. What voltage do they each supply (magnitude)?

   b) Find the total power lost in the lines and the overall efficiency of the system.

   c) Three capacitors are Y-connected at the load to correct the power factor. Find the capacitor value(s).

   d) With the capacitors in place. the source voltage is adjusted so that the load power remains $10\ \text{kW}$. What is the new efficiency of the system with the capacitors of part c).

3. (15 pts) Find the following: Hint: Convert to Y & redraw one phase of the system. **ECE 3600 Exam 1 Fall 11 p2**

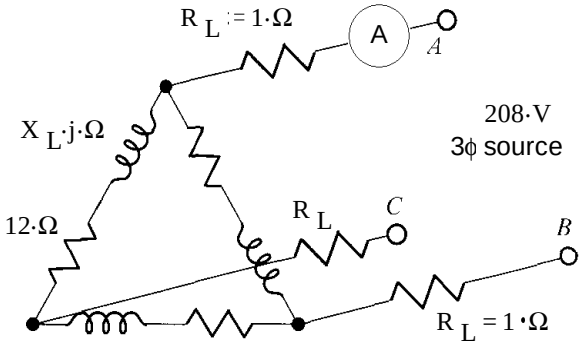
a) The power consumed by the three-phase load.
Don't include power lost in the lines.

b) Find the reactance (X_L) of the inductors.

Hint: Convert to Y, and find
magnitude of the total impedance.

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

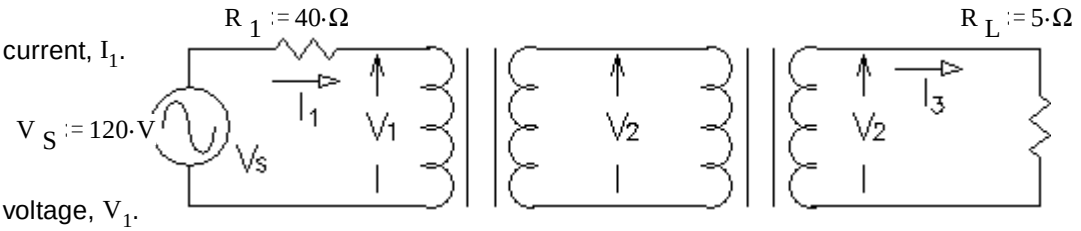
Ammeter measures 20A



4. (20 pts) Two transformers are hooked up as shown below. The first (T1) is rated at 240/80 V, 200 VA, 60 Hz and the second (T2) is rated at 200/100 V, 200 VA, 60 Hz
Find the following:

a) The first primary current, I_1.

b) The first primary voltage, V_1.



NOTE: If you can't find V_1, use 100V for the rest of the problem.

c) The other two voltages, V_2 and V_3.

d) The other two currents, I_2 and I_3.

e) Is transformer T2 operating within its ratings? Show your evidence.

Answers

Closed-book part

1. a) Coal b) Natural Gas c) Nuclear 2. Nuclear
3. Natural Gas In a combined-cycle power plant. 4. a) peak load b) base load
5. 1. It's DC 2. It's not available when the sun doesn't shine 3. $, Lots of $ up front
6. The 3 voltages are equal, the 3 currents are equal and the 3 loads are equal.
7. $Q = \sqrt{(V \cdot I)^2 - P^2}$ 8. $P_{losses} = P_{in} - \eta \cdot P_{in}$ 9. a) 60 b) 100·V c) 10·A d) 600·A

Open-book part

1. a) $1.2 - 0.493 \cdot j$ kVA Assumes I_S lags V_S and the Load 1 pf is lagging.
   b) Parallel R & C: 48·Ω & 22.7·uF OR SeriesR & C: 41.1·Ω & 157·uF
2. a) 302.2·V b) 85.0·% c) 117·μF d) 92.0·%
3. a) 4.8·kW b) 9.97·Ω c) 180·V
4. a) 0.545·A b) 98.2·V c) 32.7·V & 16.4·V d) 1.64·A & 3.27·A e) NO