



The Ohio State University  
Department of Electrical Engineering

EE 341

Energy Conversion  
Home work Set # 3

**Print Your Name**

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1. Solve Problem 2-1(text, page 133)

2-1. The secondary winding of a transformer has a terminal voltage of

$v_s(t) = 282.8 \sin 377t$  V. The turns ratio of the transformer is 50:200 ( $a = 0.25$ ). If

the secondary current of the transformer is  $i_s(t) = 7.07 \sin(377t - 36.87^\circ)$  A, what is the primary current of this transformer? What are its voltage regulation and efficiency? The impedances of this transformer referred to the primary side are

$$R_{eq} = 0.05\Omega \qquad R_c = 75\Omega$$

$$X_{eq} = 0.225\Omega \qquad X_M = 20\Omega$$

2. Solve Problem 2-3(text, page 134)

2-3. A 1000-VA 230/115-V transformer has been tested to determine its equivalent circuit. The results of the tests are shown below.

Open-circuit test	Short-circuit test
$V_{oc} = 230 \text{ V}$	$V_{sc} = 13.2 \text{ V}$
$I_{oc} = 0.45 \text{ A}$	$I_{sc} = 6.0 \text{ A}$
$P_{oc} = 30 \text{ W}$	$P_{sc} = 20.1 \text{ W}$

All data given were taken from the primary side of the transformer.

- Find the equivalent circuit of this transformer referred to the low-voltage side of the transformer.
- Find the transformer's voltage regulation at rated conditions and (1) 0.8 PF lagging, (2) 1.0 PF, (3) 0.8 PF leading.
- Determine the transformer's efficiency at rated conditions and 0.8 PF lagging.

3.

(2-18, page 138) Three 25-kVA 24,000/277-V distribution transformers are connected in  $\Delta$ -Y. The open-circuit test was performed on the low-voltage side of this transformer bank, and the following data were recorded:

$$V_{line,OC} = 480 \text{ V} \quad I_{line,OC} = 4.10 \text{ A} \quad P_{3\phi,OC} = 945 \text{ W}$$

The short-circuit test was performed on the high-voltage side of this transformer bank, and the following data were recorded:

$$V_{line,SC} = 1400 \text{ V} \quad I_{line,SC} = 1.80 \text{ A} \quad P_{3\phi,SC} = 912 \text{ W}$$

- (a) Find the per-unit equivalent circuit of this transformer bank.
- (b) Find the voltage regulation of this transformer bank at the rated load and 0.90 PF lagging.
- (c) What is the transformer bank's efficiency under these conditions?