Physics Department

Physics 112

Experiment 8 : Impedance and reactance

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Abstract :

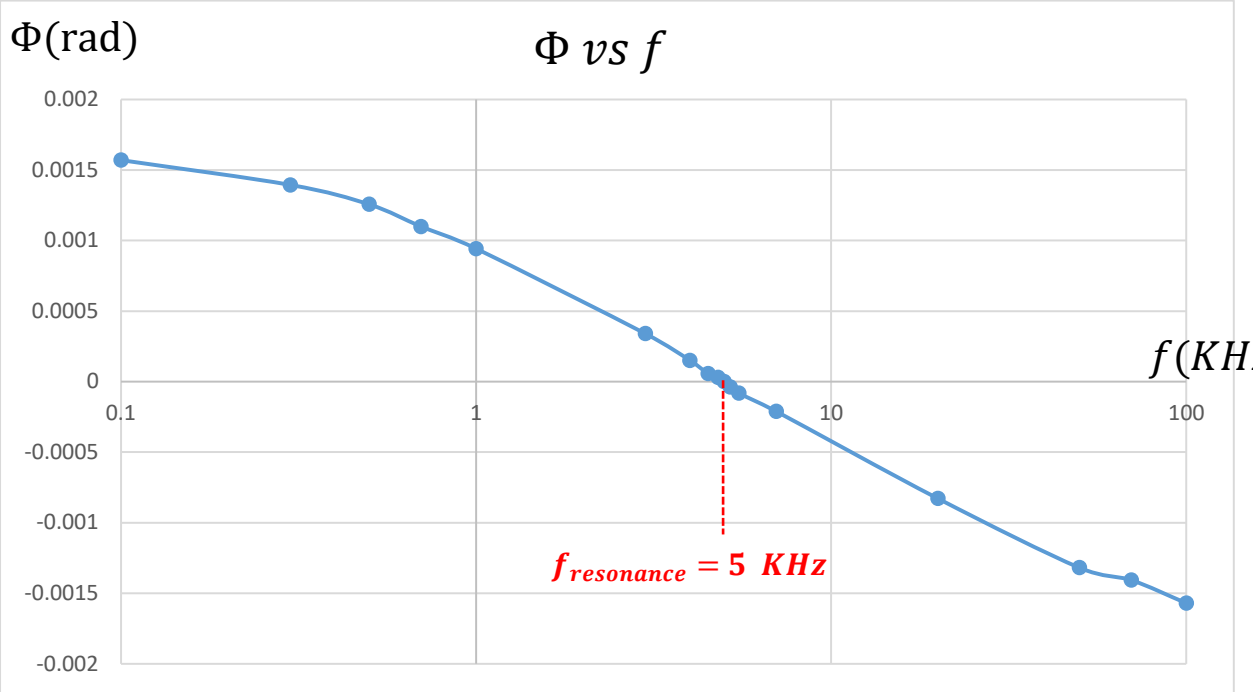
The aim of experiment is to find the phase shift of some components (Capacitor, inductor, resistor) and find the resonance frequency .

The main result is : $f_{resonance} = 5\ KHz$.

Data :

Frequency	Δt	w	$\Phi = w\Delta t$
0.1	0.0025	0.628	0.00157
0.3	0.00074	1.884	0.001394
0.5	0.0004	3.14	0.001256
0.7	0.00025	4.396	0.001099
1	0.00015	6.28	0.000942
3	0.000018	18.84	0.000339
4	0.000006	25.12	0.000151
4.5	0.000002	28.26	5.65E-05
4.8	0.000001	30.144	3.01E-05
5	0	31.4	0
5.2	-0.0000012	32.656	-3.9E-05
5.5	-0.0000024	34.54	-8.3E-05
7	-0.0000048	43.96	-0.00021
20	-0.0000066	125.6	-0.00083
50	-0.0000042	314	-0.00132
70	-0.0000032	439.6	-0.00141
100	-0.0000025	628	-0.00157

The graph below presents the phase shift vs the frequency :



Calculations :

From the graph :

At f = 5KHz , $\Phi = 0$, so $f_{resonance} = 5\ KHz$

Theoretical:

$$\omega = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{10 \times 10^{-3}(0.1 \times 10^{-6})}} = 31622.78Hz$$

$$f = \frac{\omega}{2\pi} = \frac{31622.78}{2*3.14} = 5035.47\ Hz$$

$$\Phi = \tan^{-1}\left(\frac{-\omega L + \frac{1}{\omega C}}{R}\right)$$

$$= \tan^{-1}\left(\frac{(-31622.78 \times (10^{-2}) + \frac{1}{31622.78x(0.1x10^{-6})}}{1000}\right)$$

$$= -0.00000389 \approx 0$$

Results and conclusion :

This experiment discussed the phase difference between the graphs of resistor voltage and voltage input. It was found that all values of Δt were at a higher value when frequency was at a lower value, but slowly started to decrease as frequency increased. However, after the frequency, 5 KHz, the time half and phase shift were equal to 0, the frequency and time-half began to increase. Therefore, determining that frequency and time-half have an alternating relationship where their graph would be a cosine graph.

The theoretical and exponential values for the phase shift and omega had been proven to be similar with a small percentage error. As for the phase shift vs. Omega graph, it was shown to be an exponential decay due to the negative values received after Δt is equal to 0.