Lab 5 : Prelab

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a). Voltage division

$$V_0(s) = \frac{V_s(s) \times \frac{1}{sc}}{R + \frac{1}{sc}}$$

$$\frac{V_0(s)}{V_s(s)} = \frac{1/sc}{\frac{sc \cdot R + 1}{sc}} = \frac{1}{1 + scR}$$

$$\longrightarrow \frac{V_0(s)}{V_s(s)} = \frac{1}{1+s\tau} \qquad \# \tau = \text{time constant} = RC$$

$$\text{cutoff frequency}, \; f_c = \frac{1}{\tau} = \frac{1}{RC}$$

$$\therefore \omega_c = 2\pi f_c = \frac{2\pi}{RC} \; \text{rad/sec}$$

b). First-order high pass filter
-Voltage division

$$V_0(s) = \frac{V_s(s) \times sL}{R + sL}$$

$$\frac{V_0(s)}{V_s(s)} = \frac{sL}{R+sL}$$

$$\frac{s(\frac{L}{R})}{\frac{R}{R} + \frac{sL}{R}} = \frac{s(\frac{L}{R})}{1+s\frac{L}{R}} \longrightarrow \tau = \frac{L}{R}$$

$$f_c = \frac{1}{\tau} = \frac{R}{L}$$

$$\therefore \omega_c = 2\pi f_c = \frac{2\pi R}{L} \; \text{rad/sec}$$