HOMEWORK ASSIGNMENT #3

Prob. 1. Using Simulink (MatLab) design and simulate the following tuning schemes:

a) Frequency-locked loop
b) Adaptive LMS algorithm

For a BP filter with a transfer function given by

\[
H_{BP}(s) = \frac{k\omega_o s}{s^2 + \frac{\omega_o s}{Q} + \omega_o^2}
\]

Let \( \omega_o = 1 \text{ r/s} \), \( Q = 2 \) as goals (normalized values)

The initial condition must be \( \omega_o \neq 1 \text{ r/s} \) and \( Q \neq 2 \)

Show simulations that the two tuning schemes operate correctly.

EXTRA CREDIT

Implement an Active-RC two integrator loop and show how the tuning schemes can be used.
Prob. 2.  

a) Design an op amp with GB=60 MHz, phase margin $\leq 70^\circ$, $A_o \geq 40dB$. Using a two stage amplifier i.e. see p 22 notes Lect. 7.

b) Obtain the non-linear macromodel of the op map designed in a) and compare your transistor and macromodel simulations.

c) Design the second-order filter shown below with

$$\omega_{p_1} = 2\pi \times 1M \, r/s \text{ and } \omega_{p_2} = 2\pi \times 3M \, r/s$$

![Filter Circuit Diagram](image)

$$\omega_{p_1} = \frac{1}{R_1C_1} ; \quad \omega_{p_2} = \frac{1}{R_2C_2}$$

d) Simulate the above circuit at the transistor and macromodel level and compare simulations in the frequency domain and for a step response.

Write a Summary Table of all your results and make comments.
Prob. 3. The super-source follower-based filter is a very compact filter.

\[ H(s) \approx \frac{A_o}{1 + s \frac{C_1}{g_{m1}} + s^2 \frac{C_1 C_2}{g_{m1} g_{m2}}} \]

Design the filter for \( \omega_o = 2\pi \times 10^3 M \) \( \frac{r}{s} \), \( Q=1.3 \) using 0.18\( \mu \)m CMOS technology.

Reference


Provide a table summarizing your results, include also noise and linearity results.