1. (100 points – 70pts design plots/calc., 30points Multisim) Design a single-stage amplifier with the 2N3904 NPN-BJT transistor to satisfy the following constraints.

- $|A_v| \geq |-8|
- R_{in} \geq 30k\Omega
- R_{out} \leq 5k\Omega
- v_{omax} = 300mV_{pk} \text{ with harmonic distortion below -30dB}
- V_{CC} = 5V

Assume that the load impedance is 5kΩ, and the maximum input signal is 37.5mV_{pk} (75mV_{pp}). Note, for the IC necessary to meet the $R_{in}$ spec the transistor will have a Beta near 150.

Use the graphical design approach outlined in the notes. On one graph, plot 5 curves which capture the following constraints.

- Negative $v_{omax}$ Swing and $R_{in}$ constraints
- Positive $v_{omax}$ Swing constraint
- $A_v$ and $R_{in}$ constraint
- $v_{omax}$ harmonic distortion constraint
- $R_{out}$ constraint

Color in the design space area and choose an acceptable design point.

Verify the design in Multisim. Provide the following 5 plots

- AC Plots from 100Hz to 100kHz: $A_v$, $R_{in}$, $R_{out}$
- Transient plot of output signal with 10kHz sine wave of 37.5mV 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 portion of the Multisim output that details the harmonic distortion.