The Ohio State University
Department of Electrical Engineering

EE 341

Energy Conversion
Home work Set # 5

Print Your Name

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The Last Four Digits of Your SSN:

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1. A 100-kVA, 240/120 Y-Y three-phase power transformer has a per-unit resistance of 0.01 pu and a per-unit reactance of 0.035 pu. The excitation branch elements are $R_C = 80$ pu and $X_M = 20$ pu.

   (a) If this transformer supplies a rated load at 0.8 PF lagging, draw the phasor diagram of one phase of the transformer.
   (b) What is the voltage regulation of the transformer bank under these conditions?
   (c) Sketch the equivalent circuit referred to the low-voltage side of one phase oh this transformer. Calculate all the transformer impedances referred to the low-voltage side.

2. Problem 2-19 on textbook (Chapman)
   A 20-kVA, 20,000/480-V 60-Hz distribution transformer is tested with the following results.

Open-circuit test (measured from secondary side)	Short-circuit test (measured from primary side)
$V_{OC} = 480V$	$V_{SC} = 1130V$
$I_{OC} = 1.51A$	$I_{SC} = 1.00A$
$P_{OC} = 271W$	$P_{SC} = 260W$

   (a) Find the per-unit equivalent circuit for this transformer at 60 Hz.
   (b) What would the rating of this transformer be if it were operated on a 50-Hz power system? (Hint: If this transformer were operated at 50 Hz, both the voltage and apparent power would have to be derated by a factor of 50/60.)
   (c) Sketch the equivalent circuit of this transformer referred to the primary side *if it is operating at 50 Hz*. (Hint: when frequency changes, the resistances will be unaffected, but the reactances will be changed because $X = \omega L = 2\pi f L$.)