ECE 320: Homework #3

DUE DATE: By 5:00pm on Wednesday September 24.

1. A 20 kVA 8000/277-V distribution transformer has the following resistances and reactances:

   Rp := 32ohm Rs := 0.05ohm

   Xp := 45ohm Xs := 0.06ohm

   Rc := 250kΩ Xm := 40kΩ

   The excitation branch impedances are given referred to the high-voltage side of the transformer.

   (a) Find the equivalent circuit of this transformer referred to the high-voltage side

   (b) Assume that this transformer is supplying rated load at 277V and 0.8 PF lagging. What is this transformer's input voltage? What is its voltage regulation?

   (c) What is the transformer's efficiency under the conditions of part (b)?

2. A 1000VA 230/115-V transformer has been tested to determine its equivalent circuit. The results of the test are shown below.

Open Circuit Test	Short Circuit Test
Voc := 230V	Vsc := 13.2V
Ioc := 0.45A	Isc := 6.0A
Poc := 30W	Psc := 20.1W

   All data given were taken on the primary side of the transformer

   (a) Find the equivalent circuit for the transformer referred to the low voltage side of the transformer.

   (b) Find the transformer's voltage regulation at rated conditions and (1) 0.8 PF lagging, (2) 1.0 PF and (3) 0.8 PF leading.

   (c) Determine the transformer's efficiency at rated conditions and unity power factor. Repeat at 0.8 PF lagging.

3. A 15kVA 8000/230-V distribution transformer has an impedance referred to the primary of 80 +j300 Ω. The components of the excitation branch referred to the primary side are Rc=350kΩ and Xm=70kΩ

   (a) If the primary voltage is 7967V and the load impedance is ZL=3.2+j1.5 Ω, what is the secondary voltage of the transformer? What is the voltage regulation of the transformer?

   (b) If the load is disconnected and a capacitor of -j3.5Ω is connected in its place, what is the secondary voltage of the transformer? What is its voltage regulation under these conditions?

4. Why does the short-circuit test essentially show only i^2R losses and not excitation losses in a transformer?

5. Why does the open circuit test essentially show only excitation losses and not i^2R losses?