جامعة بيرزيت

BIRZEIT UNIVERSITY

Faculty of Engineering and Technology

Electrical and Computer Engineering Department

ENEE2110

ELECTRIC CIRCUITS LAB

Experiment.7 Prelab

Impedance and sinusoidal steady state

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Part A: Impedance Measurement

1. For the circuits shown in Figures 7.7 - 7.10 calculate the magnitude of the impedances ZR, ZC, ZL, and ZRC respectively, for the following frequencies: 250, 500, 1000 and 2000 Hz

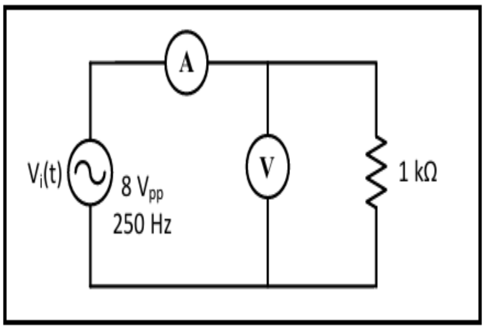


Figure 7.7

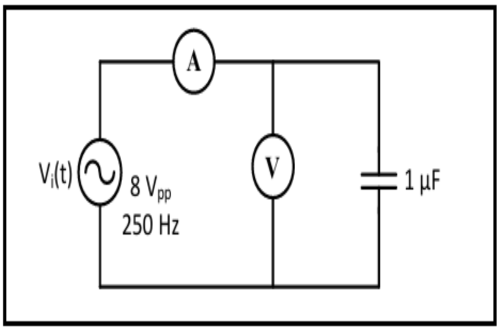


Figure 7.8

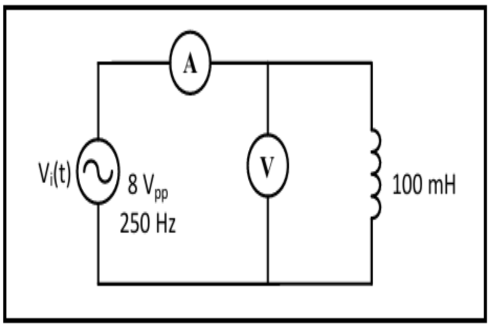


Figure 7.9

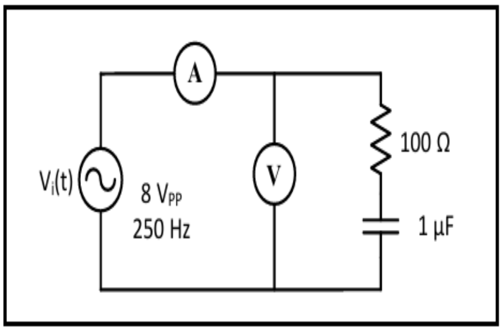


Figure 7.10

- $Z_r = R = 1\text{K}\Omega$ "$constant\ at\ any\ frequency$"

- $Z_c = \frac{1}{jwc}$, $w = 2\pi f$, $C = 1\mu F$
  - $f = 250Hz$

$$Z_c = \frac{1}{j \times 2\pi \times 250 \times 10^{-4}} = -j636.94\Omega$$

  - $f = 500Hz$

$$Z_c = \frac{1}{j \times 2\pi \times 500 \times 10^{-4}} = -j318.47\Omega$$

- $f = 1000Hz$

$$Z_c = \frac{1}{j \times 2\pi \times 1000 \times 10^{-4}} = -j159.24\Omega$$

- $f = 2000Hz$

$$Z_c = \frac{1}{j \times 2\pi \times 2000 \times 10^{-4}} = -j79.62\Omega$$

➢ $Z_l = jwl \,, w = 2\pi f \,, l = 100mH$

- $f = 250Hz$

$$Z_l = j \times 2\pi \times 250 \times 0.1 = j157\Omega$$

- $f = 500Hz$

$$Z_l = j \times 2\pi \times 500 \times 0.1 = j314\Omega$$

- $f = 1000Hz$

$$Z_l = j \times 2\pi \times 1000 \times 0.1 = j628\Omega$$

- $f = 2000Hz$

$$Z_l = j \times 2\pi \times 2000 \times 0.1 = j1256\Omega$$

➢ $Z_{Rc} = \sqrt{{z_R}^2 + {z_c}^2} \,, z_R = 100\Omega$

- $f = 250Hz$

$$Z_{Rc} = \sqrt{(100)^2 + (636.94)^2} = 644.74\Omega$$

- $f = 500Hz$

$$Z_{Rc} = \sqrt{(100)^2 + (318.47)^2} = 333.80\Omega$$

- $f = 1000Hz$

$$Z_{Rc} = \sqrt{(100)^2 + (159.24)^2} = 188.03\Omega$$

- $f = 2000Hz$

$$Z_{Rc} = \sqrt{(100)^2 + (79.62)^2} = 127.82\Omega$$

Part B: Phase Measurement

1. For the circuit shown in Figure 7.11

a. Use PSPICE to do transient analysis of the circuit, show Vin(t) and VR(t) on one plot (you may need to use different Y-axes).

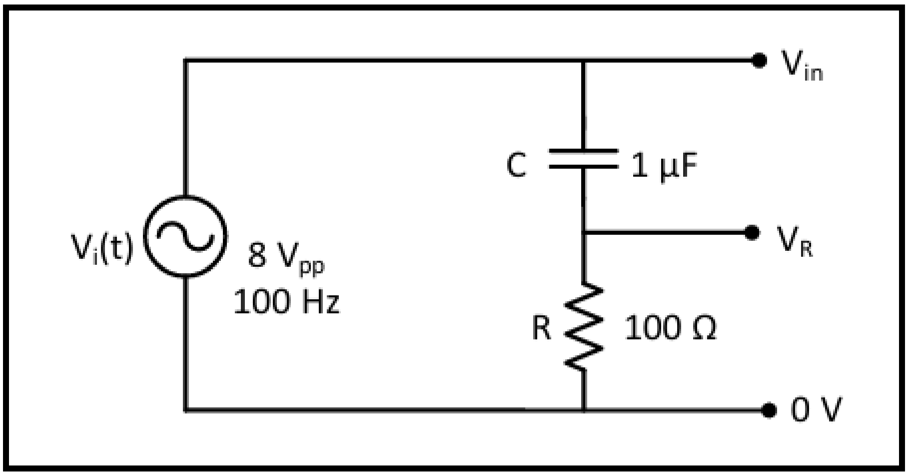
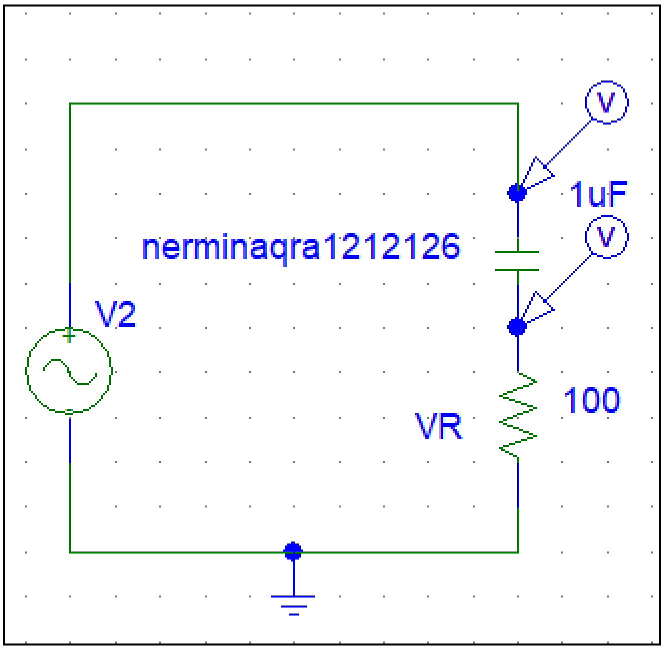
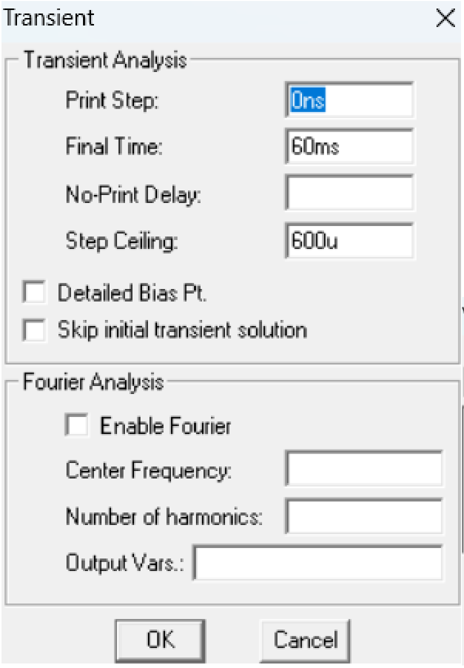
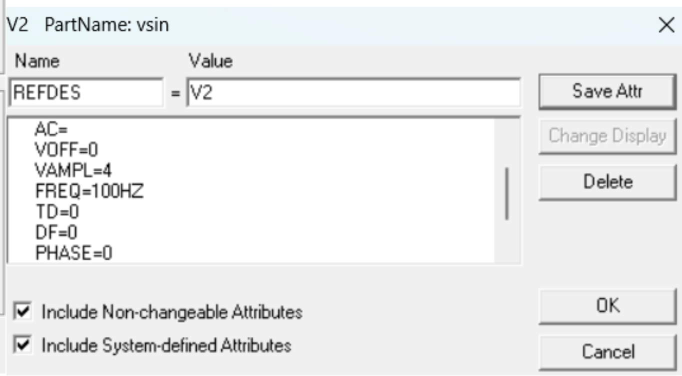
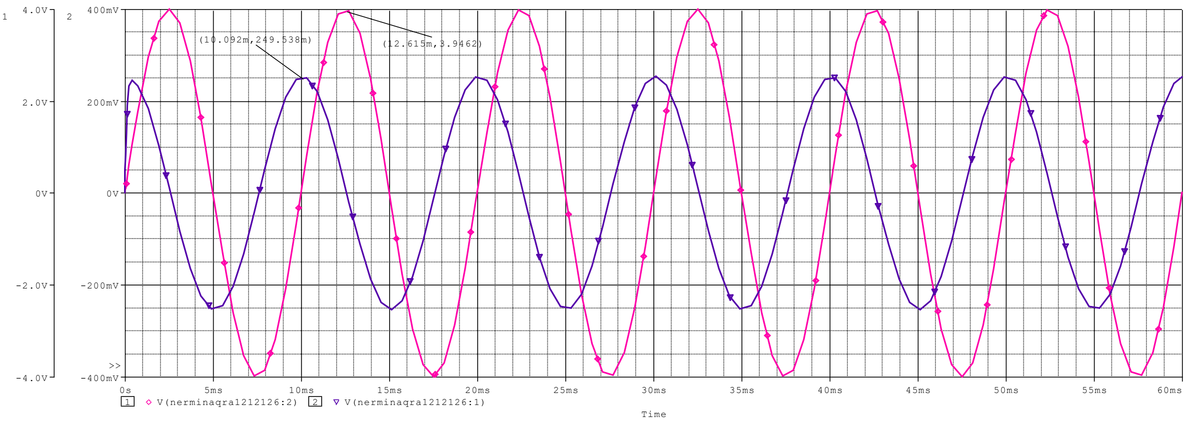


Figure 7.11









b.Use cursors to measure the time difference between the peaks of the two signals, then use the following relationship to calculate the phase shift using the measured time {**Δθ=360°x f x Δt**}.

$$\Delta\theta = 360^{\circ} \times f \times \Delta t$$

$$\Delta t = 12.615ms - 10.092ms = 2.52ms$$

$$\Delta\theta = 360^{\circ} \times 100 \times 2.52 \times 10^{-3}$$

$$\Delta\theta = 90.7^{\circ}$$

2. Repeat the same procedure in step 1 above for the circuit shown in Figure 7.12.

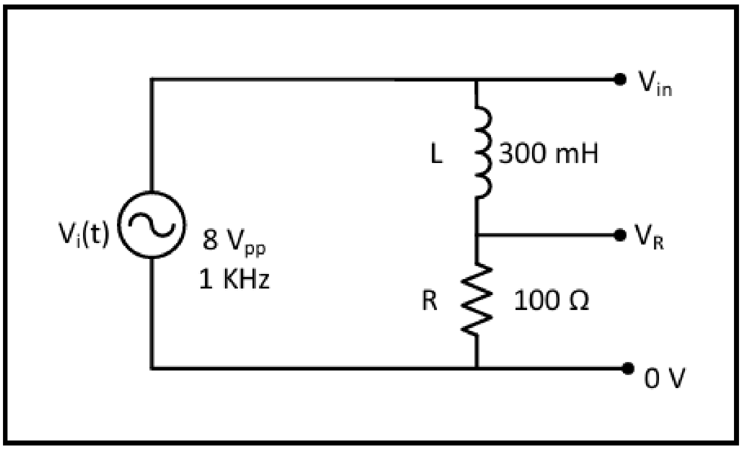
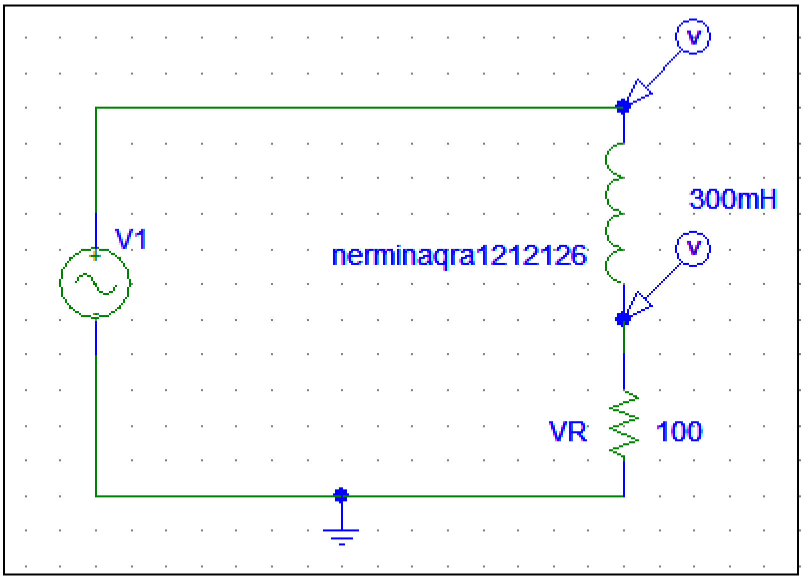
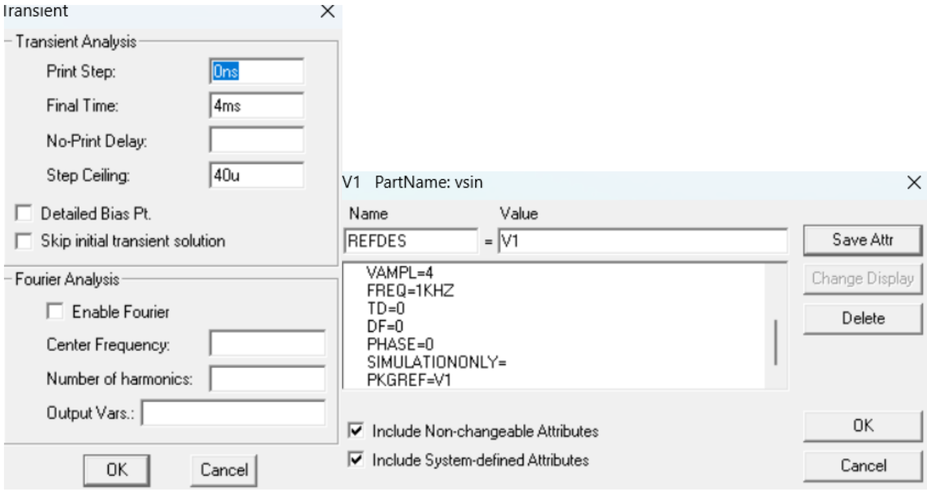
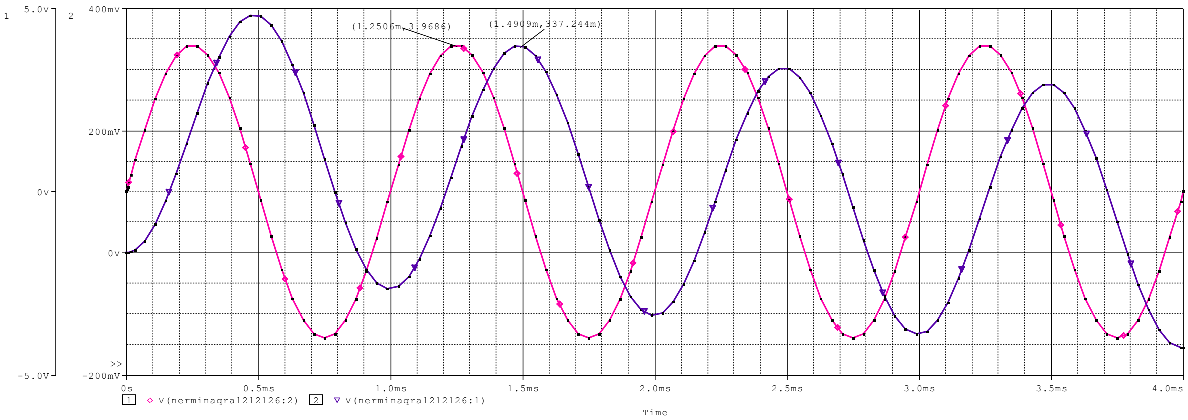


Figure 7.12







b.Use cursors to measure the time difference between the peaks of the two signals, then use the following relationship to calculate the phase shift using the measured time {**Δθ**=**3**60°**x fx** Δ**t**}.

$$\Delta\theta = 360^{\circ} \times f \times \Delta t$$

$$\Delta t = 1.4909ms - 1.2506ms = 0.2403ms$$

$$\Delta\theta = 360^{\circ} \times 1000 \times 0.2378 \times 10^{-3}$$

$$\Delta\theta = 86.508^{\circ}$$