# University of Jordan
# School of Engineering
# Electrical Engineering Department

# EE 204
# Electrical Engineering Lab

## EXPERIMENT 3 REPORT & PRE-LAB
## NETWORK THEOREMS

**Section # _______________ Group # _______________**

| | Student Name | ID |
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| 1. | | |
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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?

. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .

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?

. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .

**Table 1**

| | Vs & Vd **in circuit** | | Vs **only in circuit** | | Vd **only in circuit** | | **column 2+column 3** | |
|---|---|---|---|---|---|---|---|---|
| | **Theory** | **Meas.** | **Theory** | **Meas.** | **Theory** | **Meas.** | **Theory** | **Meas.** |
| **$I_1$ (mA)** | | | | | | | | |
| **$I_2$ (mA)** | | | | | | | | |
| **$I_3$ (mA)** | | | | | | | | |
| **$V_{R1}$ (V)** | | | | | | | | |
| **$V_{R2}$ (V)** | | | | | | | | |
| **$V_{R3}$ (V)** | | | | | | | | |
| **$V_{R4}$ (V)** | | | | | | | | |

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?

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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?

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

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**Table 2**

| | Vs & Vd **in circuit** | | Vs **only in circuit** | | Vd **only in circuit** | | **column 2+column 3** | |
|---|---|---|---|---|---|---|---|---|
| | **Theory** | **Meas.** | **Theory** | **Meas.** | **Theory** | **Meas.** | **Theory** | **Meas.** |
| **$P_{R1}$ (mW)** | | | | | | | | |
| **$P_{R2}$ (mW)** | | | | | | | | |
| **$P_{R3}$ (mW)** | | | | | | | | |
| **$P_{R4}$ (mW)** | | | | | | | | |
| **$P_{Vs}$ (mW)** | | | | | | | | |
| **$P_{Vd}$ (mW)** | | | | | | | | |

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?

. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .

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

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## 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.** |
| | | | | | | | |

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

. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .

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

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## PROCEDURE C – MAXIMUM POWER TRANSFER

**Table 4**

| Potentiometer Resistance (Ω) | $V_P$ (V) | | P (mW) | |
|---|---|---|---|---|
| | Theory | Measured | Theory | Measured |
| 220 Ω | | | | |
| 441 Ω | | | | |
| 661 Ω | | | | |
| 881 Ω | | | | |
| 1322 Ω | | | | |
| 1762 Ω | | | | |
| 2203 Ω | | | | |

6. Why can't you just measure the potentiometer resistance while it is still connected to the circuit?

. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .

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?

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

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## CONCLUSIONS

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

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