Sekolah Pendidikan Profesional dan Pendidikan Berterusan (SPACE)

JABATAN KEJURUTERAAN ELEKTRIK
PUSAT PENGAJIAN DIPLOMA (PPD), SPACE
UNIVERSITI TEKNOLOGI MALAYSIA
KUALA LUMPUR

ELECTRICAL ENGINEERING LABORATORY 2

(DDWE 2701)

CIRCUIT THEORY 2

EXPERIMENT 3
SERIES RLC AND RESONANCE

Group members	**1.**
	2.
	3.
	4.
	5.
Lecturer	**:**
Date	**:**

No.	PO	CO	Student Marks	Marks
1	PO1	CO1		20%
2	PO2	CO4		50%
3	PO8	CO5		10%
		Total Marks		/80%

EXPERIMENT 3 : SERIES RLC AND RESONANCE

OBJECTIVES

After doing this experiment, students will be able to:

1. understand the concept of lagging and leading of phase angle in reactive circuits.
2. draw the voltage phasor diagrams for reactive circuits.
3. verify experimentally the condition for series resonance.

APPARATUS

1. Function Generator
2. Audio Generator
3. Oscilloscope
4. Multimeter
5. Decade resistor
6. Decade inductor
7. Decade capacitor

PROCEDURE

PART 1 : DETERMINATION OF RESONANT FREQUENCY

1. Set the frequency of the function generator to 200 Hz and the amplitude of the sine wave to 20 $V_{p\text{-}p}$.
2. Connect the circuit of Figure 1.
3. Observe the voltage waveform across the resistor (V_R) through **CH2**.
4. Record peak value of V_R, in Table l.
5. Repeat step 4 for each of the frequencies shown in Table 1.
6. Calculate the rms voltage of V_R and the current for each of the frequencies and tabulate the values in Table 1.
7. Plot a graph of current versus frequency on the grid provided in Figure A. Label the resonant frequency, f_r, the lower cutoff frequency, f_1 and the upper cutoff frequency, f_2.

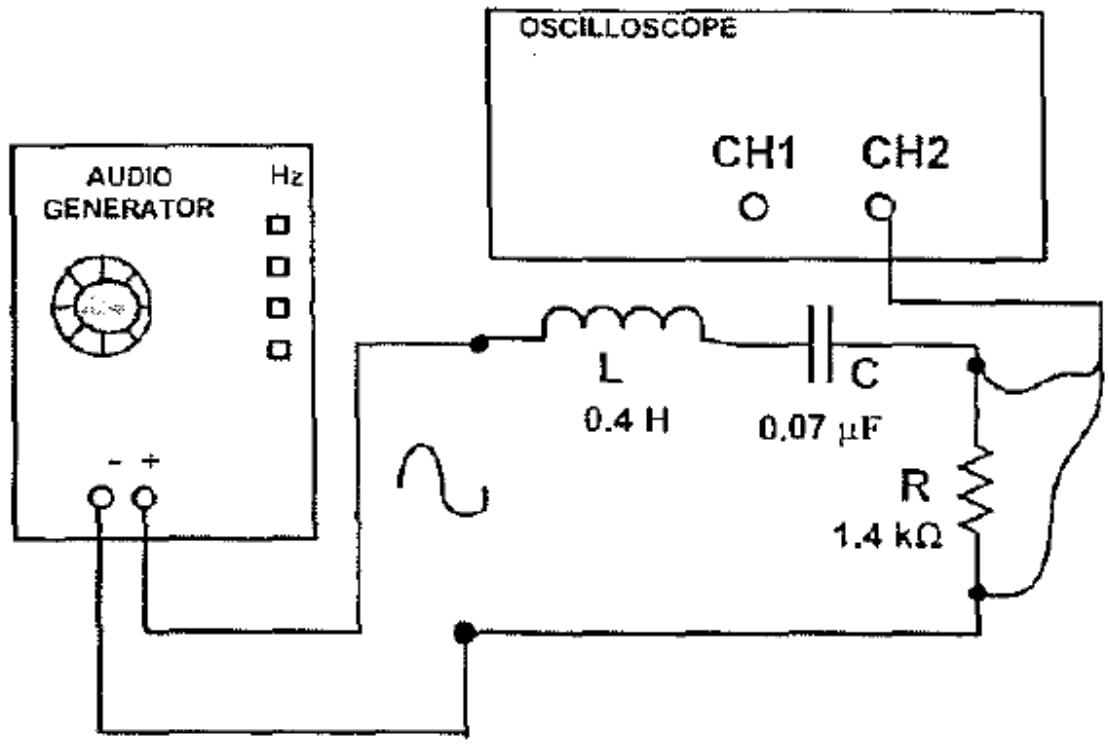


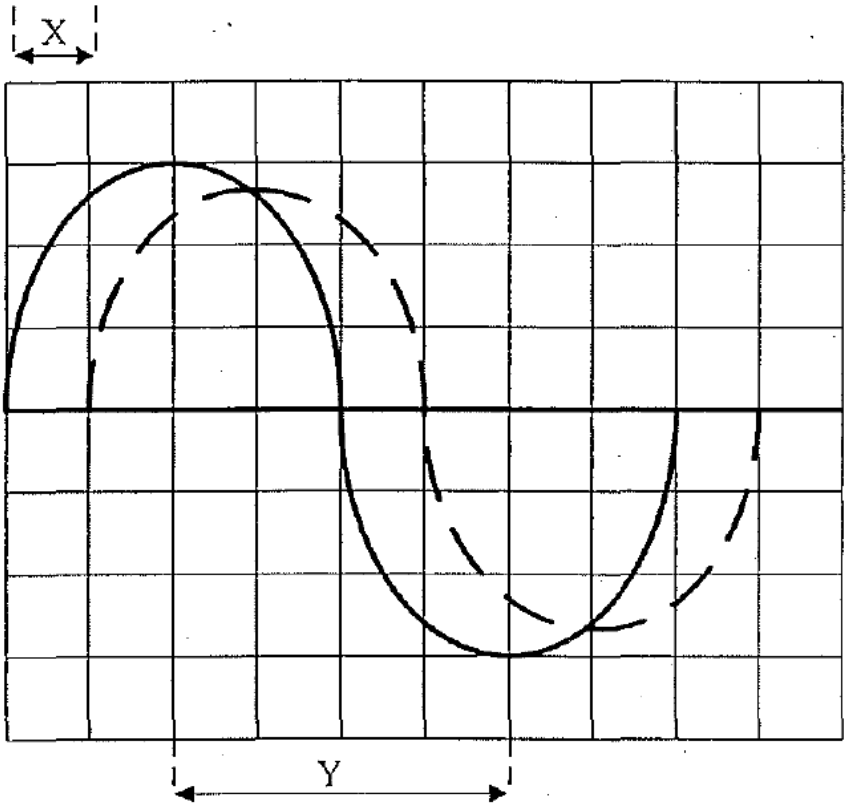
Figure 1

PART 2 : MEASUREMENT OF V_R, V_L AND V_C AT RESONANT FREQUENCY

1. Use the same circuit as in Part 1.
2. Set the frequency of the function generator to the resonant frequency, f_r obtained in Part 1 and the amplitude to 20 $V_{p\text{-}p}$. Observe this sinewave with the oscilloscope through **CH1**.
3. Observe the voltage waveform across resistor, V_R. Record the peak to peak value of V_R and the phase difference between V_S and V_R in Table 3.
4. Repeat Step 3 for voltage across inductor, V_L and voltage across capacitor, V_C. Complete Table 3.

   (Note: Make sure one terminal of the component to be measured must be connected to ground by rearranging the component in the series circuit.)
5. Disconnect the oscilloscope.
6. Measure the voltage across resistor using multimeter. This is the voltage at resonance, V_r. Record the value in Table 4.
7. Calculate the value of voltage at 70.7% of V_r. This is the value of voltage at f_1 and f_2. Record the value in Table 4.
8. Varies the frequency of the function generator until the voltage across resistor is equal to the value obtained in step 7. Record f_1 and f_2 values in Table 4.

Figure 2 : Phase Angle Measurement



$$Phase\ angle, \theta = \frac{X}{Y}\ \ x\ 180\,^{\circ}$$

RESULT & REPORT

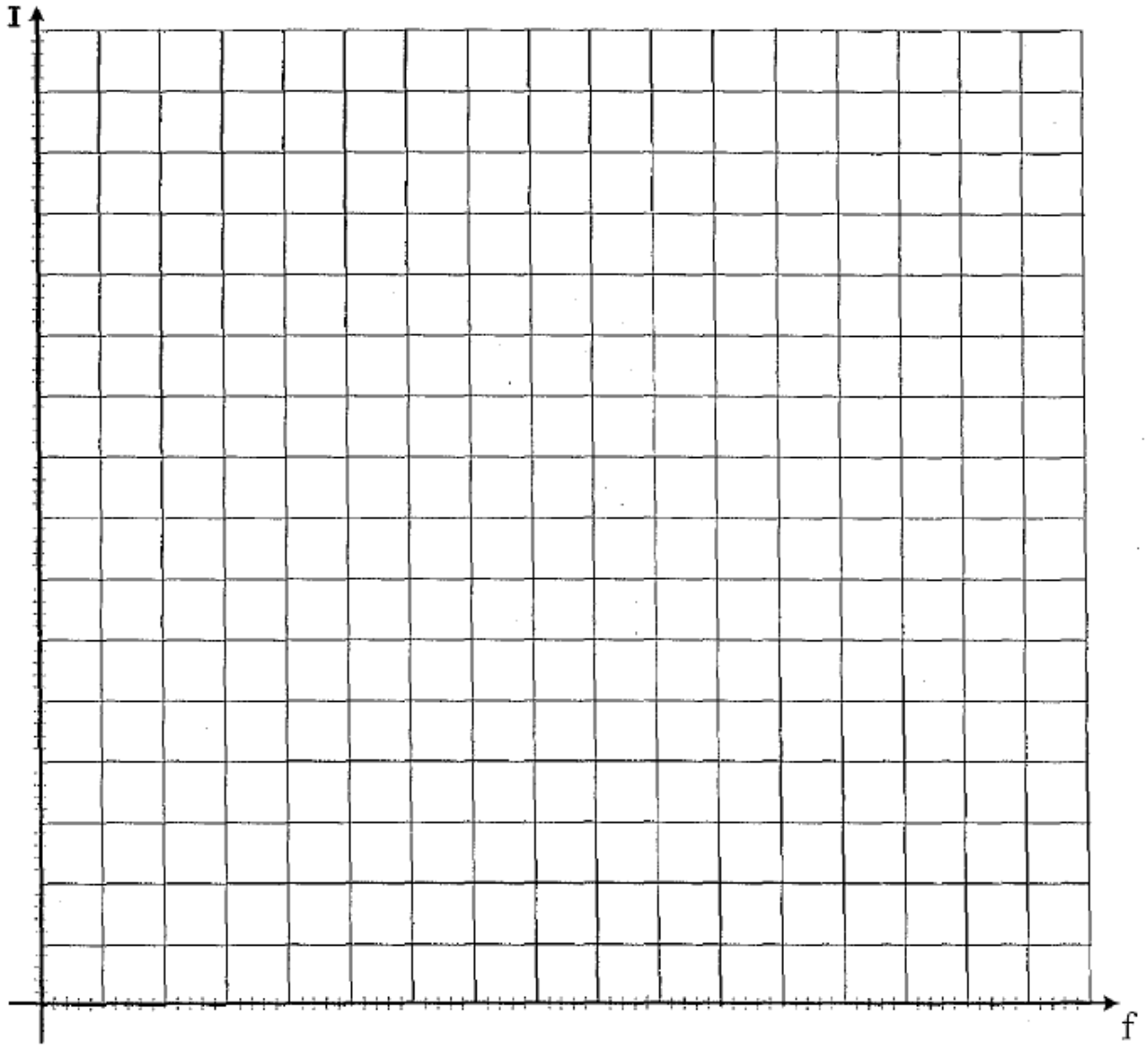
PART 1 : DETERMINATION OF RESONANT FREQUENCY

Table 1 (Step 4-6)

Frequency (Hz)	$V_{R\,(P)}$ (V)	$V_{R\,(rms)}$ (V)	$I = V_{R\,(rms)} / R$ (mA)
200			
300			
400			
500			
600			
700			
800			
900			
1000			
1100			
1200			
1300			
1400			
1500			
1600			

PO1	CO1	..... /10m

Figure A (Step 7)



PO1	CO1	..... /10m

Referring to **Figure A,** complete **Table 2**.

f_r (Hz)		I_r (mA)	
f_1 (Hz)		BW (Hz)	
f_2 (Hz)			

PO1	CO1	..... /10m

2. State the total impedance of the circuit at resonance.

$\mathbf{Z_r}$ = ...

PO1	CO1	..... /4m

CONCLUSION:

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.....

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PO1	CO1	..... /6m

PART 2 : MEASUREMENT OF V_R, V_L and V_C AT RESONANT FREQUENCY

Table 3 (Step 3 - 4)

Peak-to-peak value (p-p)	Root-mean-square (rms)	Phase angle and phase relationship. (V_S as a reference)
V_R =	V_R =	θ =
V_L =	V_L =	θ =
V_C =	V_C =	θ =

PO1	CO1	..... /10m

Table 4 (Step 6 - 8)

Voltage (V)		*Frequency* (Hz)	
$\mathbf{V_r}$		f_r	
$\mathbf{V_1}$		f_1	
$\mathbf{V_2}$		f_2	

PO1	CO1	..... /10m

Compare the values f_1 and f_2 in Table 4 (Part 2) with the values in Table 2 (Part 1).

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PO1	CO1	..... /4m

CONCLUSION:

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PO1	CO1	..... /6m

TOTAL MARKS (PO1, CO1) = ... / 70 marks

		Marks	PO2	PO8
Group members	**1.**			
	2.			
	3.			
	4.			
	5.			
Lecturer	**:**			
Date	**:**			

Guideline of practical skill rubric: PO2

Practical skill (100 marks)						
Scale :	**1 (5marks)**	**2 (10marks)**	**3 (15marks)**	**4 (20marks)**	**5 (25marks)**	**Marks**
Criteria ✓ **Demonstrate the practical skill**	**Very Poor**	**Poor**	**Moderate**	**Good**	**Excellent**	
A. Circuit assembly/construction	5	10	15	20	25	
B. Using appropriate measurement equipment and technique	5	10	15	20	25	
C. Troubleshooting skill and technique	5	10	15	20	25	
D. Follow lab regulation	5	10	15	20	25	
					Total marks	**...../100**

Guideline of ethic rubric: PO8

ETHIC AND PROFESSIONAL MORAL (100 marks)					
Scale :	**1 (5marks)**	**2 (10marks)**	**3 (15marks)**	**4 (20marks)**	**5 (25marks)**
Criteria ✓ **Understand the economic, environmental and socio-cultural impacts of professional practice**	**Very Poor**	**Poor**	**Moderate**	**Good**	**Excellent**
A. Professional Practice (Punctuality/Follow the Rules)	Tidak menepati/ Tidak Mematuhi	Kurang menepati/ Kurang mematuhi	Adakala menepati / Adakala mematuhi	Menepati / Mematuhi	Sentiasa menepati / Sentiasa mematuhi
B. Ethical Behavior (Trustworthy / Respectfulness)	Tidak mengamalkan	Kurang mengamalkan	Adakala mengamalkan	Mengamalkan	Sentiasa mengamalkan
C. Social Cultural (Racial Harmony)	Tidak mengamalkan	Kurang mengamalkan	Adakala mengamalkan	Mengamalkan	Sentiasa mengamalkan
D. Personality	Tidak menepati	Kurang menepati	Adakala menepati	Menepati	Sentiasa menepati