UNIVERSITY OF CALIFORNIA AT BERKELEY

College of Engineering

Department of Electrical Engineering and Computer Sciences

EE105 Lab Experiments

Experiment 6: Single-Stage Amplifiers

Pre-Lab Worksheet

Student 1 name:

Student 2 name:

Lab group: Tuesday 8-11 / Tuesday 5-8 / Thursday 8-11 / Thursday 5-8

Before adding Cadence plots to your report, please **change the background color to white**:

Edit->Properties-> Click the black rectangle near the "Background" -> change to white.

Submit the pre-lab worksheet to Gradescope. It will be due before the start of lab.

# Pre-Lab

# Specifications

# Biasing Circuit

* + 1. What is the transfer function ? You can assume that  to simplify your calculations.
    2. What kind of response is it (low-pass/band-pass/high-pass)? What its 3dB frequency?
    3. What is the problem with biasing the transistor with Rs=0? How does Rs solve this problem? Why do we need the Cs capacitor in the circuit?

# Transfer Function

* + 1. Draw a small-signal equivalent circuit of the entire amplifier. Write an expression for the transfer function .
    2. Now write an expression for the desired transfer function . What are the poles and zeros of the transfer function? What is the mid-band gain Amid? What is the high -3dB frequency fH? Sketch a bode plot of the transfer function.
    3. Calculate the required values of the resistors and capacitors to meet the specifications.
    4. Change the component values in the simulation if needed to meet specifications and list those values.

|  |  |  |
| --- | --- | --- |
| **Component** | **Hand calculation** | **Cadence simulation** |
| Rd |  |  |
| Rs |  |  |
| Cs |  |  |

* + - 1. Use AC analysis to plot the transfer function.
      2. Use transient analysis to verify the output swing requirement.
    1. What is the simulated total current consumption of the amplifier? What part of it is the transistor and what part is the Rg1,Rg2 biasing?
    2. Fill out the following table with all of the values you got from hand calculation and cadence simulation:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameter** | **Spec** | **Hand calculation** | **Cadence simulation** | **Units** |
| Middle band gain (Amid) | >50 |  |  | - |
| High -3dB frequency (fH) | >20 |  |  | KHz |
| Low -3dB frequency (fL) | <300 | - |  | Hz |
| Output Swing | >6 | - |  | Vptp |

# Higher bandwidth spec

* + 1. What should be the new values of Rd, Rs and Cs to fulfill the new spec? *Hint*: do not repeat the calculations from part 2.3. Think about the difference from the previous circuit.

|  |  |  |
| --- | --- | --- |
| **Component** | **Hand calculation** | **Cadence simulation** |
| Rd |  |  |
| Rs |  |  |
| Cs |  |  |

* + 1. Attach the AC transfer function plot of the new design.
    2. What is the simulated total current consumption of the amplifier? What part of it is the transistor and what part is the Rg1,Rg2 biasing?
    3. Fill out the following table with all of the values you got from hand calculation and cadence simulation:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameter** | **Spec** | **Hand calculation** | **Cadence simulation** | **Units** |
| Middle band gain (Amid) | >50 |  |  | - |
| High -3dB frequency (fH) | >20 |  |  | KHz |
| Low -3dB frequency (fL) | <300 | - |  | Hz |
| Output Swing | >6 | - |  | Vptp |