University of Jordan
School of Engineering
Electrical Engineering Department

EE 204
Electrical Engineering Lab

EXPERIMENT 4 REPORT & PRE-LAB
SINUSOIDAL SIGNALS

Section # ____________ Group # ____________

	Student Name	**ID**
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EXPERIMENT 4
SINUSOIDAL SIGNALS

***Note**: Use MATLAB to quickly perform theoretical calculations by defining a vector of time instants then using array arithmetic.*

PROCEDURE A – CAPACITORS AND INDUCTORS

Table 1

	C_1	C_2	C_3
Code or color on the capacitor			
Nominal Value			
Tolerance (%)			
Breakdown voltage			
Capacitor type			
Measured @ f_1			
Deviation (%)			
Measured @ f_2			
Deviation (%)			

3. What are the two frequencies f_1 and f_2 that the RLC meter uses for its measurements?

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Table 2

	L_1		L_2	
Code or color on the inductor				
Nominal Value				
Tolerance (%)				
Measured @ f_1				
Deviation (%)				
Measured @ f_2				
Deviation (%)				
Internal series resistance R_{DC}	@f_1	@f_2	@f_1	@f_2

PROCEDURE B – OSCILLOSCOPE AND PEAK-TO-PEAK VERSUS RMS VALUES

6. If the vertical position or horizontal position on the oscilloscope is not set in the middle, perform the necessary adjustments. How many cycles of the sinusoidal wave do you see on the oscilloscope screen?

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7. Increase the frequency of the sinusoidal signal using the function generator controls. What do you see on the oscilloscope screen?

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8. Decrease the frequency of the sinusoidal signal using the function generator controls. What do you see on the oscilloscope screen?

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9. How do you increase the voltage level coming out of the function generator?

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10. Now increase the voltage level from the function generator. What do you see on the oscilloscope screen?

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11. If you increased the signal voltage level from the function generator until it exceeds the screen limits of the oscilloscope, what should you do to see the signal again on the oscilloscope screen?

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12. What other signal shapes (other than sinusoidal wave) can the function generator produce? See them on the oscilloscope screen.

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15. What is the period (one cycle) of the above sinusoidal wave signal in units of horizontal screen divisions and also in units of milliseconds?

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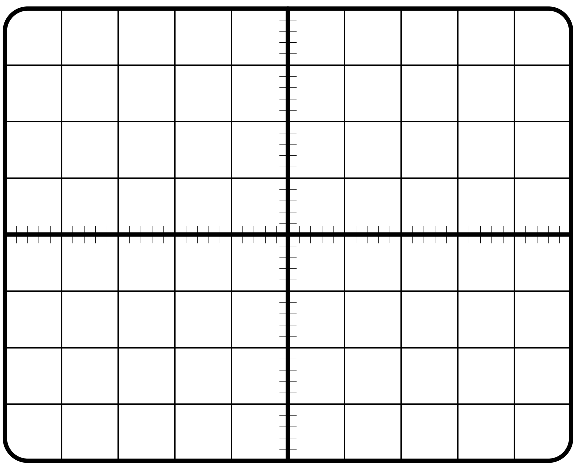
16. Draw what you see on the oscilloscope screen below. Make sure you have Channel 1 of the oscilloscope set to 0.5 V/DIV and the sweep set to 0.25 ms/DIV.



17. 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 3. 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 3

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								

20. Now 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 3. How are the voltmeter and oscilloscope different in reading the AC voltage?

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

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22. Use the ammeter to *measure* the rms value I_{rms} of the current, and record the answer in the last column of Table 3. Are the measurements close to the theoretical answers?

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

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24. 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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PROCEDURE C – AC-EXCITED CIRCUIT

3. Use theoretical AC steady-state analysis to determine the voltages in the circuit $v_S(t)$ and $v_C(t)$ at the time instances shown in Table 4. Record these values in the table? Also explain below the complex-number equations you used to calculate the complex quantities $\boldsymbol{V_S}$ and $\boldsymbol{V_C}$, and how did you convert the results into $v_S(t)$ and $v_C(t)$.

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4. Use the oscilloscope screen to measure the actual times (in ms) plus the instantaneous values of the voltages $v_S(t)$ (using channel 1 of the oscilloscope) and $v_C(t)$ (using channel 2 of the oscilloscope). Record these values in Table 4 for all required time instants. Use as your reference (i.e., when $t = 0$) the point in time in which $v_S(t)$ crosses zero from negative to positive value. Remember that you can change the oscilloscope horizontal sweep settings to get more accurate readings. Alternatively, to speed up your work, you can use the cursor feature of the oscilloscope as explained below. Are the measured values close to the theory-based answers?

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Table 4

Time since positive zero crossing for $v_S(t)$	Time t (in ms)		Voltage $v_S(t)$		Voltage $v_C(t)$	
	Theory	**Meas.**	**Theory**	**Meas.**	**Theory**	**Meas.**
$t = 0$	0		0 V			
$t = T/8 \equiv 45°$						
$t = T/4 \equiv 90°$	0.8333		4 V			
$t = 3T/8 \equiv 135°$						
$t = T/2 \equiv 180°$						
$t = 5T/8 \equiv 225°$						
$t = 6T/8 \equiv 270°$						
$t = 7T/8 \equiv 315°$						
$t = T \equiv 180°$	3.3333		0 V			

5. Using the measured values in Table 4, plot (**by hand**) the following figure using the graph paper attached at the end of the report: $v_S(t)$ and $v_C(t)$ on the same plot versus time. Make sure you include one full cycle of $v_S(t)$ in the plot.

CONCLUSIONS

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

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