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S. No.	Name of the Experiment	Page No.	Date of Experiment	Date of Submission	Remarks
1.	Photo Devices & Error Analysis		15.11.2021		Nanditha
2.	verification of series & parallel resonance		18.11.2021		
3.	Measurement of inductance by Maxwell's Bridge		22.11.2021		
4.	Torque & force transducers		25.11.2021		
5.	Measurement of self & mutual inductance.		29.11.2021		w.4
6.	Measurement of capacitance by De-Sauty Bridge.		29.11.2021		
7.	verification of Network theorems.		02.12.2021		
8.	Viscosity measurement		06.12.2021		Nanditha
9.	Linear & Angular Displacement		09.12.2021		Seen 11/12/21
10.	Temperature Transducer		09.12.2021		

PHOTO DEVICES AND ERROR ANALYSIS OF SINGLE PHASE ENERGY METER

OBJECTIVE

To study the characteristics of LDR, photodiode and phototransistor.

OBSERVATION

1. Measurement of resistance of LDR for change in source displacement and intensity.

Distance (cm)	Output Resistance (Ω)	
	Up readings	Down Readings
5	3.75	3.7
7	4.8	4.9
9	6.11	6.05

Intensity (LUX)	Output Resistance (Ω)	
	Up readings	Down Readings
595	13.85	13.82
750	9.82	9.67
930	6.71	6.66

2. Measurement of voltage in Photodiode for change in source displacement and intensity.

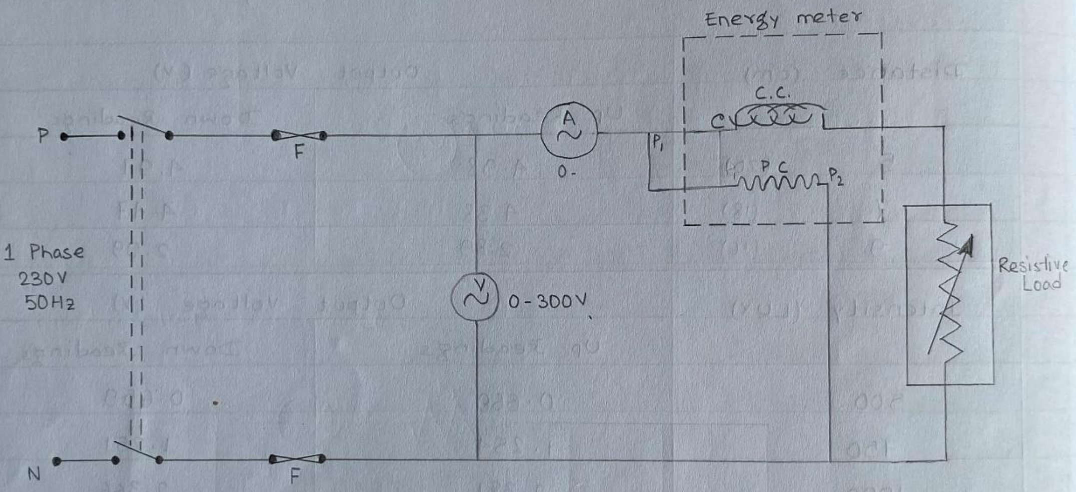
Distance (cm)	Output Voltage (V)	
	Up Readings	Down Readings
5 (20)	0.970	0.964
7 (18)	0.637	0.618
9 (16)	0.436	0.437

Intensity (LUX)	Output Voltage (V)	
	Up Readings	Down Readings
750	0.334	0.331
900	0.457	0.464
1200	0.884	0.846

3. Measurement of voltage in Phototransistor for change in source displacement and intensity.

Distance (cm)		Output Voltage (V)	
		Up Readings	Down Readings
5	(20)	4.98	4.97
7	(18)	4.38	4.47
9	(16)	2.89	2.99

Intensity (LUX)	Output Voltage (V)	
	Up Readings	Down Readings
500	0.669	0.659
750	1.254	1.251
1000	2.381	2.366



Energy meter
C.C.
C
P1
PC
P2
P
N
F
F
A
0-
V
0-300V
1 Phase
230V
50Hz
Resistive Load

Expt. No.

Date

Page No. 05

ERROR ANALYSIS OF SINGLE PHASE ENERGY METER

OBJECTIVE

To study the characteristics of single phase energy meter at unity power factor.

TABULAR COLUMN

1. Energy Meter constant, K = 600 rev/kWh

2. Recorded Energy (RE) for 10 revolutions $= \frac{10 \times 3600 \times 1000}{K}$

$= 6 \times 10^4$ watt-sec

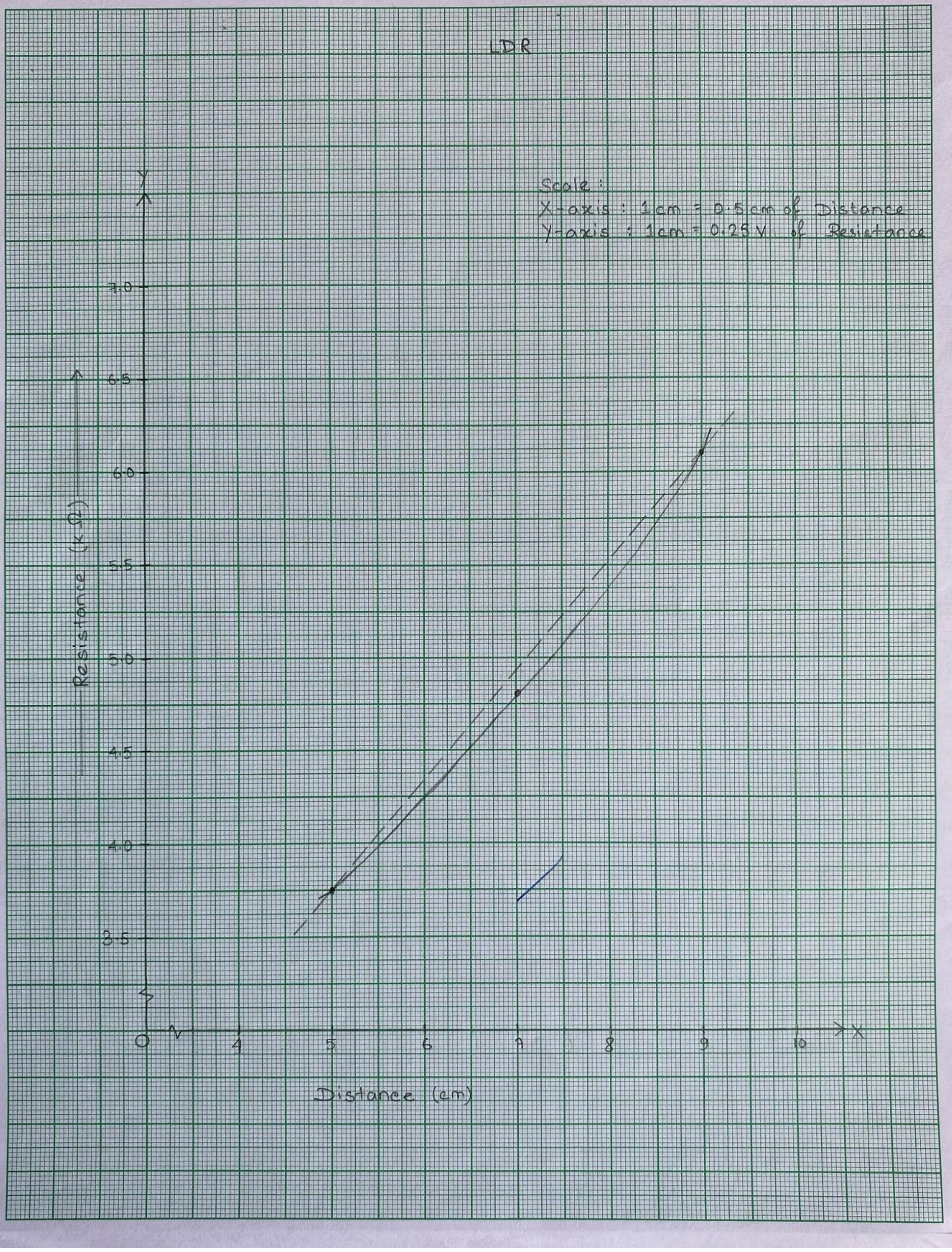
Trial No.	Load Current I (A)	Supply Voltage V (V)	Time for 10 revolutions 't' (secs)	True Energy = (VIcosϕt) (watt-secs)	Percentage (%) error $= \frac{RE - TE}{RE} \times 100$
1.	1.1	120	505	66660	−11.1
2.	1.6	120	330	63360	−5.6
3.	2.15	120	235	60630	−1.05
4.	2.7	120	185	59940	+0.1
5.	3.2	120	164	62976	−4.96

CONCLUSIONS

Given meter has an average error of −4.522%.

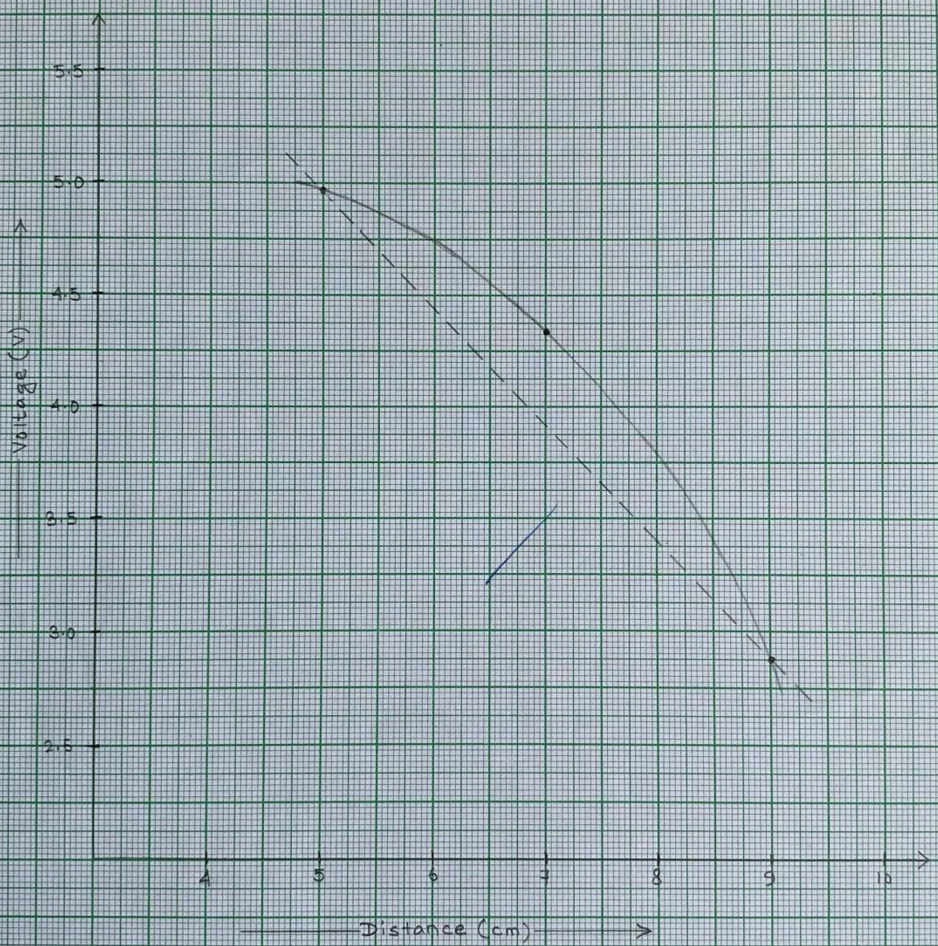
Nandhini
18/11/2021

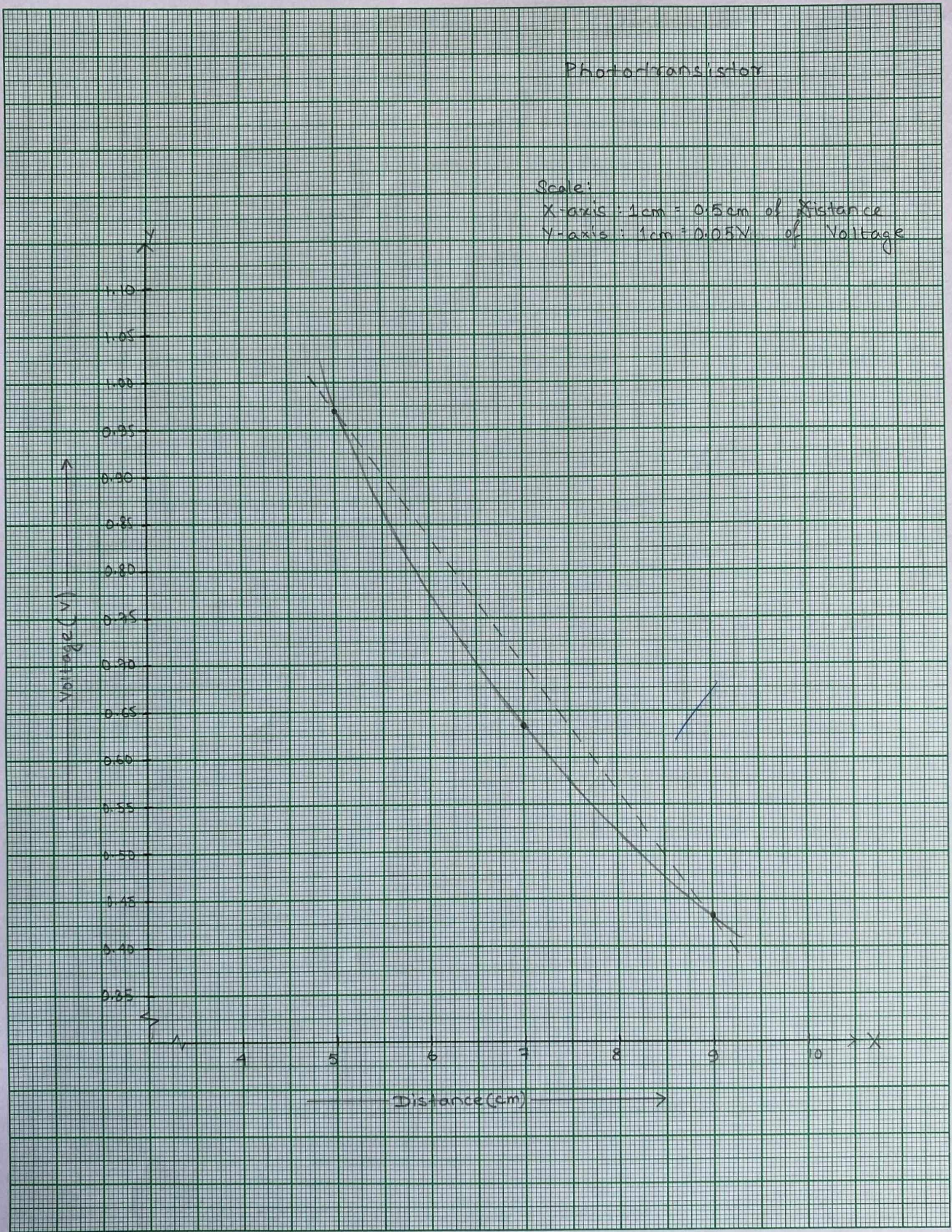
Teacher's Signature


LDR
Scale :
X-axis : 1cm = 0.5 cm of Distance
Y-axis : 1cm = 0.25 V of Resistance
Resistance (kΩ)
Distance (cm)
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
O
4
5
6
7
8
9
10
X
Y

Photodiode

Scale:
X-axis : 1cm = 0.5cm of Distance
Y-axis : 1cm = 0.25 V of Resistance




Photortransistor
Scale:
X-axis : 1cm = 0.5cm of Distance
Y-axis : 1cm = 0.05V of Voltage
Y
1.10
1.05
1.00
0.95
0.90
0.85
0.80
0.75
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
Voltage (V)
4
5
6
7
8
9
10
X
Distance (cm)

VERIFICATION OF SERIES AND PARALLEL RESONANCE

OBJECTIVE

To observe series and parallel resonance for the given RLC circuit and obtain the frequency response.

FORMULA TO BE USED

Resonant frequency (theoretically), $F_r = \frac{1}{2\pi\sqrt{LC}}$ KHz

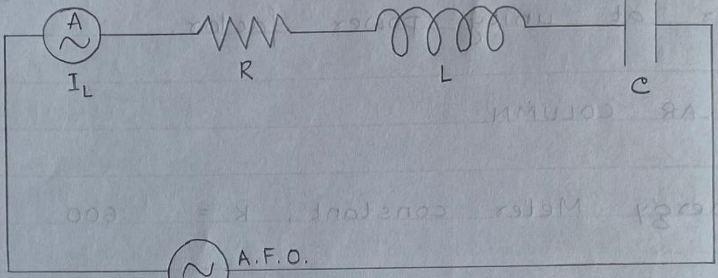
TABULAR COLUMN

Series Resonance

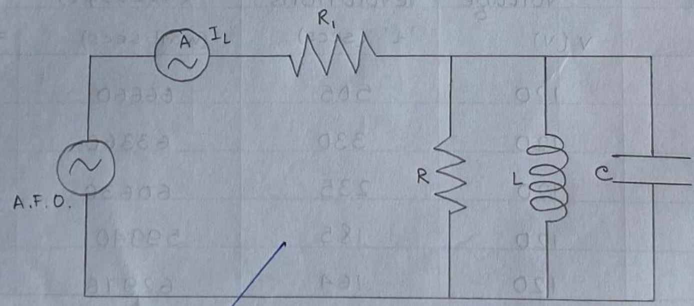
Frequency (Hz)	Current (mA)	$X_L = 2\pi f L$ (Ω)	$X_C = 1/2\pi f C$ (Ω)	$Z = \lvert R + j(X_L - X_C)\rvert$ (Ω)
200	0.22	25.13	795.77	777.10
300	0.35	37.67	530.52	502.90
400	0.48	50.26	397.89	361.47
500	0.62	62.83	~~398~~ 318.31	274.35
600	0.76	75.39	265.26	214.59
700	0.90	87.96	227.36	171.56
800	1.02	100.53	198.94	140.30
900	1.11	113.10	176.84	118.59
1000	1.17	125.663	159.235	105.47
1100	1.19	138.16	144.7596	100.208
1200	1.17	150.72 ~~125.663~~	132.6963 ~~159.235~~	101.64
1300	1.13	163.36	122.43	108.05
1400	1.07	175.92	113.68	117.79

CIRCUIT DIAGRAM

(i) Series Resonance



(ii) Parallel Resonance.



$L_R = 0.02530$ H
C = 1 μF

Date

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1500	1.01	188.50	106.10	129.57
2000	0.74	251.33	79.58	198.74
2500	0.56	314.16	63.66	269.72
3000	0.44	376.98	53.05	339.02
4000	0.29	502.4	39.80	473.28
4500	0.24	565.2	35.38	539.17
5000	0.20	628	31.84	604.48

L = 20 mH ; R = 100 Ω ; C = 1 μF

Parallel Resonance

L = 20 mH

C = 1 μF

R_s = 100 Ω ; R_p = 300 Ω

Frequency (Hz)	Current (mA)	$X_L = 2\pi f L$ (Ω)	$X_C = \frac{1}{2\pi f C}$ (Ω)	$P = \frac{1}{R} + j\left(\frac{1}{X_L} - \frac{1}{X_C}\right)$ (℧)	$Z = \frac{1}{\lvert P \rvert}$
200	0.96	25.12	796.17	0.038	26.32
300	0.91	37.68	530.78	0.025	40
400	0.85	50.24	398.08	0.0178	56.2
500	0.77	62.8	318.47	0.0134	74.6
600	0.68	75.38	265.39	0.0101	99.0
700	0.60	87.92	227.47	0.0078	128.2
800	0.51	100.48	199.04	0.0060	166.7
900	0.44	113.04	176.92	0.0046	217.4
1000	0.39	125.6	159.235	0.0037	270.3
1100	0.38	138.16	144.759	0.0033	303.0
1200	0.40	150.72	132.696	0.0034	294.1
1300	0.43	163.28	122.48	0.0038	263.2

Teacher's Signature

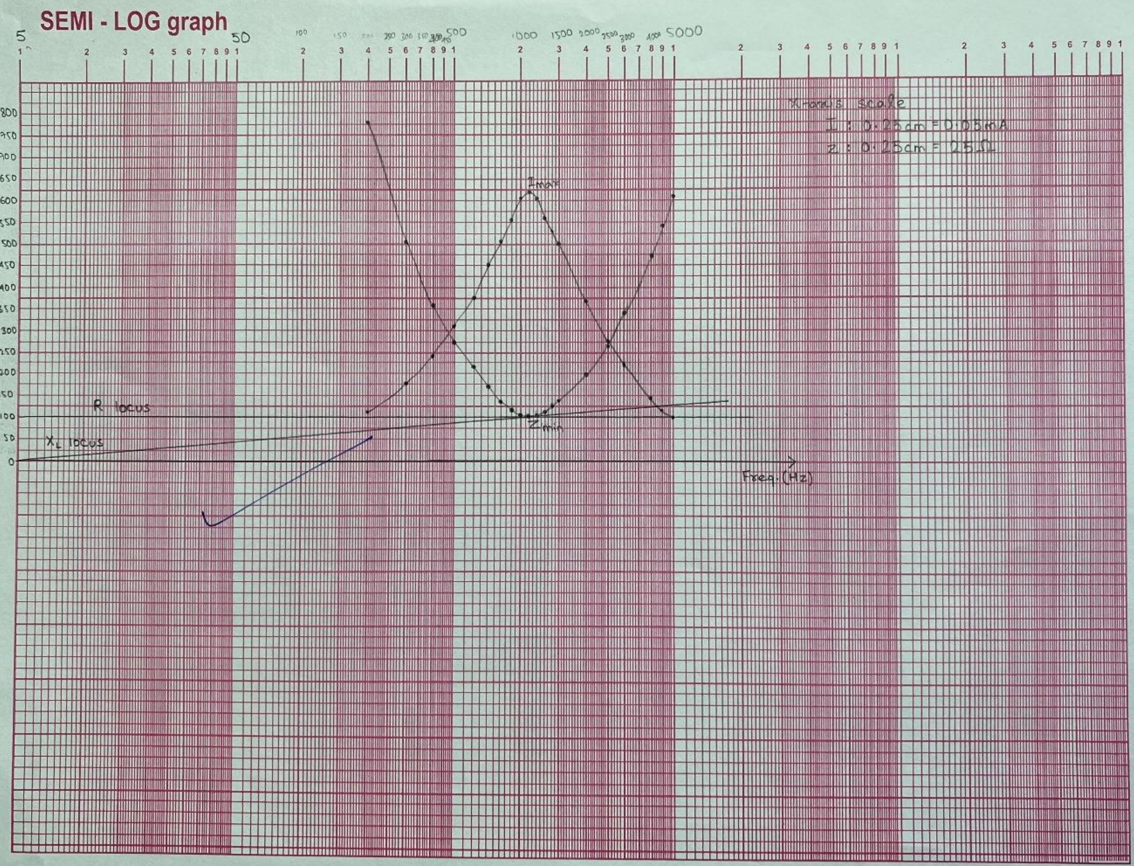
1400	0.48	175.84	113.73	0.0045	222.2
1500	0.53	188.4	106.15	0.0052	192.3
2000	0.72	251.2	79.61	0.0091	109.9
2500	0.84	314	63.69	0.0130	76.92
3000	0.90	376.8	53.07	0.0160	62.5
3500	0.94	502.4	39.80	0.0260	38.46
4000	0.96	565.2	35.38	0.0270	37.04
5000	0.99	628	31.84	0.0300	33.3

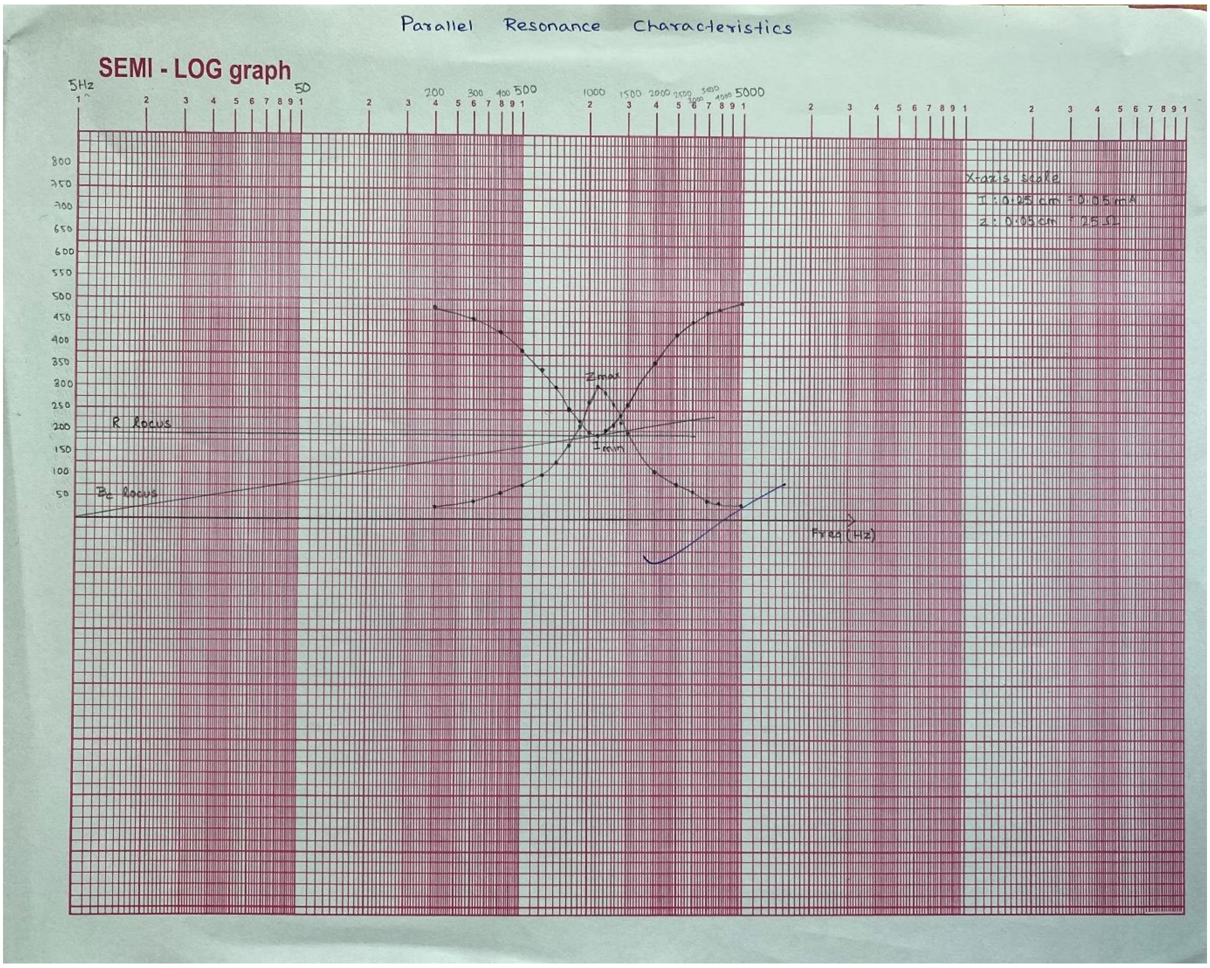
CONCLUSION

1. Series resonance occurs at 1100 Hz.
2. Parallel resonance occurs at 1100 Hz.

28/11

Series Resonance Characteristics





Parallel Resonance Characteristics
SEMI - LOG graph
X-axis scale
I : 0·25 cm = 0·05 mA
z : 0·05 cm = 25 Ω
Zmax
Imin
R locus
R_L locus
Freq (Hz)

Expt. No. 02

Page No. 11

Date

MEASUREMENT OF INDUCTANCE BY MAXWELL'S BRIDGE

OBJECTIVE

To measure the (a) inductance of the given inductor using Maxwell's bridge

TABULAR COLUMN

Frequency of supply from Oscillator, 'f' = Hz

Trial No.	R_2 (Ω)	R_3 (Ω)	R_4 ($k\Omega$)	C_4 (F)	$R_x = \frac{R_2 \times R_3}{R_4}$ (Ω)	$L_x = R_2 R_3 C_4$ (H)	$Q = \frac{\omega L_x}{R_x} = \omega C_4 R_4$	Time constant $\tau = L_x/R_x$ (S)	Power factor of coil $\cos\phi = \frac{R_x}{\sqrt{R_x^2 + (\omega L_x)^2}}$
1.	200	200	7.6kΩ	0.6μF	5.26Ω	24mH	6.84	4.56×10^{-3}	0.1446
2.	200	400	16kΩ	0.3μF	5.00Ω	24mH	7.2	4.8×10^{-3}	0.1376

RESULTS

(1) DC resistance of the given coil = 5.13Ω

(2) Average Quality factor of the coil = 7.02

(3) τ of given coil = 4.68×10^{-3} s

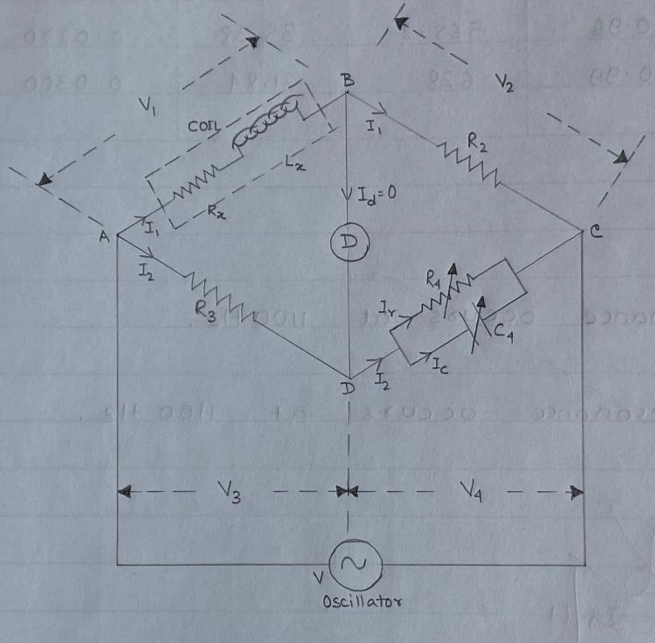
(4) Power factor of the given coil = 0.1411

CONCLUSION :

Using Maxwell's bridge, the inductance of the given inductor was measured. And hence DC resistance, average Quality factor, time constant and power factor of the given coil were found.

Teacher's Signature

Circuit Diagram of Maxwell's bridge :



TORQUE AND FORCE TRANSDUCERS

A. TORQUE TRANSDUCERS

OBJECTIVE

To study the characteristics of the developed torque due to load applied to the beam and the bridge output in millivolts.

FORMULA TO BE USED : (for radial distance = 1 meter)

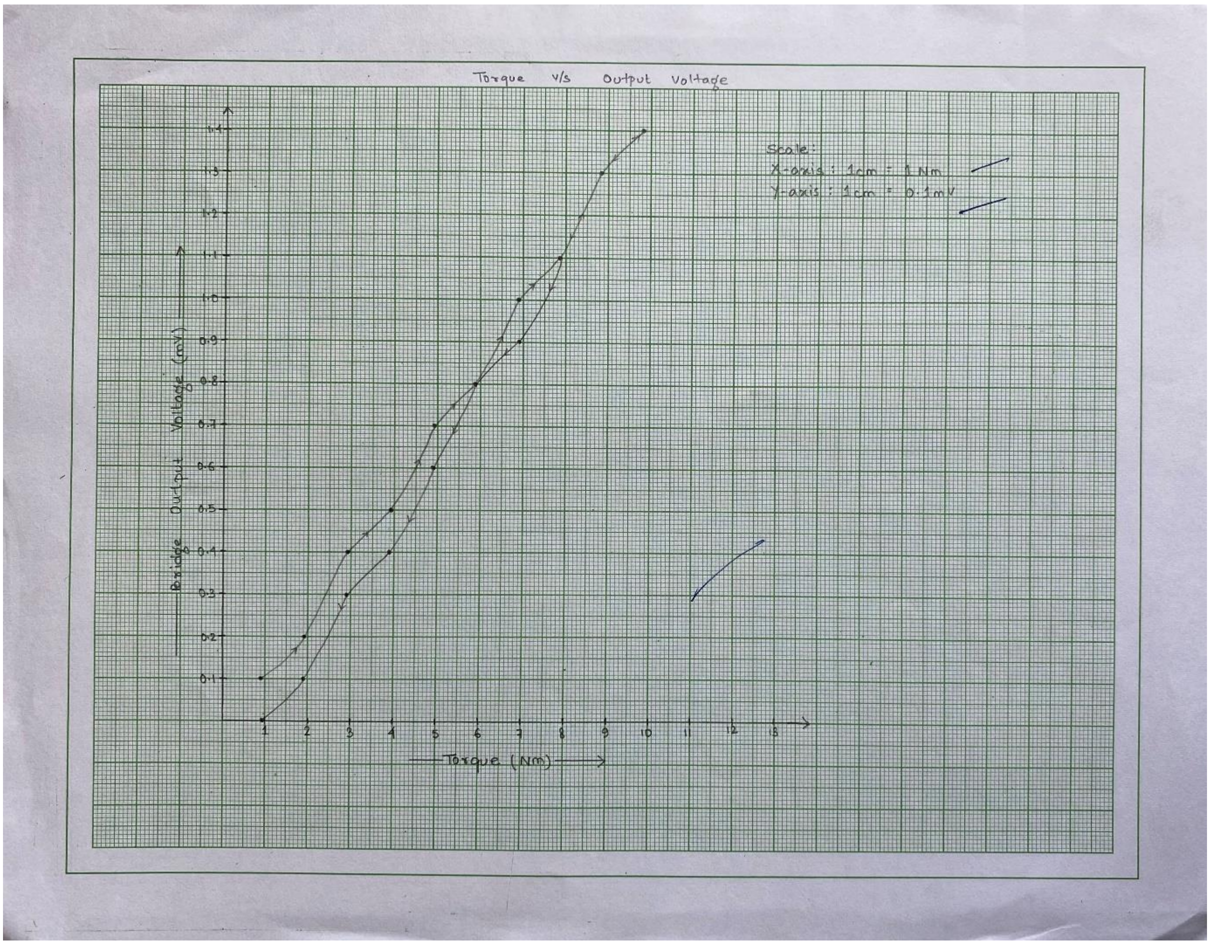
Theoretical torque = mass (m) * acceleration due to gravity (g) * radial distance (x)

= 1 kg * 9.81 m/s² * 1 m = 9.81 Nm

TABULAR COLUMN

Trial No.	Theoretical Torque (Nm)		Bridge Output Voltage (mV)	
			Loading	Unloading
1.	(100g × 1 × 9.81)	0.981	0.1	0
2.	(200g × 1 × 9.81)	1.962	0.2	0.1
3.	(300g × 1 × 9.81)	2.943	0.4	0.3
4.	(400g × 1 × 9.81)	3.924	0.5	~~0.9~~ 0.4
5.	(500g × 1 × 9.81)	4.905	0.7	0.6
6.	(600g × 1 × 9.81)	5.886	0.8	0.8
7.	(700g × 1 × 9.81)	6.867	~~1m~~ 1.00	0.9
8.	(800g × 1 × 9.81)	7.848	1.1	1.1
9.	(900g × 1 × 9.81)	8.829	1.3	1.3
10.	(1000g × 1 × 9.81)	9.81	1.4	1.4

Teacher's Signature


Torque v/s Output Voltage
Scale:
X-axis : 1cm = 1 Nm
Y-axis : 1cm = 0.1mV
Bridge Output Voltage (mV)
Torque (Nm)
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
1
2
3
4
5
6
7
8
9
10
11
12
13

Date

Expt. No.

OBJECTIVE

To study the characteristics of the developing torque and the signal conditioned sensor output voltage (for radial distance = 1 meter).

FORMULA TO BE USED

$$\%e = \frac{\text{Actual torque} - \text{Theoretical torque}}{\text{Actual torque}} \times 100$$

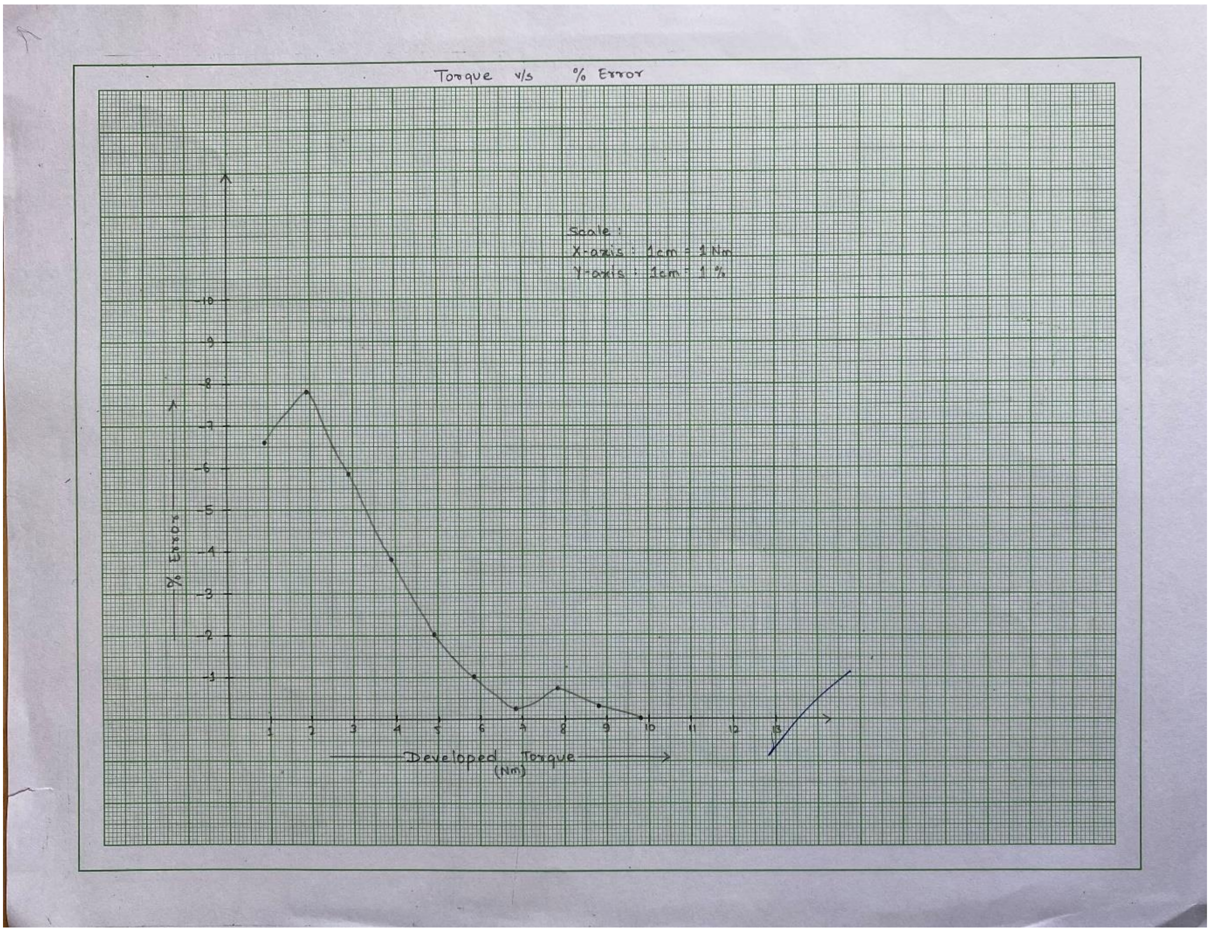
TABULAR COLUMN

Trial No.	Theoretical Torque (Nm)	Signal conditioning voltage (V)	Actual Torque (Nm)	% Error
1.	0.981	0.3	0.92	-6.6%
2.	1.962	0.8	1.82	-7.8%
3.	2.943	1.3	2.78	-5.86%
4.	3.924	1.8	3.78	-3.81%
5.	4.905	2.4	4.80	-2.08%
6.	5.886	2.7	5.80	-1.04%
7.	6.867	3.4	6.85	-0.24%
8.	7.848	3.9	7.79	-0.75%
9.	8.829	4.4	8.80	-0.32%
10.	9.81	4.98	9.81	0%

CONCLUSION

Characteristics of the developed torque due to load applied to beam and bridge output in mV were observed using graphs.

Teacher's Signature



Torque v/s % Error
Scale :
X-axis : 1cm = 1 Nm
Y-axis : 1cm = 1 %
% Error
-10
-9
-8
-7
-6
-5
-4
-3
-2
-1
1
2
3
4
5
6
7
8
9
10
11
12
13
Developed Torque
(Nm)

Date 29.11.2021

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MEASUREMENT OF SELF AND MUTUAL INDUCTANCE

OBJECTIVE

To measure the self and mutual inductances of the given inductive coils.

TABULATION & CALCULATIONS

(i) To find DC resistances of the two coils

COIL - 1			COIL - 2		
V_1 Volts	I_1 Amp	$r_1 = \frac{V_1}{I_1}$ Ω	V_2 Volts	I_2 Amp	$r_2 = \frac{V_2}{I_2}$ Ω
1	0.12	8.3	1	0.12	8.3
2	0.25	8	2	0.25	8.0
3	0.37	8.1	3	0.38	7.9

R_1 = Avg of r_1 = 8.1 Ω ; R_2 = avg of r_2 = 8.00 Ω

(ii) To find self inductances of the two coils

COIL - 1

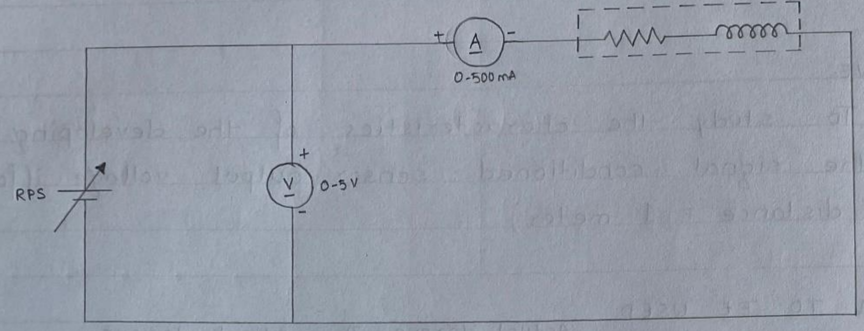
V_1 Volts	I_1 Amp	$Z_1 = \frac{V_1}{I_1}$ (Ω)	$X_{L1} = \sqrt{Z_1^2 - R_1^2}$ (Ω)	$L_1 = \frac{X_{L1}}{2\pi f}$ (H)
10	0.92	10.86	7.23	0.023
20	1.46	13.69	11.03	0.035
30	1.94	15.30	12.9	0.041

Avg. self inductance = 0.033 H

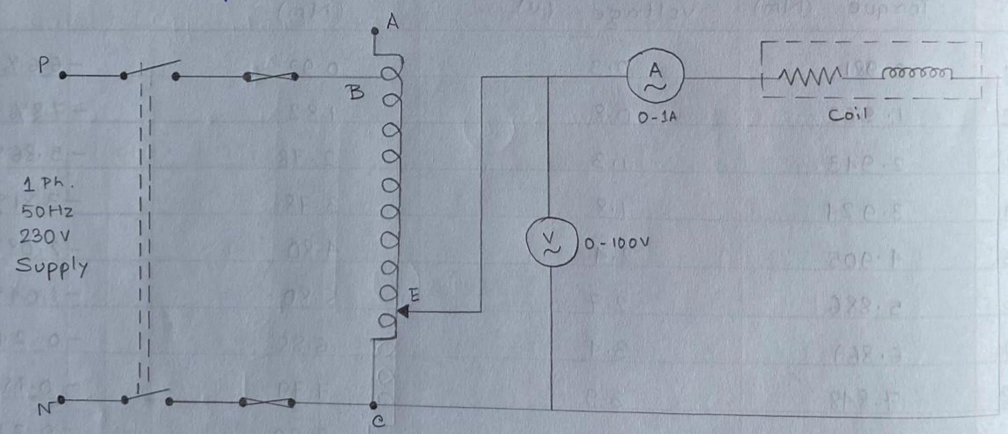
Teacher's Signature

Circuit Diagram :

(i) To find DC resistances of the coil

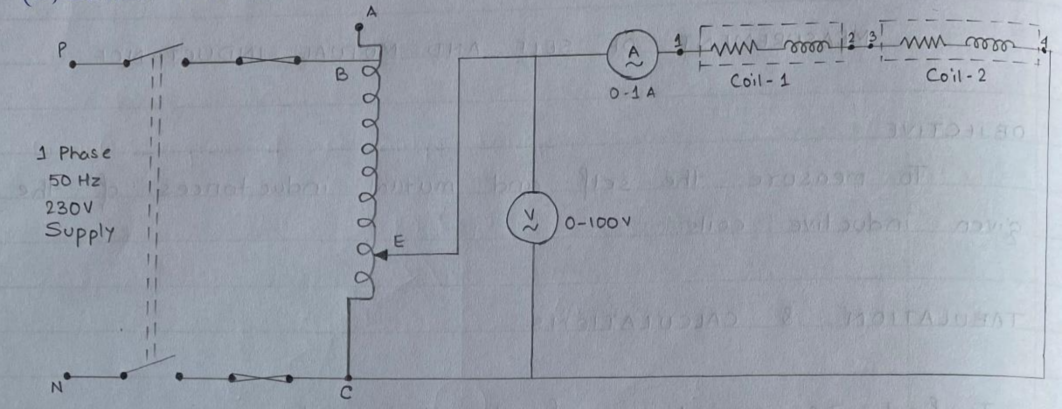


(ii) To find self-inductances of the coil

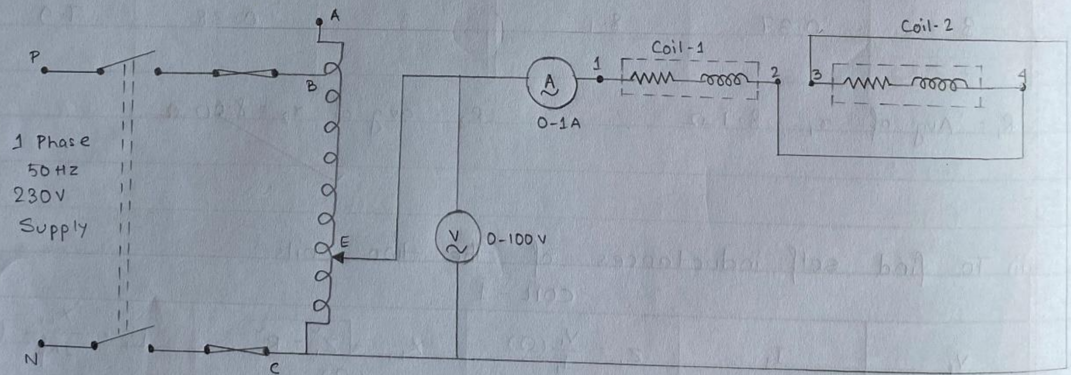


(iii) To find mutual inductance between the two coils.

(a) Series Addition:



(b) Series Opposition



CALCULATIONS

i. $X_{L_1} + X_{L_2} - 2\omega M = \sqrt{(Z_2')^2 - (R_1 + R_2)^2} = m_1 = 29.73$ —(i)

ii.) $X_{L_1} + X_{L_2} - 2\omega M = \sqrt{(Z_2')^2 - (R_1 + R_2)^2} = m_2 = 9.15$ —(ii)

From (i) & (ii): $4\omega M = m_1 - m_2$

$$M = \frac{m_1 - m_2}{4\omega} = \frac{m_1 - m_2}{8\pi f}$$

$M = 0.016\ H$

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COIL - 2

V_2 Volts	I_2 Amp	$Z_2 = \frac{V_2}{I_2}$ (Ω)	$X_{L2} = \sqrt{Z_2^2 - R_2^2}$ (Ω)	$L_2 = \frac{X_{L2}}{2\pi f}$ (H)
10	0.52	10.86	7.34	0.023
20	1.48	13.51	10.82	0.034
30	1.94	15.46	13.23	0.042

Avg. self inductance = 0.033 H

(iii) To find mutual inductance between the two coils

Series Addition			Series Opposition		
V_1' Volts	I_1' Amps	$Z_1 = \frac{V_1'}{I_1}$ (Ω)	V_2' Volts	I_2' Amps	$Z_2' = \frac{V_2'}{I_1'}$ (Ω)
10	0.35	20.57	10	0.66	15.15
20	0.51	39.21	20	1.02	19.60
30	0.72	41.66	30	1.44	20.83

RESULTS

1. Self inductance of coil 1 = 0.033 H
2. self inductance of coil 2 = 0.033 H
3. Mutual inductance between 2 coils = 0.016

CONCLUSIONS

self inductance of both coils are 0.033H.
Mutual inductance of coils is 0.016 H.

Teacher's Signature ______

10.9
02/12/21

Date 29.11.2021

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MEASUREMENT OF CAPACITANCE BY DE-SAUTY BRIDGE

OBJECTIVE

To measure the capacitance of the given capacitor using De Sauty's bridge.

TABULAR COLUMN

Frequency of supply from Oscillator, 'f' = Hz

Trial No.	R_1 (Ω)	R_2 (Ω)	R_3 (Ω)	R_4 (Ω)	C_2 (μF)	$R_x = \left(\frac{R_2 \times R_1}{R_4}\right) - R_1$ (Ω)	$C_x = \left(\frac{R_4}{R_3}\right) \times C_2$ (μF)	Dissipation Factor $D = \omega C_x R_x$
1.	400	200	600	300	3	0	2	0
2.	400	400	400	400	2.15	0	2	0
3.	200	100	200	100	40	0	1.5	0
4.	200	200	200	200	2.1	0	1.5	0

RESULTS

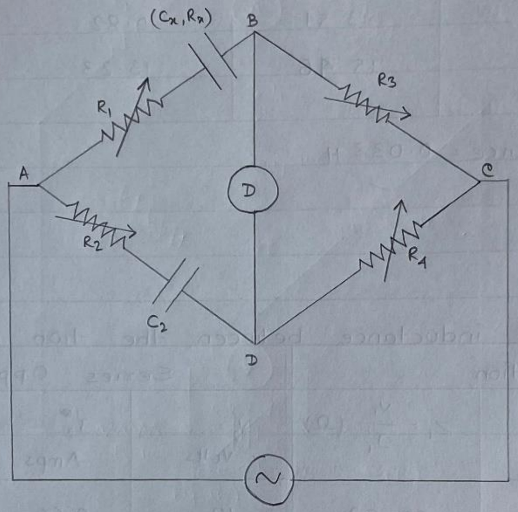
1. DC resistance of the unknown capacitor = Ω ?
2. Capacitance of the unknown capacitor = μF
3. Dissipation factor of the given coil =

CONCLUSION

DC resistance and capacitance of the unknown ~~resistor~~ capacitor and dissipation factor of the given coil were found.

Teacher's Signature

Circuit Diagram of De sauty's Bridge :



VERIFICATION OF NETWORK THEOREMS

OBJECTIVE

To verify (a) Thevenin's theorem, (b) Maximum power transfer theorem, (c) Superposition theorem & (d) Reciprocity as applied to electric circuits.

(b) Maximum Power Transfer Theorem

For the circuit shown in Fig. 1(b), replace R_L with decade resistance box and vary the value of resistance measuring corresponding voltage and current across it.

V_{th} = R_{th} =

Trial No.	V (Volts)	I_L' in (mA)	$R_L = \frac{V}{I_L}$ (Ω)	$P = (I_L^2 R_L)$ (mW)
1.	0.078	0.7	100	49
2.	0.15	0.7	200	98
3.	0.21	0.66	300	130
4.	0.38	0.59	500	174.05
5.	0.56	0.51	1000	260
6.	0.72	0.43	1500	277.35
7.	0.85	0.37	2000	273.8
8.	0.89	0.36	2200	285.12
9.	0.95	0.33	2500	272.25
10.	1.03	0.30	3000	270

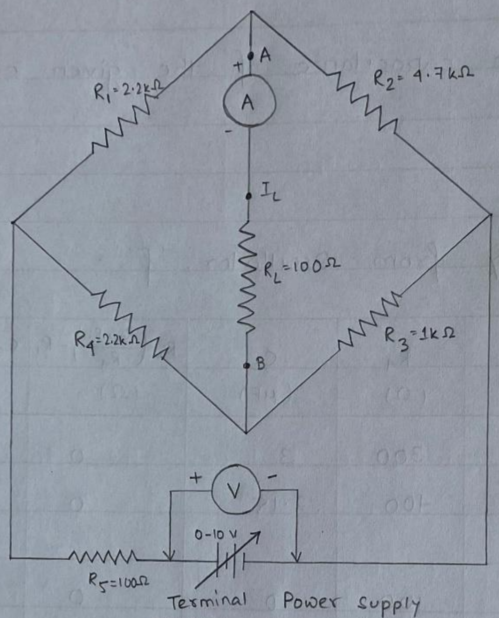
R_1 = ——

R_L = ——

Teacher's Signature ________

(a) Verification of Thevenin's theorem

(i) To find Load current in the circuit



$V = 5V$

$I_L = 0.73mA$

$V_{Th} = 1.75V$

$R_{Th} = 2.17k\Omega$

Verification

$I_L' = 0.73mA$ ✓

Fig: 1(a)

(ii) To find load current from Thevenin's equivalent circuit

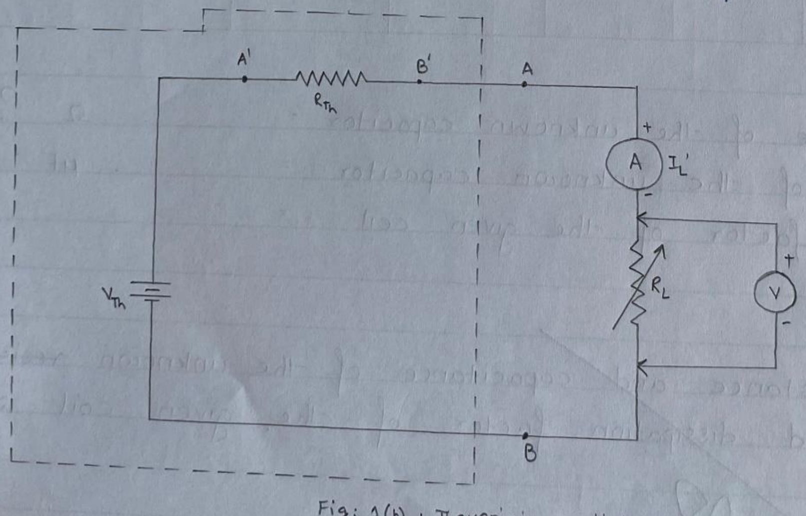
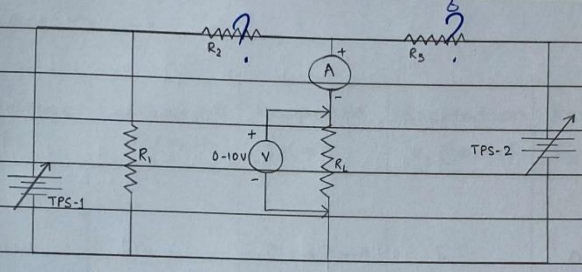


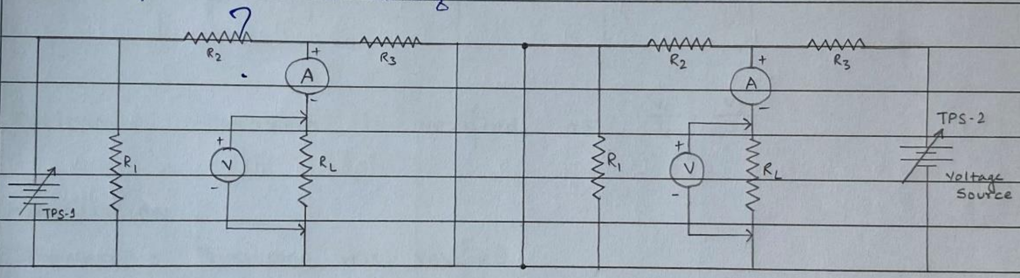
Fig: 1(b) : Thevenin's Equivalent Circuit

(C) Superposition theorem

(i) With both energy sources acting



(ii) With only one source acting :



Tabular Column

Supply Voltage		Both sources acting		Source 1 acting		Source 2 acting		$V_1 + V_2$	$I_1 + I_2$
TPS-1	TPS-2	V (Volts)	I (mA)	V_1 (Volts)	I_1 (mA)	V_2 (Volts)	I_2 (mA)	(Volts)	(Amps)
8	3	0.389	3.9	0.105	1.02	0.283	2.86	0.388	3.88
9	4	0.497	5.04	0.120	1.17	0.377	3.81	0.497	4.98

Superposition theorem is verified as $V = V_1 + V_2$ & $I = I_1 + I_2$

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(d) Reciprocity theorem

Tabular Column

Supply Voltage (TPS)	Excitation V_1 (Volts)	Response I_1 (mA)	Excitation V_2 (Volts)	Response I_2 (mA)	$\frac{V_1}{I_1}$ (Ω)	$\frac{V_2}{I_2}$ (Ω)
5	5	0.42mA	5	0.42	11.90	11.90
7	7	0.60 mA	7	0.6	11.66	11.66

Reciprocity theorem is verified as $\frac{V_1}{I_1} = \frac{V_2}{I_2}$

CONCLUSION

(a) Thevenin's Theorem was verified

(b) Maximum Power Transfer Theorem was verified using a graph.

(c) Superposition theorem was verified as $V = V_1 + V_2$ & $I = I_1 + I_2$

(d) Reciprocity theorem was verifed as $\frac{V_1}{I_1} = \frac{V_2}{I_2}$

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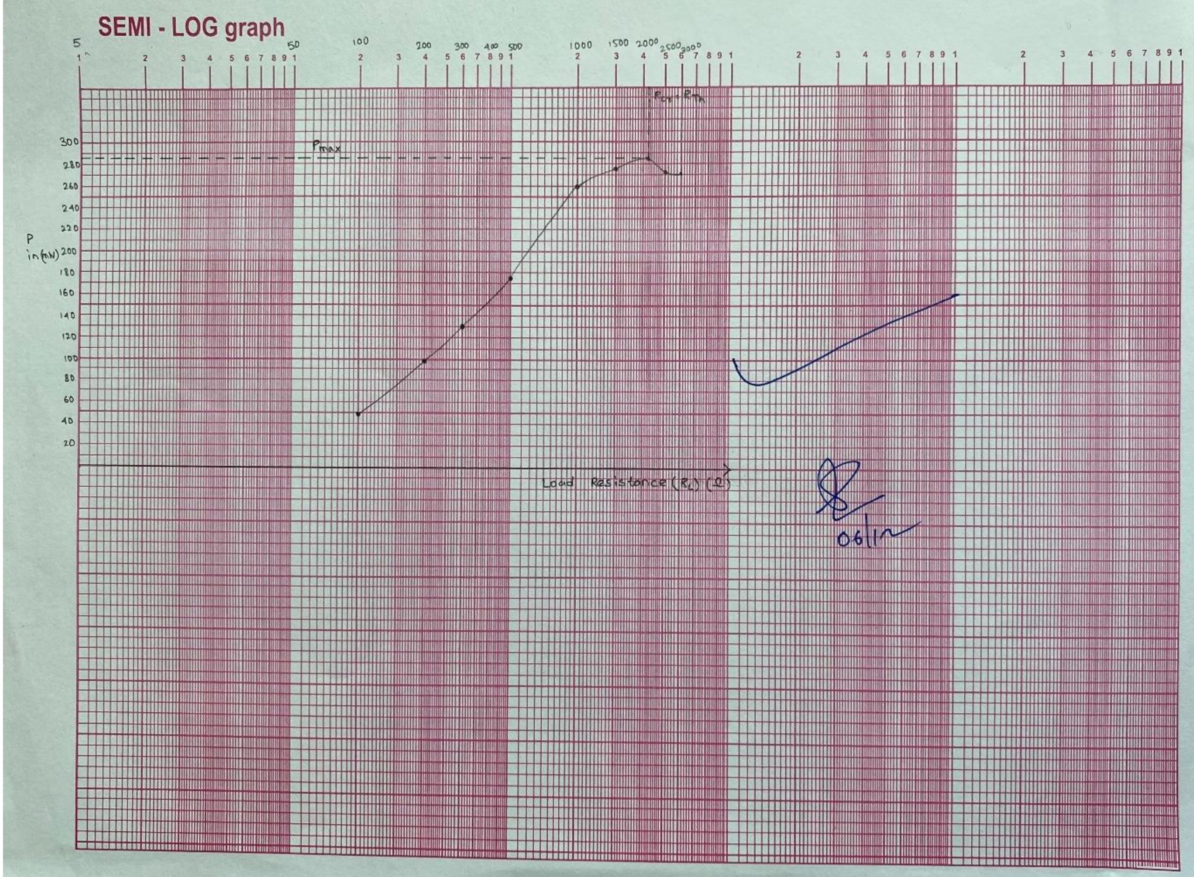
Sudipta Basak.

Maximum Power Transfer Theorem



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Date

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VISCOSITY MEASUREMENT

OBJECTIVE

To measure the Kinematic viscosity of the oil sample.

FORMULA TO BE USED

For $t < 100s$ $\nu = 0.00226t - 1.95/t$

For $t > 100s$ $\nu = 0.00220t - 1.35/t$

TABULAR COLUMN

Trial No.	Temperature (°C)	Time 't' (sec)	Kinematic viscosity (Stokes)
1.	30	87	0.174
2.	40	80	0.156
3.	50	69	0.128
4.	60	58	0.097
5.	70	51	0.077

Volume of oil in flask at the end of the reading = 60ml

Nanditha 9/12/2021

CONCLUSION

The kinematic viscosity of the oil sample was found.

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LINEAR AND ANGULAR DISPLACEMENT TRANSDUCER

OBJECTIVE

To analyze the characteristics of Capacitive transducer, Resistive transducer for variation in displacement.

TABULAR COLUMN :

Measurement of linear displacement using potentiometer

Distance (mm)	Output ~~Voltage (V)~~ Resistance (kΩ)	
	Up readings (kΩ)	Down readings (kΩ)
0	9.95	9.98
10	8.93	9.0
20	8.80	7.99
30	7.07	7.04
40	6.07	6.04
50	5.03	5.14
60	4.08	4.08
70	3.120	3.057
80	2.133	2.043
90	1.199	1.199

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Measurement of angular displacement using capacitive transducer

Angle	Output capacitance (nF)	
	Up readings	Down readings
20	1.290	1.293
40	1.260	1.272
60	1.248	1.251
80	1.220	1.221
100	1.199	1.199

Measurement of linear displacement using ultrasonic transducer

Distance (mm)	Output voltage (V)	
	Up readings	Down Readings
100	0.534	~~0.0~~ 0.559
200	1.046	1.070
300	1.536	1.566
400	2.058	2.078
500	2.560	2.590
600	3.078	3.094
700	3.614	3.60
800	4.10	4.11
900	4.6	4.62
1000	5.02	5.02

CONCLUSION

Linear displacement using potentiometer, ultrasonic transducer and angular displacement using capacitive transducer were found.

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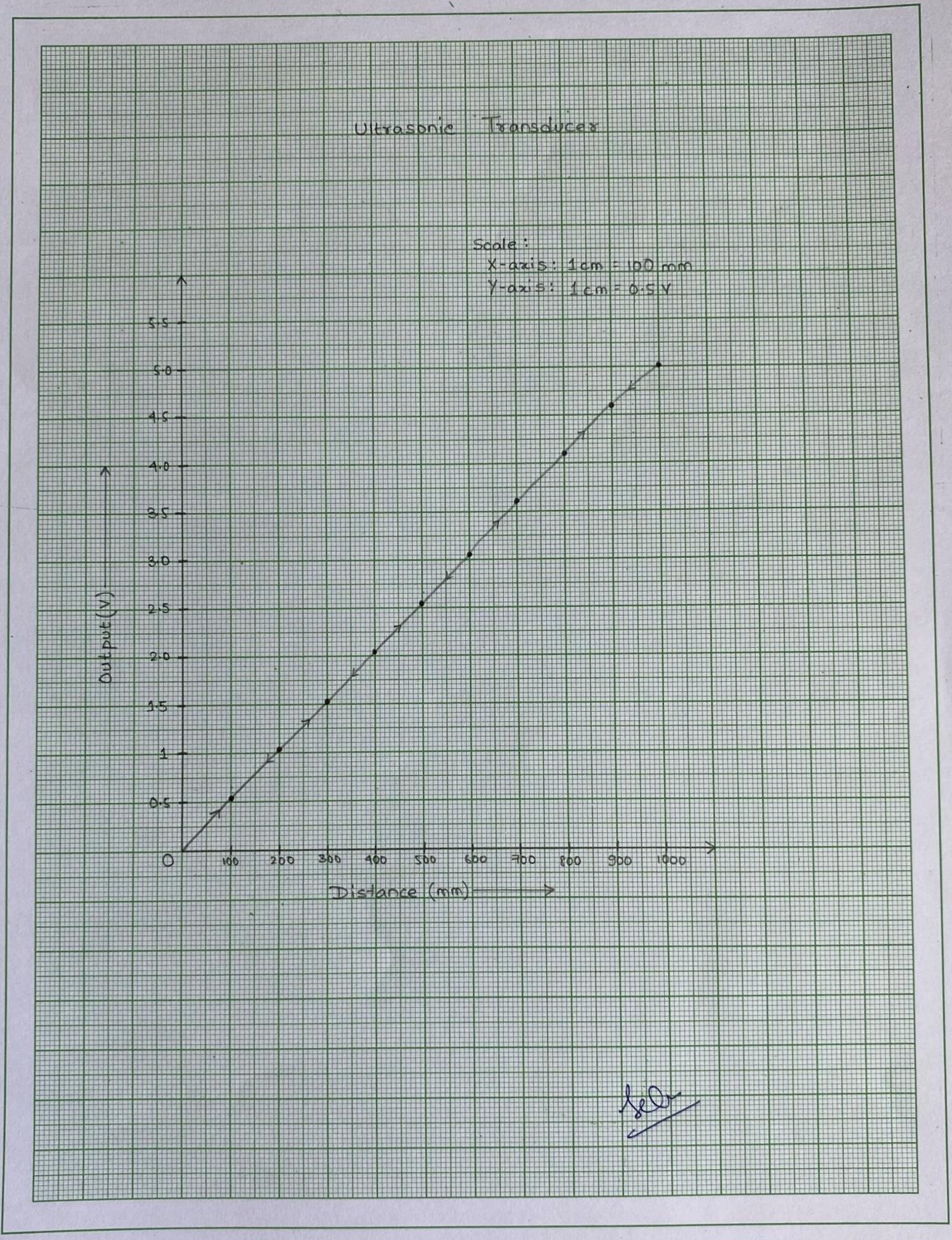
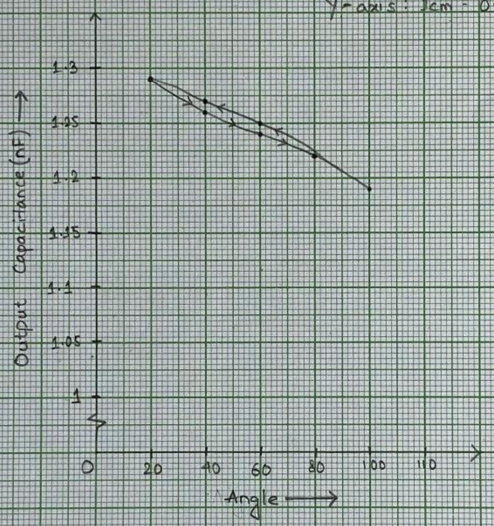

Ultrasonic Transducer
Scale :
X-axis : 1cm = 100 mm
Y-axis : 1cm = 0.5 V
Output (V)
Distance (mm)
0
100
200
300
400
500
600
700
800
900
1000
0.5
1
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5

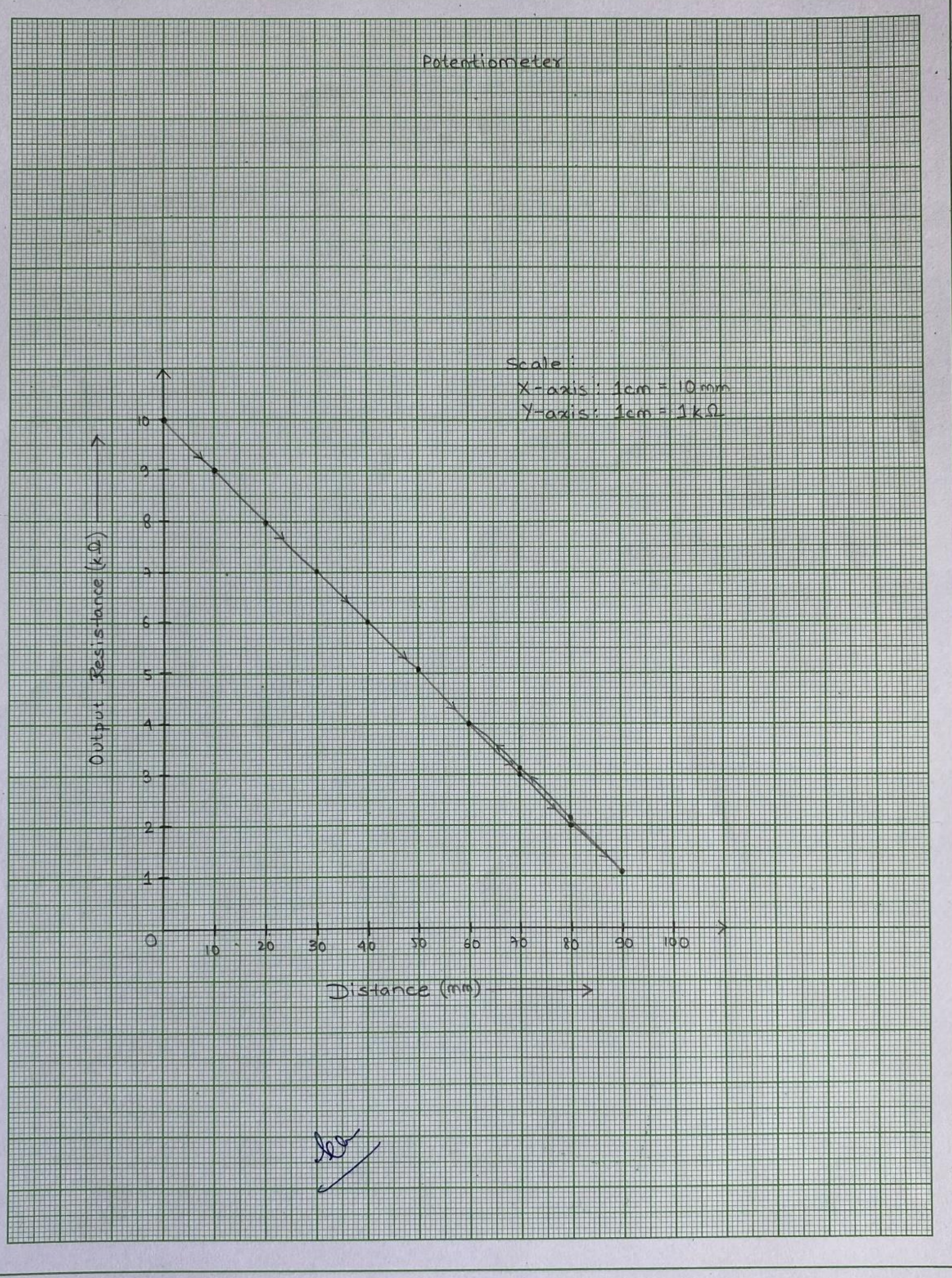
Capacitive Transducer

Scale:

X-axis: 1cm = 20°

Y-axis: 1cm = 0·05 nF




Potentiometer
Scale:
X-axis: 1cm = 10mm
Y-axis: 1cm = 1kΩ
Output Resistance (kΩ)
Distance (mm)
0
10
20
30
40
50
60
70
80
90
100
1
2
3
4
5
6
7
8
9
10

Date

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TEMPERATURE TRANSDUCERS

OBJECTIVE

To study the characteristics of Resistance Temperature Detector (RTD) for variation in temperature.

OBSERVATIONS

Resistance in RTD for change in temperature:

$R_{ref} = 103\,\Omega$

Trial No.	Temperature (°C)	Theoretical Output (Ω)	Output Resistance UP (Ω)	Output Resistance DOWN (Ω)	Measured Voltage (mV)
1.	35	103	113.2	113.7	0.01
2.	40	105.1	116.3	116.5	7.8
3.	45	107.02	117.5	117.8	15.9
4.	50	109.04	119.2	119.2	37.5
5.	55	111.05	120.2	120.5	52
6.	60	113.06	122.4	122.4	67.2

CONCLUSION

Studied the characteristics of RTD

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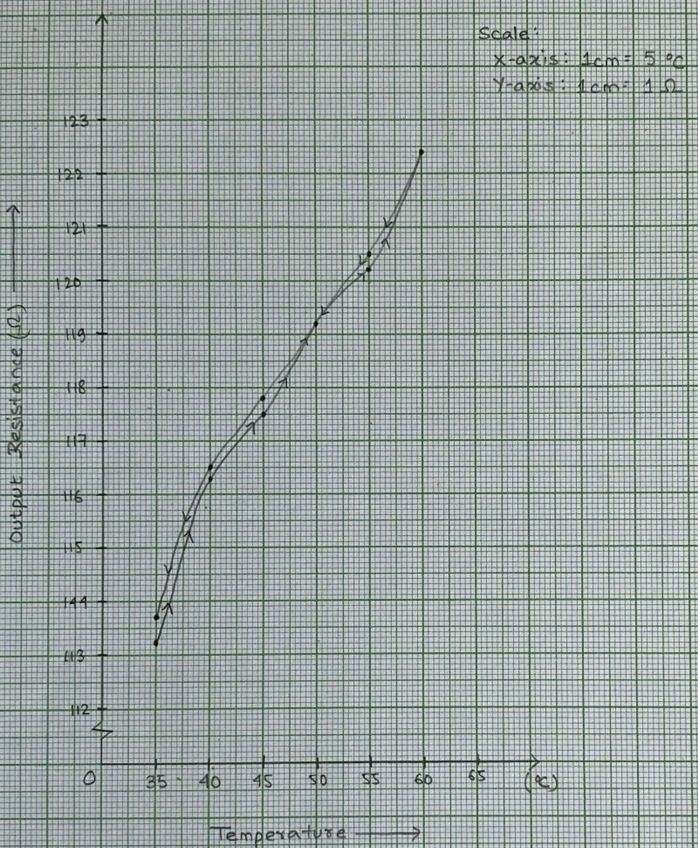
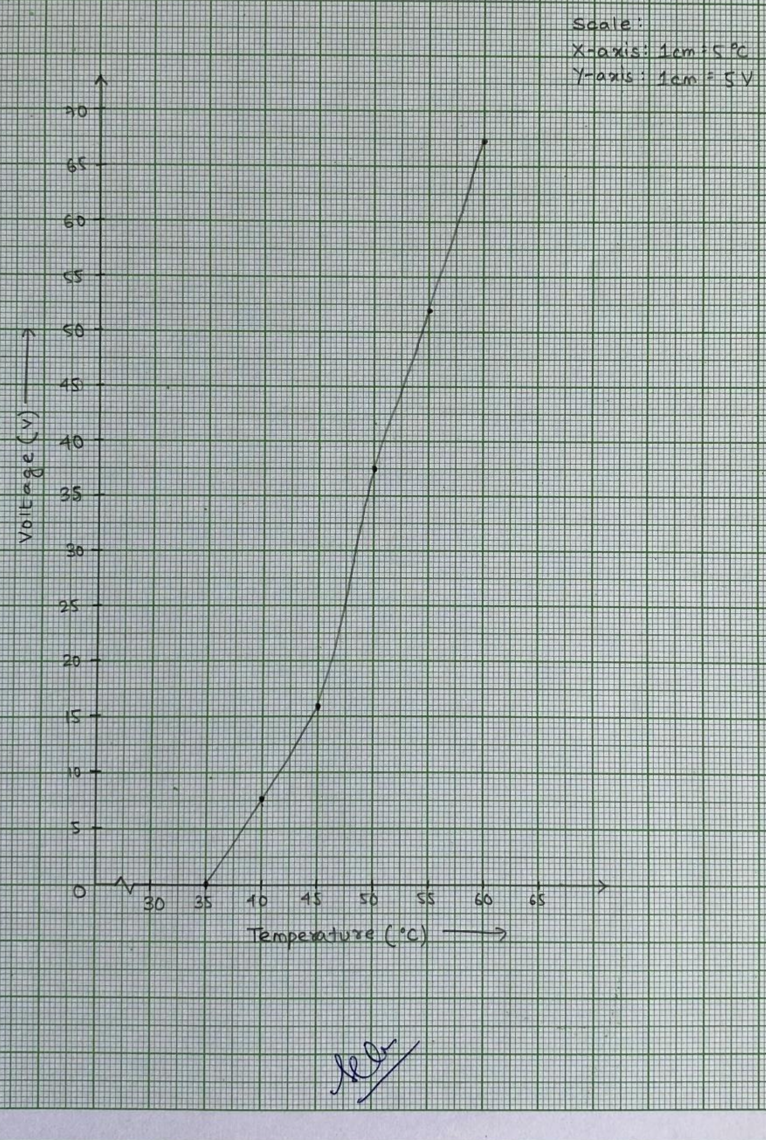

Scale:
X-axis: 1cm = 5 °C
Y-axis: 1cm = 1 Ω
Output Resistance (Ω)
Temperature
(°C)
123
122
121
120
119
118
117
116
115
114
113
112
0
35
40
45
50
55
60
65


Scale:
X-axis: 1cm = 5 °C
Y-axis: 1cm = 5 V
Voltage (V)
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
30
35
40
45
50
55
60
65
Temperature (°C)