HW-5 CMPE-460

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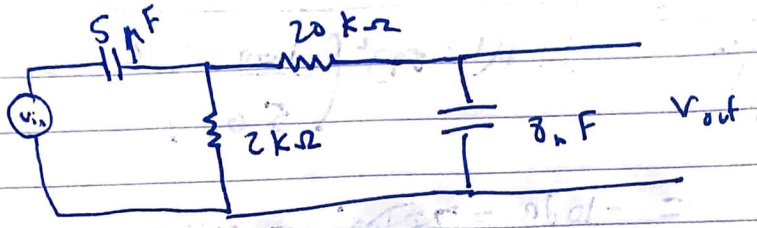


$$\left|\frac{v_{out}}{v_{in}}\right| = \frac{1}{\sqrt{1+(\omega RC)^2}} = 0.707 \Rightarrow F_H$$

Low Pass

$$\frac{1}{\sqrt{1+\left((2\pi f)(20k)(8n)\right)^2}} = 0.707$$

$$\frac{1}{(0.707)^2} = 1+\left((40k)(8n)(f)(\pi)\right)^2$$

$f_H = 9945.3$ Hz

$f_H = 9947$

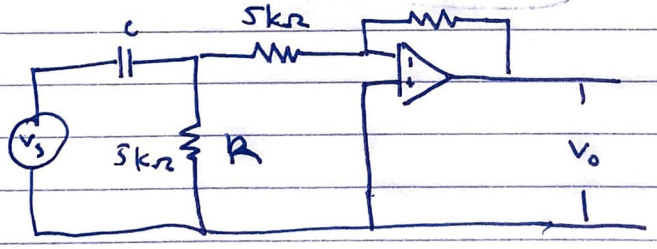
High Pass

$$f_L = \frac{1}{2\pi RC} = \frac{1}{2\pi(5\mu F)(2k\Omega)} = 15.92 \text{ Hz} = F_L$$

$$F_C = \sqrt{f_H f_L} = 125.824 \text{ Hz} = f_{cen}$$

2., 3. (see other images / matlab script)

4.



HPF + Gain stage

$$f_c = \frac{1}{2\pi RC} = \frac{1}{2\pi(5k\Omega)(C)} = 318 \text{ Hz}$$

$C = 0.100\ \mu F$

$$\frac{v_{out}}{v_{in}} = -\frac{R_f}{5k} = 4 \text{ dB}$$

$$= 20\log\left(\frac{v_{out}}{v_{in}}\right)$$

$$\Rightarrow \frac{v_{out}}{v_{in}} = 1.585$$

$$1.585 \cdot (5k\Omega) = 7924\ \Omega$$

$$|H(j\omega)| = \frac{1}{\sqrt{1+\varepsilon^2\left(\frac{\omega}{\omega_p}\right)^{2n}}} = \frac{1}{\sqrt{1+(1.259)^2\left(\frac{1000}{500}\right)^{2n}}}$$

6. $2\text{dB} = 20\log(\varepsilon)$

$\varepsilon = 1.259$ $= -10\text{dB} = 20\log(\quad) = .3162$

$-10\text{dB} = 20\log\left(\frac{v_{out}}{v_{in}}\right)$

$\frac{v_{out}}{v_{in}} = 0.316$ $\left(\frac{1000}{500}\right)^{2n} = 5.678$

$n = 1.253 \Rightarrow$ at least 2nd order butterworth

7. $0.707 = \frac{1}{\sqrt{1+(0.25)\left(\frac{\omega}{500}\right)^{2(5)}}}$

$0.707 =$

$\frac{1}{2} = \frac{1}{1+(0.25)\left(\frac{\omega}{500}\right)^{10}}$ $1 = (0.25)\left(\frac{\omega}{500}\right)^{10}$

$\sqrt[10]{4} = \frac{\omega}{500}$

$\omega = 574$

$f_c = 91.41$ Hz