

ECE 431 Electric Machinery

NAME: _____

Test #1 February 19, 2014

You may use *your own* hand-written notes as reference.

Please do all work on this test. Label any solutions that are written on backs of pages or on this spare sheet.

Q1. (25 points):

A balanced 3 phase, 4160 V_{l-l rms} source feeds a balanced 3 phase load of $(1.2+j5) \Omega$ /phase.

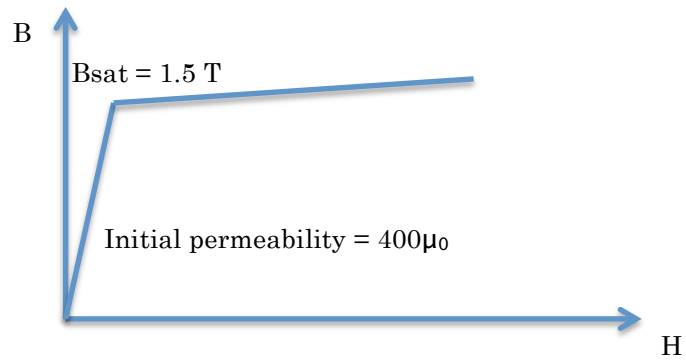
a) Show in a circuit diagram how you would measure the total power being drawn by the load using the two Watt-meter method.

b) Compute the voltage, current, and power readings you would expect in each wattmeter.

c) A capacitor bank is used to correct the load power factor to unity. Re-compute the wattmeter readings.

Q2. (25 points):

A 400 turn coil is wound around a magnetic core with a cross-sectional area of 2cm^2 and a mean length of 10cm . The core's magnetic property is approximately characterized by the B-H curve below.



- Calculate the inductance of the coil when the core is not saturated.
- What is the maximum current the inductor can be run at and remain below saturation?
- How much energy is stored in the inductor for this maximum current?

Q3. (25 points):

Three single phase transformers, each rated 3000V:208V, 200kVA with a series impedance of $2\ \Omega$ referred to the high side, are connected in the following manner:

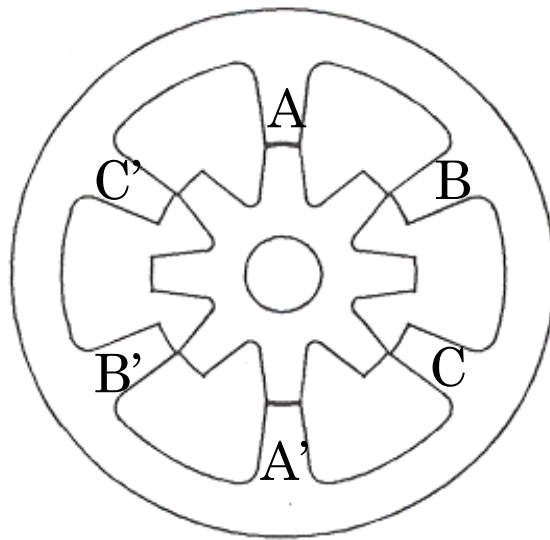
- (i) Wye-Wye
- (ii) Delta-Wye
- (iii) Delta-Delta

a) For each case, what is the resulting rating (Voltages, kVA) and per-phase (Wye equivalent) series impedance referred to the high side?

b) A single-phase transformer is rated at 240V:50V and 1kVA. The nameplate shows a $j1\ \Omega$ series impedance referred to the LV side (you may assume low magnetizing impedance and negligible resistances). What is the high-side voltage magnitude needed to provide 50 V across a $2.5\ \Omega$ resistive load? Compute the load regulation for this transformer.

Q4. (25 points)

A 6/8 reluctance machine is shown below, and is operated by exciting only one phase at a time.



- a) What should the sequence of excitation be to obtain a clockwise rotation?
- b) How many steps are required to make one complete revolution?
- c) Comment on what effect doubling the air-gap length would have on the peak torque capability, assuming same current input.
- d) What would happen to the peak torque if the stator and rotor teeth width are reduced by 10%?

