Name_____ ECE 3600 Homework 8A   Non-Ideal transformers   c

1. The parameters of a step-down transformer are shown below.   Due: Sat, 2/1/25
   The transformer is loaded with $\mathbf{Z}_L := (2.5 + 0.8 \cdot j) \cdot \Omega$ and the secondary voltage is $V_2 := 36 \cdot V$

$$R_m := 2 \cdot k\Omega \qquad R_s := 2 \cdot \Omega \qquad X_m := 800 \cdot \Omega \qquad X_s := 5 \cdot \Omega \qquad N := 5$$

a) Draw the model with the load connected. Label parts, voltages and currents as needed for the rest of the problem.

b) Find the primary, source voltage. Magnitude only. $\left| \mathbf{V}_S \right|$ = ?

c) Find the total complex power supplied the primary, source voltage. $\mathbf{S}_S = P_S + j \cdot Q_S$ = ?

d) Find the magnitude of the current flowing from the primary, source voltage. $\left| \mathbf{I}_S \right|$ = ?

1. continued e) Find the efficiency of the transformer.

f) The transformer would be fully loaded if $V_S := 208 \cdot V$ and $Z_L := 2 \cdot \Omega$ all real
Find the voltage regulation as defined in your notes. $\% VR = ?$

2. The parameters of a step-down transformer are shown below. The primary voltage is $V_S := 120 \cdot V$
The transformer is loaded with $\mathbf{Z_L} = R_L + jX_L$ and the secondary current is $I_2 := 3.2 \cdot A$

$R_m := 1.5 \cdot k\Omega$ $R_s := 5 \cdot \Omega$ $X_m := 1 \cdot k\Omega$ $X_s := 7 \cdot \Omega$ $N := 4$
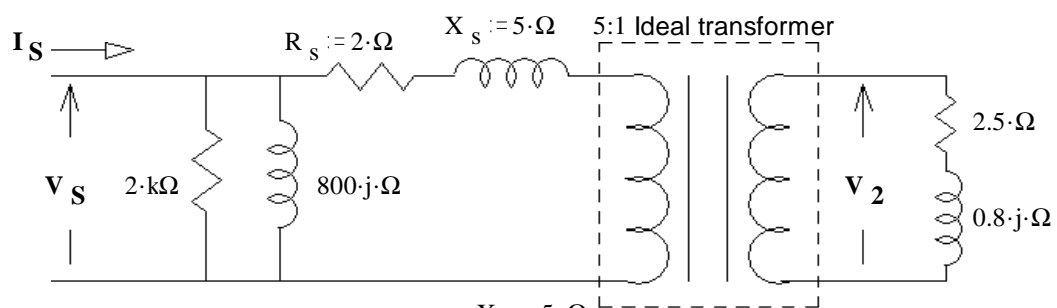
a) The primary, source voltage provides 40 VARs $Q_S := 40 \cdot VAR$ Find X_L
Hint: draw the model with the load.

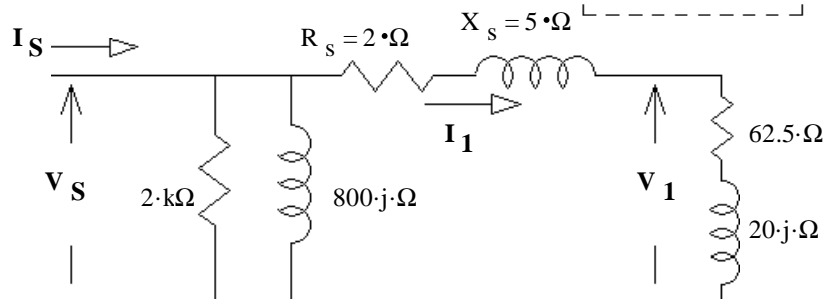b) Find R_L

c) Find the efficiency of this transformer.

Answers

1. a)

$\mathbf{I_S} \longrightarrow$ $R_s := 2 \cdot \Omega$ $X_s := 5 \cdot \Omega$ 5:1 Ideal transformer

$\mathbf{V_S}$ $2 \cdot k\Omega$ $800 \cdot j \cdot \Omega$

$\mathbf{V_2}$ $2.5 \cdot \Omega$

$0.8 \cdot j \cdot \Omega$

and/or $\mathbf{I_S} \longrightarrow$ $R_s = 2 \cdot \Omega$ $X_s = 5 \cdot \Omega$

$\mathbf{I_1}$

$\mathbf{V_S}$ $2 \cdot k\Omega$ $800 \cdot j \cdot \Omega$

$\mathbf{V_1}$ $62.5 \cdot \Omega$

$20 \cdot j \cdot \Omega$

b) $189.7 \cdot V$ c) $503.3 + 233.1 \cdot j$ VA   d) $2.923 \cdot A$ e) $93.4 \cdot \%$ f) $4.48 \cdot \%$

2. a) $2.062 \cdot \Omega$ b) $8.723 \cdot \Omega$ c) $87.5 \cdot \%$