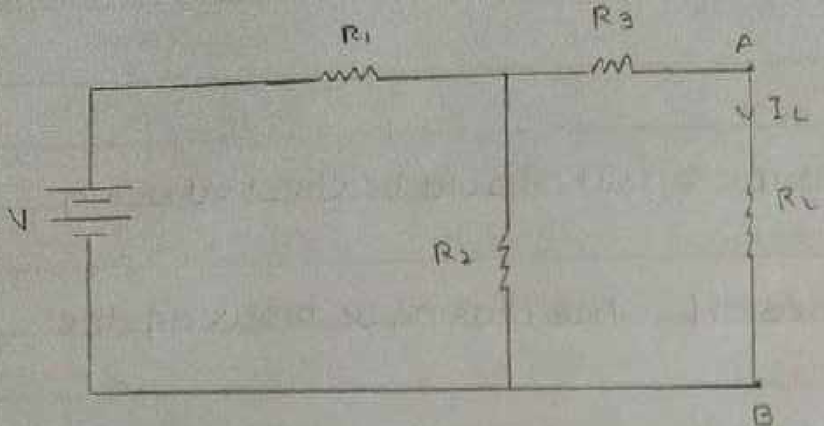
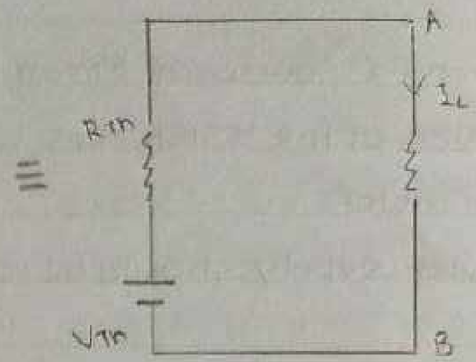
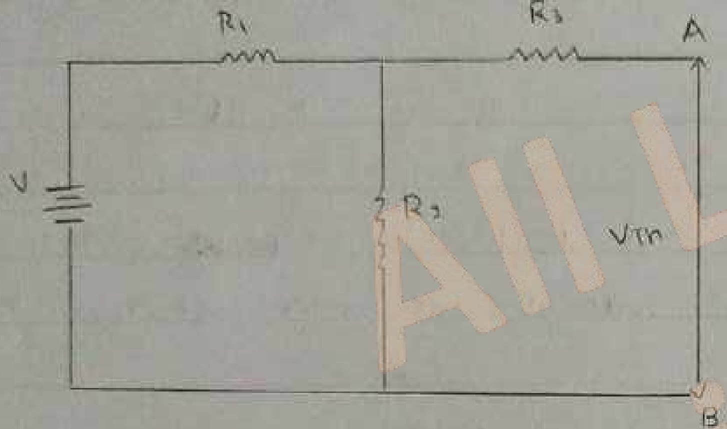
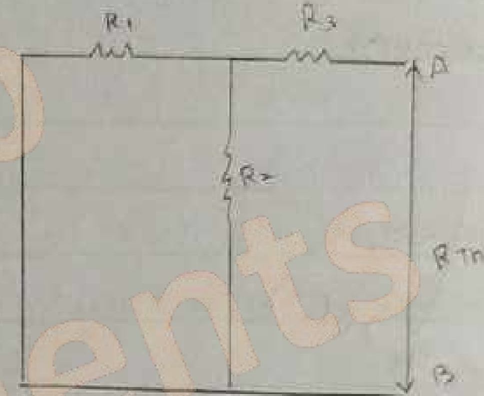
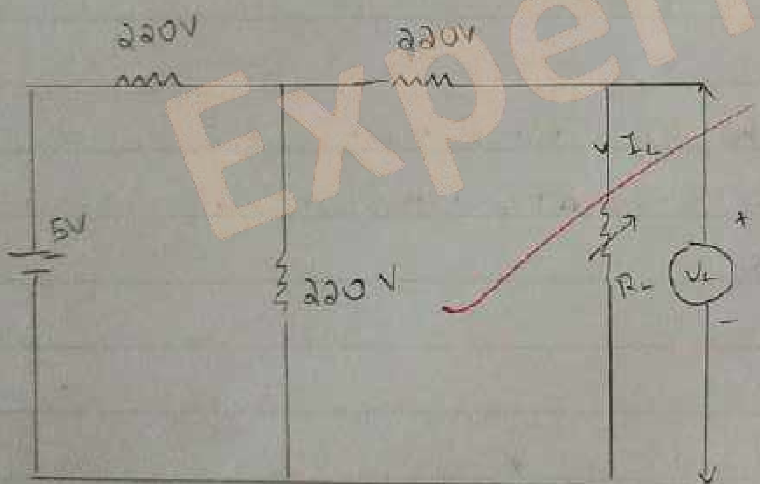
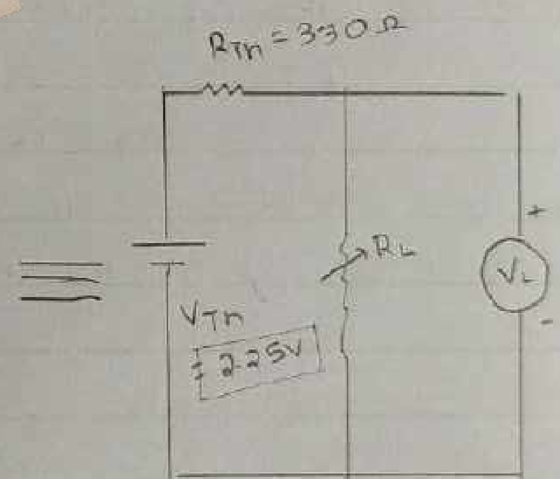












Thevenin Equivalent

Aim:

To verify Thevenin's Theorem.

Apparatus:

A variable regulated power supply (0-15V), resistors (three of 220 Ω each) one of 330 Ω, a variable resistance (a resistance box), a bread board, a digital multimeter and connecting wires.

Theory

Thevenin's Theorem states that any linear, two terminal network containing resistances and voltage and/or current sources, can be replaced by a single voltage V_{TH} in series with a single resistance R_{Th}. The thevenin equivalent voltage V_{Th} is the open circuit voltage at the terminals, and the Thevenin resistance R_{Th} is the resistance between the terminals when all voltage sources in the network are short-circuited and all current sources are open-circuited.

$$V_{Th} = \frac{R_2}{R_1+R_2} V$$

The Thevenin's resistance R_{Th} is the resistance between the terminals A & B (with R_L removed) when the power supply is replaced by a short circuit.

3.19

$$R_{Th} = \frac{R_1 R_2}{R_1+R_2} + R_3$$

According to the max power theorem, a linear, two terminal network consisting of a voltage source & resistances will transfer max. power load connected between its two terminals when the load resistance is equal to the thevenin resistance R_{Th} of the network

Observations : [$V_{in} = 2.5V$]

S.NO	R_L	V_L	Power = V_L^2/R
1.	100	0.570	0.403249
2.	150	0.759	0.00384
3.	220	0.980	0.004365
4.	330	1.220	0.004510
5.	470	1.432	0.004363
6.	560	1.542	0.004246
7.	680	1.650	0.004003
8.	820	1.736	0.003673
9.	1200	1.924	0.003084

5V - constant

S.No	R_L	V_L
1.	100	0.564
2.	150	0.762
3.	220	0.981
4.	330	1.224
5.	470	1.437
6.	560	1.549
7.	680	1.658
8	820	1.744
9.	1200	1.936

Calculation:

$$P = \frac{V_L^2}{R}$$

max power at R_L = 330 = R_{Th}

Hence proved.

Result:

(V_{Th}) measured = 2.5 V

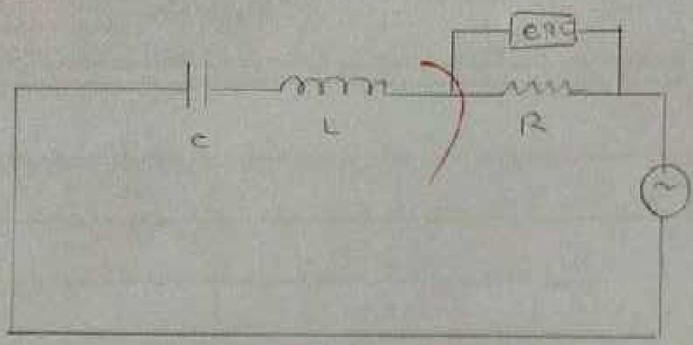
(R_{Th}) measured = 3.30 V

max power = 0.004510 watt

The measured values of V_L & I_L are approximately the same for both the original & the thevenin equivalent circuit

Precautions & sources of error:

1. The output voltage of the power supply should remain constant during the experiment
2. The interval resistance of the power supply, if any is neglected.
3. The power supply should be switched off while making or breaking the circuit



Observations

I: R=1Ω, L=1mH, C=0.01μF

F (KHz)	V_R(mV)=I(mA)
10	10
15	16
20	22
25	28
30	36
35	50
40	64
45	92
50	135
51	140
52	150.5
55	150.2
56	145
60	120
65	95
70	54
75	46
80	40
85	36
90	32
95	28
100	34

II R=1Ω, L=2mH, C=0.01μF

F (KHz)	V_R(mV)=I(mA)
10	5
15	7
20	11
25	17
30	29
35	50
36	56
37	57
38	56
40	48
45	30
50	22
55	18
60	14

III R=2Ω, L=2mH, C=0.01μF

F (KHz)	V_R (mV)	I(mA)
10	12	6
15	18	9
20	26	13
25	42	21
30	72	36
35	128	64
36	138	69
37	140	70
40	120	60
45	76	38
50	56	28
55	44	22
60	36	18
65	22	16
70	28	14

Calculations:

Case I: f_0 from graph = 52 kHz

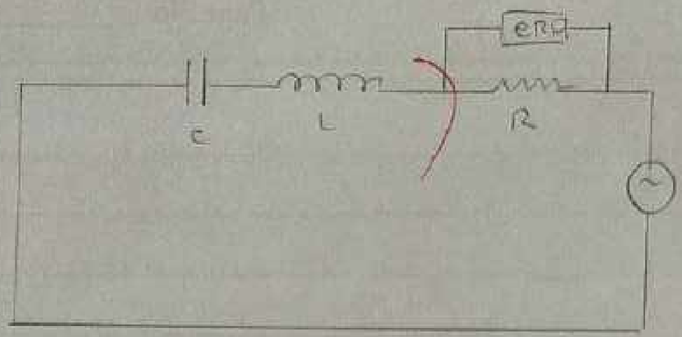
Theoretically, $f_0 = \frac{1}{2\pi\sqrt{LC}} = \frac{1}{2\times3.14\sqrt{0.01\times10^{-3}\times10^{-6}}} = 50.2$ kHz

% Error, $\frac{(52-50.2)\times10^3}{50.2\times10^3} = 3.6$ %

Bandwidth, B = 61.5 − 46.5 = 15.0 kHz

$Q = \frac{f_0}{B} = \frac{50.2\times10^3}{15\times10^3} = 3.34$

Theoretically, $Q = \frac{1}{R}\sqrt{\frac{L}{C}} = \sqrt{\frac{10^{-3}}{0.01\times10^{-6}}} = 3.164\times10^2$



Observations

I: R=1Ω, L=1mH, C=0.01μF   II: R=1Ω, L=2mH, C=0.01μF   III: R=2Ω, L=2mH, C=0.01μF

f (kHz)	V_R(mV)=I(mA)	f (kHz)	V_R(mV)=I(mA)	f (kHz)	V_R (mV)	I(mA)
10	10	10	5	10	12	6
15	16	15	7	15	18	9
20	22	20	11	20	26	13
25	28	25	17	25	42	21
30	36	30	29	30	72	36
35	50	35	50	35	128	64
40	64	36	56	36	138	69
45	92	37	57	37	140	70
50	135	38	56	40	120	60
51	140	40	48	45	76	38
52	150.5	45	30	50	56	28
55	150.2	50	22	55	44	22
56	145	55	18	60	36	18
60	120	60	14	65	22	15
65	95			70	28	14
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Calculations:

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