LAB 4 DATA

Data is provided here for the transformer in Lab 4 that you may use for your report. The plots on pages 2-3 show traces that would be observed on the oscilloscope. Phases are stated with respect to $v_T(t)$, the voltage at the terminals of the waveform generator. The phasor voltages are *peak* values (not rms).

1. Source at primary with "helper" resistor R_h = 10 Ω, open-circuit secondary:

$$\mathbf{V}_T = 0.54\angle 0^\circ \text{ V}$$
$$\mathbf{V}_1 = 0.40\angle 36.6^\circ \text{ V}.$$
$$\mathbf{V}_2 = 3.63\angle 41.2^\circ \text{ V}$$

2. Source at secondary with "helper" resistor R_h = 1 kΩ, open-circuit primary:

$$\mathbf{V}_T = 19.61\angle 0^\circ \text{ V}$$
$$\mathbf{V}_1 = 1.33\angle 41.2^\circ \text{ V} \quad .$$
$$\mathbf{V}_2 = 14.80\angle 36.6^\circ \text{ V}$$

(When you calculate *M*, you can *average* the estimates obtained in parts 1 and 2. Ideally both would give the same result, but they are different due to measurement errors.)

3. Source at primary with "helper" resistor R_h = 10 Ω, load resistor R_L = 5 kΩ at secondary:

$$\mathbf{V}_T = 0.56\angle 0^\circ \text{ V}$$
$$\mathbf{V}_1 = 0.39\angle 32.4^\circ \text{ V}.$$
$$\mathbf{V}_2 = 3.34\angle 34.3^\circ \text{ V}$$

Calculate the currents $\mathbf{I}_1$ and $\mathbf{I}_2$ from the voltage phasors, and compare the phasor voltages and currents with the ideal transformer equations using $n = \sqrt{L_2/L_1}$.
How closely do the voltages and currents match the ideal transformer model?

Replace the transformer and load with a single "reflected impedance" $\mathbf{Z}_R$ calculated using the linear and ideal transformer models (you will get a different $\mathbf{Z}_R$ for each model). Which $\mathbf{Z}_R$ gives a closer approximation to the given $\mathbf{V}_1$ and $\mathbf{I}_1$ phasor values?

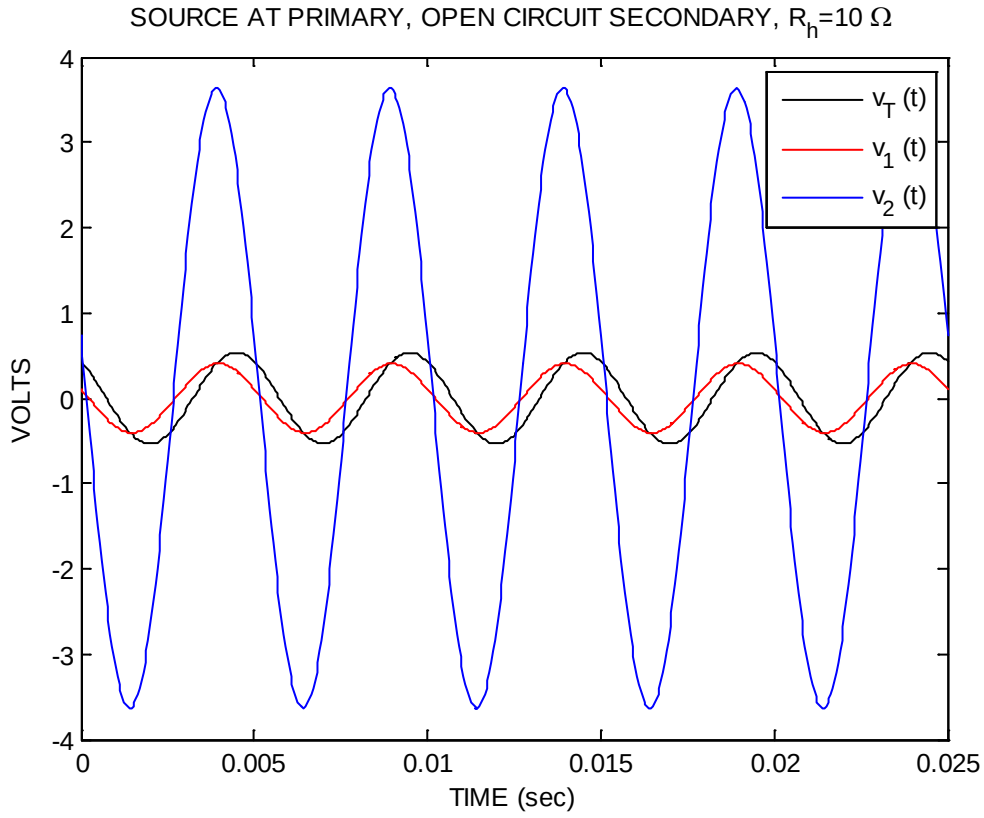
Also calculate the average power delivered to the load resistor (using $\mathbf{V}_2$).

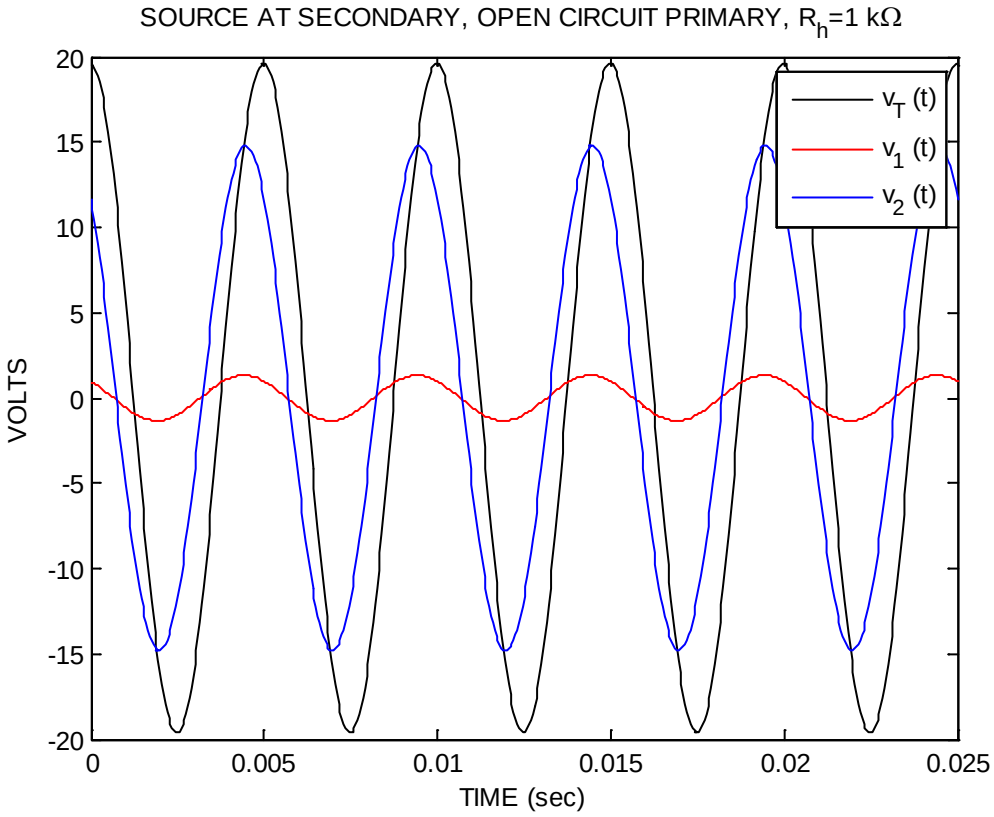
When the same load is attached at nodes *a*-*b* with the same helper resistor:

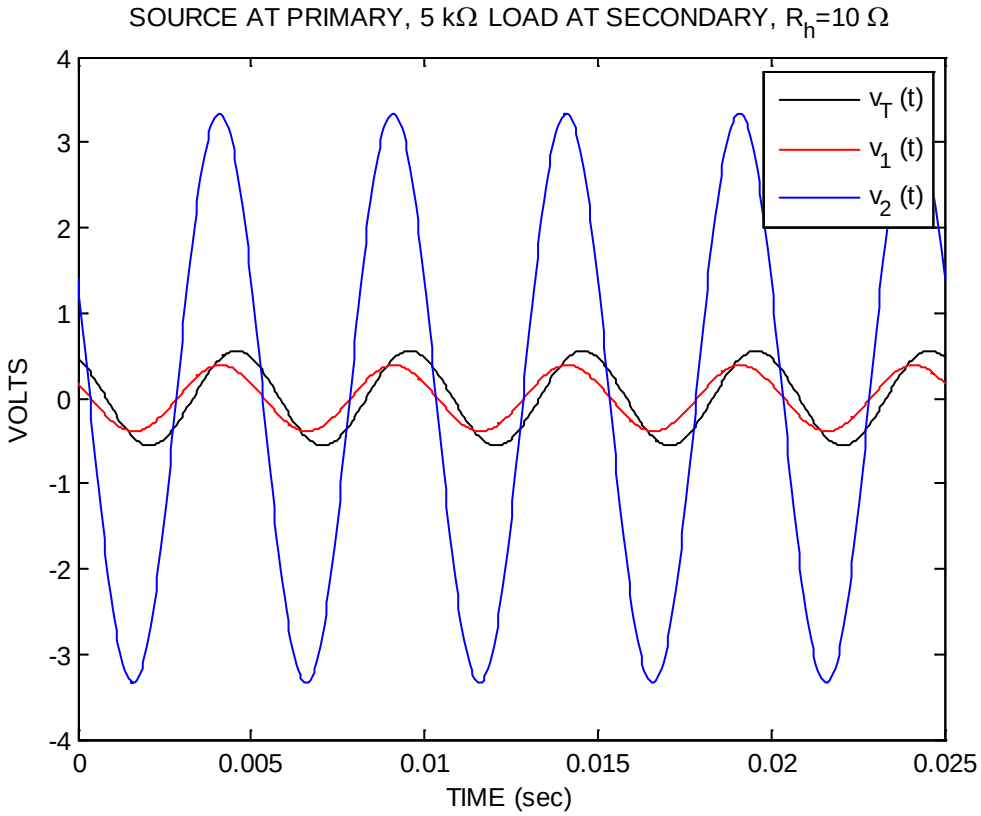
$$\mathbf{V}_L = \mathbf{V}_{a-b} = 1.98\angle 0^\circ \text{ V}.$$

Use this to calculate the average power delivered to load if the transformer is *removed*.

See plots of voltage waveforms on pages 2 and 3 (available online, but not included on handout given in class).


SOURCE AT PRIMARY, OPEN CIRCUIT SECONDARY, R_h=10 Ω
VOLTS
TIME (sec)
v_T (t)
v_1 (t)
v_2 (t)
4
3
2
1
0
-1
-2
-3
-4
0
0.005
0.01
0.015
0.02
0.025


SOURCE AT SECONDARY, OPEN CIRCUIT PRIMARY, R_h=1 kΩ
VOLTS
TIME (sec)
v_T (t)
v_1 (t)
v_2 (t)
20
15
10
5
0
-5
-10
-15
-20
0
0.005
0.01
0.015
0.02
0.025


SOURCE AT PRIMARY, 5 kΩ LOAD AT SECONDARY, R_h=10 Ω
VOLTS
TIME (sec)
v_T (t)
v_1 (t)
v_2 (t)
4
3
2
1
0
-1
-2
-3
-4
0
0.005
0.01
0.015
0.02
0.025