جامعة بيرزيت

BIRZEIT UNIVERSITY

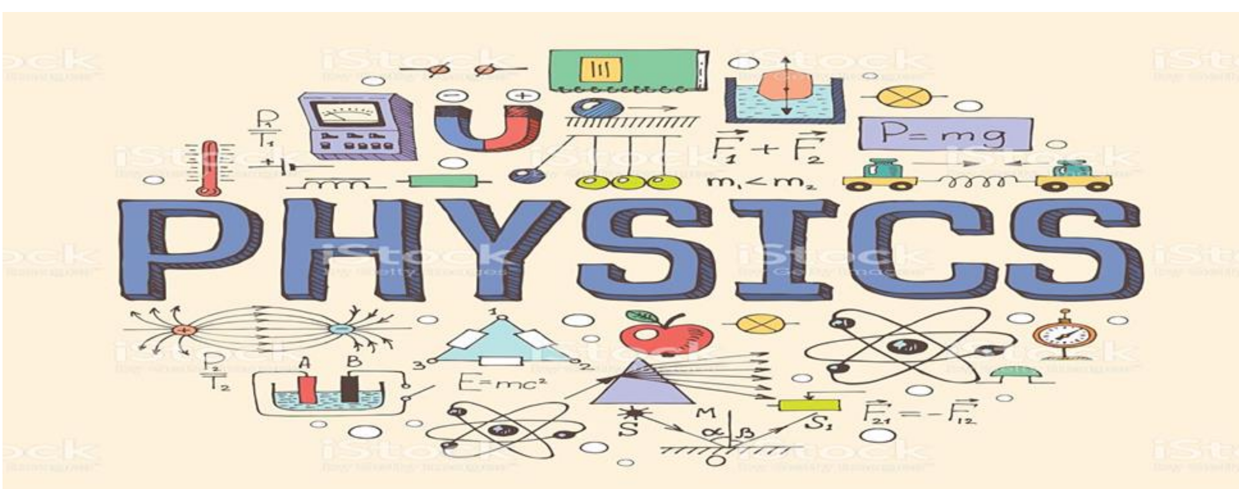
Physics Department

Physics 112

Report 8

Done by :Rayan Ghnimat

“The world is a book and those who do not travel read only one page.”



جامعة بيرزيت

BIRZEIT UNIVERSITY

BIRZEIT UNIVERSITY

Physics Department

Physics 112

8.5

Experiment Number 8:

IMPEDANCE AND REACTANCE

" ويرى الذين أوتوا العلم الذي أنزل إليك من ربك هو الحق ويهدي إلى صراط العزيز الحميد "

Student's name: Rayan Ghnimat.

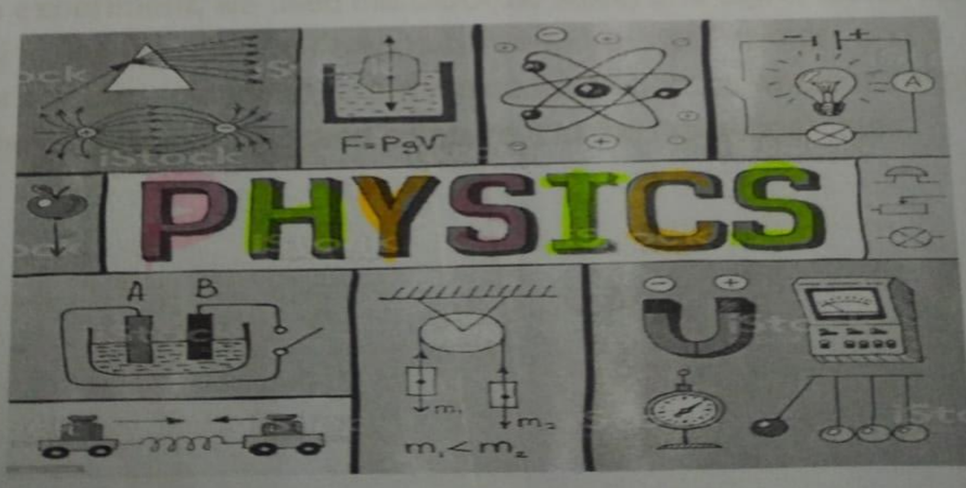
Student's no: 1211073.

Partner's name: Layan,Aya.

Partner's no. : 1211439

Section: 6

Instructor: Khalid eid.



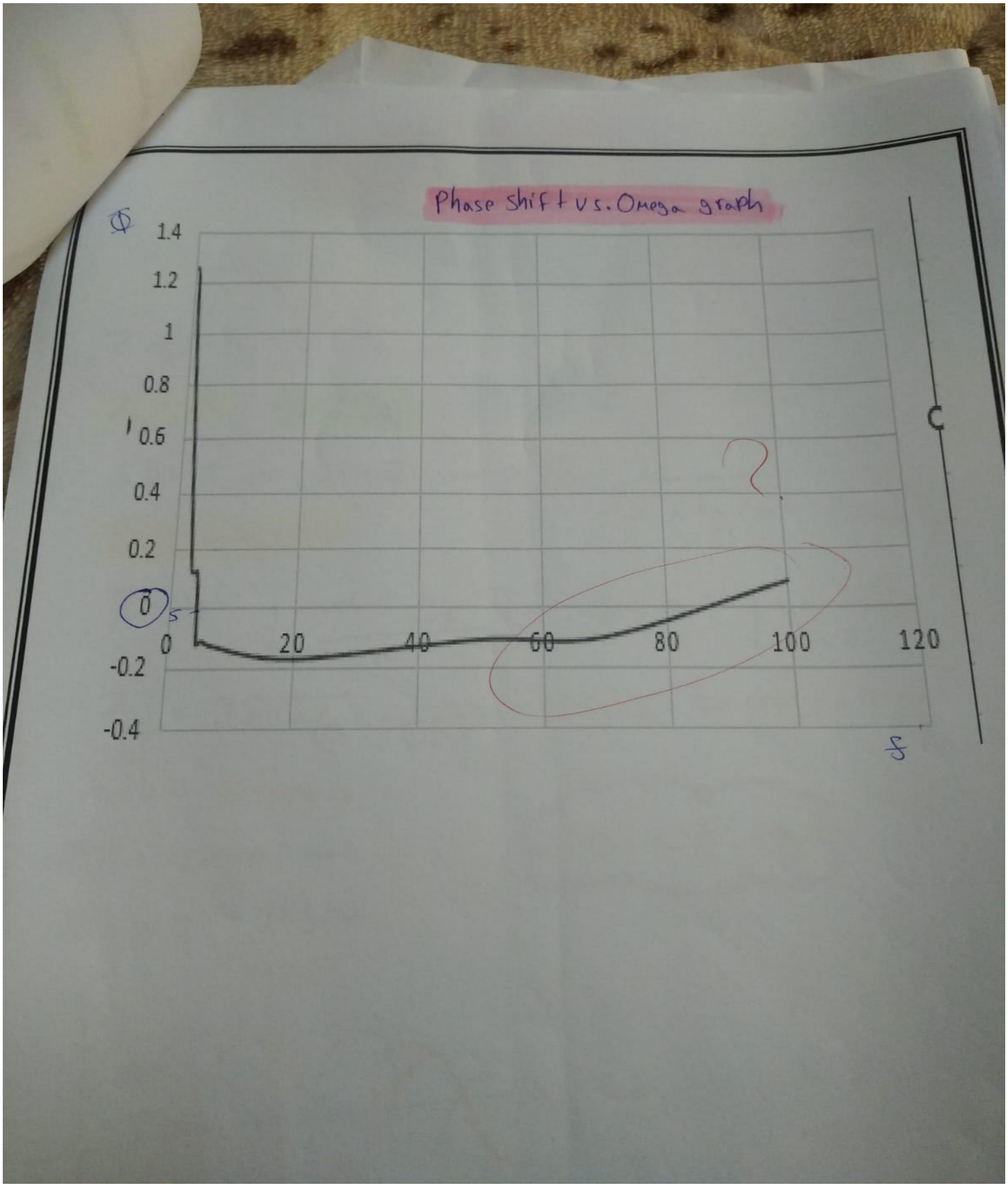
Abstract:

- **The aim of the experiment**: is to show the difference and the similarities between V_r , V_c and V_l graphs, and to measure the phase shift between each of them and the driving voltage.

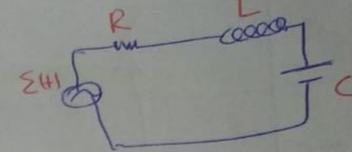
- **The method used**: by using the time divisions on the CRO screen within the internal mode, and intercepts within the external mode, to analyze the graphs of our circuit which is powered by the signal generator with AC current.

INTRODUCTION:

In this experiment, we used the DCO(the input) and Signal Generator(the output) to find the phase difference between V_{in}, input voltage, and V_r, resistor voltage,. in addition to determine the frequency wherein the phase difference is equal to zero, and compare it to the theoretical value.


Phase shift vs. Omega graph
Φ
1.4
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
0
20
40
60
80
100
120
f
?

Impedance and Reactance



$$I(t) = \frac{\Sigma(t)}{Z_{eq}}$$

$$Z_{eq} = Z_R + Z_c + Z_L$$

$Z_R = R$, $Z_c = \frac{-j}{wc}$, $Z_L = jwL$ $\Rightarrow j = \sqrt{-1}$

$I(t) = I_o \cos(wt + \Phi) \Longrightarrow I_o = \frac{\Sigma_o}{\sqrt{R^2 + (wL - \frac{1}{wc})^2}}$

Φ : phase shift

$\Phi = \tan^{-1}\left[\frac{-wL + \frac{1}{wc}}{R}\right]$, $\Phi = \tan^{-1}\left[\frac{V_L - V_c}{V_R}\right]$

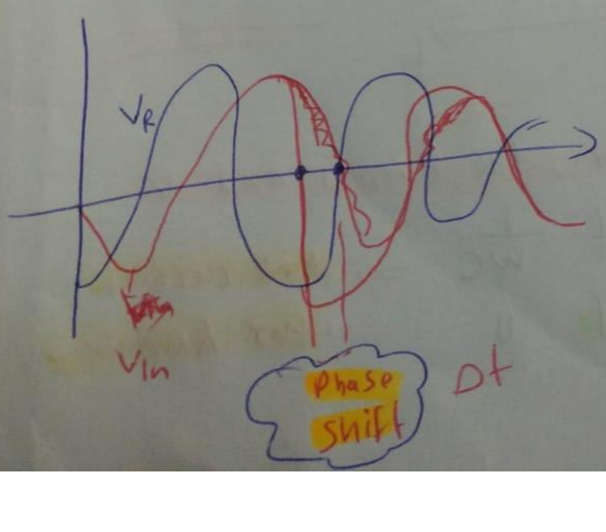
$Z_{eq} = \sqrt{R^2 + (wL - \frac{1}{wc})^2}$ $\Rightarrow V_R$ = circuit current

circuit Impedance.

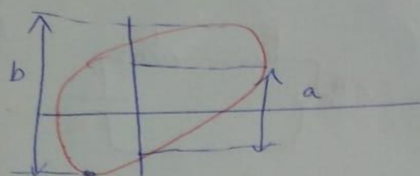
1rad = $\frac{180}{\pi}$ degree

⊛ By Internal Mode

. $\Phi = w\Delta t = 2\pi f \Delta t$



External Mode



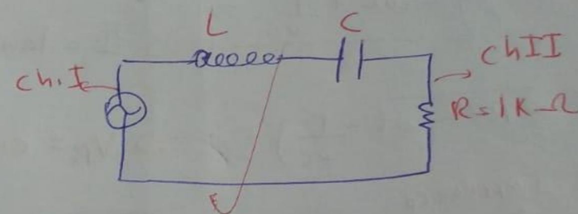
$\Phi = \sin^{-1}\left(\frac{a}{b}\right)$

$\Rightarrow V_C = \frac{1}{C}\int I(t)\,dt = \frac{I_0}{wC}\sin(wt + \Phi)$.

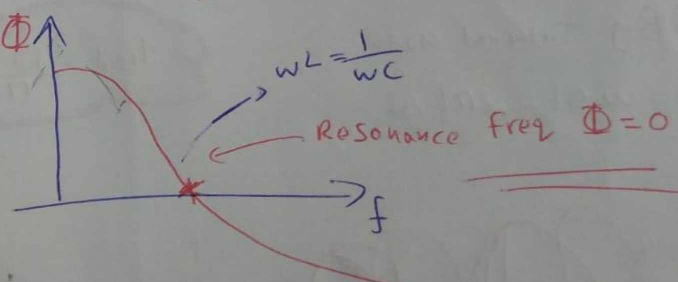
$\Rightarrow V_L = L\frac{dI(t)}{dt} = -wLI_0\sin(wt + \Phi)$

$\Rightarrow V_R = R\,I(t) = RI_0\cos(wt + \Phi) \Rightarrow$ circiut current.

Experiment



on semi log paper



At Resonance frequency, Φ = zero, the current and V in phase with each other $\Rightarrow wL = \frac{1}{wC}$ $\Rightarrow$ Max current $\Rightarrow$ Max Amplitude

$w = \frac{1}{\sqrt{LC}}$ "Angular Natural frequency"

$$f = \frac{w}{2\pi} \Rightarrow w = \frac{1}{\sqrt{LC}}$$

$$\Rightarrow f = \frac{1}{2\pi\sqrt{LC}}$$

$L = 10mH$, $C = 0.1 \mu F$

$$f_0 = \frac{1}{2 * 3.14 * \sqrt{10 \times 10^{-3} \times 0.1 \times 10^{-6}}} = 5032.421 \text{ HZ}$$

$$w_0 = 2\pi f = 2\pi \times 5032.421 = 31.6 \times 10^3 \text{ rad/sec}$$

$$\Phi = \tan^{-1}\left(\frac{-wL + \frac{1}{wC}}{R}\right) = \tan^{-1}\left(\frac{-31.6 \times 10^3 (10 \times 10^{-3}) + \frac{1}{31.6 \times 10^3 \times 10^{-7}}}{1 \times 10^3}\right)$$

$= 0$

$\Phi = 0$

EXPERIMENT 8

Impedance and Reactance

Student's Name: Rayan Jamal   Student's No.: 1211073

Partner's Name: Layan, Aya   Partner's No.: 1211439

Instructors Name: Khalid eid   Section No.: 6

Date: 4/1/2023

C = 0.1μF   L = 10 mH   R = 1 kΩ

Frequancy (KHz)	Δt	Ω = 2πf	Φ = ωΔt
0.1	2.6 Ms	628	2.6×10^{-7}
0.3	760 Ms	1.884	1.43×10^{-3}
0.5	400 Ms	3140	1.256
0.7	280 Ms	4396	1.23
1.0	100 Ms	6280	1.00
3.0	6.4 Ms	18840	0.125
4.0	4.8 Ms	25120	0.120
4.5	4.4 Ms	28260	-0.124
4.8	4 Ms	30144	-0.120
5.0	3.8 Ms	31400	-0.119
5.2	3.6 Ms	32656	-0.117
5.5	3.2 Ms	34540	-0.116
7	3 Ms	43960	-0.131
20	1.4 Ms	125600	-0.175
50.0	360 Ms	31400	-0.113
70.0	240 Ms	439600	-0.1055
100.0	140 Ms	628000	-0.087

Conclusion:

We notice that the phase shift becomes zero when the frequency becomes 4.0 KHz. and we notice that the input voltage in phase with the output voltage when using a resistor. And there is a phase shift when using both inductor and capacitor.,We can notice the effect of the errors in the semi-log plot of Phase Shift vs. Frequency.

But generally, we got good results.