University of Jordan
School of Engineering
Electrical Engineering Department

10/10

EE 204
Electrical Engineering Lab

EXPERIMENT 3 REPORT & PRE-LAB
NETWORK THEOREMS

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EXPERIMENT 3
NETWORK THEOREMS

PROCEDURE A – SUPERPOSITION THEOREM

3. Use theoretical analysis (say nodal or mesh analysis) to determine all the currents in the circuit: I_1, I_2, I_3, and the voltages across all resistors: V_{R1}, V_{R2}, V_{R3}, V_{R4}. Record these values in the first column under Theory in Table 1. What analysis method did you use?

..Both nodal and mesh analysis..

4. Use the digital multimeter (DMM) to measure all the currents in the circuit: I_1, I_2, I_3, and the voltages across all resistors: V_{R1}, V_{R2}, V_{R3}, V_{R4}. Record these values in the first column of Table 1. Are the measured values close to the theory-based answers?

..yes...

Table 1

	Vs & Vd in circuit		~~Vs~~ Vd only in circuit		~~Vd~~ Vs only in circuit		column 2+column 3	
	Theory	Meas.	Theory	Meas.	Theory	Meas.	Theory	Meas.
I_1 (mA)	5.98	5.97	0.949	0.92	5.027	4.8	5.98	5.72
I_2 (mA)	4.19	4.07	3	2.9	1.187	1.16	4.19	4.06
I_3 (mA)	1.79	1.67	-2.051	-1.92	3.84	3.6	1.79	1.68
V_{R1} (V)	5.98	5.95	0.949	0.962	5.027	5.01	5.98	5.972
V_{R2} (V)	9.21	9.3	6.6	6.65	2.61	2.66	9.21	9.31
V_{R3} (V)	1.21	1.23	-1.4	-1.42	2.61	2.66	1.21	1.24
V_{R4} (V)	2.81	2.84	0.446	0.459	2.363	2.39	2.81	2.85

8. Add the contributions of both sources in the last column of Table 1. Compare the sum of the contributions (last column in Table 1) with the voltage and current values found when the two sources were active (first column in Table 1). What are your conclusions?

The current through (or voltage across) resistor can be determined by summing the contributions from each source independently with remaning the other sources switched OFF.

9. Compare the sum of Vs and Vd contributions to power (last column in Table 2) with the power values found when the two sources are active (first column in Table 2). What are your conclusions?

The values are not equivalent because the power is non-linear quantity.........

10. Is power a linear quantity or non-linear quantity? Why is this significant?

non-linear quantity, because the power is the multiple of current and voltage (two linear quantities), so the relation $P = P' + P''$ is unvalid while using superposition method.

Table 2

	Vs & Vd in circuit		~~Vs~~ Vd only in circuit		~~Vd~~ Vs only in circuit		column 2+column 3	
	Theory	Meas.	Theory	Meas.	Theory	Meas.	Theory	Meas.
P_{R1} (mW)	35.76	35.52	0.9	0.885	25.27	24.05	26.17	24.94
P_{R2} (mW)	38.59	37.851	19.8	19.29	3.1	3.086	22.9	22.38
P_{R3} (mW)	2.166	2.054	2.87	2.73	10.02	9.58	12.89	12.31
P_{R4} (mW)	16.8	16.95	0.423	0.422	11.88	11.47	12.3	11.89
P_{Vs} (mW)	-59.8	-59.7	0	0	-50.27	-48	-50.27	-48
P_{Vd} (mW)	-33.52	-32.56	~~0~~ -24	-23.2	0	0	-24	-23.2

11. What is the relationship between $P_{R1} + P_{R2} + P_{R3} + P_{R4}$, on the one side, and $P_{Vs} + P_{Vd}$, on the other side?

Σ Power generated by the sources = Σ Power consumed by the resistors.

12. When is it preferable to use superposition compared to nodal and mesh analysis?

In linear circuits

PROCEDURE B – THÉVENIN AND NORTON EQUIVALENT CIRCUITS

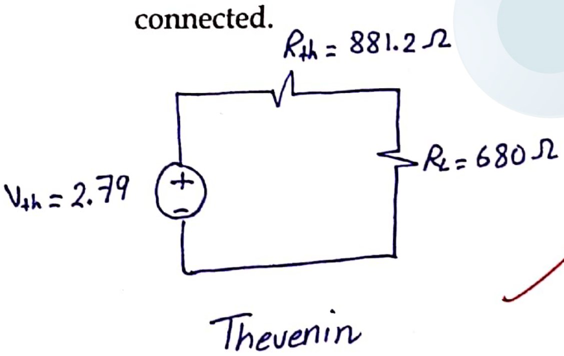
Table 3

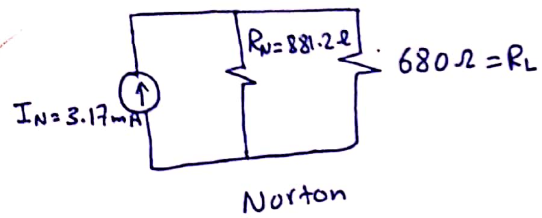
V_{OC} (V)		I_{SC} (mA)		V_{OC}/I_{SC} (Ω)		R_{ab} (Ω)	
Theory	Meas.	Theory	Meas.	Theory	Meas.	Theory	Meas.
2.79	2.8	3.17	3.16	880.1	886.1	881.2	880.2

8. Compare the values of V_{OC}/I_{SC} and R_{ab}. State your conclusions.

close to each other.

9. Draw the theoretical Thévenin and Norton equivalent circuits for the above circuit with R_3 connected.





PROCEDURE C – MAXIMUM POWER TRANSFER

Table 4

Potentiometer Resistance (Ω)	V_P (V)		P (mW)	
	Theory	Measured	Theory	Measured
220 Ω	0.557	0.558	1.41	1.42
441 Ω	0.931	0.933	1.96	1.974
661 Ω	1.2	1.19	2.18	2.14
881 Ω	1.39	1.39	2.19	2.193
1322 Ω	1.67	1.68	2.11	2.135
1762 Ω	1.86	1.86	1.96	1.963
2203 Ω	2	2	1.82	1.816

6. Why can't you just measure the potentiometer resistance while it is still connected to the circuit? Because that may damage the DMM and also will give wrong reading, it will give the resistance for the circuit seen from potentiometer.

7. Plot the absorbed power P versus potentiometer resistance (*provide handwritten plots on the graph paper attached at the end of the report*). At what resistance value do you observe maximum power transfer?

Around 880Ω.

8. What is so special about the above resistance value? Hint: review procedure B.

equals to Thevenin (Norton) equivalnt resistance.

CONCLUSIONS

Summarize in clear but concise format what you learned from this experiment:

First, In superposition procedure we learned more about superposition method and see how it works practically, when we could use it and its simplicity while having a linear circuits, how to make the connections between components wher killing the different sources, and the required calculations and analysis in this method.

Second, the Thevenin and Norton equivalent circuit.
In this procedure we concentrate on how to find Thevenin and Norton equivalent circuits by measuring the equivalent resistance of the circuit seen from the load using DMM, after that measure the V_{oc} while the load is removed to find V_{th} or put a wire (short ckt) insted of the load to measure I_{sc} to find I_N. We know also the shape and connection of each Thevenin and Norton equivalent circuit.

Finally, in maximum power procedure we learned about new electrical ~~componet~~ component, the potentiometer, this component consider as a variable resistance we use it to find the maximum power delivered to the load resistance and the relation between varying the resistance value and the variation in power value, this is important in real life to find at which resistance you could deliver the maximum power from the circuit to the load resistance which we discover in this experiment that it equals to Thevenin (Norton) equivalent resistance.

** End **