ECE 3600 Exam 1 given: Fall 22

9/22/22

First part, Closed EVERYTHING

Closed book, Closed notes, No reference sheet (pink sheet), No Calculator.

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

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

2. 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?

3. A single-phase transformer is rated at $600/300\ \text{V},\ 1.2\ \text{kVA}$. The primary is hooked to a 400V source.

   A 40-Ω resistor is hooked to the secondary. Determine if this transformer is operating within its ratings and show how you determine this.

When you are done with this part, turn it in to get the second part.

Questions _____/ 16

Answers 1. $P_{in} - \eta \cdot P_{in}$ 2. a) $200 \cdot V$ b) $2 \cdot kVA$ c) $20 \cdot \Omega$ d) Purely resistive, power factor of 1

e) 5 : 1 f)25 times bigger

OPEN NOTE SHEET 1. a) 0.862 b) $6.78 \cdot A$ c) $61.7 \cdot \mu F$

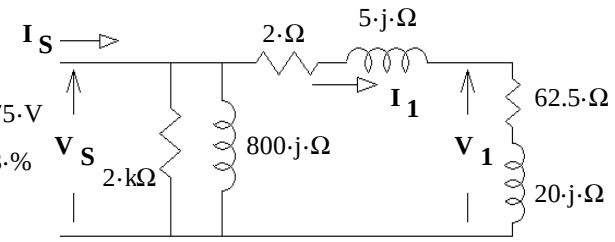
3. $4 \cdot A < 5 \cdot A$ NO

2. a) $5.333 + 3.6 \cdot j\ kVA$ b) $9.288 \cdot A$ c) $2.061 \cdot \Omega$

d) $373 \cdot V$ e) $28.98 \cdot \Omega$ $102.5 \cdot mH$

f) $86.95 \cdot \Omega$ $307.5 \cdot mH$

3. a)



b) 189.75·V

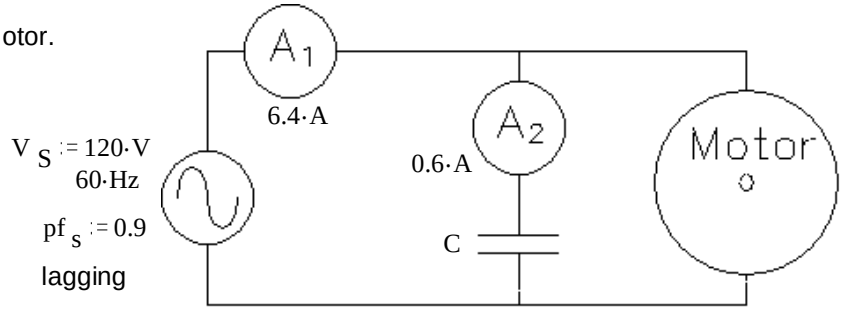
c) 94.43·%

OPEN NOTE SHEET

1. (24 pts) A capacitor (C) is used to partially correct the power factor of a motor to 0.9. That is, the power factor as seen by the source is 0.9. Two ammeters (A_1 and A_2) read the currents shown.

Find the following:

a) The original power factor of the motor. As part of your solution, find the P and Q of the motor.



If you can't find this power factor, mark an x here _____ and assume $\mathrm{pf_m} = 0.85$ for the rest of the problem.
You may salvage some points from a) if you find the motor Q from this $\mathrm{pf_m}$, otherwise skip to b)

b) How much current flows through the motor (magnitude).

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

2. (40 pts) A 3-phase generator produces 400-V, 60-Hz 3-phase power. It is connected through 3 lines to a single 3-phase load which consumes $4.8\ \text{kW}$ with a 80% lagging power factor. Each line has a resistance of R_{line} and no reactance. The system efficiency is 90%.

   Source end: 400-V Lines: R_{line} Efficiency: 90% Load end: $4.8\ \text{kW}$, 80% pf, lagging

   a) Find the complex power provided by the source. P_S = ? Q_S = ?

   b) Find the line current that would be measured by an ammeter.

   c) What is the value of the line resistance? R_{line} = ?

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

e) Assume the load is Y-connected and each phase has two parallel components.
Find the values of those components

f) Assume the load is Δ-connected and each phase has two parallel components.
Find the values of those components

3. (20 pts) The parameters of a $5{:}1$ step-down transformer are shown below. The transformer is loaded with $\mathbf{Z}_L := (2.5 + 0.8\cdot j)\cdot\Omega$ and the secondary voltage is $V_2 := 36\cdot V$

$R_m := 2\cdot k\Omega$ $R_s := 2\cdot\Omega$ $X_m := 800\cdot\Omega$ $X_s := 5\cdot\Omega$

a) draw the model with the load connected. Label parts, voltages and currents as needed for the rest of the problem.

b) Find the primary, source voltage. Magnitude only. $|\mathbf{V}_S|$ = ?

c) Find the efficiency of the transformer.

Answers on Page 2