EE2019 – Analog Systems and Lab.

Tutorial #5

Qadeer Ahmad Khan & Saurabh Saxena

Question-1

A filter transfer function is given by

$$\boldsymbol{H(s) = \frac{10\left(1 + \frac{s^2}{\omega_p^2}\right)}{1 + \frac{s}{\omega_p Q_p} + \frac{s^2}{\omega_p^2}}}$$

Here, $\omega_p = 10^8$ and $Q_p = \frac{1}{3}$.

a) Draw s-domain block diagram of the above filter using integrators and gain blocks.
b) Realize the above filter transfer function using ideal opamps, resistors, and capacitors.
c) If 10pF capacitors are used for all integrators, find all resistor values used in your design.
d) Draw Bode magnitude and phase plots for the filter transfer function.

Question-2

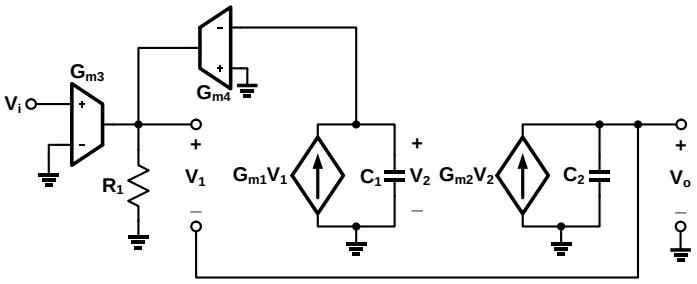
The magnitude of a filter transfer function is given by

$$\boldsymbol{|H(j\omega)|^2 = \frac{4}{1 + \left(\frac{\omega}{\omega_p}\right)^6}}$$

Here, $\omega_p = 10^8$.

a) Find transfer function for the filter in s-domain with magnitude response as given above. The filter should be stable.
b) Draw s-domain block diagram of the above filter using integrators and gain blocks.
c) Realize the above filter transfer function using ideal opamps, resistors, and capacitors.
d) If 10pF capacitors are used for all integrators, find all resistor values used in your design.
e) Draw Bode magnitude and phase plots for the filter transfer function.

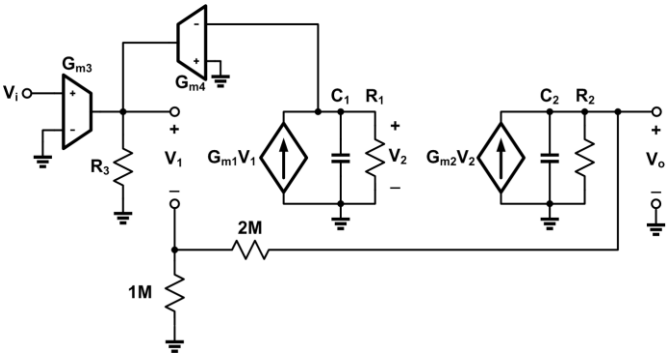
Question-3



For the closed loop feedback system shown above G_{m1} = 4 mA/V, G_{m2} = 25mA/V, G_{m3} = 1 mA/V, R_1 = 1kΩ, C_1 = 10 pF, C_2 = 100 pF,

a) Find loop gain and phase margin when G_{m4} = 0.
b) Find G_{m4} such that the closed loop $\frac{V_o(s)}{V_i(s)}$ is a second-order transfer function with Butterworth (maximally flat) response in signal band.
c) For G_{m4} value found in part (b), find loop gain and plot Bode magnitude and phase plots for the loop gain. Also, find the phase margin for loop.

Question-4



For the closed loop feedback system shown above G_{m1} = 25 mA/V, G_{m2} = 40 mA/V, G_{m3} = 1 mA/V, R_1 = 1kΩ , R_2 = 100Ω, R_3 = 1kΩ, C_1 = 100 pF, C_2 = 1 nF,

a) Find loop gain and phase margin when G_{m4} = 0.
b) Find G_{m4} such that the closed loop $\frac{V_o(s)}{V_i(s)}$ is a second-order transfer function with Butterworth (maximally flat) response in signal band.
c) For G_{m4} value found in part (b), find loop gain and plot Bode magnitude and phase plots for the loop gain. Also, find the phase margin for loop.
