ECE 3600 Exam 1 Given Fall 2019 (The space between problems has been removed.)

First part, Closed EVERYTHING

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

1. The three largest sources of energy used to produce electricity in the US are:

   a) Which of these sources is best from a global-warming perspective?

   b) Which of these sources can be used in a significantly more efficient way? How?

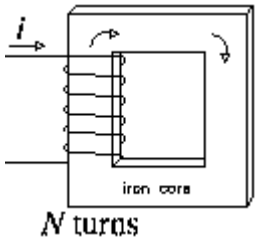
2. Name 3 sources of electrical power for the grid which do not produce greenhouse gasses by normal operation.

3. The Rankin-cycle (steam cycle) that is used in many power plants can be separated into 4 main steps or operations. List those steps in order, starting with the step where heat energy enters the cycle.

   1 2 3 4

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

5. Electrical circuits can be used as analogy of magnetic "circuits".
   Fill in the blanks below with electromagnetic terms or symbols to comlete the analogies.
   _____ is like voltage.
   _____ is like resistance.
   _____ is like current.



6. A single-phase transformer is rated at $2400\ \text{VA}, 1200/240\ \text{V}$. The primary is hooked to a 1000V source
   a) The primary is hooked to a 1000-V source, what is the secondary voltage?

   b) At this voltage (1000-V primary), what is the maximum power that transformer should be allowed to transform? (Assuming the right type and value of load.)

   c) In order to actually transform this much power, what should the load impedance value be?

   d) In order to actually transform this much power, what type load impedance should be used?

   e) What is the turns ratio of this transformer?

   f) A resistor, R_L, hooked to the secondary of this transformer would appear how big from the primary side?

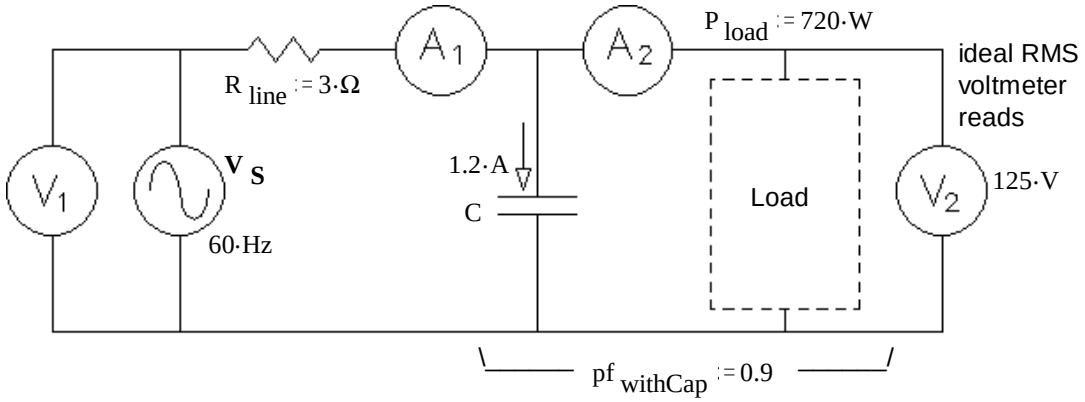
7. A single-phase transformer is rated at $500/250\ \text{V}, 1\ \text{kVA}$. The primary is hooked to a 250V source.
   A 25-Ω resistor is hooked to the secondary. Determine if this transformer is operating within its ratings and show how you determine this.

F19 Problems Closed book, Closed notes except reference sheet. Calculator are OK.

1. (40 pts) A capacitor (C, shown below) is used to partially correct the power factor of a load to 0.9. A_1 and A_2 are ideal ameters. V_1 and V_2 are ideal voltmeters. The load uses 720W. Find the following:

a) The RMS readings of the two ideal ammeters.
I_{A1} = ? I_{A2} = ?

Note: there are a number of steps involved here.
For A_1, do calculations on the load and cap together.
For A_2 you'll need numbers for the load alone.



b) The load can be modeled as 2 parts in series. Draw the model and find the values of the parts.

c) The voltage measured by the ideal voltmeter, labeled V_1. V_1 = ?

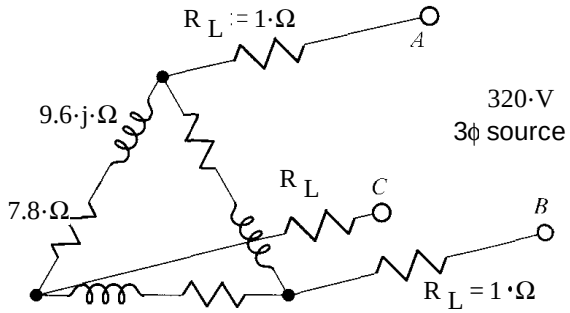
d) The efficiency. η = ?

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

f) Without making any additional calculations, would the efficiency be better or worse with the added component of part e)? circle one
i) better (higher η) ii) worse (lower η) iii) could be either iv) no difference

ECE 3600 Exam 1 Fall 19 p3

2. (35 pts) Find the following:



All $\mathbf{Z} := (7.8 + 9.6\cdot j)\cdot\Omega$ load impedance

Line resistance

a) The line current that would be measured by an ammeter.

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 efficiency of this system?

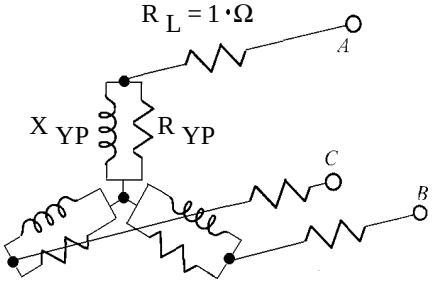
e) What is the line voltage at the load? Just magnitude.

f) The same load could also be represented by Y-connected, parallel R_{YP} and X_{YP}

Find the value of R_{YP} .

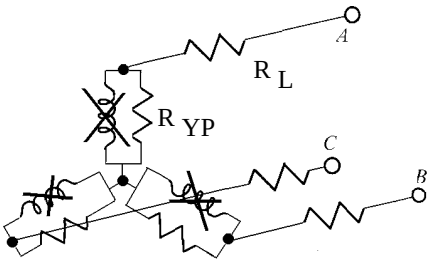
R_{YP} can be found from the load voltage and power, both found on the last page.

Line resistance



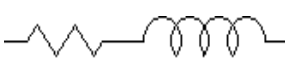
g) The load power factor is corrected at the load.
(Now the load looks like R_{YP} alone with no X_{YP} .)
What is the new load power of this system?

h) What is the new efficiency of this system?



Answers Questions

1. Natural Gas Coal Nuclear a) Nuclear b) Natural Gas In a combined-cycle power plant.
2. 3 of these: Hydroelectric wind solar (steam or solar-cells) nuclear geothermal
3. 1 Boiler 2 Steam turbine 3 Condenser 4 Boiler feed pump 4. $P_{losses} = P_{in} - \eta\cdot P_{in}$
5. Ni or Ampere-turns is like voltage. $\mathcal{R}$ or Reluctance is like resistance. Φ or Flux is like current.
6. a) $200\cdot V$ b) $2\cdot A$ c) $20\cdot A$ d) Purely resistive, power factor of 1 e) 5 : 1 f) $25\cdot R_L$
7. NO $I_{2,rated} = 4\cdot A < 5\cdot A$ actual current

Problems 1. a) $6.4\cdot A$ $7.01\cdot A$ b)  c) $142.5\cdot V$ d) $85.4\cdot\%$
e) $59.2\cdot\mu F$ in parallel with C f) i) $14.7\cdot\Omega$ $26.94\cdot mH$
2. a) $184.8\cdot V$ $38.4\cdot A$ b) 0.631 c) $11.48\cdot kW$ d) $72.2\cdot\%$ e) $273.9\cdot V$
f) $6.54\cdot\Omega$ g) $11.78\cdot kW$ h) $87.7\cdot\%$