**Pre-lab:**

1. Watch the “EENG 331 Pre-Lab Video 3” which can be found under Panopto recordings on Canvas.
2. Design a CS stage without source degeneration for a gain of 10 and a power budget of 5 mW. Assume the channel modulation effects are neglected, Vov = 100 mV and kp = 100 micro A/V2. VDD = 5V, and VTH = 0.5V.
3. Design a CS stage with self-biasing and an active load for the same constraints in b (Use the same Id).

**Lab Tasks:**

*Task# 1:*

1. Using LTspice, export the “Harvey\_super\_cool” wave file to LTspice. Use a voltage divider to reduce the level of the signal by a factor of (1/201). Plot the speech file without attenuation and after attenuation. (run the transient analysis for 2 seconds). Justify the drop theoretically and mathematically.
2. Using LTspice, export the attenuated signal to your spice directory and listen to it. What do you notice?
3. Use the values from the pre-lab part (b) to design the CS stage.
4. Run a “.op” analysis to verify your operating point values.
5. Use an input test voltage of 1mV amplitude and 100 Hz frequency to justify the operation of the CS stage in “c”. Plot the input and the output voltage and observe the effect on the gain and the phase. Justify this theoretically and mathematically.
6. Use the CS stage to amplify the attenuated speech file. What do you notice? Is there any clipping? If there is, then you need to check what is the range for the speech file amplitudes. Based on that you may justify your answer.
7. You will notice that the input impedance for the CS stage is in the KOhm region. What do we need to do to increase this input impedance to 100 kOhms? Implement your solution using LTspice.
8. Is it possible to increase the gain to 200? Justify your answer.

*Task #2:*

1. Using LTspice, create the CS stage in the pre-lab part “c”.
2. Assume that the transistor used for this stage has a Lambda = 0.1 V-1. What is the gain of this stage? Assume the current source acts as an infinite resistance when performing an AC analysis.
3. Run a “.op” to verify the gain.
4. Use the 1mV test voltage to verify the gain for this stage. Plot the input and the output voltage. Justify your observation theoretically and mathematically.
5. Use the attenuated speech file as an input to this stage. Export the output and listen to it. What do you notice?
6. Change Lambda to = 0.01 V-1 and repeat “d”.
7. Change Lambda to = 0.001 V-1 and repeat “d”.
8. If you have noticed clipping in “f” or “g” then verify your results theoretically and mathematically.
9. What is the advantage of the biasing method in Task#2?