ECE137A, Lab Project #2

You must purchase lead-free solder from the electronics shop. Do not purchase solder elsewhere, as it will likely be tin/lead solder, which is toxic. "Solder-sucker" desoldering tools are not permitted in the lab, as they disperse a dust of solder granules into the air and onto surrounding surfaces. If you are also foolishly using tin/lead solder, you will then poison yourself. Again, use lead-free solder from the shop, and use desoldering wick to remove solder. ***Projects assembled using lead-containing solder will receive a grade of zero***.

In this project, you will design, build, and test a small audio power amplifier to drive a loudspeaker. The project must constructed with components soldered on a circuit board.

The speaker is an 8 Ohm load.
The circuit specifications are as follows
All testing is with an 8 Ohm load resistance.
Voltage Gain: 10, plus or minus 10%, measured at 1 kHz.
Input impedance: 1000 Ohms or more.
Variation in gain less than +/- 1 dB between 100 Hz and 10 kHz
 ---this sets a minimum size on bypass and coupling capacitors.
Peak-peak output swing before clipping:
 at least 3 volts peak-peak.
 1-10 additional points will be rewarded for signal swings between 3 Volts peak-peak and 8 Volts peak-peak.
Power supplies: Positive and negative 5 volts.
The input is to be differential, but, in testing, 1 of the 2 inputs will be AC and DC grounded, with the other driven

The amplifier can only be partially AC coupled: DC blocking capacitors are allowed on the input, if desired, but an output DC blocking capacitor is not allowed.

Use of a push-pull class AB output stage is strongly suggested: these will be discussed in lecture, but are also in the notes and in the book, so you can read ahead. Beware of thermal runaway: the thermal stability factor, K, given below, must be less than 1 or the push pull circuit can spontaneously destroy itselt. Vcc is the supply voltage. Re the emitter degeneration, and the theta terms are thermal resistances.

$$k = \frac{(2.2mV/C)V_{cc}(\theta_{junction-case} + \theta_{\text{case-heatsink}} + \theta_{\text{heatsink-ambient}})}{r_e + R_e}$$

$\theta_{junction-case}$ is given on the transistor datasheet, $\theta_{\text{case-heatsink}}$ should be less than 2 C/W if you firmly attach the transistor to the heatsink with minimal air gaps, thermal conductive compound, and a thin mica insulator. $\theta_{\text{heatsink-ambient}}$ is approximately

$\theta_{\text{heatsink–ambient}} \approx 50/\sqrt{A}(C/W \cdot cm^2)$, where A is the surface area of the heat sink. Heat sink surfaces should be vertical for best thermal convection.