University of Salahaddin – Erbil
College of Science
Physics Department

Laboratory Manual
Electricity and Magnetism
2^{nd} Course

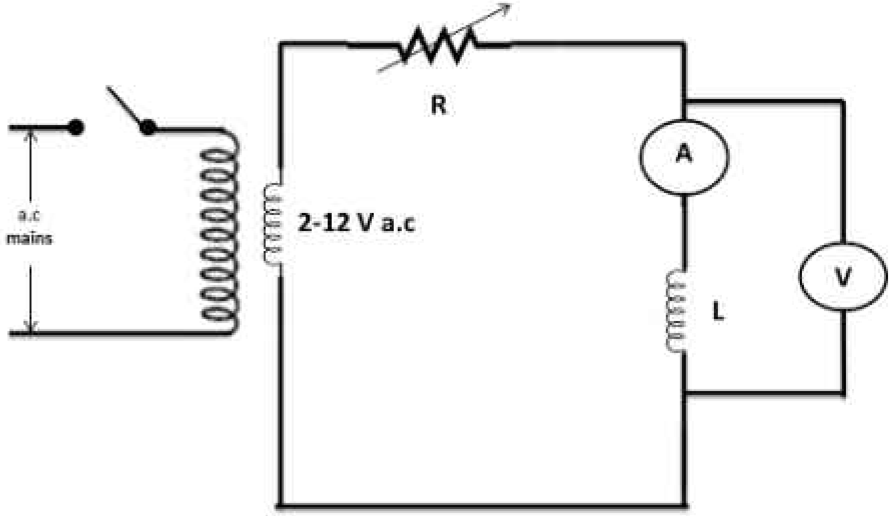
Assist. Lecturer. Safa Gh. Hameed

Safa.hameed@su.edu.krd

1Year – Physics
2023-2024

Experiment No. (1)

To show that the behavior of an inductance in A.c. circuit is analogous to that of a resistor which obeys Ohm's law and hence to measure inductance



A.C Circuit

Experiment No. (1)

Data // part (1)

$f = 1500\ Hz$

$L = 35\ mH$

V/ volt	$I/A \times 10^{-3}$
1	
1.5	
2	
2.5	
3	
3.5	
4	
4.5	

Experiment No. (1)

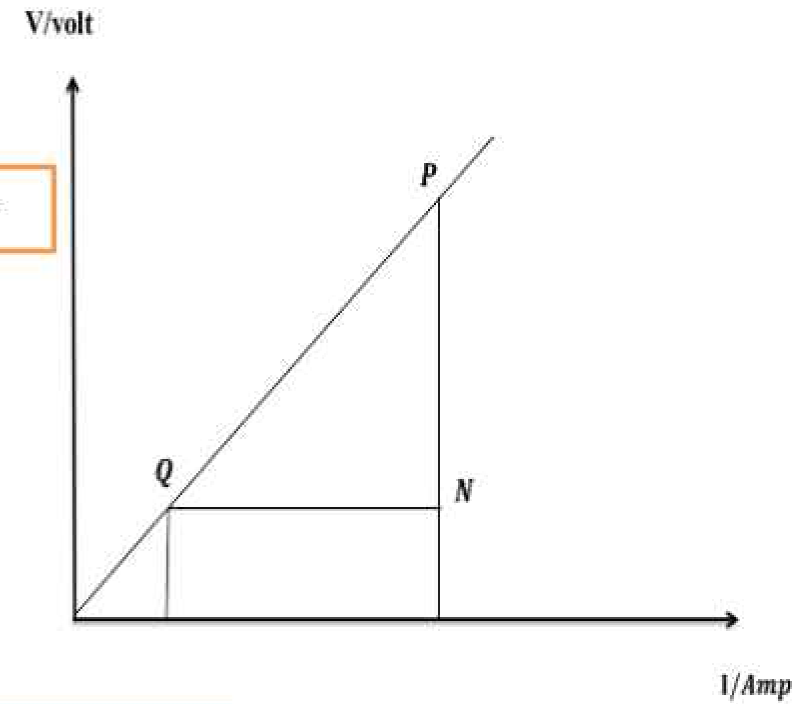
Data // part (1)

L= 35 *mH*

Theory value

$X_L = 2\pi f L$, where $f = 1500Hz$

Graph & Calculation // part (1)/ Practically



$$slop = \frac{\Delta V}{\Delta I} = X_L$$

Practically value

$$Eror\ ratio\ (X_L) = \left|\frac{theory - practically}{theory}\right| \times 100\%$$

Experiment No. (1)

Data // part (2)

L= 35 mH

$f\ Hz$	V/ volt	$I/A \times 10^{-3}$	$X_L = \frac{V}{I}\ /\Omega$
1000			
2000			
3000			
4000			
5000			
6000			
7000			
8000			
9000			

Experiment No. (1)

Data // part (2)

$L = 35\ mH$

Theory value

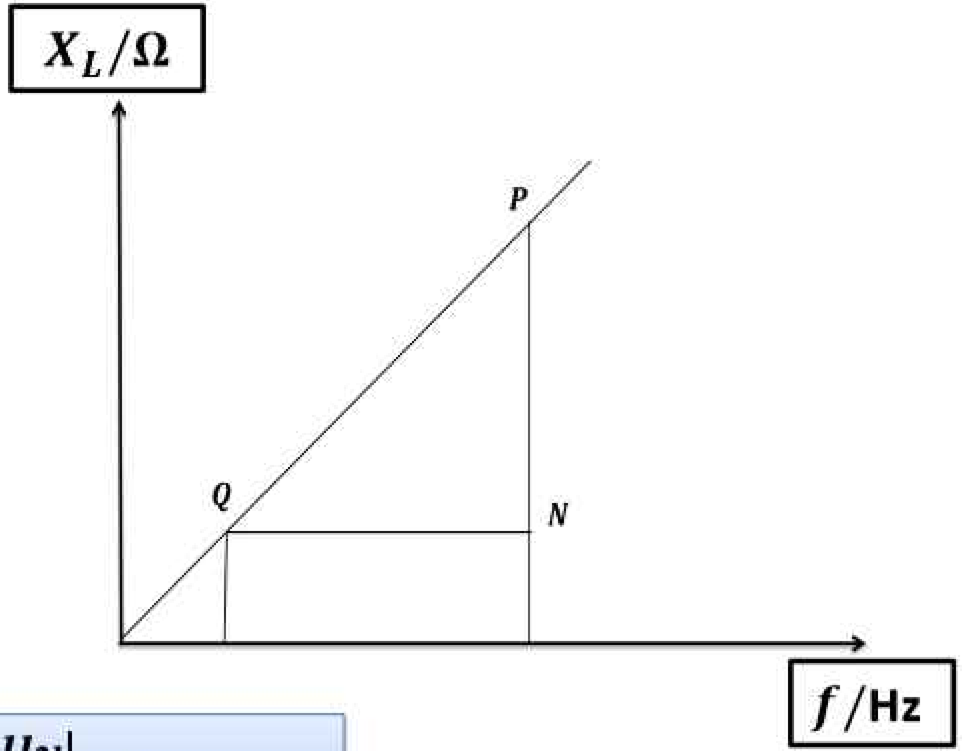
Graph & Calculation // part (2)/ Practically

$$slop = \frac{\Delta X_L}{\Delta f}$$

Practically value

$$X_L = 2\pi f L$$

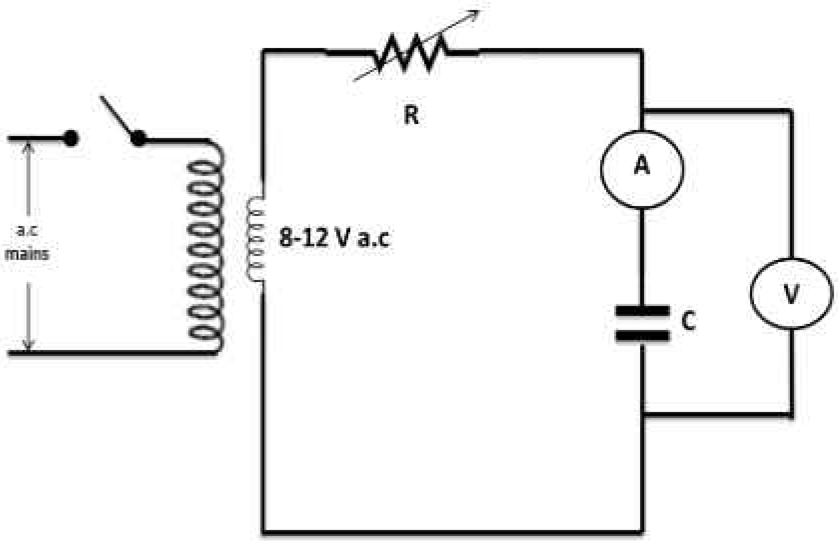
$$L = \frac{X_L}{2\pi f} = \frac{slop}{2\pi}$$

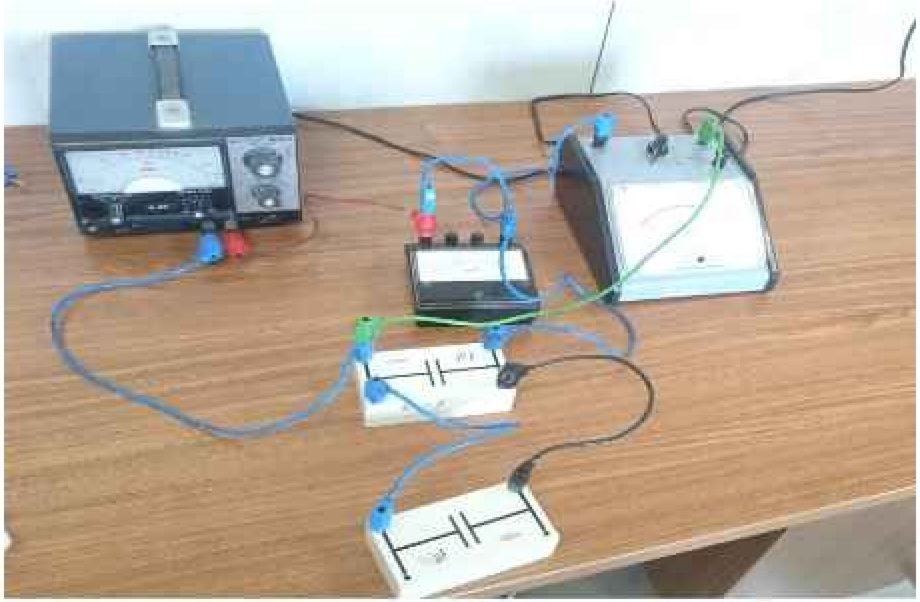


$$Eror\ ratio\ (L) = \left|\frac{theory - practically}{theory}\right| \times 100\%$$

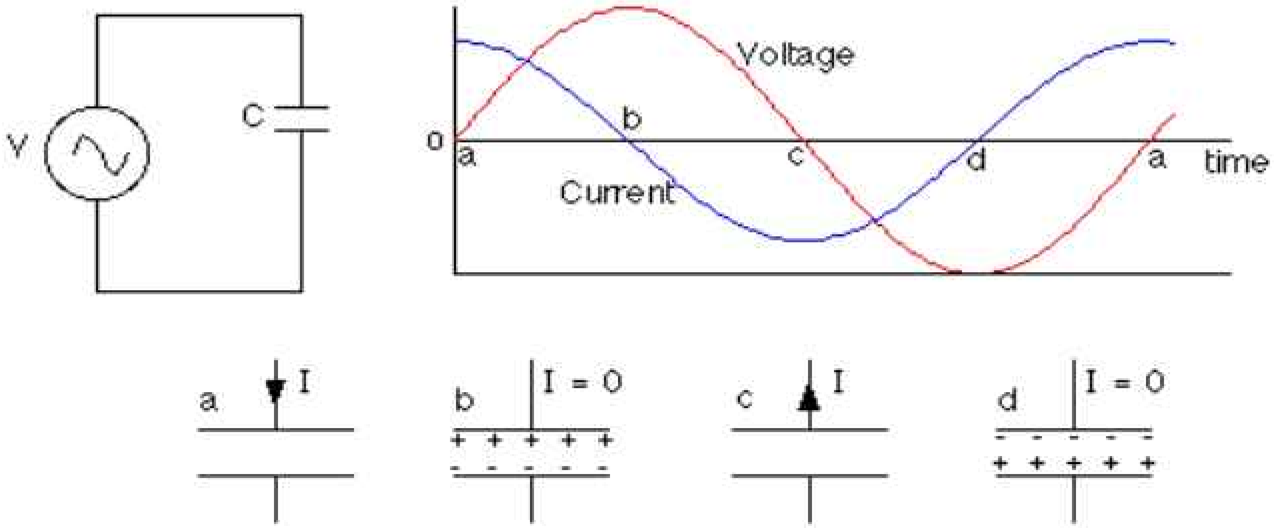
Experiment No. (2)

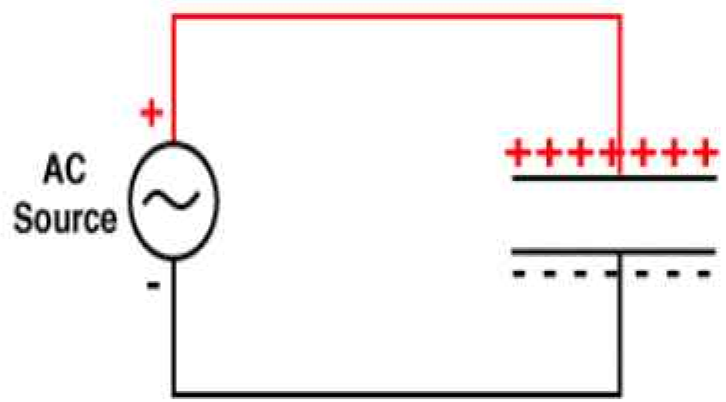
To show that the behavior of an capacitance in an A.c. circuit is analogous to that of a resistor which obeys Ohm's law and hence to measure capacitance





A.C Circuit


V
C
Voltage
Current
time
o
a
b
c
d
a
I
I = 0
I
I = 0


AC
Source
+
-

Experiment No. (2)

Data // part (1)

$f = 50\ Hz$

C= $2\mu F$

V/ volt	$I/A \times 10^{-3}$
1	
1.5	
2	
2.5	
3	
3.5	
4	
4.5	
5	
5.5	
6	

Experiment No. (2)

Data // part (1)

$C = 2\mu F$

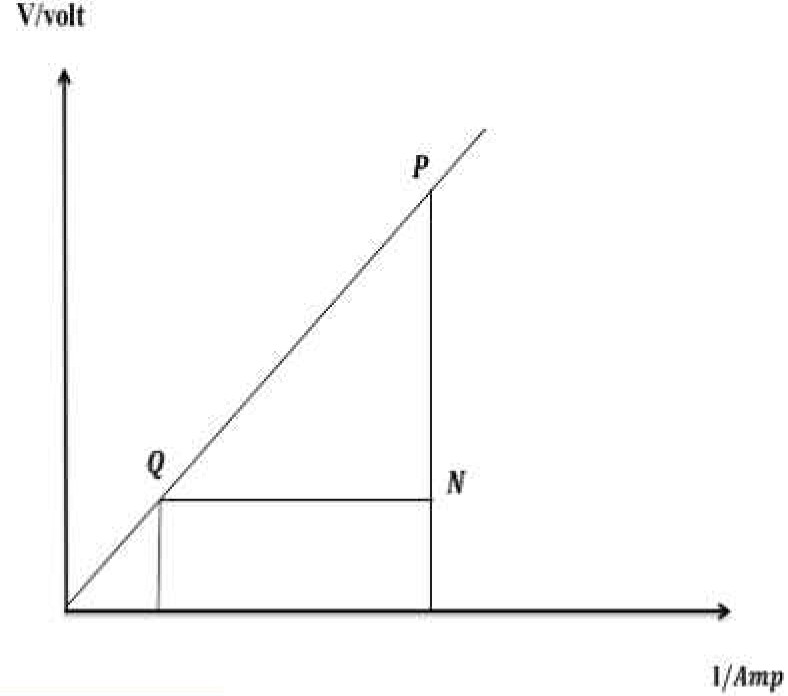
Graph & Calculation // part (1)/ Practically

Theory value

$$X_C = \frac{1}{2\pi f C} \quad , \text{where } f = 50Hz$$

$$slop = \frac{V}{I} = X_C$$

Practically value



$$Eror\ ratio\ (X_C) = \left| \frac{theory - practically}{theory} \right| \times 100\%$$

Experiment No. (2)

Data // part (2)

$f = 50\ Hz$

$C = 4\mu F$

V/ volt	$I/A \times 10^{-3}$
1	
1.5	
2	
2.5	
3	
3.5	
4	
4.5	
5	
5.5	
6	

Experiment No. (2)

Data // part (2)

$C = 4\mu F$

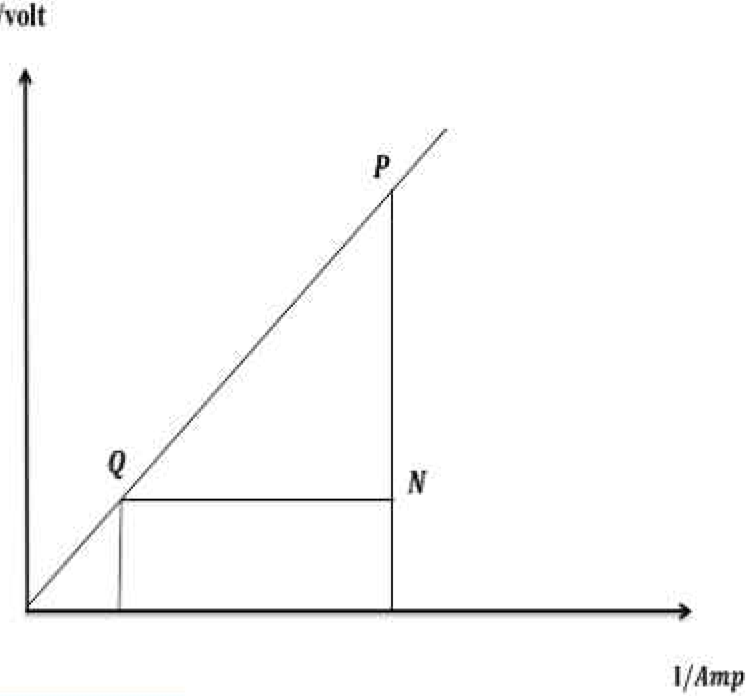
Graph & Calculation // part (2)/ Practically

Theory value

$$X_C = \frac{1}{2\pi f C} \quad \text{, where } f = 50Hz$$

$$slop = \frac{V}{I} = X_C$$

Practically value



$$Eror\ ratio\ (X_C) = \left|\frac{theory - practically}{theory}\right| \times 100\%$$

Experiment No. (2)

Data // part (3)

$C = 2\mu F$

f Hz	V/ volt	$I/A \times 10^{-3}$	$X_C = \frac{V}{I}$ /Ω	$1/f$ S
30				
40				
50				
60				
70				
80				
90				
100				

Experiment No. (2)

Data // part (3)

$C = 2\mu F$

Theory value

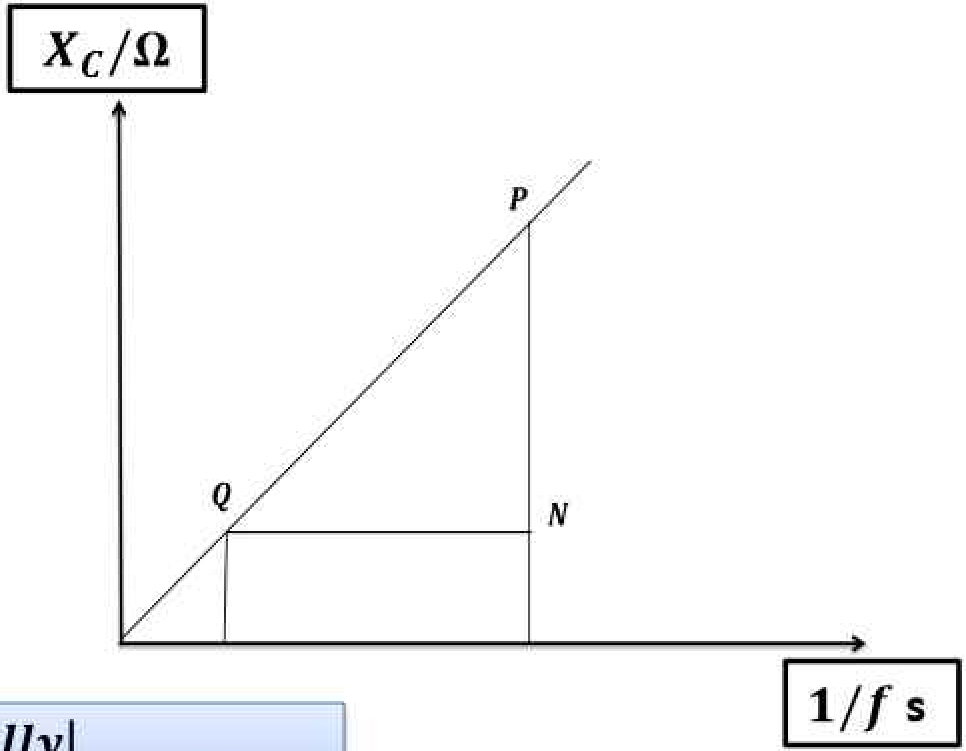
Graph & Calculation // part (2)/ Practically

$$slop = \frac{X_C}{1/f} = X_C f$$

Practically value

$$X_C = \frac{1}{2\pi f C}$$

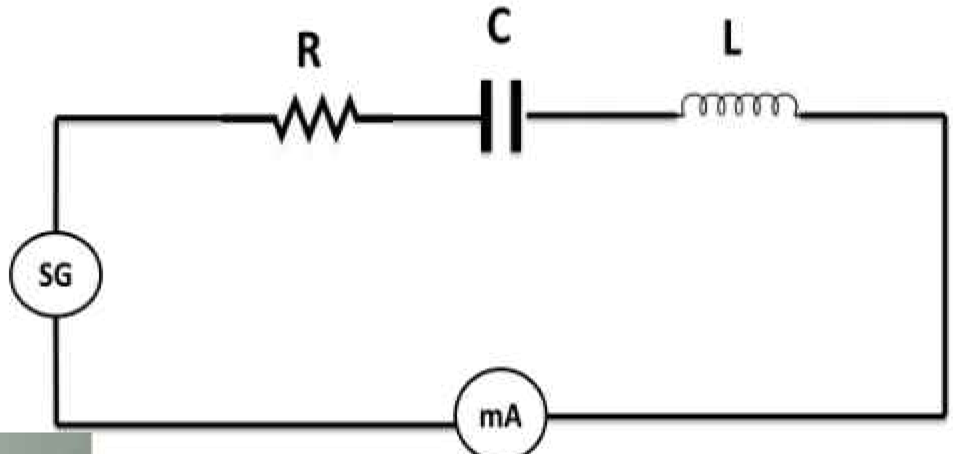
$$C = \frac{1}{2\pi f X_C} = \frac{1}{2\pi slop}$$



$$Eror\ ratio\ (C) = \left|\frac{theory - practically}{theory}\right| \times 100\%$$

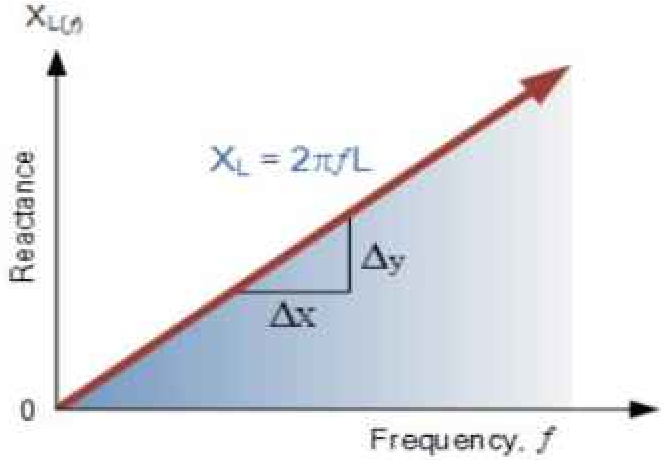
Experiment No. (3)

L-C-R Series and Parallel Resonance

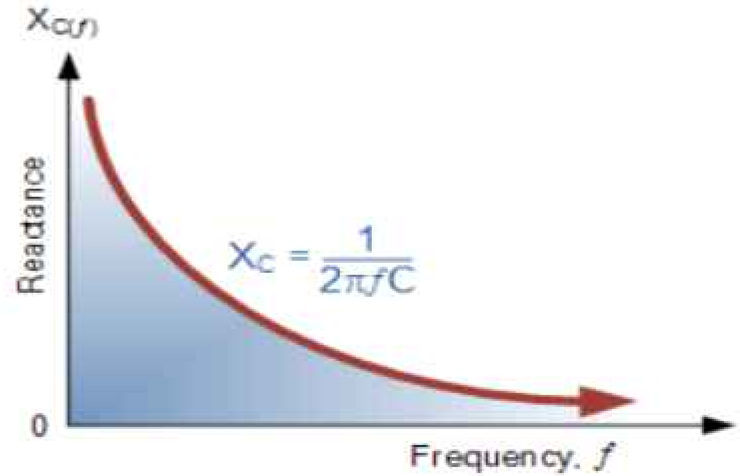


L-C-R Series

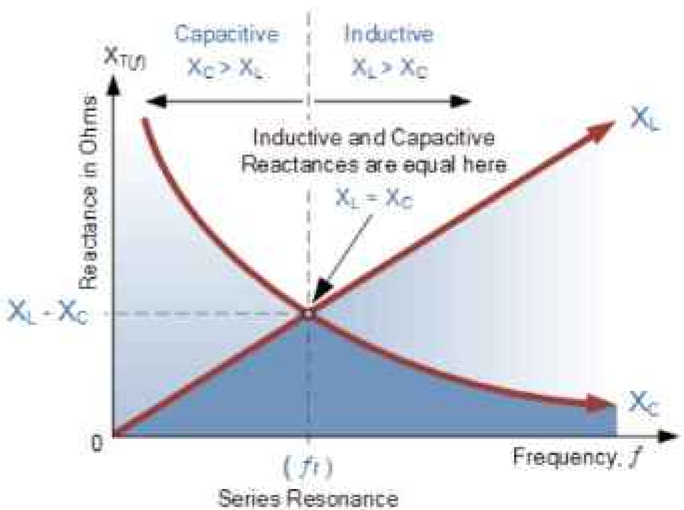
Inductive Reactance against Frequency



Capacitive Reactance against Frequency



Series Resonance Frequency



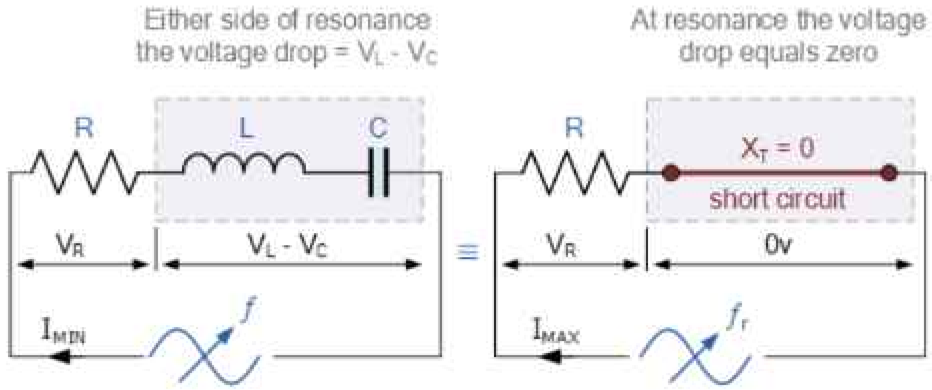
$$X_L = X_C \quad \Rightarrow \quad 2\pi f L = \frac{1}{2\pi f C}$$

$$f^2 = \frac{1}{2\pi L \times 2\pi C} = \frac{1}{4\pi^2 LC}$$

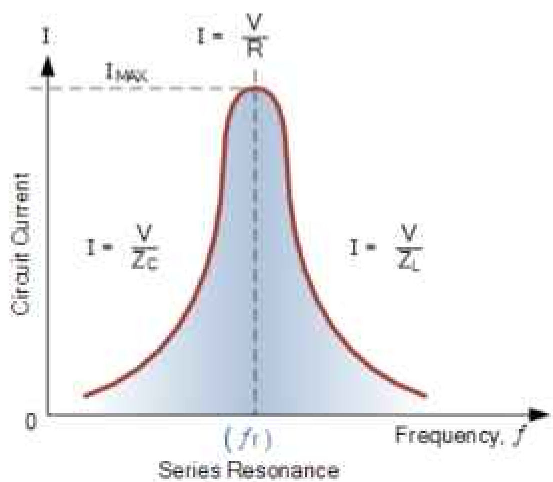
$$f = \sqrt{\frac{1}{4\pi^2 LC}}$$

$$\therefore \; f_r = \frac{1}{2\pi\sqrt{LC}} \text{ (Hz)} \quad \text{or} \quad \omega_r = \frac{1}{\sqrt{LC}} \text{ (rads)}$$

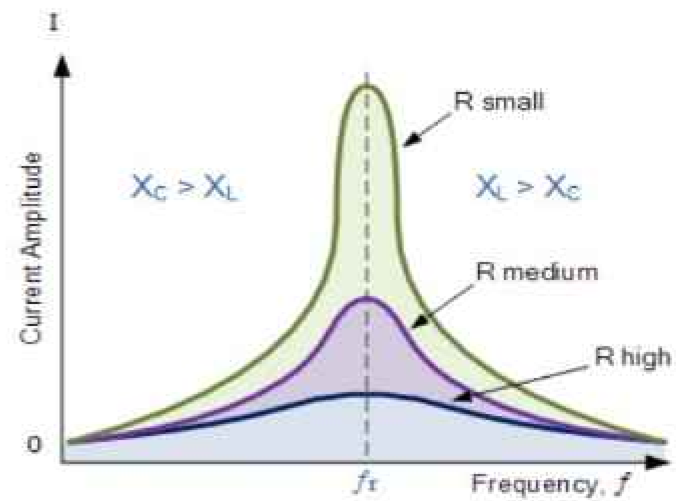
Series RLC Circuit at Resonance



Series Circuit Current at Resonance



Bandwidth of a Series RLC Resonance Circuit



Experiment No. (3)

Data

$R = 5\Omega$ $L = 35\ mH$ $C = 6\mu F$

$f\ /Hz$	$I/A \times 10^{-3}$
50	
60	
70	
80	
90	
100	
150	
200	
300	
400	
500	

$f\ /Hz$	$I/A \times 10^{-3}$
600	
700	
800	
900	
1000	
1500	
2000	
3000	

Experiment No. (3)

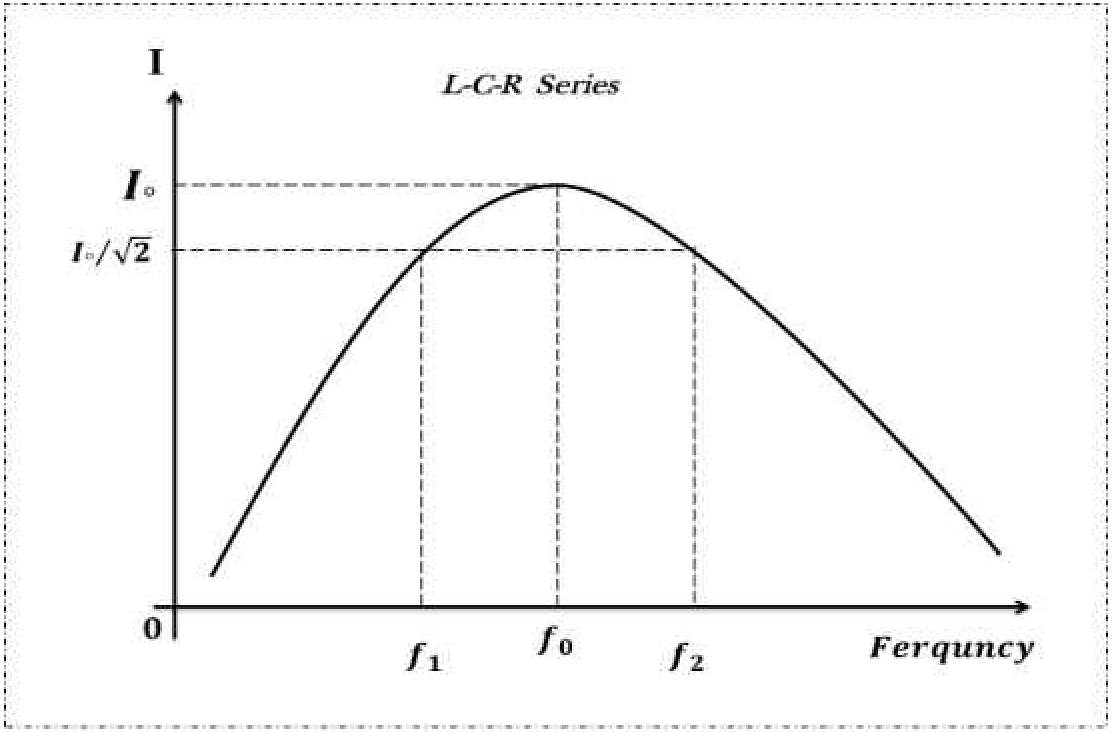
$$Q = \frac{2\pi \ f_{\circ} L}{R}$$

Theory value

Graph & Calculation / Practically

Practically value

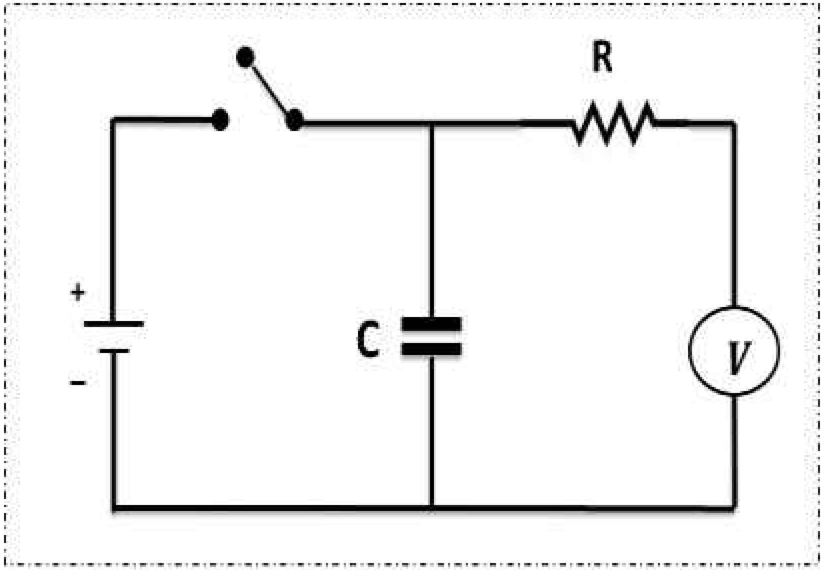
$$slop = Q = \frac{f_{\circ}}{f_2 - f_1}$$

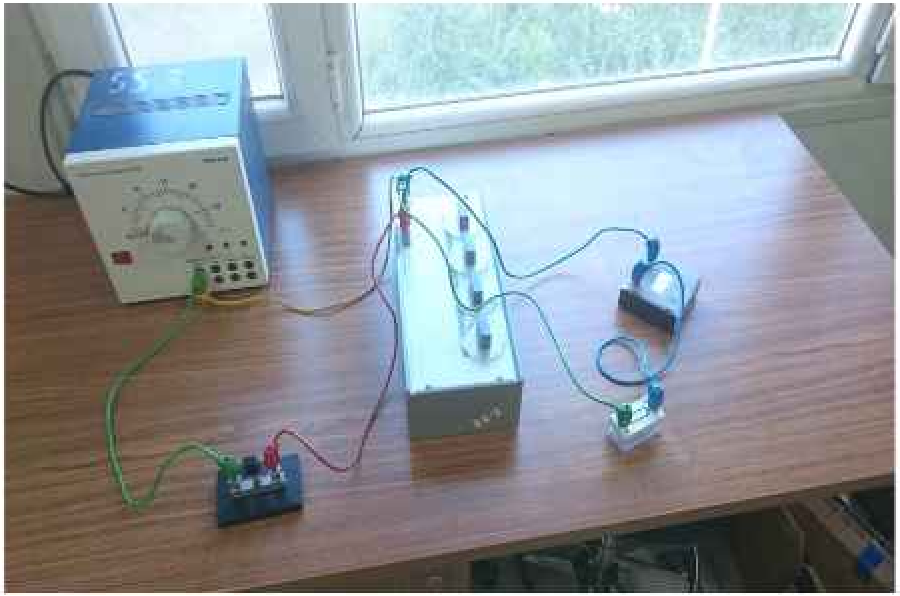


$$Eror\ ratio\ (f_{\circ}) = \left|\frac{theory - practically}{theory}\right| \times 100\%$$

Experiment No. (4)

Time constant for RC-Circuit





Circuit

Experiment No. (4)

Data

$R = 1M\Omega$ | $V0 = 7.04\ v$ | $C = 10\mu F$ | $R_v = 10.04M\Omega$

T/sec	V /v
0	
10	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	

T/sec	V /v
120	
130	
140	
150	
160	
170	
180	
190	
200	
210	
220	

T/sec	V /v
230	
240	
250	

Experiment No. (4)

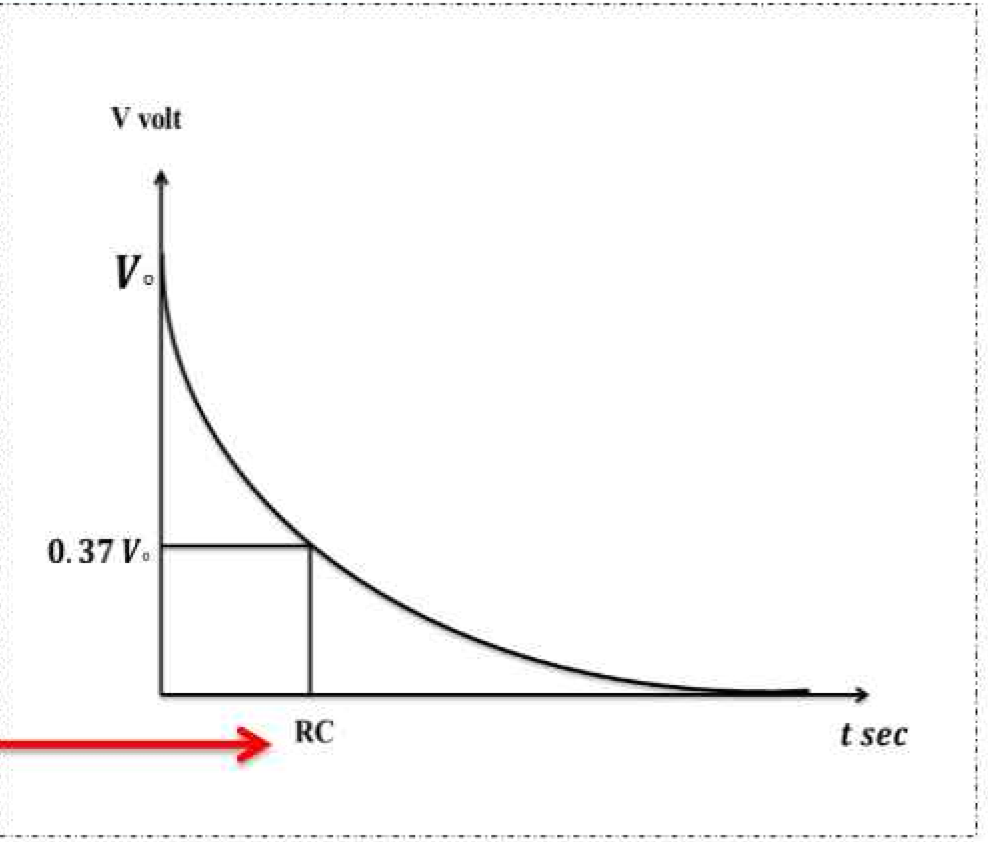
$$\tau = RC = (R + R_v) \times C = ??$$

Theory value

Graph & Calculation / Practically

Practically value

$$slop = RC = \tau$$



$$Eror\ ratio\ (\tau) = \left| \frac{theory - practically}{theory} \right| \times 100\%$$

Experiment No. (4)

$$T_{1/2} = 0.693\,RC$$

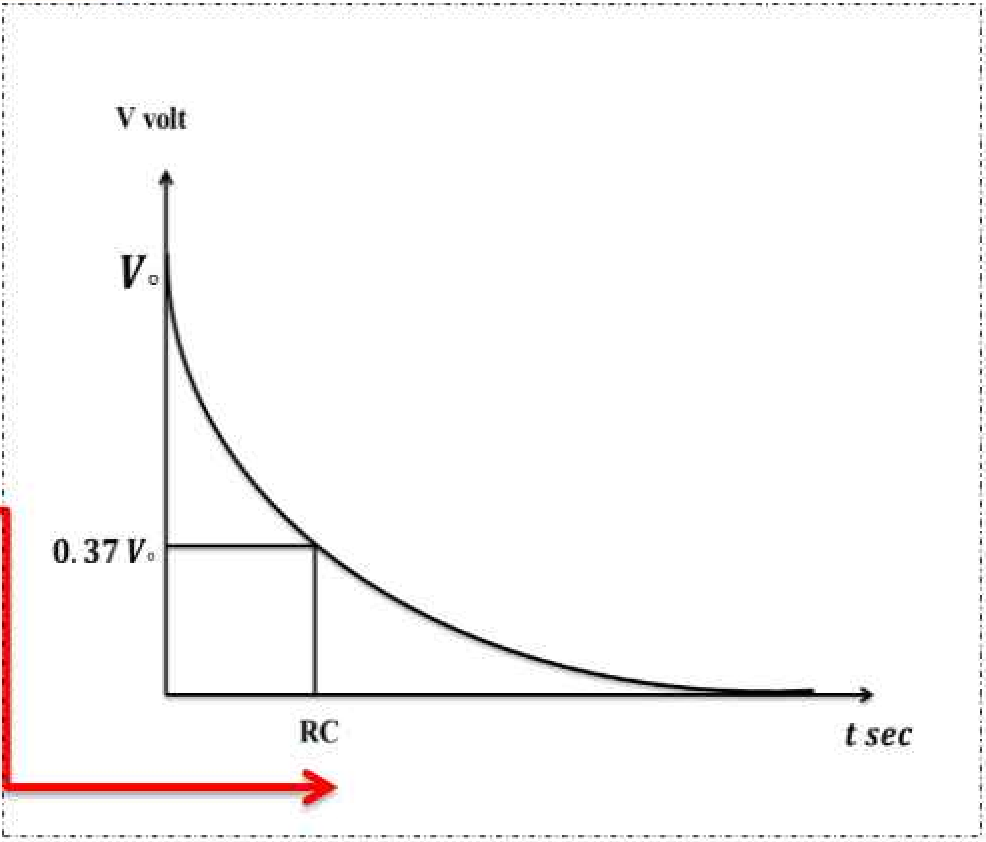
Theory value

Graph & Calculation / Practically

Practically value

$$slop = RC = ??$$

$$T_{1/2} = 0.693\,RC$$



$$Eror\ ratio\ (T_{1/2}) = \left|\frac{theory - practically}{theory}\right| \times 100\%$$

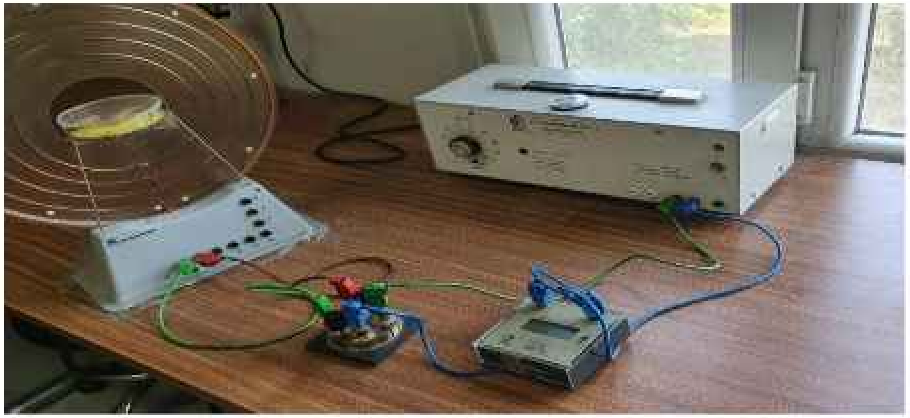
Experiment No. (5)

Experiments with a deflection magnetometer:

To investigate how the magnetic flux density due to the current in a long straight wire varies with

(a) the current in the wire

(b) the distance from the wire



Experiment No. (5)

Data // part 1

D= 8 cm

Current I /Amp	Magnetometer deflections					$\tan\theta$
	θ_1	θ_2	θ_3	θ_4	$Mean\theta^{\circ}$	
0.3						
0.6						
0.9						
1.2						
1.5						
1.8						
2.1						
2.4						
2.7						

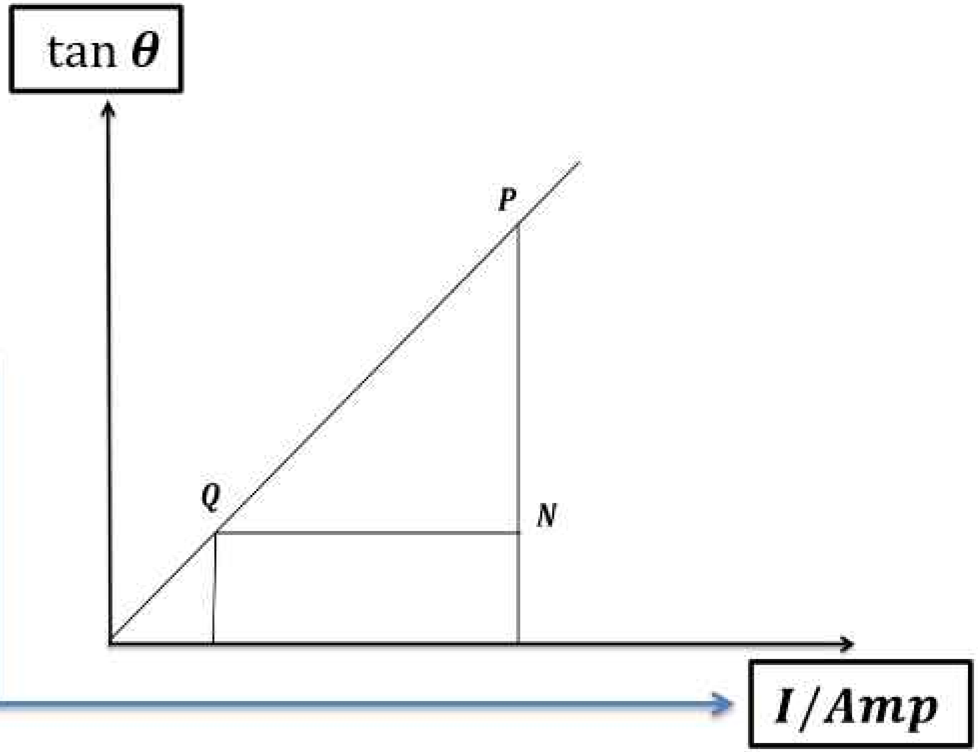
Experiment No. (5)

$$B_{E1} \tan\theta = \frac{\mu_\circ I}{2\pi D}$$

Graph & Calculation / Practically

slope 1

$$slope = \frac{\Delta \tan\theta}{\Delta I}$$



$$slop1 = \frac{1}{slope}$$

$$\therefore B_{E1} = \frac{\mu_\circ}{2\pi \times D} \times slop1$$

Experiment No. (5)

Data // part 2

I= 2.6 Amp.

Distance D/cm	Magnetometer deflections					$\cot\theta$
	θ_1	θ_2	θ_3	θ_4	$Mean\theta^{\circ}$	
8						
10						
12						
14						
16						

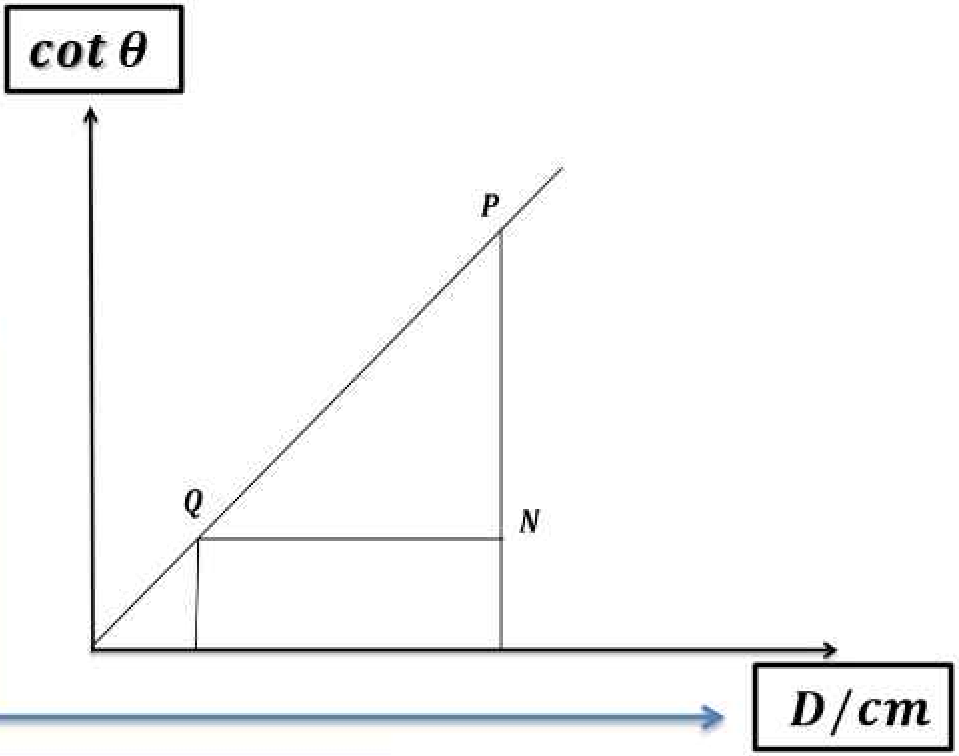
Experiment No. (5)

slope 2

$$D = \frac{\mu_\circ \, I}{2\pi \, B_{E2}} \cot\theta$$

Graph & Calculation / Practically

$$slop2 = \frac{\Delta \cot \theta}{\Delta D}$$



$$\therefore B_{E2} = \frac{\mu_\circ \times I}{2\pi} \times \ slope2$$

$$Eror\ ratio\ (B_E) = \left| \frac{B_{E2} - B_{E1}}{B_{E2}} \right| \times 100\%$$

Thanks