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Physics 208-CC3

Lab 6- Electrical Resonance

PROCEDURE:

In this Lab we will study the behavior of the R-L-C circuit and characterize of the sinusoidal signal, Resonance occurs in electrical circuit also, which we can simulate using the sinusoidal signal. And set up the R-L-C circuit with sinusoidal signal and oscilloscope; make sure all setting is correct.

Apparatus:

- R-L-C Circuit board
- Signal generator

Oscilloscope Tektronix

TDS1002 with two sets of leads

Data/Calculations/Questions:

❖ Formula: L-R-C Circuit

$$V_s = V_c + V_L + V_R$$

$$V_s = V_0 \sin \omega t$$

$$V_R = I_0 R \sin(\omega t - \phi), \quad \tan \phi$$

$$= \frac{\omega L - \frac{1}{\omega C}}{R}$$

$$I_0 Z = V_0, \quad Z = \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$$

F	V0	Vr	K-Vr/V0
2	1.08	0.118	0.10925926
3	1.06	0.192	0.18113208
4	1.04	0.32	0.30769231
5	1.02	0.48	0.47058824
5.2	1.02	0.52	0.50980392
5.4	1.02	0.56	0.54901961
5.6	1	0.608	0.608
5.8	0.98	0.656	0.66938776
6	0.98	0.696	0.71020408
6.2	0.98	0.736	0.75102041
6.4	0.98	0.76	0.7755102
6.6	0.98	0.784	0.8
6.8	0.96	0.792	0.825
7	0.96	0.784	0.81666667
7.2	0.96	0.768	0.8
7.4	0.94	0.752	0.8
7.6	0.94	0.72	0.76595745
7.8	0.94	0.688	0.73191489
8	0.94	0.656	0.69787234
9	0.92	0.52	0.56521739
10	0.9	0.416	0.46222222

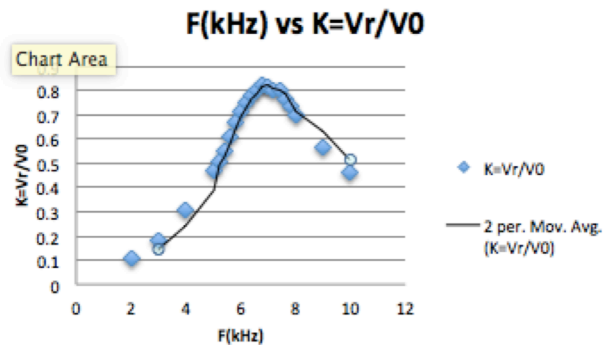
When,

$$\omega L - \frac{1}{\omega C} = 0 \Rightarrow \omega = \frac{f}{2\pi} = \sqrt{LC}$$

$$Z=R \rightarrow \text{min} \Rightarrow I_a \rightarrow \text{max}$$

$$V_R \rightarrow \text{max}$$

$$\Rightarrow \frac{V_R}{V_0} \rightarrow \text{max}, \phi \rightarrow 0$$



Analysis

1. Frequency of Resonance $f_0 = ?$ $k = ?$

➤ R-L-C series circuit

$$\omega_0 = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{0.031 \times 0.025 \times 10^{-6}}} = 35921.06 \text{ rad/s}$$

$$f_0 = \frac{\omega_0}{2\pi \text{rad}} = 5717.01 = 5.7 \text{ kHz}$$

2. Window $f_2 - f_1 = ?$

➤ Window $f_2 - f_1 = 0.3 \text{ kHz}$

3. Quality factor: $Q = \frac{f_0}{f_2 f_1} = ?$

$$Z = \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C} \right)^2}$$

$$Q = 2.41$$

➤ z from formula 1087 ohm

$$z = V_0 / I_0 = 990.56$$

$$\frac{1.05}{1.06 \times 10^{-3}} = 990.56 \text{ ohm}$$

Discussion

Experiment of this lab, investigated resonance phenomena of the electrical circuit in the system of RLC and as know $Z=R(\omega L-1/\omega C=0)$. And concept of resonance and understand the phase shifts between the current and voltages in a RLC circuit and the electrical resonance phenomena. And be able to calculate the current flow, voltage, and phase difference using the data through mathematical equation.