Experiment No.7

Maximum Power Transfer Theorem

Object

To prove Maximum Power Transfer theorem practically**.**

Theory

the process of finding the load that will receive maximum power from a particular system is quite straightforward due to the **maximum power transfer theorem,** which states the following:

A load will receive maximum power from a network when its resistance is exactly equal to the Thévenin resistance of the network applied to the load. That is

$$R_L = R_{th}$$

In other words, for the Thévenin equivalent circuit in Fig. 1, when the load is set equal to the Thévenin resistance, the load will receive maximum power from the network. Using Fig. 1 with *RL* = *RTh*, the maximum power delivered to the load can be determined by first finding the current

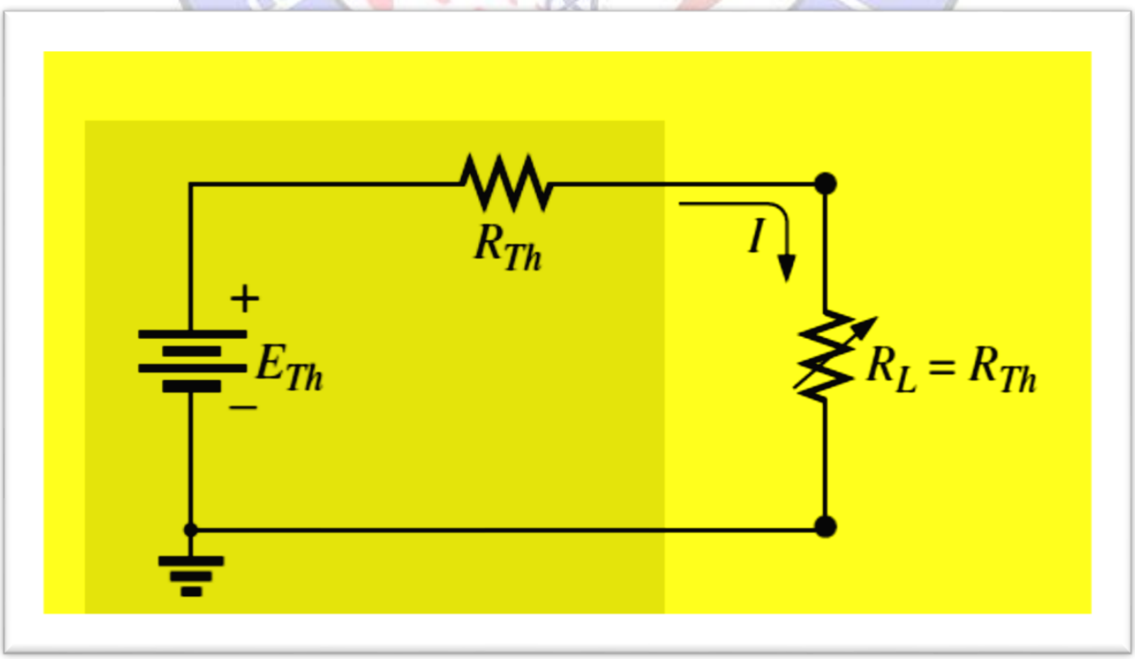


Fig.1

$$I_L = \frac{E_{Th}}{R_{Th} + R_L} = \frac{E_{Th}}{R_{Th} + R_{Th}} = \frac{E_{Th}}{2R_{Th}}$$

Then substitute into the power equation:

$$P_L = I_L^2 R_L = \left(\frac{E_{Th}}{2R_{Th}}\right)^2 (R_{Th}) = \frac{E_{Th}^2 R_{Th}}{4R_{Th}^2}$$

and

$$P_{L_{max}} = \frac{E_{Th}^2}{4R_{Th}}$$

consider the Thévenin equivalent circuit in Fig. 2

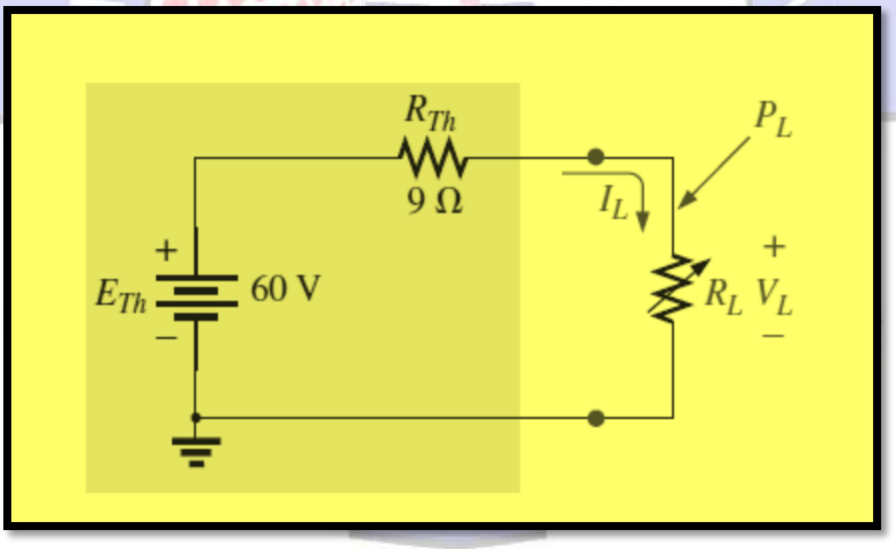
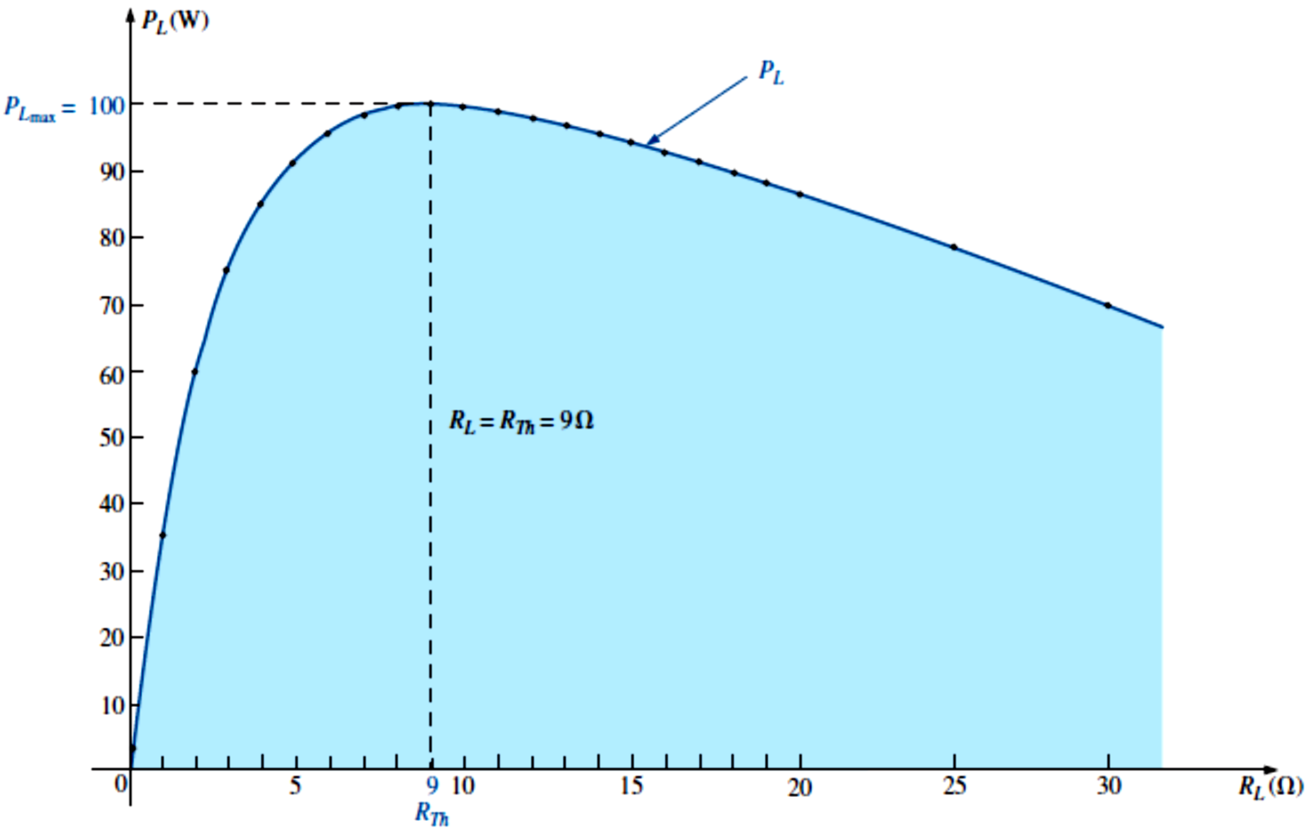


Fig.2

If we tabulate the three quantities versus a range of values for *RL* from 0.1 Ω to 30 Ω we obtain the results appearing in Table 1. Note in particular that when *RL* is equal to the Thévenin resistance of 9 Ω the power has a maximum value of 100 W, the current is 3.33 A or one-half its max-

Table. 1

R_L (Ω)	P_L (W)		I_L (A)		V_L (V)	
0.1	4.35		6.60		0.66	
0.2	8.51		6.52		1.30	
0.5	19.94		6.32		3.16	
1	36.00		6.00		6.00	
2	59.50		5.46		10.91	
3	75.00		5.00		15.00	
4	85.21		4.62		18.46	
5	91.84		4.29		21.43	
6	96.00		4.00		24.00	
7	98.44	Increase	3.75	Decrease	26.25	Increase
8	99.65		3.53		28.23	
9 (R_{Th})	100.00 (Maximum)		3.33 ($I_{max}/2$)		30.00 ($E_{Th}/2$)	
10	99.72		3.16		31.58	
11	99.00		3.00		33.00	
12	97.96		2.86		34.29	
13	96.69		2.73		35.46	
14	95.27		2.61		36.52	
15	93.75		2.50		37.50	
16	92.16		2.40		38.40	
17	90.53		2.31		39.23	
18	88.89		2.22		40.00	
19	87.24		2.14		40.71	
20	85.61		2.07		41.38	
25	77.86		1.77		44.12	
30	71.00		1.54		46.15	
40	59.98		1.22		48.98	
100	30.30		0.55		55.05	
500	6.95	Decrease	0.12	Decrease	58.94	Increase
1000	3.54		0.06		59.47	



P_L versus R_L for the network in Fig. 2

Apparatus

1. DC Power supply
2. Breadboard
3. Set of Resistors
4. Digital multi-meter
5. Set of wires

Procedure

1. Connect the circuit shown. let Value of R1 and R2 1kΩ in Fig.3
2. Measure the value Rth and Vth

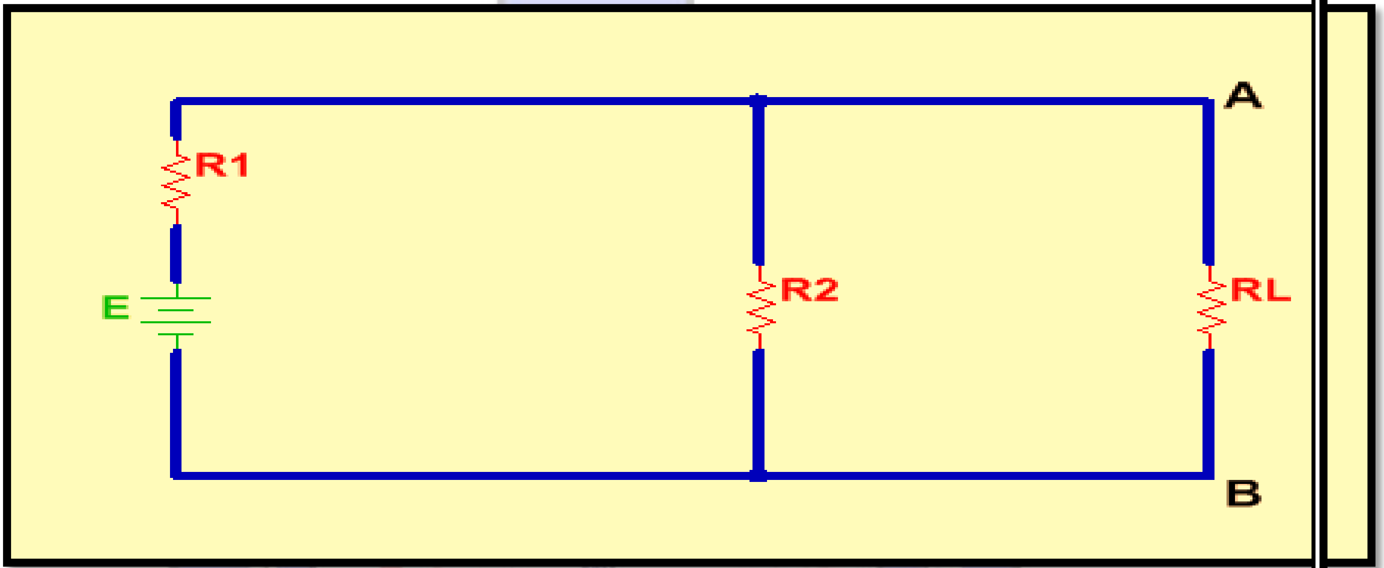
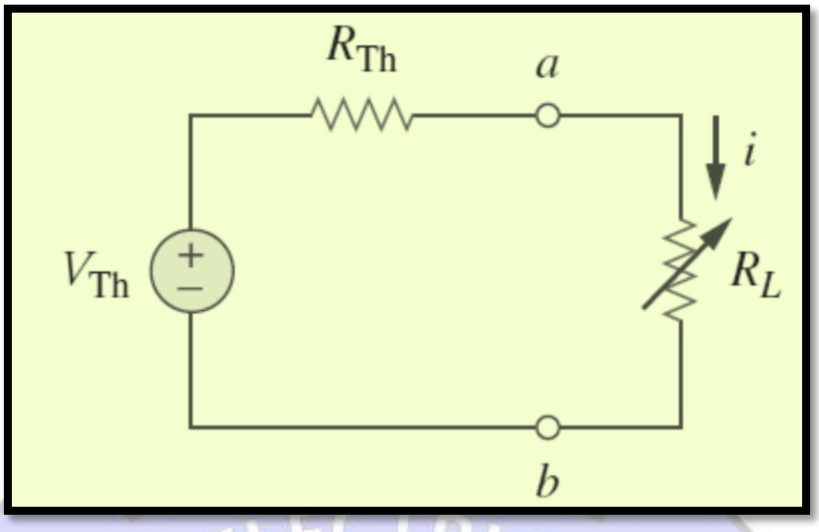


Fig.3

3 Draw the equivalent circuit.



4 .Change the value of R_L and For each value of RL measure the voltage V_L , I_L and P_L record them in table 2.

Table 2

R_L (Ohm)	P_L (watt)	I_L (A)	V_L (V)
50			
100			
150			
200			
250			
300			
350			
400			
450			
500			
550			
600			
650			
700			
750			
800			
850			
900			
950			
1000			

Table 1

Discussion

1 .Plot the curve of the power against the load resistance and determine the maximum power

2. Compare between the theoretical and practical results

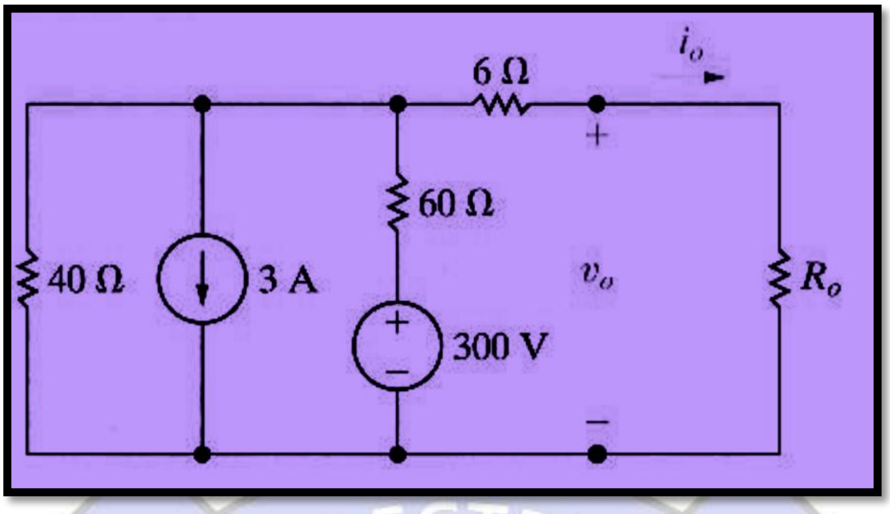
3. Compare between power when the load applied is less than the Thévenin resistance and the applied load is greater than the Thévenin resistance,

4.a Determine i_o and V_o in the circuit shown, using Thévenin theorem when R_o is(0,2,4,10,15,20,30,50,60,70)

b calculate the power delivered for each value of R_o

c. plot the power delivered for each value of R_o versus the resistance R_o

d At what value of R_o is the power delivered to R_o a maximum


6 Ω
i_o
+
60 Ω
40 Ω
3 A
v_o
R_o
+
–
300 V
–