



**Faculty of Information Technology**  
**Electrical and Computer Engineering Department**  
**CIRCUITS AND ELECTRONICS LABORATORY (ENEE2103)**

**Prelab Experiment#4**  
**“Sinusoidal Steady State Circuit Analysis”**

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**Teacher: Eng. Mostafa Helal**

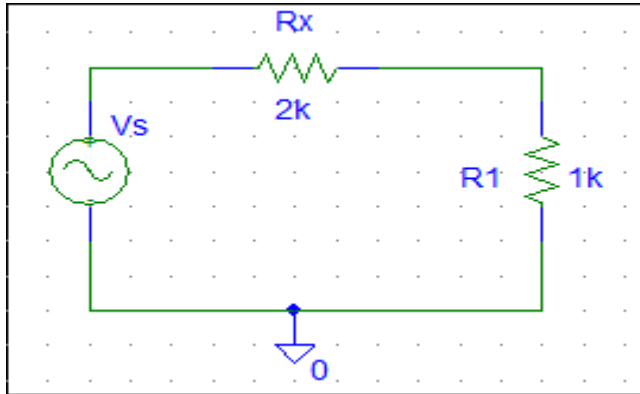
**Student Name: Mays Sbaih**

**Student Number:1160006**

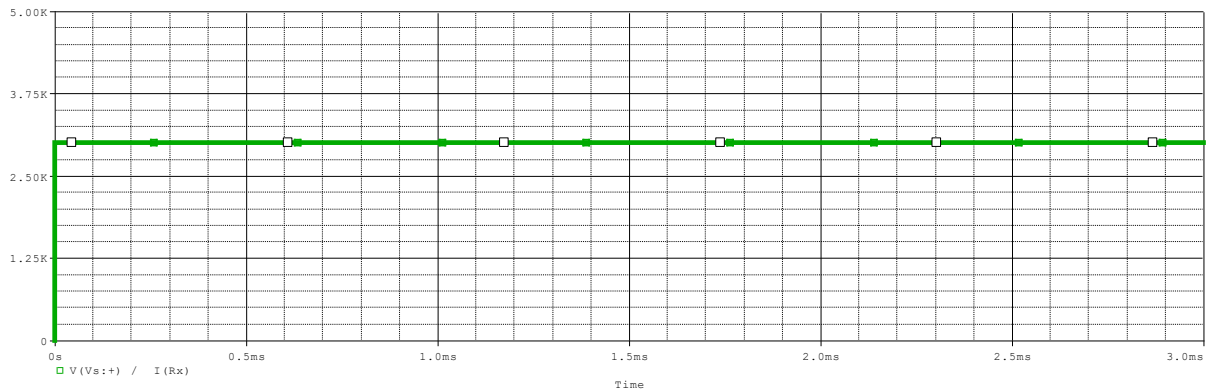
**Section 3**

**Due to:4-3-2019**

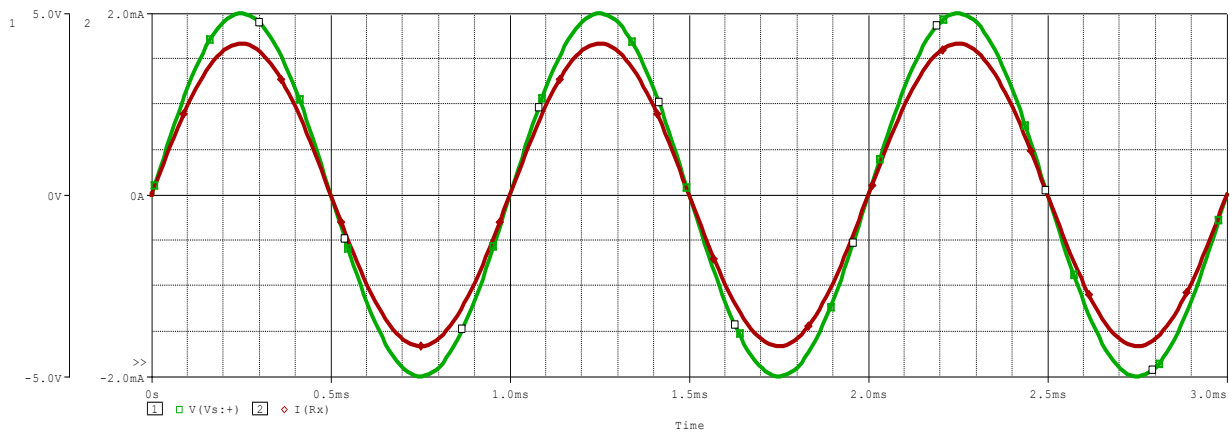
## A. Impedance:



➤ Frequency = 1000Hz.

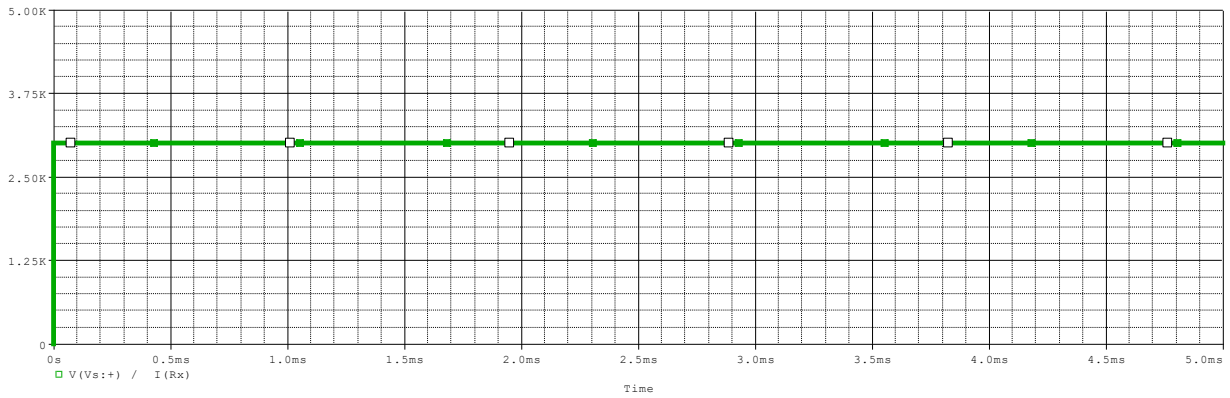


- Total impedance =  $V_s/I = 3K\Omega$ .

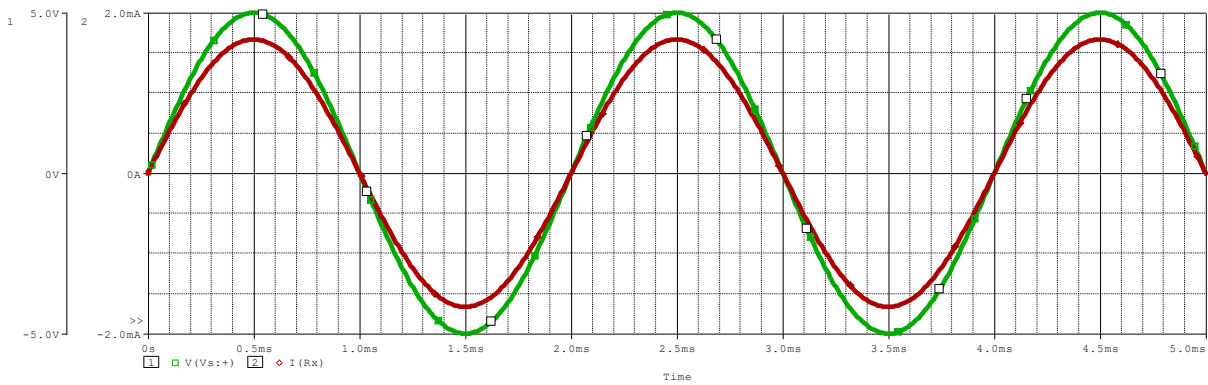


- Phase shift between  $V$  and  $I = 0$ . (since resistors do not result in phase shift).

➤ **Frequency = 500Hz.**

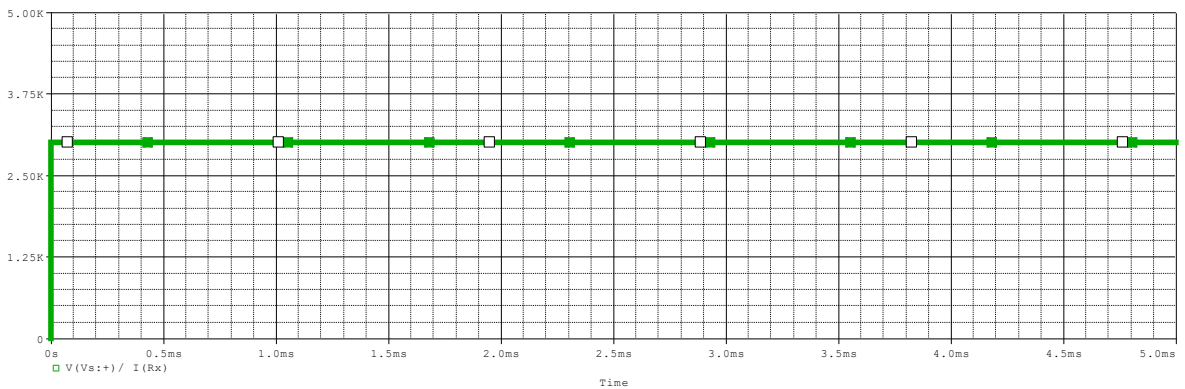


- Total impedance =  $V_s/I = 3K\Omega$ .

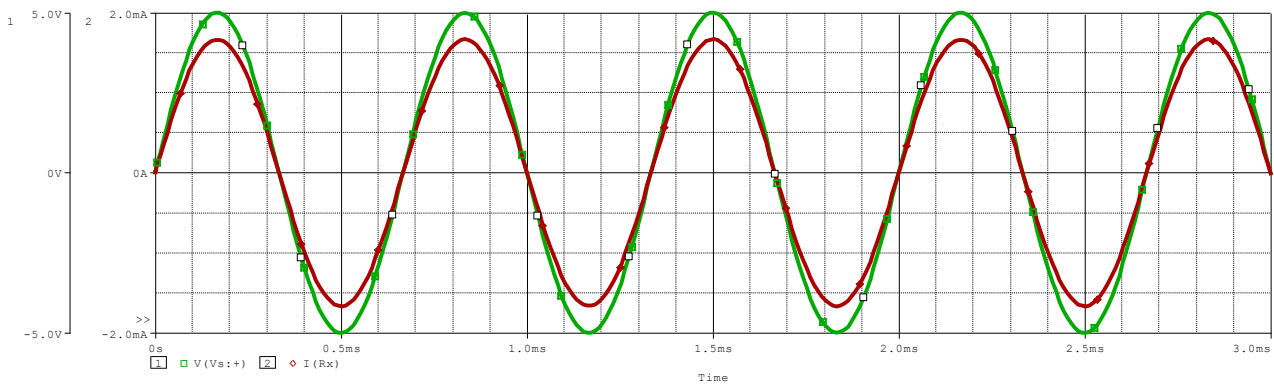


- Phase shift between V and I = 0.

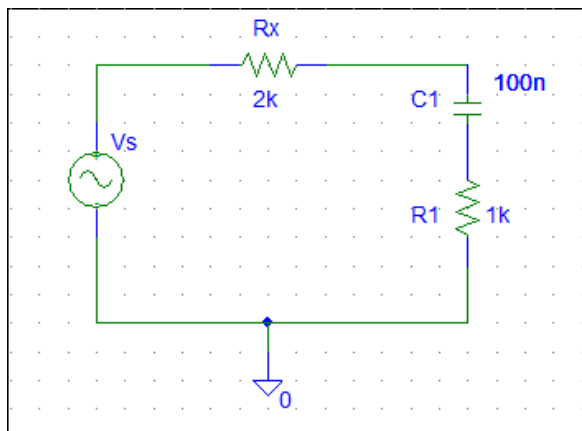
➤ **Frequency = 1500Hz.**



- Total impedance =  $V_s/I = 3K\Omega$ .

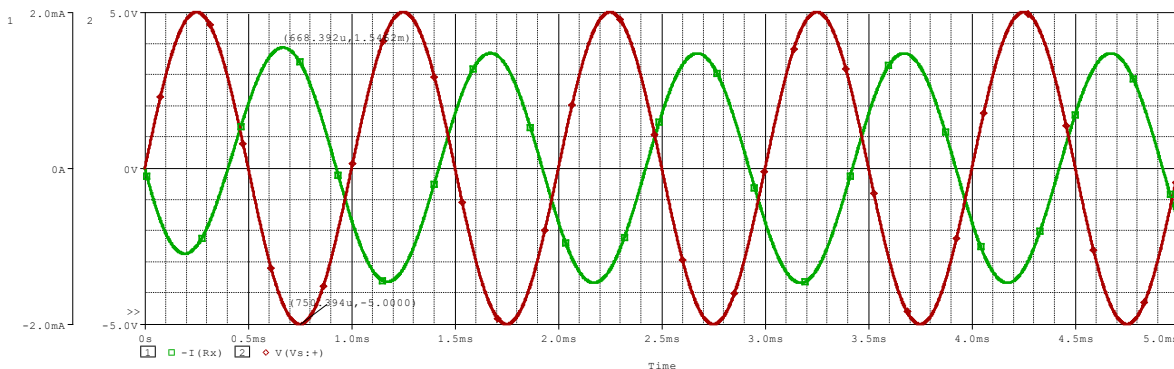


- Phase shift between V and I = 0.
- ✓ **The impedance remains the same when frequency changes**



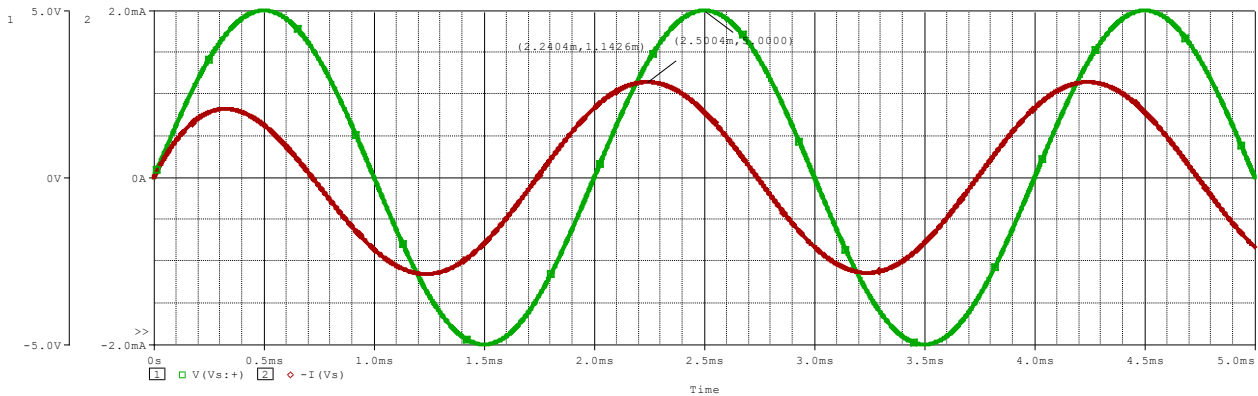
➤ **Frequency = 1000Hz.**

- Phase shift theoretically =  $\tan^{-1} \left( \frac{1/\omega C}{R} \right) = 27.9467$  degree; since:  $R=3K$ ,  $\omega = 2\pi f = 2000\pi$ .
- Phase shift practically =  $\Delta t * \omega = (750.394 - 668.392) \mu * 360 * 1000 = 29.521$  degree
- $Z_C = -\frac{j}{\omega C} = -1.592j$  k $\Omega$ .
- Total impedance =  $3 - 1.592j$  k $\Omega$



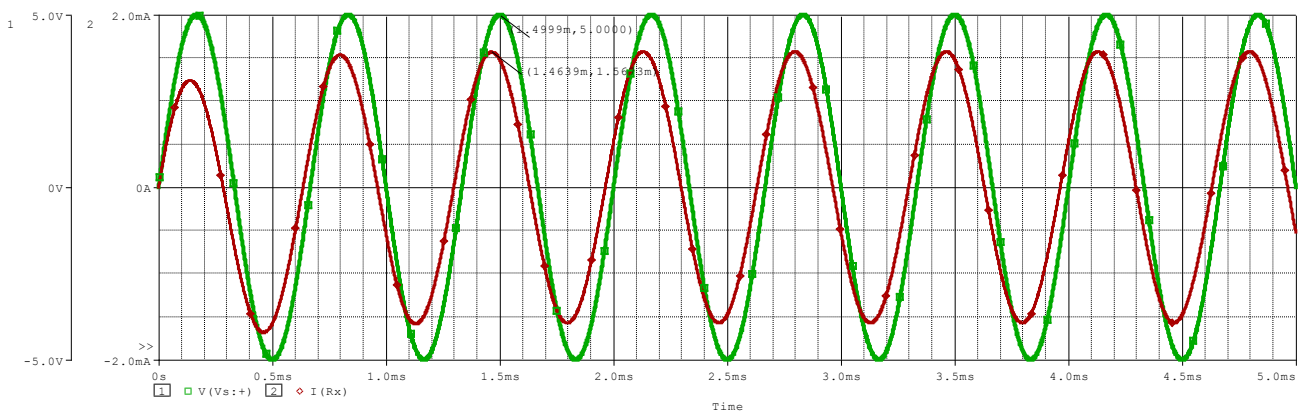
➤ **Frequency = 500Hz.**

- Phase shift theoretically =  $\tan^{-1} \left( \frac{1/\omega C}{R} \right) = 46.696$  degree; since:  $R=3K$ ,  $\omega = 2\pi f = 1000\pi$ .
- Phase shift practically =  $\Delta t * \omega = (2.5004 - 2.2404) \text{ m} * 360 * 500 = 46.8$  degree
- $Z_C = -\frac{j}{\omega C} = -3.1831j \text{ k}\Omega$ .
- Total impedance =  $3 - 3.1831j \text{ k}\Omega$ .

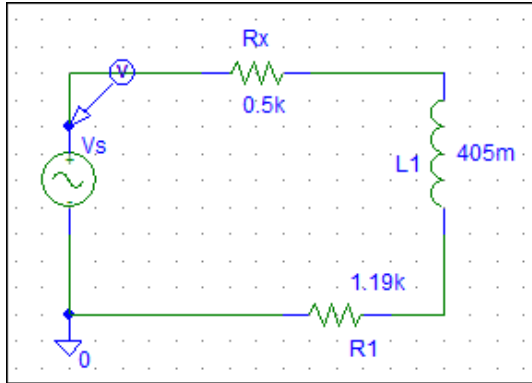


➤ **Frequency = 1500Hz.**

- Phase shift theoretically =  $\tan^{-1} \left( \frac{1/\omega C}{R} \right) = 19.478$  degree; since:  $R=3K$ ,  $\omega = 2\pi f = 3000\pi$ .
- Phase shift practically =  $\Delta t * \omega = (1.4999 - 1.4639) \text{ m} * 360 * 1500 = 19.44$  degree
- $Z_C = -\frac{j}{\omega C} = -1.061j \text{ k}\Omega$ .
- Total impedance =  $3 - 1.061j \text{ k}\Omega$ .

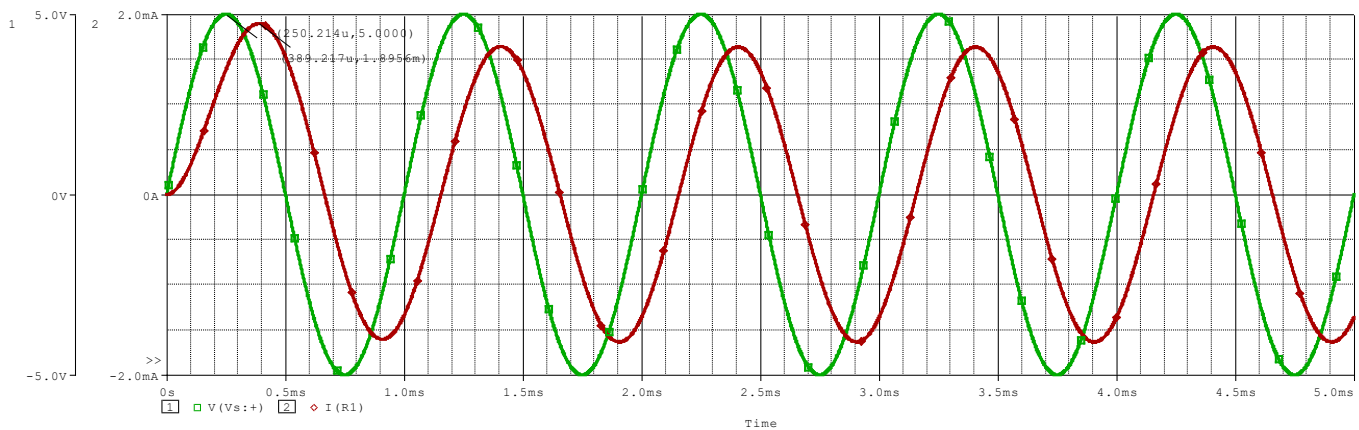


✓ **Impedance is affected by frequency**



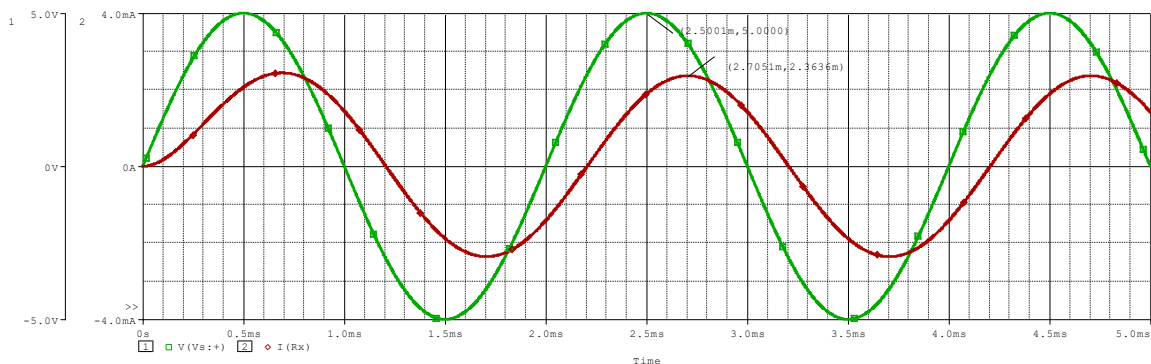
➤ **Frequency = 1000Hz.**

- Phase shift theoretically =  $\tan^{-1}\left(-\frac{\omega L}{R}\right) = -56.411$  degree; since:  $R=1.69K$ ,  $\omega = 2\pi f = 2000\pi$ .
- Phase shift practically =  $\Delta t * \omega = (2.2503 - 2.4063) \text{ m} * 360 * 1000 = -56.16$  degree
- $Z_L = j\omega L = 2.545j \text{ k}\Omega$ .
- Total impedance =  $1.69 + 2.545j \text{ k}\Omega$ .



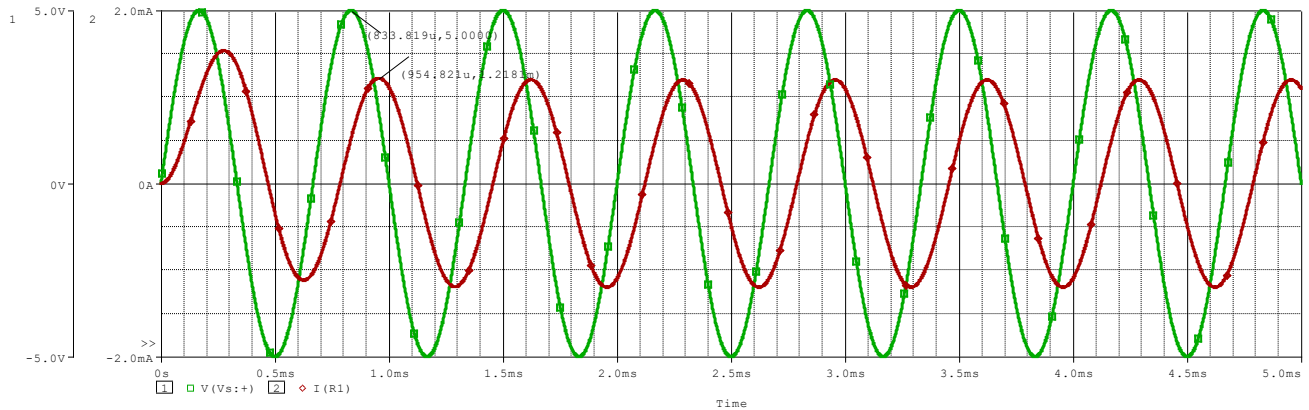
➤ **Frequency = 500Hz.**

- Phase shift theoretically =  $\tan^{-1}\left(-\frac{\omega L}{R}\right) = -36.975$  degree; since:  $R=1.69K$ ,  $\omega = 2\pi f = 1000\pi$ .
- Phase shift practically =  $\Delta t * \omega = (2.7051 - 2.5001) \text{ m} * 360 * 500 = 36.9$  degree
- $Z_L = j\omega L = 1.272j \text{ k}\Omega$ .
- Total impedance =  $1.69 + 1.272j \text{ k}\Omega$ .



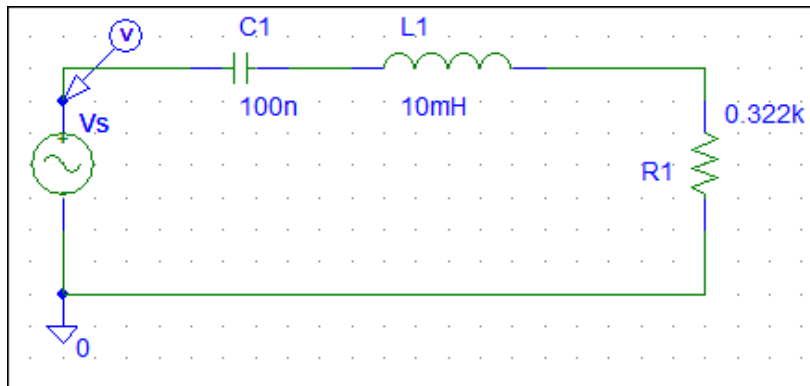
➤ **Frequency = 500Hz.**

- Phase shift theoretically =  $\tan^{-1}\left(-\frac{\omega L}{R}\right) = -66.12$  degree; since:  $R=1.69K$ ,  $\omega = 2\pi f = 3000\pi$ .
- Phase shift practically =  $\Delta t * \omega = (954.821 - 833.819) \mu * 360 * 1500 = 65.34$  degree
- $Z_L = j\omega L = 3.817j$  k $\Omega$ .
- Total impedance =  $1.69 + 3.817j$  k $\Omega$ .

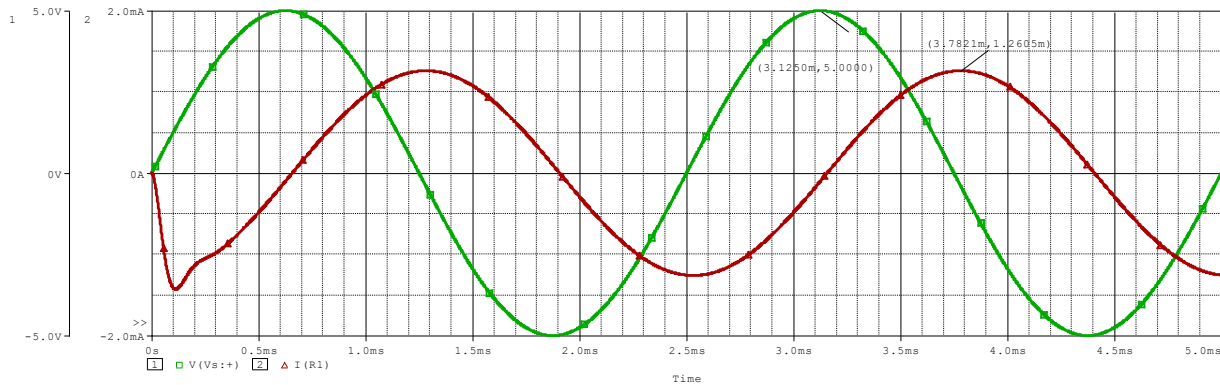


✓ **impedance is changed when frequency is changed**

**B. Capacitive and inductive behavior:**

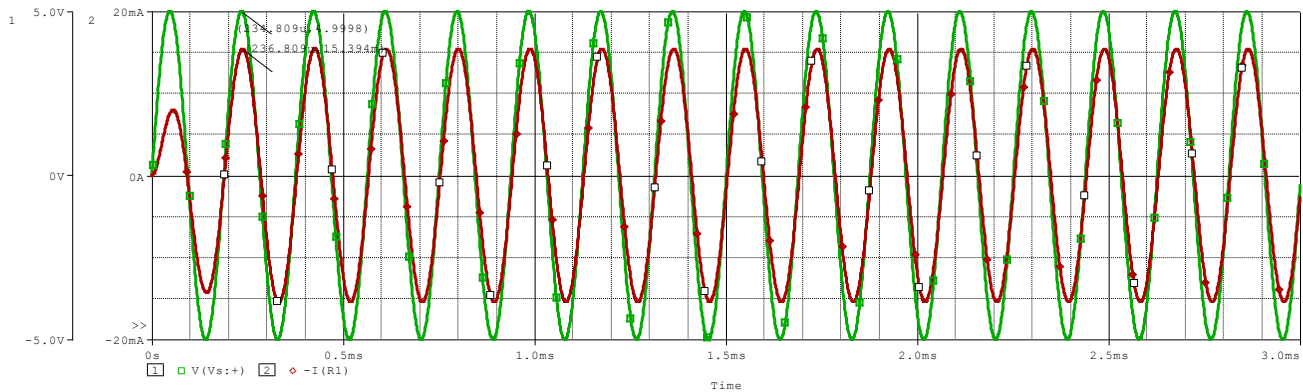


➤ **Frequency = 400Hz.**



- Phase shift =  $\Delta t * \omega = (3.7821 - 3.1250) \text{ m} * 360 * 400 = 94.6224 \text{ degree}$
- Resonant frequency ( $f_0$ ) =  $\frac{1/\sqrt{LC}}{2\pi} = 5.33 \text{ KHz.}$

➤ **Frequency =  $f_0 = 5.33\text{KHz}$**

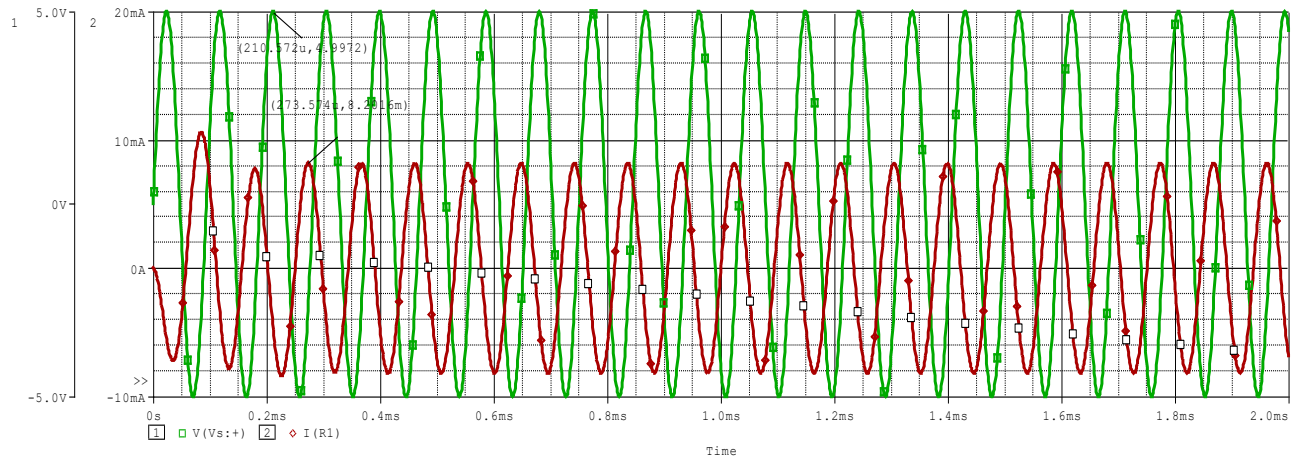


- Phase shift =  $\Delta t * \omega = (236.809 - 234.809) \text{ u} * 360 * 5.33\text{k} = 3.8376 \text{ degree.}$

The phase shift is very small we can ignore it.

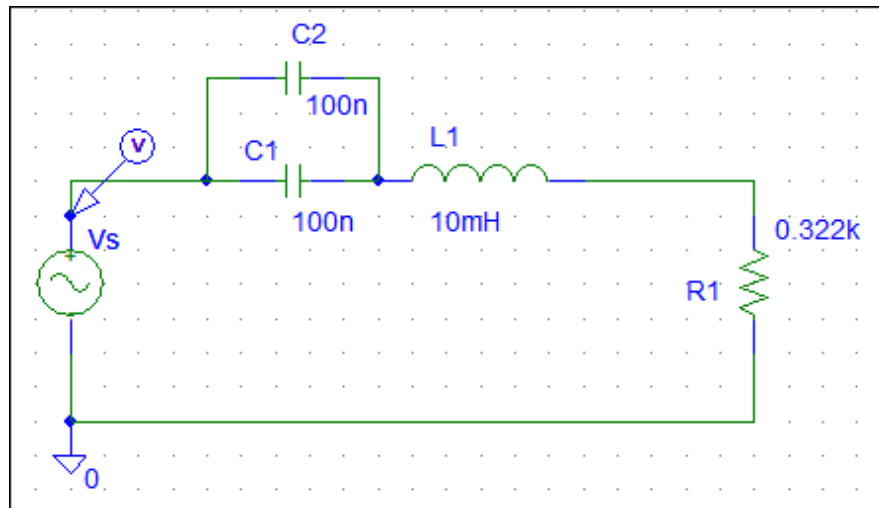


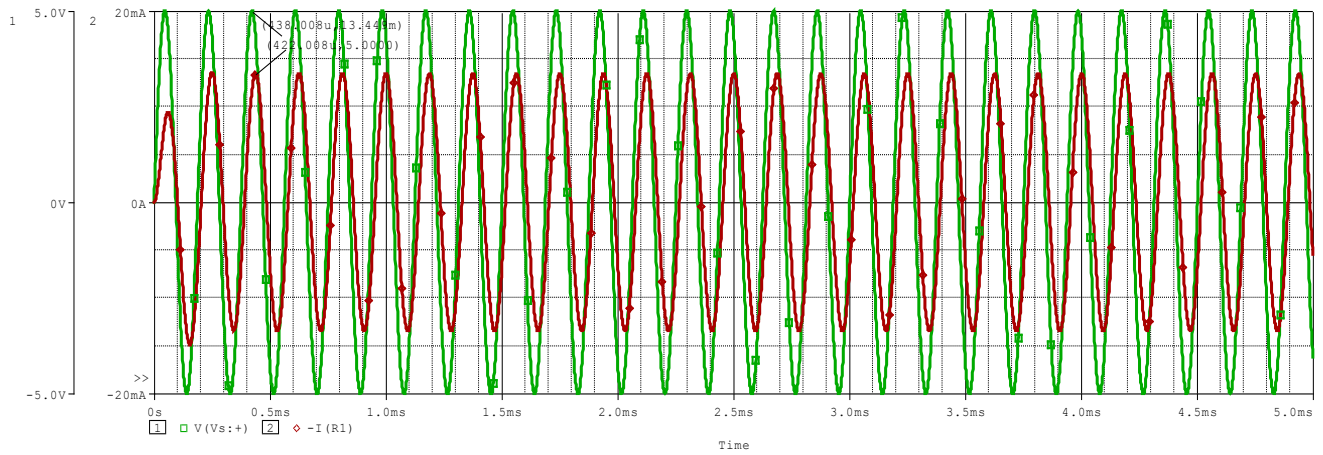
➤ **Frequency =  $2f_o = 10.66\text{KHz}$**



• Phase shift =  $\Delta t * \omega = (273.574 - 210.572) \mu * 360 * 10.66\text{k} = 241.776 \text{ degree}$ .

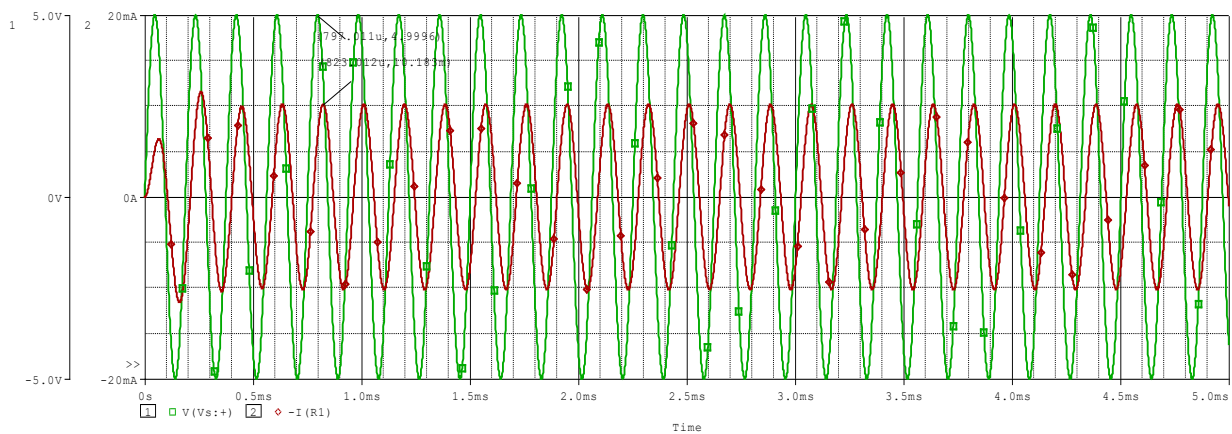
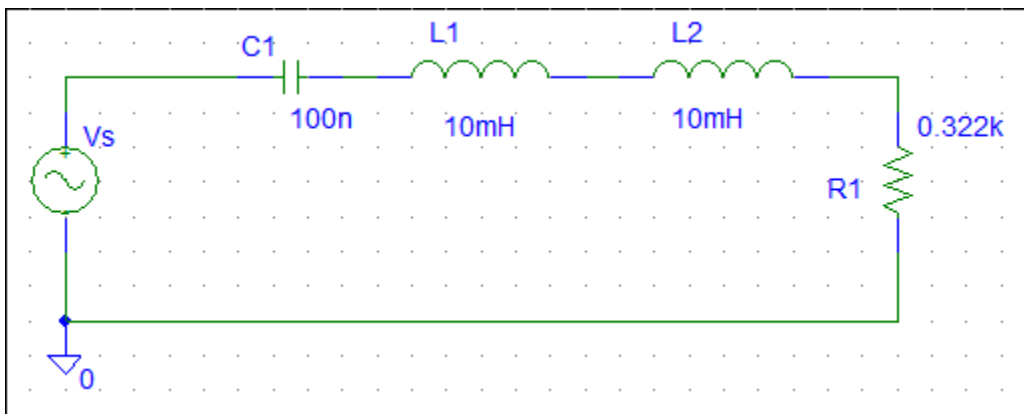
➤ **After doubling the value of the capacitor (at Frequency =  $f_o = 5.33\text{KHz}$ )**





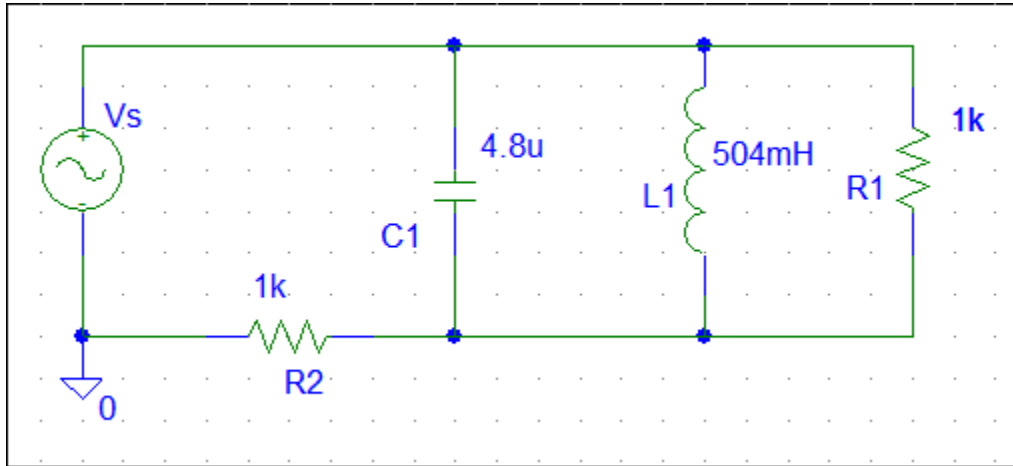
• Phase shift =  $\Delta t * \omega = (438.008 - 422.008) \mu * 360 * 5.33k = 30.7008$  degree.

➤ **After doubling the value of the Inductor (at Frequency =  $f_o = 5.33KHz$ )**



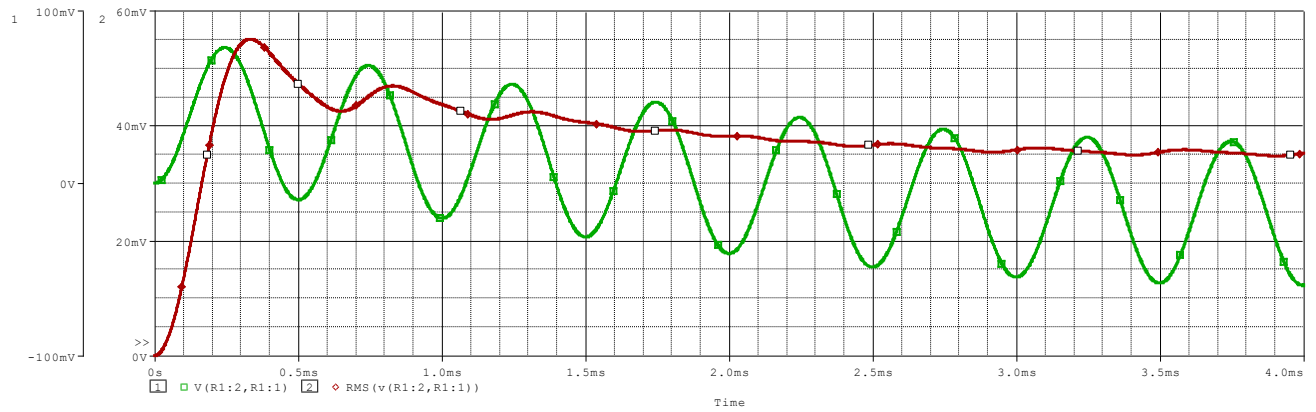
• Phase shift =  $\Delta t * \omega = (823.012 - 797.011) \mu * 360 * 5.33k = 49.891$  degree.

### C. Sinusoidal steady state power:

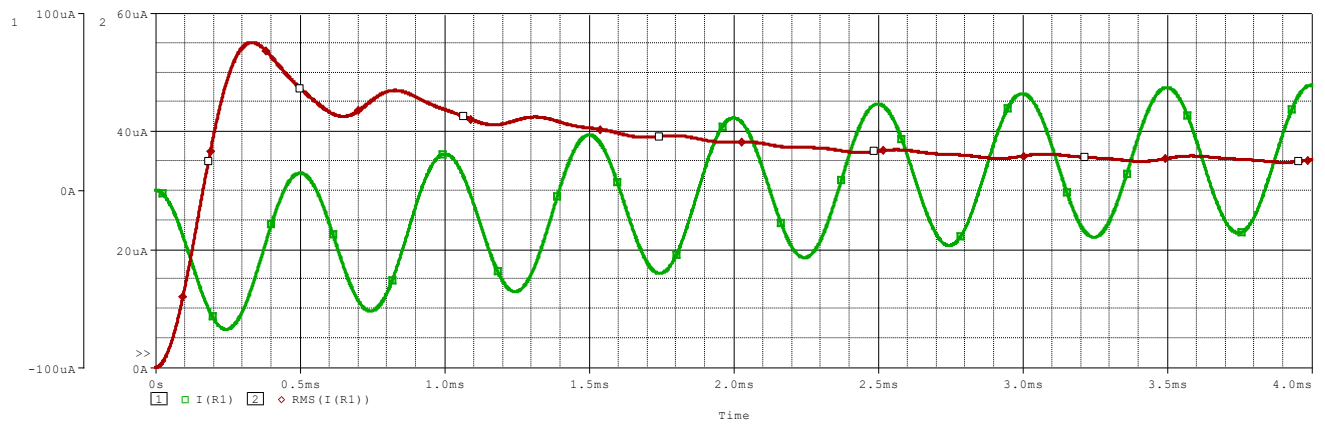


- Frequency = 2KHz.

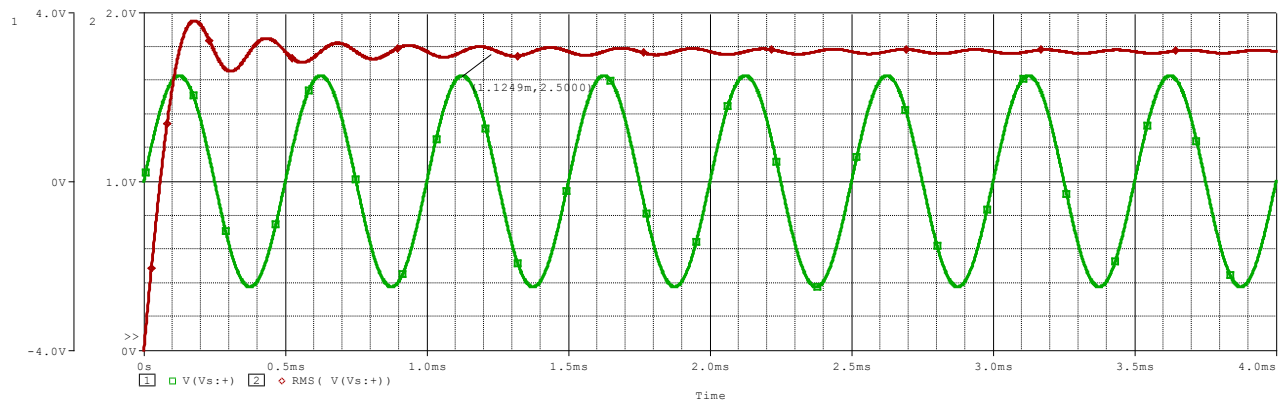
**V(R1):**



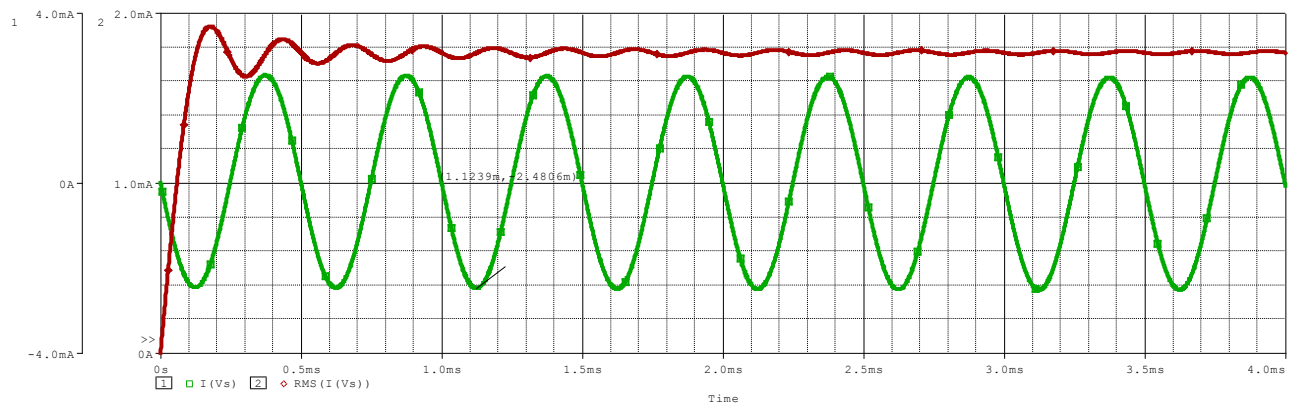
**I(R1):**



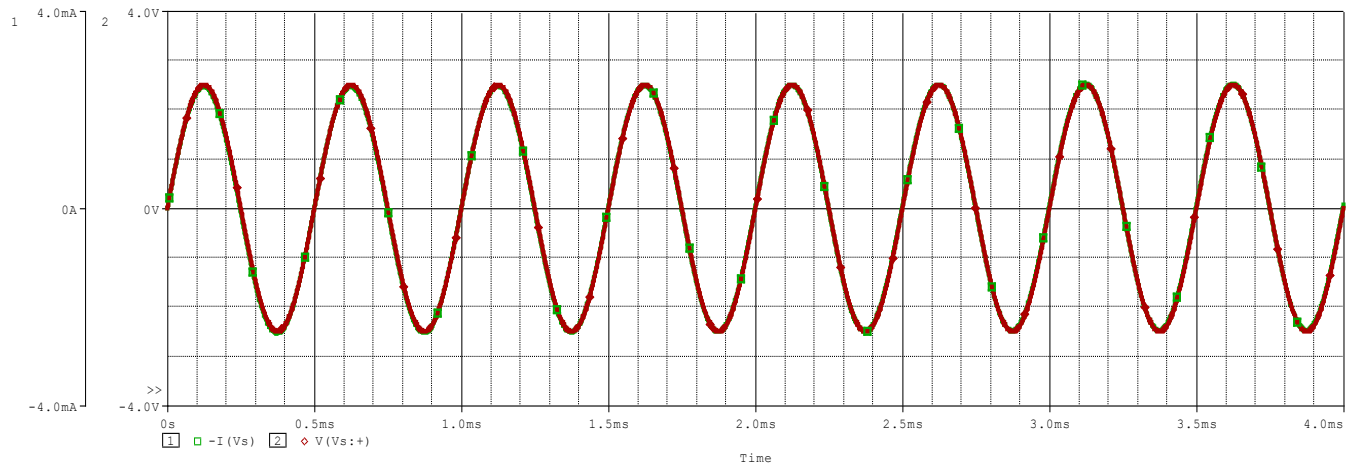
$V_s$ :



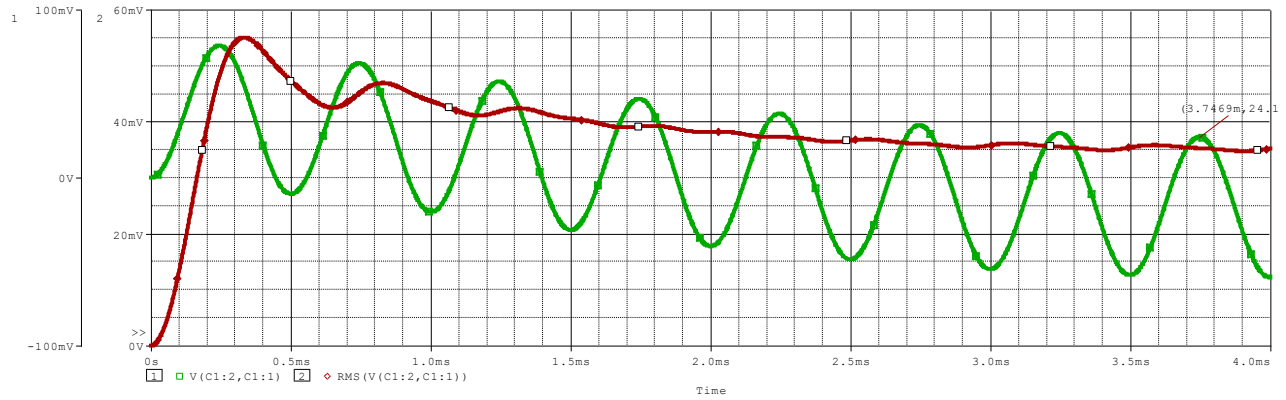
$I_s$ :



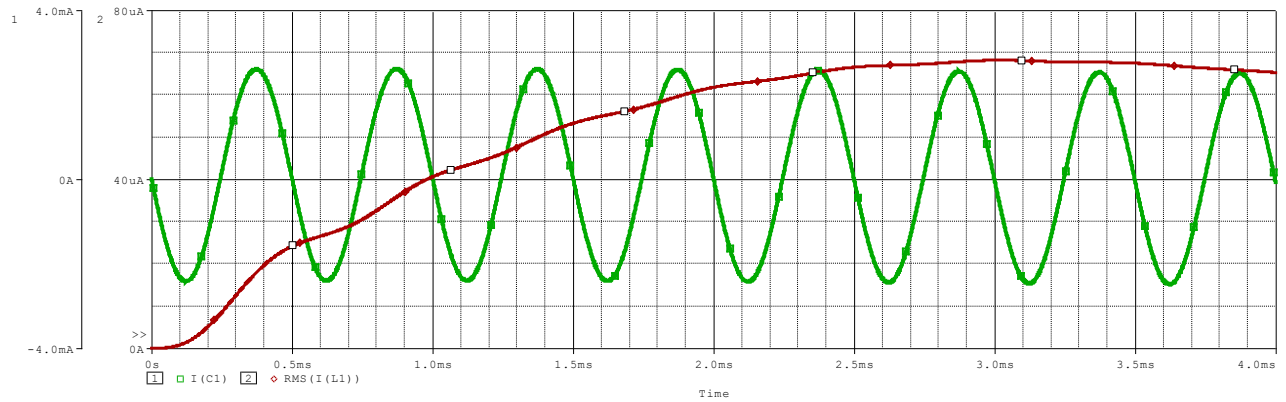
- Phase shift between  $V_s$  and  $I_s = 0$ .



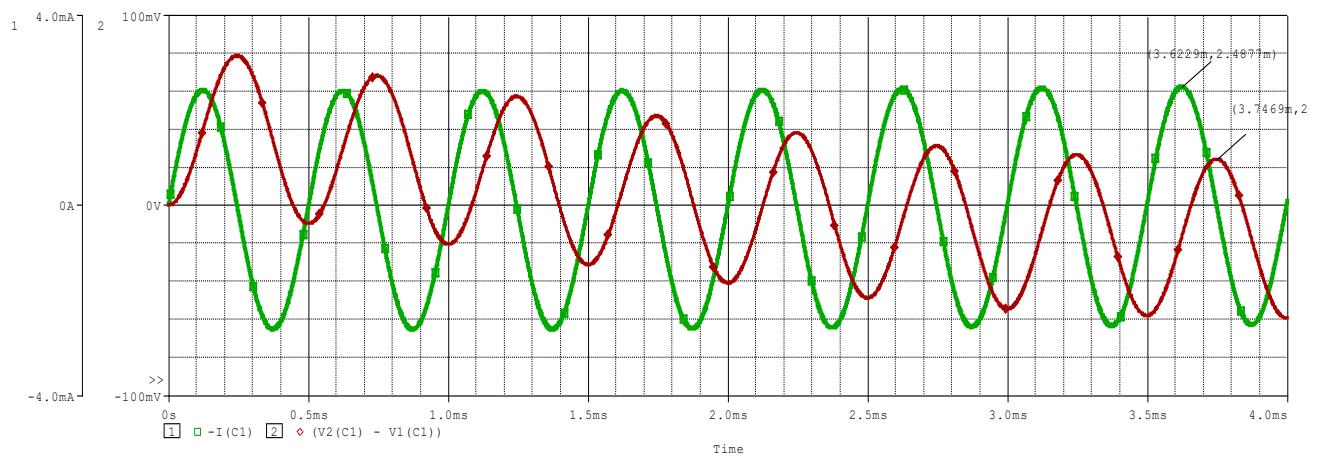
Vc:



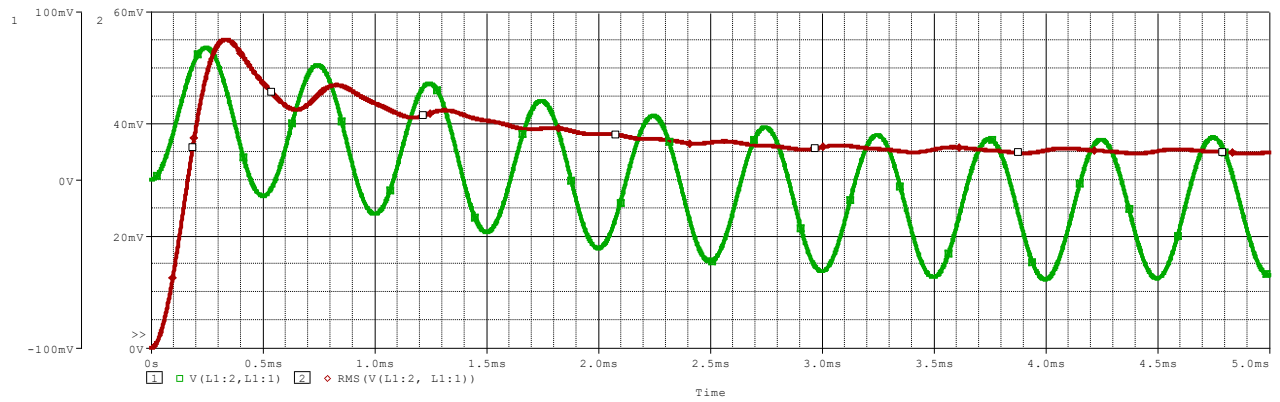
Ic:



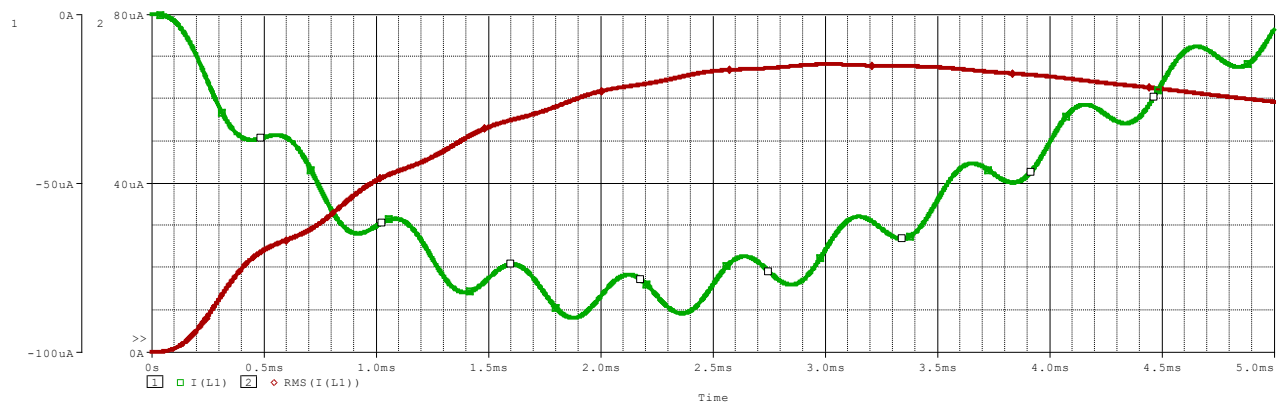
• Phase shift between  $V_s$  and  $I_s = \Delta t * \omega = (3.7469 - 3.6229) \text{ m} * 360 * 2\text{k} = 89.28$ .



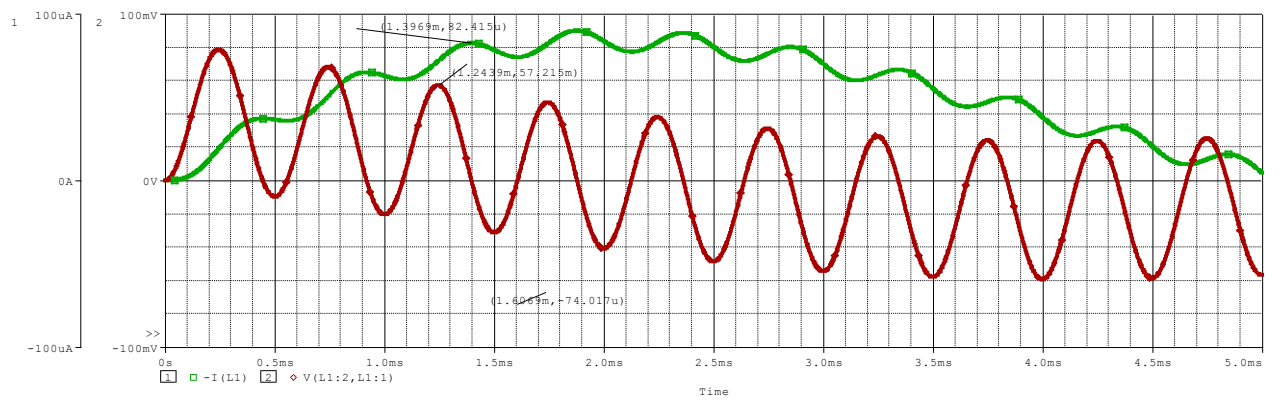
$V_L$ :



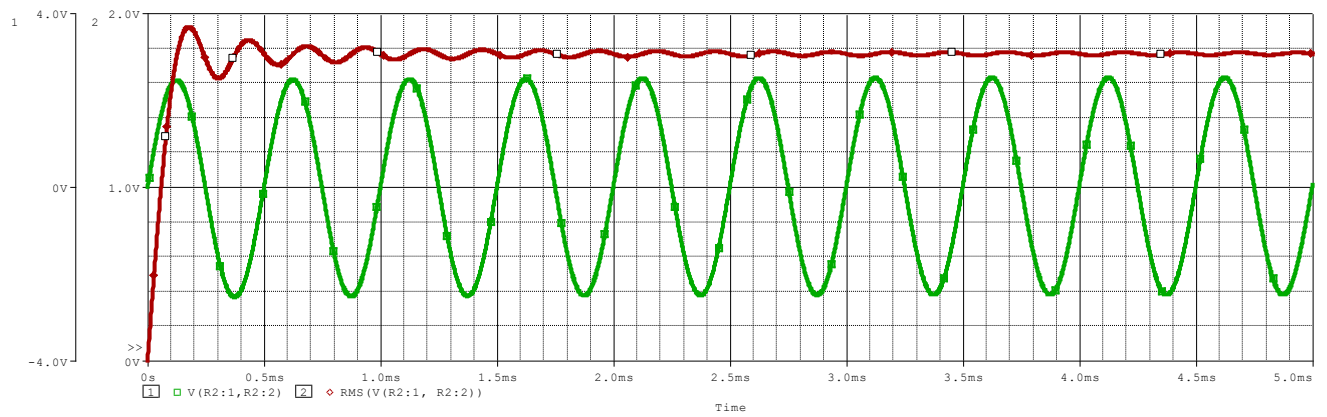
$I_L$ :



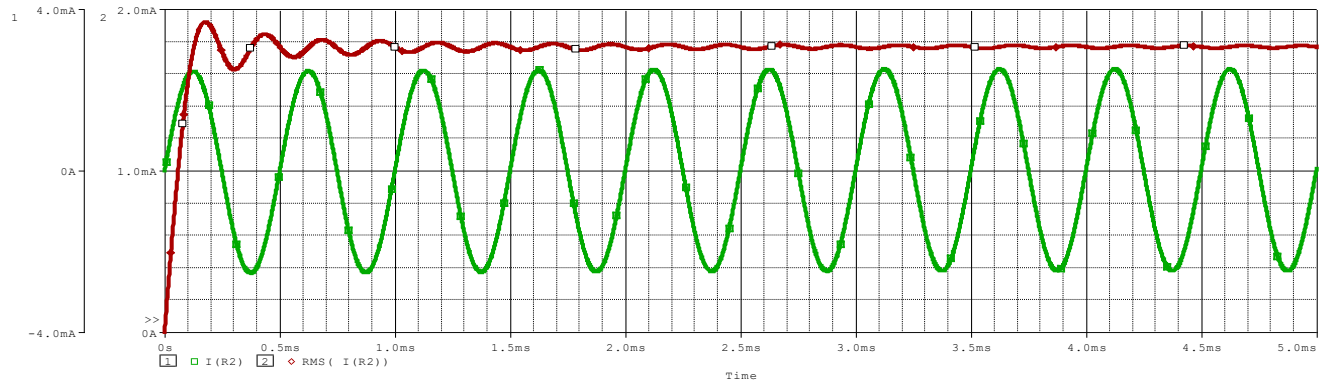
• Phase shift between  $V_L$  and  $I_L = \Delta t * \omega = (1.3969 - 1.2439) \text{ m} * 360 * 2\text{k} = 110.16$ .



V(R2):



I(R2) = Is:



• Phase shift between  $V_{(R2)}$  and  $I_{(R2)} = 0$

