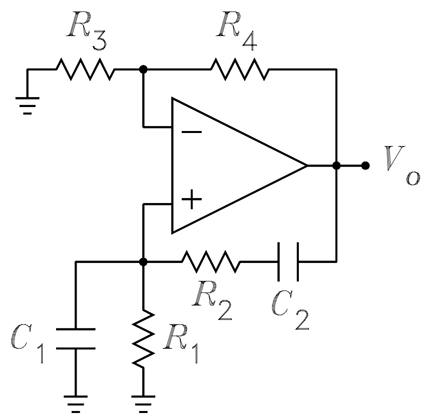
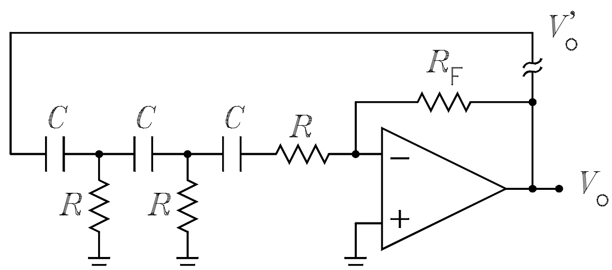
ECE3050 Assignment 19

1. The circuit shows a Wein bridge oscillator. If $R_1 = R_2$, $C_1 = 0.1\,\mu\text{F}$, $C_2 = 0.22\,\mu\text{F}$, and $R_4 = 10\,\text{k}\Omega$, specify R_1, R_2, and R_3 for the circuit to have stable oscillations at $f = 1000\,\text{Hz}$. Answers: $R_1 = R_2 = 1073\,\Omega$ and $R_3 = 6875\,\Omega$.



2. The figure shows a phase-shift oscillator with the feedback loop broken.

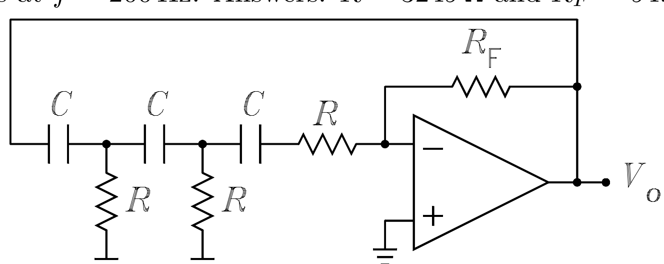


By writing node equations, it can be shown that the loop-gain transfer function is given by

$$\frac{V_o'}{V_o} = -\frac{R_F}{R}\,\frac{(RCs)^3}{(RCs)^3 + 6\,(RCs)^2 + 5\,(RCs) + 1}$$

(a) To solve for the frequency of oscillation, what do you set V_o'/V_o equal to? Answer: $1\angle 0^\circ$. (b) Use the transfer function to solve for the frequency of oscillation. Answer: $f_0 = 1/\left(2\pi\sqrt{6}RC\right)$. (c) Use the transfer function to solve for value of R_F/R in order for $|V_o'/V_o| = 1\angle 0^\circ$ at $f = f_0$. Answer: $R_F/R_1 = 29$.

3. The figure shows a phase shift oscillator. If $C = 0.1\,\mu\text{F}$, specify R and R_F for the circuit to have stable oscillations at $f = 200\,\text{Hz}$. Answers: $R = 3249\,\Omega$ and $R_F = 94.21\,\text{k}\Omega$.



4. The loop-gain transfer function of a particular oscillator circuit is given by

$$\frac{V_o}{V_o'} = K\frac{s}{(s/100)^2 + 0.5\,(s/100) + 1}$$

At what frequency does the circuit oscillate and what must be the value of K for stable oscillations? Answers: $f = 15.9\,\text{Hz}$ and $K = 0.005$.