April 3, 2019

ECEN 325
Final Project

Instructor: Sam Palermo

This project must be tested in the laboratory, with a working design shown to a TA. Groups of 1-3 are allowed.

Design a three-stage amplifier with NPN and/or MOSFET transistors to satisfy the following constraints. Note, the design should use standard value resistors (no potentiometers).

Sections 501-506

- $A_V \geq 50$
- $R_{in} \geq 50k\Omega$
- Harmonic distortion below -30dB with $v_{imax} = 5mV_{pk}$ ($10mV_{pp}$)
- $V_{CC} = 5V$
- $R_{load} = 16\Omega$. Note, you may have to use multiple transistors in parallel in the output stage to drive this load. Check the power ratings of the transistors.

Sections 200

- $A_V \geq 50$
- $R_{in} \geq 50k\Omega$
- Harmonic distortion below -30dB with $v_{imax} = 5mV_{pk}$ ($10mV_{pp}$)
- $V_{CC} = 5V$
- **$R_{load} = 8\Omega$.** Note, you may have to use multiple transistors in parallel in the output stage to drive this load. Check the power ratings of the transistors.
- **Use a minimum of 3 MOSFETs in your design.** Note, if desired you can use more and also BJTS, but the intent is the MOSFETs are a key part of your design.

Your report should describe the design procedure stage-by-stage, beginning with the output stage. **Use the graphical approach outlined in class to choose initial bias points for all stages.**

Both the preliminary and final report should include the following **simulation results**:

- DC operating points (voltages & currents) for each stage
- AC Plots from 100Hz to 100kHz: A_V, R_{in}
- Transient plot of output signal with input 10kHz sine wave of 5mV amplitude
- Frequency domain plot of above transient which shows the harmonic distortion. Note, to verify the -30dB harmonic distortion spec, the harmonic distortion for a given harmonic is the ratio of the harmonic power over the fundamental power.
- Include the Multisim output of the Fourier Analysis which states the Total Harmonic Distortion (THD).
- Total power dissipation

The final report should also include the following **measurement results**:

- Bode plot showing the amplifier gain. Note, you may have to scale the plot to account for the input voltage divider.
- R_{in} measurement
- Transient plot of output signal with input 10kHz sine wave of 5mV amplitude
- Frequency domain plot of above transient which shows the harmonic distortion.

Important Dates

- Apr 22 Preliminary Report Due
- Apr 22-23 Dedicated lab time to complete design and get results for the report
- Apr 30 Project Report Due*. Email Prof. Palermo your report by 5PM.
- Apr 29-30 Project demonstrations in lab. Note, be prepared to answer questions over your design.

*Note the design should be finalized on April 30 when you turn in the report. The demonstration on April 29-30 is to verify the design that you have in the report.

Project Grading*

- Preliminary Report 20%
- Lab Performance 30%
- Report** 50%

*Note that all components are necessary to get any credit for the project

****The final report should be a comprehensive professional document.*** The report must include a summary of the key specifications, a discussion of the architecture, and a detailed design procedure. In addition to the measured results discussed earlier, **a summary table of specifications, simulated, and measured results is required**.

Extra Credit Opportunities (Up to an additional 20%)

- Use an advanced technique
  - Darlington pair, Boot-Strapped Follower, etc
- Use a MOSFET stage (not Section 200)
- Best measured performance while meeting all specifications
  - Highest Gain, Best Distortion, Lowest Power, Best Overall