ECE 431 Electric Machinery NAME:_____

Test #1 February 15, 2017

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

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

Q1. (30 points):

A balanced, 3-phase, 60Hz, wye-connected source has a line-line voltage of 4160V-rms. It is connected to a balanced three-phase delta-connected load whose impedance is $30 + j15\ \Omega$.

a. If the two-wattmeter method is used, what would each of those meters read (voltage, current and power)?
b. If a capacitor bank is used to improve the power factor of the load to unity, what would the two-wattmeter readings be?

Q2. (30 points):

The following test results were found for a single-phase, 60 HZ, 18 KVA transformer with voltage ratings 1200/480 Volts:

Open-circuit test: $V_L = 480$ V, $I_L = 5$ A, $P_2 = 180$ W
Short-circuit test: $V_H = 42$ V, $I_H = 15$ A, $P_1 = 220$W

For all parts, use the approximate equivalent circuit with the shunt elements moved directly across the source.

(a) Compute all the parameters of the approximate equivalent circuit with the shunt elements moved directly across the source.
(b) Inspection of the above transformer reveals 600 turns on the HV side. Estimate the minimum core cross section you would need to remain below 1T (peak) in the core.

Q3. (40 points)

A 8/6 reluctance machine is shown below. Rotor and stator pole arc are $\pi/6$ radians. Rotor outer radius is 50 mm, the airgap length is 0.1 mm, and number of turns per phase is 10.

a) Plot the variation of phase A inductance versus rotor position, θ, measured counter clockwise starting from the position shown, from 0 to $\pi/2$ radians. Label the axes.
b) Overlay in dashed lines, the Phase B inductance on top of the above curve.
c) What should the sequence of excitation be to obtain a clockwise rotation by exciting only one phase at a time starting from the position shown?
d) How many steps per revolution do you get under the operation described above?
e) Comment on what effect doubling the air-gap length would have on the peak torque capability, assuming same current input.