BIRZEIT UNIVERSITY

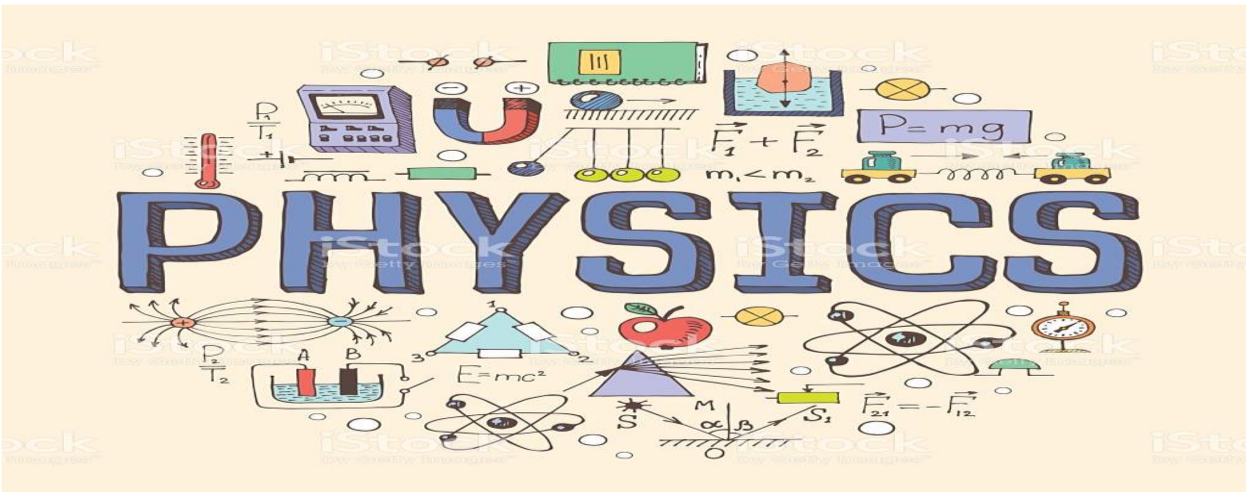
Physics Department

Physics 112

***Report** 7*

Done by :Rayan Ghnimat.

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



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Experiment Number 7:

Damped Oscillations

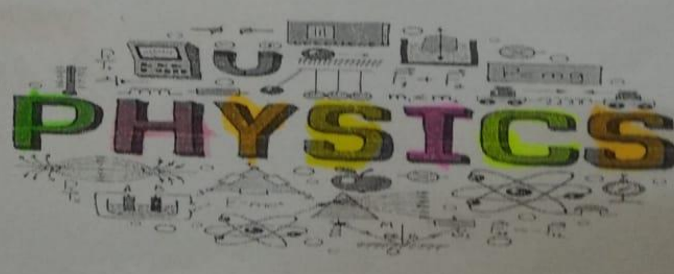
("يَرْفَعِ اللهُ الَّذِينَ آمَنُوا مِنْكُمْ وَالَّذِينَ أُوتُوا الْعِلْمَ دَرَجَاتٍ وَاللهُ بِمَا تَعْمَلُونَ خَبِيرٌ")

Student's name: Rayan Ghnimat. **Student's no: 1211073.**

Partner's name: Layan,Aya. **Partner's no. : 1211439**

Section: 6

Instructor: Khalid eid.



Abstract:

1. **The Aim**: we did this experiment to study damped Oscillations in their 3 cases ,Over damping, critical damping ,under damping ,it aims to find the ranges of values of the variable resistance where we can find the three types of oscillations ,and finds the time constant of under damping situation.

2. **The method we used**: by measuring the voltage difference across the capacitor's plates using the CRO.

Main results:

$$w = \sqrt{\frac{1}{LC} - \left(\frac{R}{2L}\right)^2}$$

For Underdamping:

R= 0

Δt= 36 μs

F= 762.0

ω =2πf = 4785.36

$L = 10\times10^{-3}\ H$, $\delta_{the} = \frac{R}{2L} = 9885\ sec^{-1}$

$C = 10\,nF = 10\times10^{-9}\ F$

$R = 1997.7\ \Omega \Rightarrow t_{1/2\,the} = \frac{2L\ln 2}{R} = \frac{\ln 2}{\delta_{theo}} = 6.93$

For Critical Damping:

R= 1410 Ω

Δt= 32 μs

$V_{PP} = 2.92\ V$

$\frac{V_{PP}}{2} = 1.46\ V$

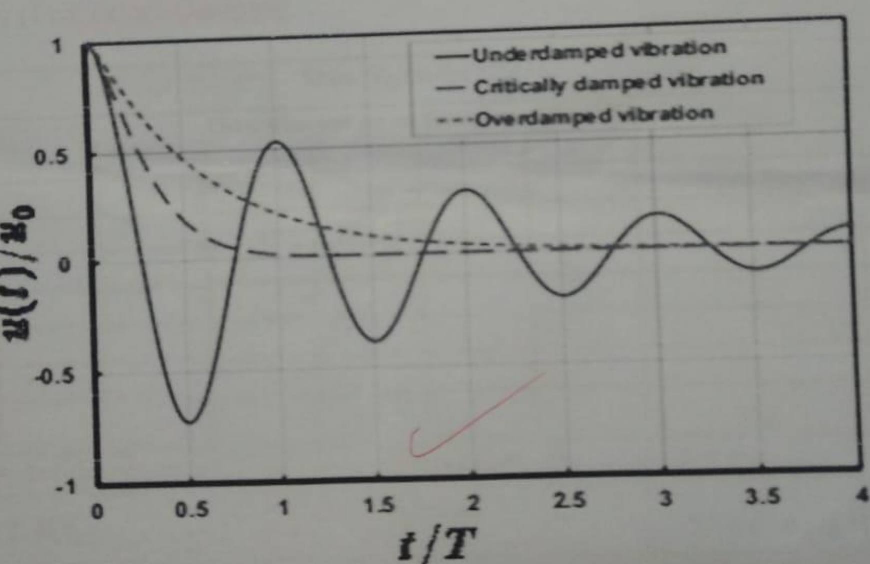
For Overdamping:

R= 2000 Ω

Δt= 64 μs

- Introduction:

In this experiment, we expected to find time-half of the 3 cases: Under damping,Over damping and critical damping. Over damping is where the $(R/2L)^2$ greater than (1/LC) it cases an exponential decay ,Critical damping is when the $(R/2L)^2$ equal (1/LC) which removes the root .Under damping is where the $(R/2L)^2$ less than (1/LC) so under the square root becomes negative. Also we can find the freqeuency.



Experiment 7

Damped Oscillations

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

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

Instructors Name: Khalid eid Section No.: 6

Date: 21 / 12/ 2022

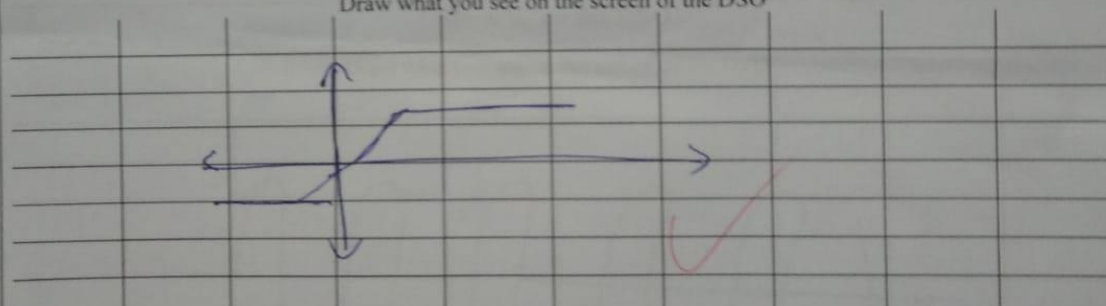
C = find best value! L = 10 mH f = (300 – 1000) Hz

-Data:

Part (1): Critical-Damping

Show V_C on the DSO

Draw what you see on the screen of the DSO



$R_{Critical}$ = 1410 Ω	$\delta_{C,Theo} = \frac{R}{2L}$ = 70500
$t_{\frac{1}{2}exp}$ = 32 μs	$\delta_{C,Exp} = \frac{\ln 2}{t_{1/2}}$ = 21660.84

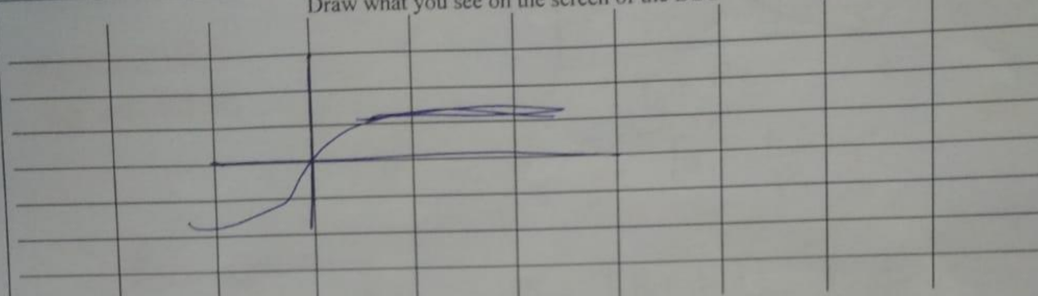
VPP = 292 V

$\frac{VPP}{2}$ = 1.46V

Part (2): Over-Damping

Show V_C on the DSO

Draw what you see on the screen of the DSO



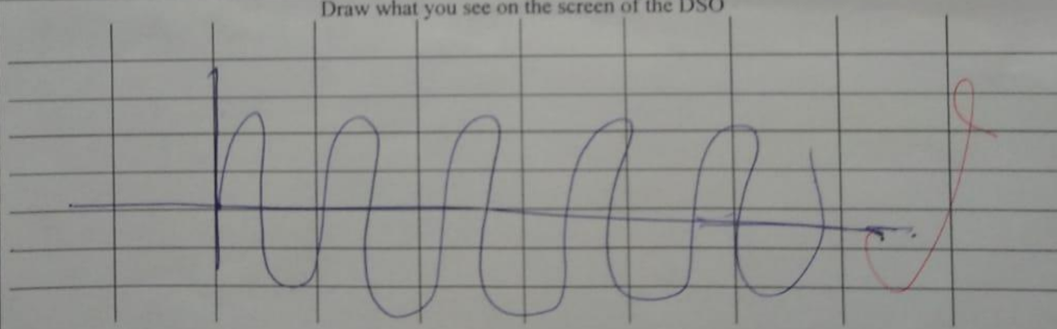
R_{Over} = 2000 Ω	$\delta_{C,Theo} = \frac{R}{2L}$ = 100 000
$t_{\frac{1}{2}exp}$ = 64 μs	$\delta_{C,Exp} = \frac{\ln 2}{t_{1/2}}$ = 10,830.42

Part (3): Under-Damping

$V_{PP} = 2.64$, $\frac{V_{PP}}{2} = 1.32$ V

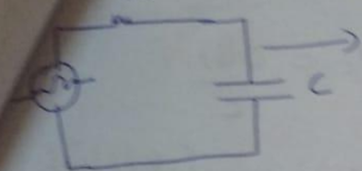
Show V_C on the DSO

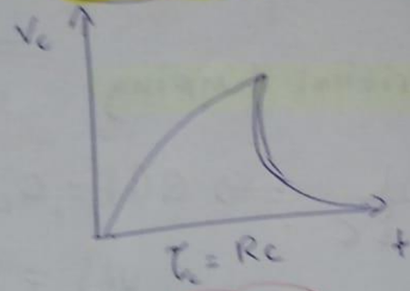
Draw what you see on the screen of the DSO



R_{under} = 0	$t_{\frac{1}{2}theo}$ = $2L \frac{\ln 2}{R}$ = 6.93×10^{-6} sec
$t_{\frac{1}{2}exp}$ = 36 μs	$\delta_{C,Theo} = \frac{R}{2L}$ = 99885 sec^{-1}
$\delta_{C,exp}$ = $\ln 2 / 36 \times 10^{-6}$ = 19254.08	
f'_{exp} = 762.0 H	f'_{theo} =

Damped OSCILLAtions

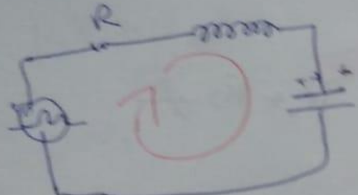




$V_c = 0.63 V_0$

$V_d = 0.37 V_0$

$\tau_{LR} = \frac{L}{R}$



$$\mathcal{E} = IR + L\frac{dI}{dt} + \frac{Q}{C}$$

$$= \frac{dQ}{dt}R + L\frac{d^2Q}{dt^2} + \frac{Q}{C}$$

$$Q(t) = Q_{10}\, e^{-\lambda t} + Q_{20}\, e^{\lambda t} \quad \text{——— ①}$$

$$\lambda_+ = \frac{-R}{2L} + \sqrt{\left(\frac{R}{2L}\right)^2 - \frac{1}{LC}}$$

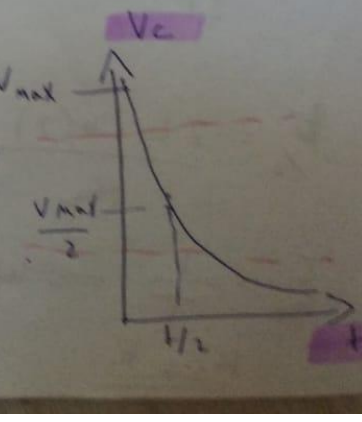
$$\lambda_- = \frac{-R}{2L} - \sqrt{\left(\frac{R}{2L}\right)^2 - \frac{1}{LC}}$$

case 1

Overdamping $\Rightarrow \left(\frac{R}{2L}\right)^2 > \frac{1}{LC}$

$\lambda = 0$

$\lambda = \frac{-R}{L}$ $\Big\}$ $Q(t) = Q_0\, e^{-\frac{R}{L}t}$



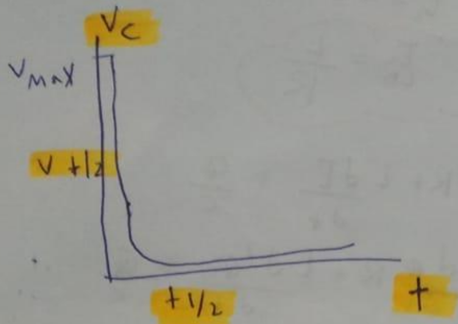
Case 2

$\Longrightarrow V_c = \frac{Q(t)}{c}$

Case 2: critical damping

$\left(\frac{R}{2L}\right)^2 = \frac{1}{LC} \Longrightarrow Q(t) = Q_{10}\, e^{-(R/2L)t} + Q_{20}\, e^{(-R/2L)t}$

$V(t) = V_0\, e^{-(R/2L)t_{1/2}} + V_0\, e^{(-R/2L)t_{1/2}}$



$\lambda = \frac{\ln 2}{t_{1/2}}$

$R_{c\,exp} = R_0 + R$

Case 3

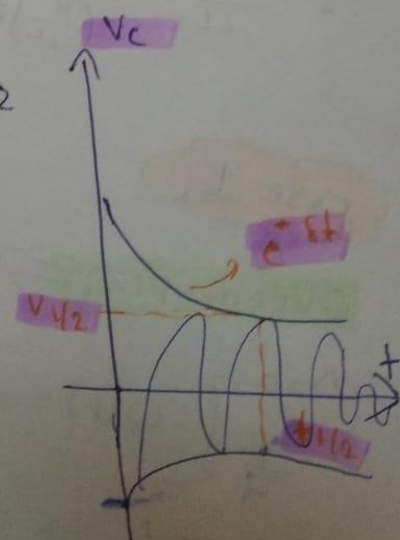
$\left(\frac{R}{2L}\right)^2 < \frac{1}{LC}$

under damping:

$\lambda = \frac{\ln 2}{t_{1/2}}$

$Q(t) = Q_0\, e^{-\delta t} \cos(w' t + \theta_0)$.

$\delta = \frac{R}{2L}$ $\quad w = \sqrt{\frac{1}{LC} - \left(\frac{R}{2L}\right)^2}$



$t_{1/2} = \frac{2L \ln(2)}{R_0}$

$f_{exp} = \frac{1}{T} \Longrightarrow w_{exp} = 2\pi f_{exp}$.

$R_0 = R$

Conclusion:

We see there are some errors like mistakes in reading the measurements When we compare theorical and the experiment values of RC we discover that they are close but there is little difference between them. As well as in the critical damping the voltage reach the min value faster than the over damping one .