Lab Experiment 2

Theoretical

V_{out} will be the voltage applied across the resistor(R_{out}) and the three capacitors, (C, C_m, C_{out})

Finding the impedance Z_{out}:

$$\begin{aligned}
Z_{out} &= \frac{1}{\frac{1}{\frac{-j}{\omega C}} + \frac{1}{\frac{-j}{\omega C_m}} + \frac{1}{\frac{-j}{\omega C_{out}}} + \frac{1}{R_out}} \\
&= \frac{1}{\frac{1}{R_{out}} - \omega \frac{C+C_m+C_{out}}{j}} \\
&= \frac{jR_{out}}{j - R_{out}\omega(C + C_m + C_{out})} \\
&= \frac{R_{out} - jR_{out}^2\omega(C + C_m + C_{out})}{1 + R_{out}^2\omega^2(C + C_m + C_{out})^2}
\end{aligned}$$

Z_{out} is in series with the resistor R and the voltage drop across this combo, and the two capacitors(C_{in}, C_s) is V_{split}.

Finding the impedance Z_{split}:

$$\begin{aligned}
Z_{split} &= \frac{1}{\frac{1}{\frac{-j}{\omega C_{in}}} + \frac{1}{\frac{-j}{\omega C_s}} + \frac{1}{R+Z_{out}}} \\
&= \frac{1}{\frac{1}{R+Z_{out}} - \omega \frac{C_{in}+C_s}{j}} \\
&= \frac{j(R + Z_{out})}{j - \omega(R + Z_{out})(C_{in} + C_s)}
\end{aligned}$$

Before taking the complex conjugate of this step, substituting Z_{out} back into the expression, because it itself is complex and needs to be accounted for.

Substituting Z_{out} back in:

$$Z_{split} = \frac{j\left(R + \frac{R_{out} - jR_{out}^2\omega(C+C_m+C_{out})}{1+R_{out}^2\omega^2(C+C_m+C_{out})^2}\right)}{j - \omega\left(R + \frac{R_{out} - jR_{out}^2\omega(C+C_m+C_{out})}{1+R_{out}^2\omega^2(C+C_m+C_{out})^2}\right)(C_{in} + C_s)}$$

stuff and things about calculating the V out:

Experiment