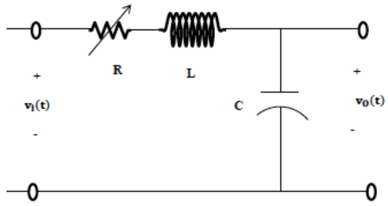
November 11, 2020 Prepared for ELE 302 TAs

EXPERIMENT #4

This experiment is about filters.

Passive Lowpass filter

Passive filters only have RLC. Without additional power, the gain will never be greater than 1.



- Voltage division with Z_L = sL and Z_c = 1/sC,

$$V_o = \frac{\frac{1}{sC}}{R + sL + \frac{1}{sC}} V_i$$

- The voltage-transfer function is

$$H(s) = \frac{V_o}{V_i} = \frac{\frac{1}{LC}}{s^2 + \frac{R}{L}s + \frac{1}{LC}}$$

- Equal the form of

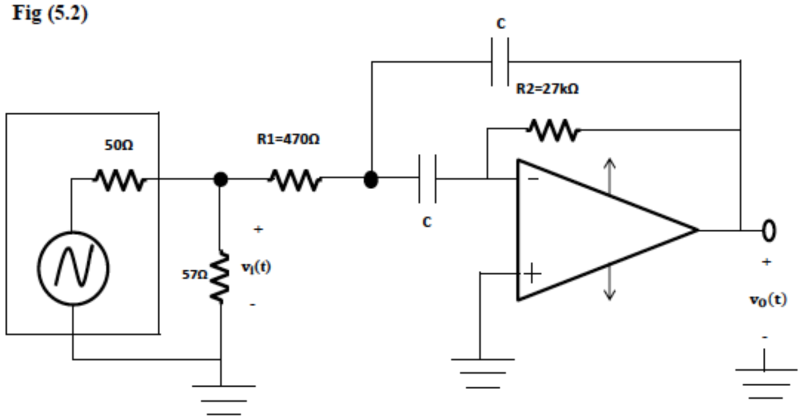
$$H(s) = \frac{V_o}{V_i} = \frac{\omega_o^2}{s^2 + \frac{\omega_o}{Q}s + \omega_o^2}$$

- To find the resonance frequency ω_o and quality factor Q in terms of R, L and C.

Active Bandpass filter

The students are **required** to do the **detailed work** in their pre-lab. Only high-level steps are provided in this part. As in Experiment #4, corner frequencies can be found at 45° phase shift. The resonance frequency has no phase shift. (DO NOT ADDED the 50Ω internal resistor of the function generator.)

Fig (5.2)



- Perform nodal analysis at V_1.
- Perform nodal analysis at V^- with $V^- = V^+ = 0$ V.
- With the 2 nodal analyses to get the transfer function to determine A, ω_o and Q.

$$H(s) = \frac{V_o}{V_i} = \frac{-\frac{1}{R_1 C}s}{s^2 + \frac{2}{R_2 C}s + \frac{1}{R_1 R_2 C^2}} = \frac{As}{s^2 + \frac{\omega_o}{Q}s + \omega_o^2}$$