Name of the experiment: To analyze the frequency response of a RLC Bandpass filter.

Objective: After completing this experiment, we will know the effect of input frequency to the output of a B.P.F. We will also know how to draw a semi-log graph of frequency vs function.

Theory: A Bandpass filter is a circuit that pass all the frequencies within a band of frequencies ($\omega_1 < \omega < \omega_2$). A B.P.F is formed when the output of a RLC series circuit is taken off the resistor shown in fig: (1)

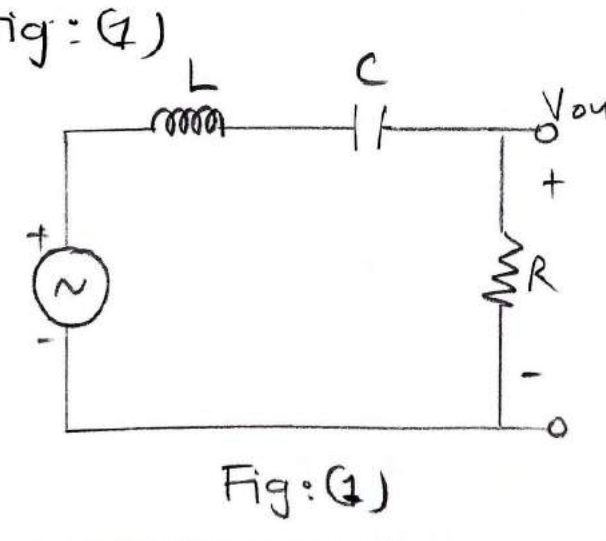


Fig: (1)

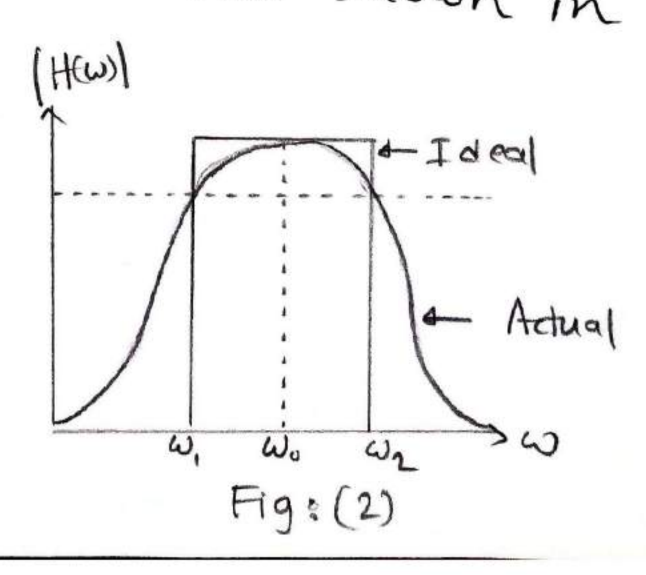


Fig: (2)

In fig(2), the frequency vs gain graph showing the ideal and actual frequency response of a Bandpass filter.

For a P.B.F, the center frequency,

$$\omega_0 = \frac{1}{\sqrt{LC}} \Rightarrow f_0 = \frac{1}{2\pi\sqrt{LC}} \quad \text{--- (i)}$$

$$B = \frac{R}{L} \quad \text{--- (ii)}$$

$$\omega_1 = \omega_0 - \frac{B}{2} \quad , \quad \omega_2 = \omega_0 + \frac{B}{2}$$

$$\Rightarrow f_1 = \frac{\omega_1}{2\pi} \quad \text{--- (iii)} \qquad \Rightarrow f_2 = \frac{\omega_2}{2\pi} \quad \text{--- (iv)}$$

Taking 5V as input voltage, $L = 330\mu H$, $C = 30\mu F$, $R = 2.4\ \Omega$, the required circuit will be same as fig(3).

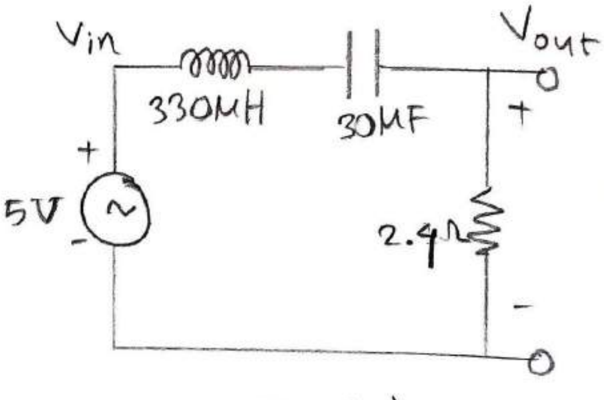


Fig:(3)

[] Apparatus:

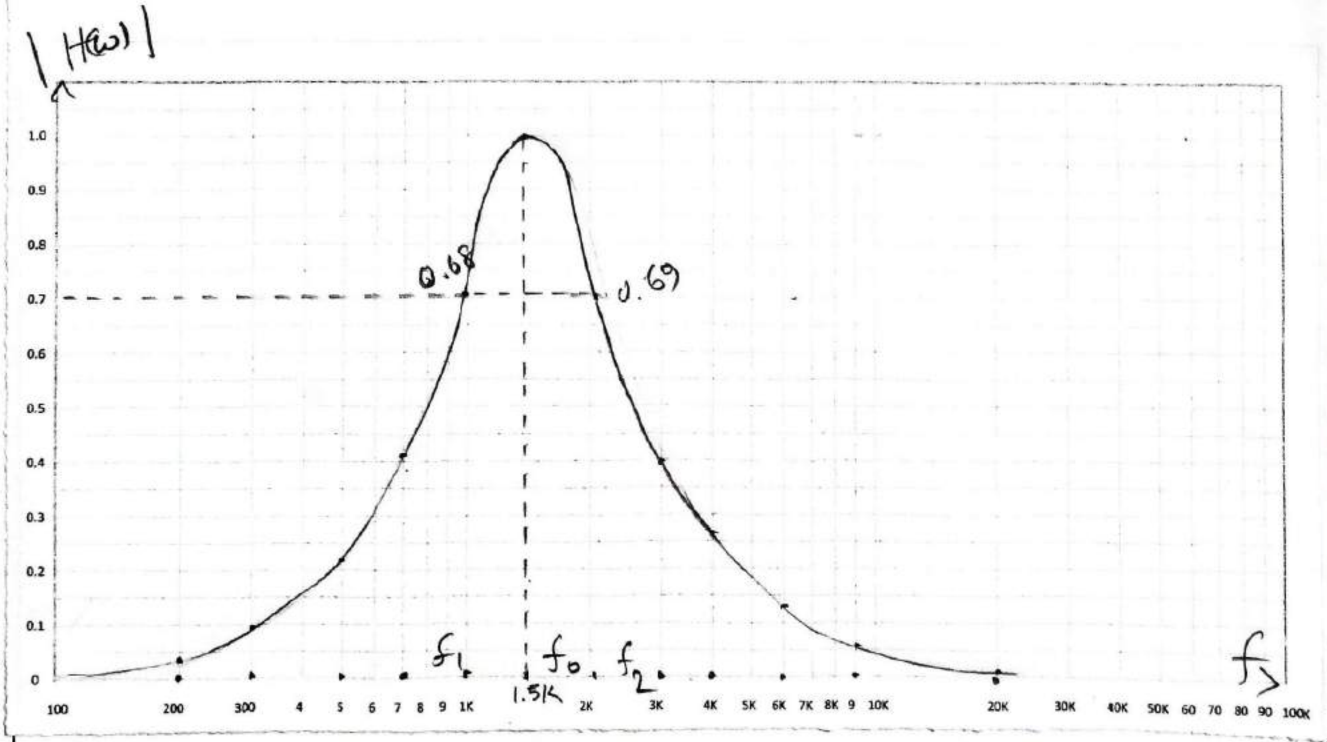
1. Frequency generator
2. Oscilloscope
3. Resistor
4. Capacitor
5. Inductor
6. Breadboard 7. Connector

四 Procedure:

1. Make the circuit and connect the frequency generator to the output.
2. To measure the frequency response, connect CH-1 and CH-2 of oscilloscope to input and output respectively.
3. Go to the 'measur' function of oscilloscope and set the peak-to-peak voltages of CH-1 and CH-2 to display.
4. For a wide range of frequency, in both side of f_1 and f_2, note the peak-to-peak voltages (VPP) of CH-1 and CH-2 and make a data table of frequency, VPP(in) VPP(out), and gain.
5. From the experimental value, draw a semi-log graph of frequency vs gain.

IV Data table : Bandpass

	Frequency (Hz)	V_{in} (PK-PK)	V_{out} (PK-PK)	$H(\omega) = \frac{V_o}{V_i}$
1	200	5	0.175	0.035
2	300	4.87	0.438	0.09
3	500	4.69	1.032	0.22
4	700	4.48	1.83	0.41
5	1K	4.35	2.856	0.68
6	1.5K	4.2	4.2	1
7	2.1K	4.01	2.76	0.69
8	3K	3.97	1.58	0.4
9	4K	3.88	1	0.26
10	6K	3.68	0.47	0.13
11	9K	3.58	0.21	0.06
12	20K	3.5	0.035	0.01



The semi-log graph of frequency vs gain.

Calculation:

$$\omega_0 = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{330 \times 30 \times 10^{-12}}} = 10K \text{ rad/s}$$

$$\therefore f_0 = \frac{\omega_0}{2\pi} = 1.5 \times 10^3 \text{ Hz}$$

$$B = \frac{R}{L} = \frac{2.4}{330 \times 10^{-6}} = 7.27 \times 10^3$$

$$\omega_1 = \omega_0 - \frac{B}{2}$$
$$= 10 \times 10^3 - 3636$$
$$= 6363 \text{ rad/s}$$

$$\omega_2 = \omega_0 + \frac{B}{2}$$
$$= 10 \times 10^3 + 3636$$
$$= 13636 \text{ rad/s}$$

$$\therefore f_1 = \frac{\omega_1}{2\pi} = 1012 \text{ Hz} \approx 1000 \text{ Hz}$$

$$\therefore f_2 = \frac{\omega_2}{2\pi} = 2170 \approx 2100 \text{ Hz}$$

Result:
The circuit is a RLC Bandpass filter from 1000Hz to 2100Hz.

Precaution:
1. Make sutee the sine wave is selected
2. Set both the coaxial cables of oscilloscope either 1x or 10x mood.
3. Make sure, both CH-1 and CH-2 is on.