UNIVERSITY OF CALIFORNIA AT BERKELEY
College of Engineering
Department of Electrical Engineering and Computer Sciences

EE105 Lab Experiments

Lab 5: Multi-Stage Amplifiers Pre-Lab Worksheet

2 Pre-Lab

Please note that sections 2.1 - 2.2 are due at the beginning of your first Lab section for Lab 5. The remaining sections are due at the beginning of the second week of Lab 5.

2.1 Back of the envelope determination of DC bias points

Output bias voltage for input stage V_D: _____

Output bias voltage for middle stage V_{E2}: _____

Output bias voltage for output stage V_{E3}: _____

2.2 Input stage

Draw the midband small signal circuit for the input stage in the space below.

Please write analytical expressions for the following parameters.

Midband gain (A_{mid}): _____

Output resistance (R_{out}): _____

Output swing (SW): _____

Component Design	Hand Calculation	HSPICE Simulation
R_{G1}		
R_{G2}		
R_D		

Table 1: Input stage component design

Performance	Hand Calculation	HSPICE Simulation
Middle Band Gain (A_{mid})		
Output Voltage (V_D)		
Output Resistance (R_{out})		
High Cutoff Frequency (f_H)	X	
Output Swing (SW)		

Table 2: Input stage performance verification

2.3 Output stage

2.3.1 Determination of bias current

Draw the midband small signal circuit for the output stage in the space below. **Please do not forget the 8 Ω speaker load!**

Please write analytical expressions for the following parameters.

Midband gain (A_{mid}): _____

Input resistance (R_i): _____

How much bias current do we need to be able to get a voltage midband gain of 0.9? 0.99? _____, _____

Please write analytical expressions for the following questions.

What is the maximum ac current that can be sourced from the supply?

What is the maximum ac current that can be sunk to ground?

What are the maximum and minimum output voltages of the stage, defining the output swing?

What bias current is required to achieve a 1 Vpp swing? _____

What are the maximum collector current and power dissipation ratings for the 2N4401 bipolar transistor?

2.3.2 Current source design

Write an equation relating I_{bias} and I_{source}.

Write an equation relating R_C to I_{bias} and I_{source}.

Component Design	Hand Calculation	HSPICE Simulation
I_{bias}		
R_C		

Table 3: Output stage component design

Performance	Hand Calculation	HSPICE Simulation
Middle Band Gain (A_{mid})		
Input Resistance (R_i)		
High Cutoff Frequency (f_H)	X	
Output Swing (SW)		

Table 4: Output stage performance verification

2.4 Middle stage

Draw the 'loaded' midband small signal circuit for the middle stage in the space below. **Please do not forget the output resistance from the input stage and the input resistance from the output stage!**

Please write analytical expressions for the following parameters.

'Loaded' midband gain (A_{mid}): _____

What are the maximum and minimum output voltages of the stage, defining the output swing?

Component Design	Hand Calculation	HSPICE Simulation
I_E		
R_E		

Table 5: Middle stage component design

Performance	Hand Calculation	HSPICE Simulation
Loaded Middle Band Gain (A_{mid})		
High Cutoff Frequency (f_H)	X	
Output Swing (SW)		

Table 6: Middle stage performance verification

2.5 Putting it all together

Attach plots of the frequency response from 1 Hz to 20 kHz as well as a plot showing evidence of a 1 Vpp output swing of the entire amplifier.