EE 320
Energy Systems I
Sample Exam #1

1. (20 pts) Either circle the correct answer or write in a short answer for each of the following. Explain answer

A (T or F) the real power loss in an ideal capacitor is 0. Explain

B What does total harmonic current distortion represent? What is considered to be a good number?

C You are given an iron core with a N-turn winding excited by an AC voltage source with a constant voltage magnitude. The peak flux density will (increase or decrease) when the frequency of the voltage is increased.

D Suppose a coil of wire is wrapped around a magnetic core. Will the inductance increase or decrease as the path length increases. Explain

E Why does the open circuit test only show excitation losses (losses within the core) and not winding (I^2R) losses?

2. (30 pts) Do the following given the 60 Hz circuit shown below:

A Calculate instantaneous power delivered by the source

B Compute the power factor of the load

C Determine the per phase capacitance needed to make the effective power factor of the load + capacitor
   bank unity.

$$Z_{line} = 1 + j\,3\ \Omega$$

480V @ 0° $Z_{load} = 7 + j\,4\ \Omega$
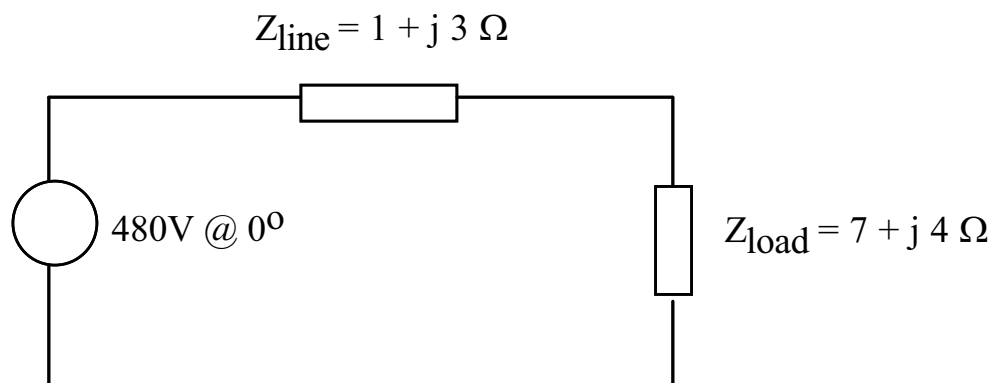
3. (25pts) A 1300:460V, 50 kVA single phase transformer supplies a rated kVA load at 0.8 PF lagging at 440V. The impedances referred to the high voltage side are:

$$
\begin{aligned}
R_1 &= R_2' &= 0.5\Omega \\
X_1 &= X_2' &= 2.0\Omega \\
&\quad X_m &= 400\Omega \\
&\quad R_c &= 1200\Omega
\end{aligned}
$$

1. Determine the transformer voltage regulation for this load.

2. Repeat for a unity power factor load

3. Determine the transformer efficiency for each case

4. How does power factor impact voltage regulation and efficiency?

4. (25 pts) The current waveforms drawn by a power supply fed by a sinusoidal voltage source have the following harmonic components (in RMS Amperes):

I_1	I_3	I_5	I_7	I_9	I_{11}
100 A	50 A	20 A	14 A	11 A	9 A

A Calculate true RMS current. Compare this to the fundamental component RMS value and comment.

B Assuming the displacement power factor is 0.9 lagging, compute the true power factor.

C Compute total harmonic distortion in the current