

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

 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

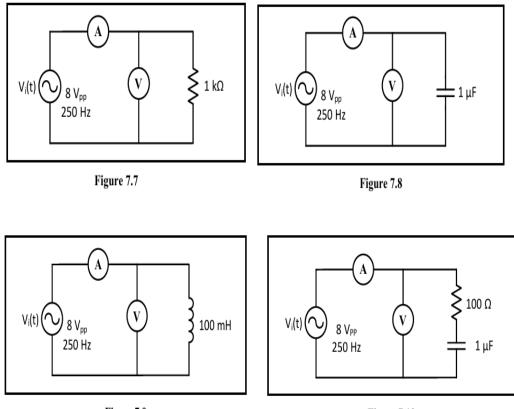




Figure 7.10

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

>
$$Z_c = \frac{1}{jwc}$$
, $w = 2\pi f$, $C = 1\mu F$
• $f = 250Hz$
 $Z_c = \frac{1}{j \times 2\pi \times 250 \times 10^{-4}} = -j636.94\Omega$
• $f = 500Hz$
 $Z_c = \frac{1}{j \times 2\pi \times 500 \times 10^{-4}} = -j318.47\Omega$

•
$$f = 1000Hz$$

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

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

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

•
$$f = 250Hz$$

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

•
$$f = 500Hz$$

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

•
$$f = 1000Hz$$

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

•
$$f = 2000Hz$$

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

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

•
$$f = 250Hz$$

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

•
$$f = 500Hz$$

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

•
$$f = 1000 Hz$$

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

•
$$f = 2000Hz$$

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

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).

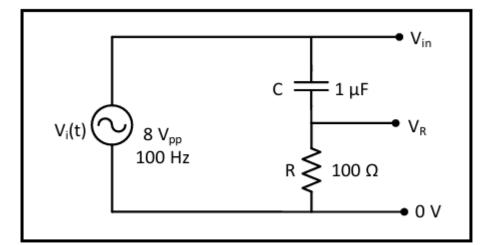
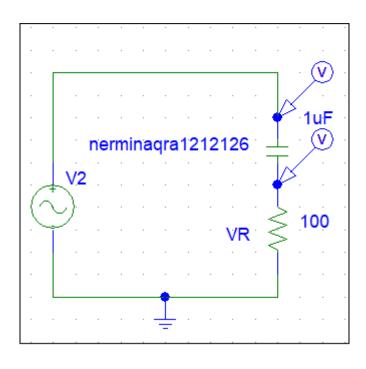
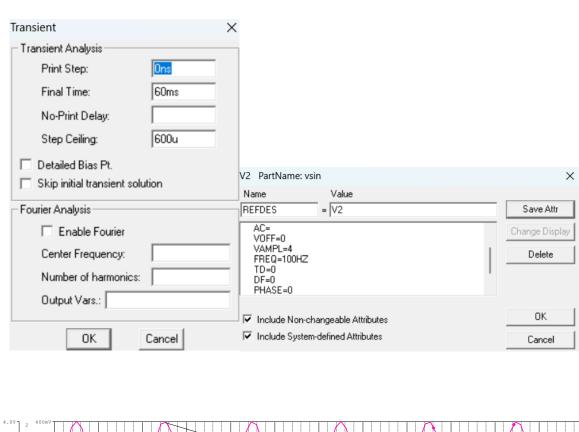
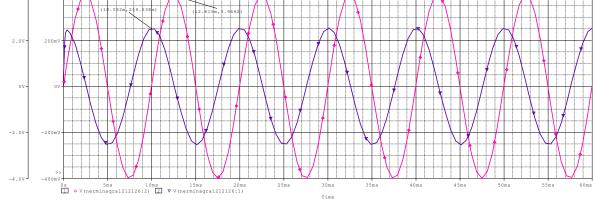


Figure 7.11







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

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

$$\Delta t = 12.615ms - 10.092ms = 2.52ms$$
$$\Delta \theta = 360^{\circ} \times 100 \times 2.52 \times 10^{-3}$$
$$\Delta \theta = 90.7^{\circ}$$

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

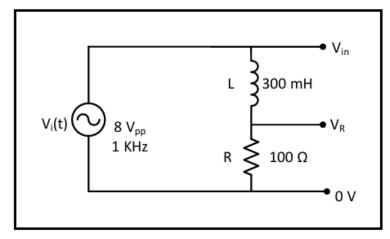
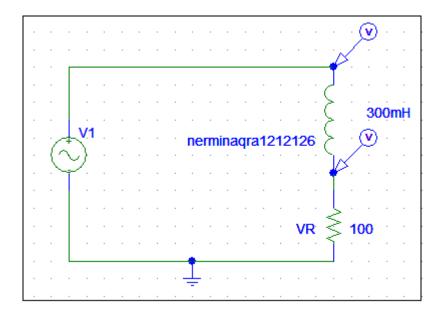
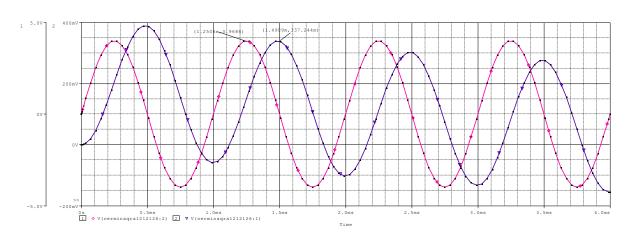
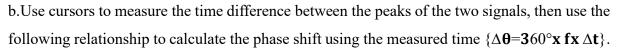


Figure 7.12



ransient Transient Analysis		×	
Print Step: Final Time:	Ons 4ms		
No-Print Delay: Step Ceiling:	40u	V1 PartName: vsin	
 Detailed Bias Pt. Skip initial transient solution 		Name Value REFDES = V1	Save Attr
Fourier Analysis Enable Fourier Center Frequency: Number of harmonics:		VAMPL=4 FREQ=1KHZ TD=0 DF=0 PHASE=0 SIMULATIONONLY= PKGREF=V1	Change Disp Delete
Output Vars.:		Include Non-changeable Attributes	OK
ОК	Cancel	Include System-defined Attributes	Cancel





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

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

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

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