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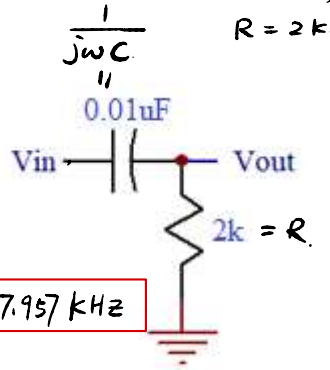
Experiment 7 Pre-Lab
ECE203 Spring 25

$C = 0.01\,\mu F$
$R = 2\,k\Omega$

1. (2 points) Find the cutoff frequency for the circuit shown.



$\frac{V_{in}-V_{out}}{\frac{1}{j\omega C}} = \frac{V_{out}-0}{R} \Rightarrow V_{in}-V_{out} = \frac{1}{j\omega RC} V_{out} \Rightarrow V_{in} = \left(1+\frac{1}{j\omega RC}\right) V_{out}$

$H(\omega) = \frac{V_{out}}{V_{in}} = \frac{1}{1+\frac{1}{j\omega RC}} = \frac{j\omega RC}{1+j\omega RC}$ $\quad |H(\omega)| = \frac{\omega RC}{\sqrt{1+(\omega RC)^2}} = \frac{1}{\sqrt{2}} \Rightarrow \omega_c = \frac{1}{RC} = 2\pi f_c \Rightarrow f_c = \frac{1}{2\pi RC} = \frac{1}{2\pi \times 2000 \times 10^{-8}} =$ **7.957 kHz**

2. (1 point each) Fill in the following table for V_{out} vs. frequency. You must take into consideration the -3dB attenuation at the filter's cutoff frequency. Assume $V_{in} = 2V_{rms}\angle 0°$.

f (Hz)	$\lvert V_{out}\rvert$ (V_{rms})	Θ_{out} (°)
80Hz	0.02	89.42°
800Hz	02	84.28°
8kHz	1.41	45°
80kHz	2.00	5.71°

$H(\omega) = \frac{j\omega RC}{1+j\omega RC}$

$|H(\omega)| = \frac{\omega RC}{\sqrt{1+(\omega RC)^2}} = \frac{2\pi f \cdot RC}{\sqrt{1+(2\pi f RC)^2}} = \frac{V_{out}}{V_{in}}$

$\angle H(\omega) = \tan^{-1}\left(\frac{\omega RC}{0}\right) - \tan^{-1}\left(\frac{\omega RC}{1}\right)$

$= 90° - \tan^{-1}(\omega RC)$

$= 90° - \tan^{-1}(2\pi f \cdot RC)$