ECE 321 - Homework #1

Op Amp Amplifiers, Push-Pull Amplifiers. Due Monday, April 6th

Please make the subject "ECE 321 HW#1" if submitting homework electronically to Jacob_Glower@yahoo.com (or on blackboard)

For all problems, assume you are using

LM833 Op Amps (max current = 50mA)

TIP112 and TIP117 transistors

- β = 1000
- | Vbe | = 1.4V   (Darlington pair)

Voltage Amplfier:

Design a circuit which mixes and amplifies two cell phones cell phone to -10V to +10V (analog), capable of driving an 8 Ohm speaker at 12.5 Watts.

Problem 1) Design an amplifier which mixes and amplifiers audio signal from two cell phones:

Input (Va amd Vb): Two cell phones

- 1Vpp AC signal
- 20 - 20kHz
- Capable of driving 1mA @ 1Vpp

Output: 1k resistor (worst case: 10mA @ 10V)

Relationship

$$V_1 = 7V_a + 3V_b$$

Problem 2) Design push-pull amplifier to connect the output of problem #1 to an 8-Ohm speaker:

Input: V1

- 10Vpp AC signal
- 20 - 20kHz
- Capable of driving 10mA @ 1Vpp

Output: V2

- 8 Ohm speaker

Relationship:

$$V_2 = V_1 \qquad \textit{i.e. no crossover distortion}$$

Problem #3: Simulate problem #1 and #2 in CircuitLab and verify that

- V2 = 7Va   (set Vb = 0)
- V2 = 3Vb   (set Va = 0)
- V2 = 7Va + 3Vb (both Va and Vb are on)

Current Amplfier:

Problem #4) Design a push-pull amplifier to take the output of probem #1 and drive an LED where the current is proportional to the voltage at V1

Input: V1
- 10Vpp AC signal
- 20 - 20kHz
- Capable of driving 10mA @ 1Vpp

Output:
- Red LED (V1 > 0)
- Blue LED (V1 < 0)

Relationship:
- The current through the LED is

$$I_d = 100V_1 \quad \text{mA}$$

Problem #5: Simulate problem #1 and #4 in CircuitLab and verify that
- Id = 700Va (mA)   (set Vb = 0)
- Id = 300 Vb (mA)   (set Va = 0)
- V2 = 700 Va + 300 Vb (mA)   (both Va and Vb are on)