University of Jordan
School of Engineering
Electrical Engineering Department

EE 219
Electrical Circuits Lab

EXPERIMENT 7 REPORT & PRE-LAB
RESONANCE

Section # _____ Group # _____

	Student Name	ID
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EXPERIMENT 7
RESONANCE

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

PROCEDURE A – SERIES RESONANCE

4. What is the equation for the resonant frequency of a series RLC circuit?

. . . . . .

5. Use that above equation to find the resonant frequency in this experiment.

. . . . . .

6. What is the equation for the quality factor Q, and bandwidth B of a series RLC circuit?

. . . . . .

7. Use the proper equations to find the frequencies f_1 and f_2, at which the current amplitude is approximately 0.707 times the resonant current (i.e., the half-power points).

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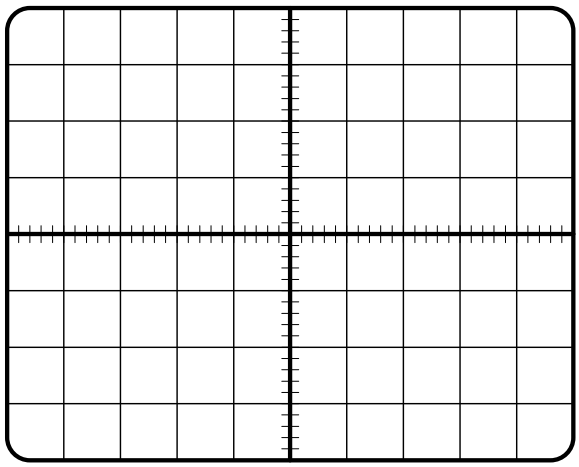
9. Set the oscilloscope to work in the X-Y mode. At the frequency of 6000 Hz, draw what you see on the oscilloscope screen.



11. Draw what you see on the oscilloscope screen at the resonant frequency in the X-Y mode.

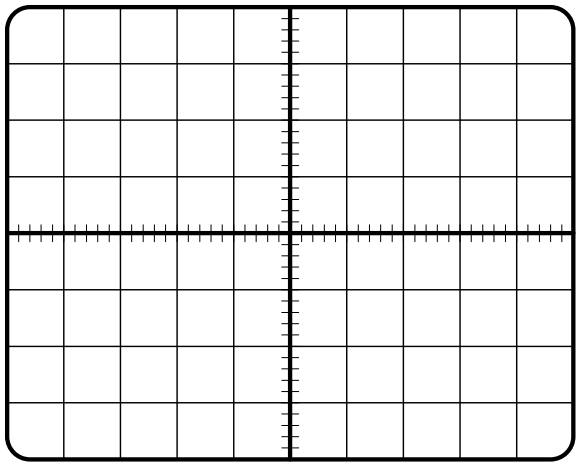


Table 1

AC Source Frequency (Hz)	$\|V_S\|$ (peak) (V)		V_S period T (μs)		$\|V_R\|$ (peak) (V)		$\measuredangle V_R$ with V_s (degrees)	
	Theory	Meas.	Theory	Meas.	Theory	Meas.	Theory	Meas.
6000								
9000								
14400								
16800								
30000								
48000								
f_r = _____								
f_1 = _____								
f_2 = _____								

Table 2

AC Source Frequency (Hz)	$\|V_C\|$ (peak) (V)		$\measuredangle V_C$ with V_s (degrees)		$\|V_L\|$ (peak) (V)		$\measuredangle V_L$ with V_s (degrees)	
	Theory	Meas.	Theory	Meas.	Theory	Meas.	Theory	Meas.
6000								
9000								
14400								
16800								
30000								
48000								
f_r = _____								
f_1 = _____								
f_2 = _____								

16. What is the relationship between the capacitor voltage $\boldsymbol{V_C}$ and inductor voltage $\boldsymbol{V_L}$ at resonant frequency?

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17. Consider the capacitor voltage amplitude $|\boldsymbol{V_C}|$. Which one is higher $|\boldsymbol{V_C}|$ at resonant frequency or $|\boldsymbol{V_C}|$ below resonant frequency?

. . . . . .

18. Consider the inductor voltage phase $\measuredangle \boldsymbol{V_L}$. Which one is higher $\measuredangle \boldsymbol{V_L}$ at resonant frequency or $\measuredangle \boldsymbol{V_L}$ below resonant frequency? Note: In phase, consider the positive or negative signs.

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Table 3

AC Source Frequency (Hz)	$\|\boldsymbol{I}\|$ **(peak) (mA)** $= \boldsymbol{V_R}/R$		$\measuredangle \boldsymbol{I}$ **with** $\boldsymbol{V_s}$ $(= \measuredangle \boldsymbol{V_R}$ **with** $\boldsymbol{V_s})$		$\|\boldsymbol{Z}\| = \|\boldsymbol{V_S}\|/\|\boldsymbol{I}\|$ **(peak/peak) (kΩ)**		$\measuredangle \boldsymbol{Z} = \measuredangle \boldsymbol{V_S} - \measuredangle \boldsymbol{I}$ **(degrees)**	
	Theory	**Meas.**	**Theory**	**Meas.**	**Theory**	**Meas.**	**Theory**	**Meas.**
6000								
9000								
14400								
16800								
30000								
48000								
$f_r =$ _____								
$f_1 =$ _____								
$f_2 =$ _____								

20. Using the measured values in Table 3, plot (**by hand**) the following figures using the graph paper attached at the end of the report: (1) $|\boldsymbol{Z}|$ versus source frequency; (2) $\measuredangle \boldsymbol{Z}$ versus source frequency; (3) $\boldsymbol{I}$ versus source frequency.

21. For the above plots, state your conclusions under the plot? Also identify the resonant frequency and bandwidth in each plot.

PROCEDURE B –PARALLEL RESONANCE

4. What is the equation for the resonant frequency of a parallel RLC circuit?

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5. Use that above equation to find the resonant frequency in this experiment.

. . . . . .

6. What is the equation for the quality factor Q, and bandwidth B of a parallel RLC circuit?

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7. Use the proper equations to find the frequencies f_1 and f_2, at which the current amplitude is approximately 1.414 = 1/0.707 times the resonant current (i.e., the bandwidth limits).

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Table 4

AC Source Frequency (Hz)	**V_S (peak) (V)**		**V_S period T (μs)**		**$V_{R'}$ (peak) (V)**		**$\measuredangle V_{R'}$ with V_s (degrees)**	
	Theory	**Meas.**	**Theory**	**Meas.**	**Theory**	**Meas.**	**Theory**	**Meas.**
6000								
9000								
14400								
16800								
30000								
48000								
$f_r =$ _____								
$f_1 =$ _____								
$f_2 =$ _____								

12. What is the relationship between the capacitor current $\boldsymbol{I_C}$ and inductor current $\boldsymbol{I_L}$ at resonant frequency?

. . . . . .

13. Consider the capacitor current phase $\measuredangle \boldsymbol{I_C}$. Which one is higher $\measuredangle \boldsymbol{I_C}$ at resonant frequency or $\measuredangle \boldsymbol{I_C}$ above resonant frequency? Note: In phase, consider the positive or negative signs.

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14. Consider the inductor current amplitude $|\boldsymbol{I_L}|$. Which one is higher $|\boldsymbol{I_L}|$ at resonant frequency or $|\boldsymbol{I_L}|$ above resonant frequency?

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Table 5

AC Source Frequency (Hz)	I (peak) (mA) $= V_{R'}/R'$		$\measuredangle I$ with V_s $(= \measuredangle V_{R'}$ with $V_s)$		$\lvert Y\rvert = \lvert I\rvert/\lvert V_S\rvert$ (peak/peak) (mS)		$\measuredangle Y = \measuredangle I - \measuredangle V_S$ (degrees)	
	Theory	Meas.	Theory	Meas.	Theory	Meas.	Theory	Meas.
6000								
9000								
14400								
16800								
30000								
48000								
$f_r =$ _____								
$f_1 =$ _____								
$f_2 =$ _____								

16. Using the *measured* values in Table 5, plot (**by hand**) the following figures using the graph paper attached at the end of the report: (1) $|Y|$ versus source frequency; (2) $\measuredangle Y$ versus source frequency; (3) I versus source frequency.

17. For the above plots, state your conclusions under the plot? Also identify the resonant frequency and bandwidth in each plot.

Table 6

AC Source Frequency (Hz)	$\lvert S\rvert$ (mVA)	$\measuredangle S$ (degrees)	P (mW)	Q (mVAR)	PF value	PF lead or lag
	Measured	Measured	Measured	Measured	Measured	Measured
6000						
9000						
14400						
16800						
30000						
48000						
$f_r =$ _____						
$f_1 =$ _____						
$f_2 =$ _____						

19. Using the values in Table 6, plot (**by hand**) the following figure using the graph paper attached at the end of the report: P and Q on the same plot versus source frequency.

20. For the above plot, state your conclusions under the plot?

21. At what frequency the real power P is minimum? Why?

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22. At what frequency the magnitude of the reactive power $|\boldsymbol{Q}|$ is maximum? Why?

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CONCLUSIONS

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

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