Hanoi University of Science and Technology
School of Engineering Physics

LAB REPORT

For Electrics and Thermodynamics
PH1026

Experiment 1

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Experiment 1

Measurement of Resistance, Capacitance, Inductance and Resonant Frequencies of RLC using Oscilloscope

1. Measurement of resistance, capacitance, and inductance

a. Measurement of unknown resistance

f (Hz)	R_0 (Ω)	R_x (Ω)	ΔR_x (Ω)
500	332.0	332.0	0.3
1000	332.0	332.0	0.3
1500	331.0	331.0	0.7
		$\overline{R_X} \approx$ **331.7**	$\overline{\Delta R_X} \approx$ **0.4**

$$s.d._{Rx} = \sqrt{\frac{\sum_{i=1}^{3}\left(R_{X_i} - \overline{R_{X_i}}\right)^2}{3}} \approx 0.5(\Omega)$$

$$S.D._{Rx} = \Delta R_X = \frac{s.d}{\sqrt{n}} \approx 0.3(\Omega)$$

Result: $\boldsymbol{R_X = \overline{R_X} \pm \Delta R_X = 331.7 \pm 0.3(\Omega)}$

b. Measurement of unknown capacitance

f (Hz)	$Z_c = R_0$ (Ω)	ΔZ_c (Ω)	$\boldsymbol{C_x = \frac{1}{2\pi f R_0}\ (\mu F)}$
1000	154.0	154.0	1.033
2000	78.0	78.0	1.020
3000	52.0	52.0	1.020
			$\overline{C_x} \approx$ **1.024**

$$s.d._{Cx} = \sqrt{\frac{\sum_1^3(\overline{C_x} - C_i)^2}{3}} \approx 0.006(\mu F)$$

$$S.D._{Cx} = \frac{s.d.}{\sqrt{n}} = \frac{0.006}{\sqrt{3}} \approx 0.003(\mu F)$$

Result: $\boldsymbol{C_X = \overline{C_X} \pm \Delta C_X = 1.024 \pm 0.003}$ **(μF)**

c. Measurement of unknown inductance

f (Hz)	R_0 (Ω)	$L_x = \dfrac{R_0}{2\pi f}$ (mH)
10000	57.5	0.915
20000	114.0	0.907
30000	105.0	0.875
		$\overline{L_X} \approx$ 0.899

$$s.d._{Lx} = \sqrt{\frac{\sum_1^3 (\overline{L_x} - L_i)^2}{3}} \approx 0.017(mH)$$

$$S.D._{Lx} = \frac{s.d.}{\sqrt{n}} \approx 0.009(mH)$$

Result: $\boldsymbol{L_X \approx \overline{L_X} \pm \Delta L_X = 0.899 \pm 0.009}$ **(mH)**

2. Determination of resonant frequency of RLC circuit

a. Series RLC circuit

Trial	f_s (kHz) (series circuit)	$\boldsymbol{\Delta f (kHz)}$
1	5.283	0.056
2	5.231	0.094
3	5.167	0.060
	$\boldsymbol{\bar{f} \approx 5.311 (kHz)}$	

$$s.d. = \sqrt{\frac{\sum_1^3 (\bar{f} - f_i)^2}{3}} \approx 0.047(kHz)$$

$$S.D. = \frac{s.d.}{\sqrt{n}} = \frac{0.047}{\sqrt{3}} \approx 0.027(kHz)$$

Result: $\boldsymbol{f_s = \bar{f} \pm \Delta f = 5.227 \pm 0.027\ (kHz)}$

b. Parallel RLC circuit

Trial	f_p (kHz) (parallel circuit)	$\Delta f(kHz)$
1	5.385	0.074
2	5.216	0.095
3	5.332	0.021
	$\bar{f} \approx 5.311(Hz)$	

$$s.d. = \sqrt{\frac{\sum_1^3 (\bar{f} - f_i)^2}{3}} \approx 0.071(kHz)$$

$$S.D. = \frac{s.d.}{\sqrt{n}} = \frac{0.071}{\sqrt{3}} \approx 0.041(kHz)$$

Result: $\boldsymbol{f_p = \bar{f} \pm \Delta f = 5.311 \pm 0.041\ (kHz)}$

****** Comparison***

Theoretical frequency:

$$\bar{f_0} = \frac{1}{2\pi\sqrt{\overline{L_x} \times \overline{C_x}}} = \frac{1}{2 \times 3.14 \times \sqrt{0.899 \times 10^{-3} \times 1.024 \times 10^{-6}}} \approx 5.245\ (kHz)$$

From those results we have following conclusions:

- The measured frequency of parallel RLC circuit is a little bigger than those of series circuit.
- The resonant frequency is quite different from two frequencies obtain of series and parallel RLC because of low-quality equipment.