$Objectives:

1-study the characteristics of passive filters by obtaining the frequency response of :obtaining the frequency response of low pass RL filter and high pass RC filter

2-determine the resonant frequency and bandwidth of the given circuit using a sinusoidal response

3-determine the type of the resultant filter and its quality factor .

$Theory:

The impedance of an inductor is proportional to frequency and the impedance of a capacitor is inversely proportional to frequency these property used to select or reject certain frequency this process is called filtering and the circuits which have this is called a filter

We will dialed with two kind of filters:

-high-pass filter : a filter passes high frequencies and rejects low frequencies

-low-pass filter : a filter passes low frequencies and rejects high frequencies

A frequency is considered passed if it's magnitude within 70% ($1/2^{(1/2)}$) of the max amplitude passed & rejected otherwise (which called the corner frequency, cut-off frequency , half power frequency).

The cut-off frequency determined as the equations :

For RC filter: $f_c = 1/(2\pi RC)$

For RL filter: $f_c = R / (2\pi L)$

*The laws of HPF-RC circuit :

-Voltage gain : $V_o/V_i = R / (R + I/jwC)$

-Forced response: $I = V / (R+ 1/jwC)$

Here the amplitude of the current is directly related to the amplitude of the forcing function and its increase as C or w increase but decrease when R increase

In capacitance the current lead the voltage by 90

*the law of LPF-RC circuit:

-Voltage gain : $V_o/V_i = R / (R +jwL)$

*the law of LPH-RL circuit :

- forced response: $I = V / (R+jwL)$

The amplitude of the current is directly related to the amplitude of the forcing function and it decreased as R L w increase

In inductor the current lag the voltage by 90

To measure phase shift with RCO the two signal should have the same frequency , same shape and the same reference axis
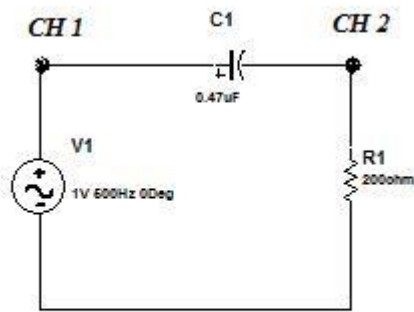
$Equipment:

FG, CRO, DMM, decade capacitance box decade inductor box

$Procedure:

PART 1:

1-connect the circuit as shown in the figure below

CH 1   C1   CH 2

0.47uF

V1

R1
200ohm

1V 600Hz 0Deg

Vp-p =2
Vp =1
Vrms = ,71

2.

1. turn the PG & CRO on
2. connect the probe FG & CRO together
3. Select the suitable range and change the frequency by its controller until the needed frequency (500 Hz)
4. select the type of the signal
5. change the amplitude of the signal by its controller until the needed value (2 Vp-p) ,then the signal will appear on CRO screen.
6. Connect channel one between the capacitor & the ground & cannel two between the resistance & the ground.
7. determine the value of the phase as in the calculation part
8. change the value of the frequency(by adding 500 Hz every time) and full the data in the table:

Frequency (Hz)	VR (v)	Distance(us)	Θ
500	534 m	373	67.164
1000	804 m	153	54.8
1500	1.15	88	47.36

2000	1.32	52.5	44.4
2500	1.45	37	32.8
3000	1.55	33.3	31.3
3500	1.63	23.5	29.2
4000	1.66	17.3	25.17
4500	1.7	14	22.65
5000	1.74	11.8	21.58

Note: Θ will be decreasing as the frequency increasing.

*PART 2:

1-connect the circuit as shown in the figure below

2-

1. turn the PG & CRO on
2. connect the probe FG & CRO together
3. Select the suitable range and change the frequency by its controller until the needed frequency (1000 Hz)
4. select the type of the signal
5. change the amplitude of the signal by its controller until the needed value (2 Vp-p) ,then the signal will appear on CRO screen.
6. Connect channel one between the capacitor & the ground & cannel two between the resistance & the ground.
7. determine the value of the phase as in the calculation part
8. change the value of the frequency(by adding 500 Hz every time) and full the data in the table.

Frequency (Hz)	VR (v)	Distance(us)	Θ

1000	1.38	25	9
1500	1.79	26.5	14.28
2000	1.75	22	16.17
2500	1.73	21	18.86
3000	1.69	19	20.76
3500	1.63	20.3	25.5
4000	1.61	18	25.89
4500	1.57	19.5	31.57

Note: Θ will be increasing as the frequency increasing.

$Conclusion:

1-to measure the phase shifting between two signal they should have the same reference axis

2-in capacitor the current lead voltage by 90 but in inductor the current lag the voltage by 90

3-in RC circuit the amplitude of the current is directly related to the amplitude of the forcing function and its increase as C or w increase but decrease when R increase

But in RL circuit The amplitude of the current is directly related to the amplitude of the forcing function and it decreased as R, L, w increase

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Experiment "9" (Filters)

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