University of Jordan
School of Engineering
Electrical Engineering Department

EE 219
Electrical Circuits Lab

EXPERIMENT 3 REPORT & PRE-LAB
NETWORK THEOREMS

Section # _____ Group # _____

	Student Name	ID
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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?

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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?

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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?

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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.

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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?

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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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PROCEDURE D – PEAK-TO-PEAK VERSUS RMS VALUES

6. What is the period *T* (in milliseconds) of the sinusoidal signal out of the function generator?

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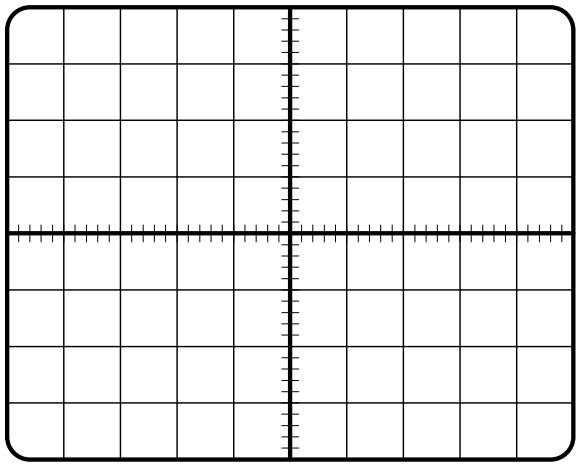
7. Draw what you see on the oscilloscope screen below. Make sure you have Channel 1 of the oscilloscope set to 0.5 V/DIV and the sweep set to 2.5 ms/DIV.



8. Use theoretical analysis to determine the **rms value** of the source voltage $v_S(t)$ and the current in the circuit $i(t)$ at the different frequencies shown in Table 5. Record these values in the table? What equation should you use to calculate the current in rms from the peak source voltage V_p?

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Table 5

AC Source Frequency (Hz)	Source V_{p-p} (V) (Oscilloscope)		Source V_{rms} (V) (Oscilloscope)		Source V_{rms} (V) (Voltmeter)		I_{rms} (mA) (Ammeter)	
	Theory	Meas.	Theory	Meas.	Theory	Meas.	Theory	Meas.
100								
1000								
2000								

11. Use the voltmeter to read the *measured* rms value V_{rms} of the source voltage, but record the answer this time in the third column of Table 5. How is the voltmeter and oscilloscope different in reading the AC voltage?

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12. What extra information about the source voltage can the oscilloscope provide, which the voltmeter cannot provide?

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13. Use the ammeter to *measure* the rms value I_{rms} of the current, and record the answer in the last column of Table 5. Are the measurements close to the theoretical answers?

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14. Does the resistor change its impedance $\mathbf{Z_R}$ with frequency?

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15. What if you only had an oscilloscope without an ammeter. How would you be able to measure the current in the circuit in rms? *Explain* clearly.

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CONCLUSIONS

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

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