Union College
ECE 248
Spring 2018
Assignment 5

Due Wednesday June 6, 2018

Unless otherwise noted, all problems from Malvino & Bates (8th ed). Some problems have a "Multisim" label – ignore this and work out the calculations on paper.

A. <u>Maximum undistorted output</u>

   8.w   Compute the maximum peak (MP) output of the swamped common emitter in Fig. 8-36 (page 323). Draw the DC and AC load lines (see page 370 in the textbook and lab 7). Assume $\beta = 200$ (do not use 100). You should get an MP around 2.9 V.

   9.x   Compute the maximum peak (MP) output of the emitter follower in Fig. 9-28 (page 361). Draw the DC and AC load lines (see page 380 in the textbook). Assume $\beta = 150$. You should get an MP = 5.2V (approximately).

   9.y   For the same circuit as Problem 9.x, suppose the source Vg is a 14V$_{PP}$ sine wave at 2 kHz. Using your results from Problem 9.x, sketch both Vg and V_LOAD over a 1 ms time interval. Label important features (e.g. amplitude and time)!

   10.3   Assume $\beta = 200$ and remember MPP (max peak-to-peak) = 2MP. You should get MPP = 10.6V$_{PP}$.

   10.z   For the same circuit as Problem 10.3, suppose the source Vg is a 10 mV$_{PP}$ sine wave at 2 kHz. Using your results from Problem 10.3, sketch both Vg and V_LOAD over a 1 ms time interval. Label important features (e.g. amplitude and time)!

B. **BJT switches**

   6.x   Design a npn BJT driver for a white LED ($V_F = 3.5$ V @ 25 mA), as shown in Fig. 1a. Assume the control signal is 0 to +3.5V, and $V_{CC} = +5$ V. Choose standard 5% resistor values (see course website for a table) for R and R_B. Choose R such that I_{LED} is NOT greater than 25 mA.

   6.y   You want to use a microcontroller (0 to +5V output signal) with an "internally driven" piezo buzzer (6 VDC @ 120 mA). Design a npn BJT driver powered by a 9V battery, as shown in Fig. 1b. Choose standard 5% resistor values. Make sure I_{PIEZO} is NOT > 120 mA.
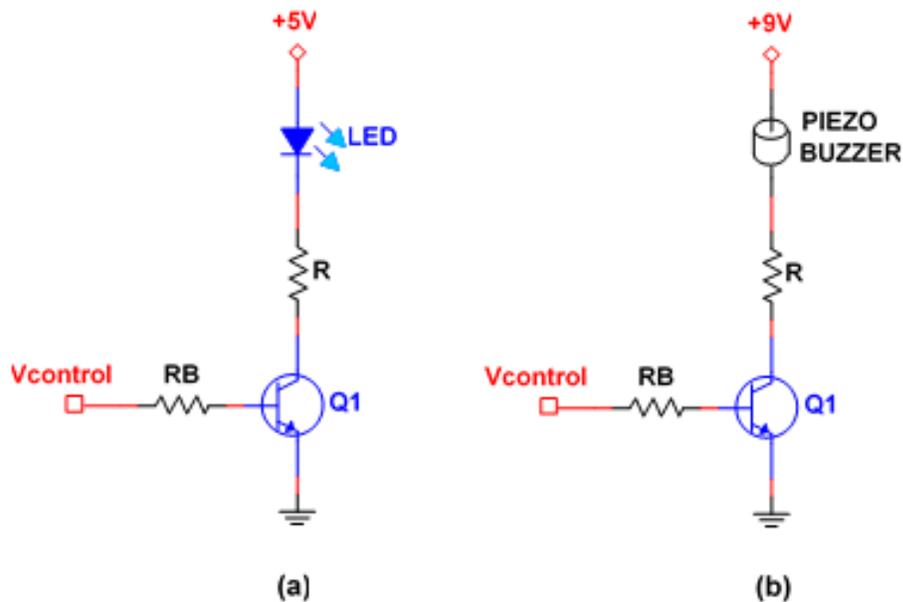
Fig. 1: (a) Circuit for Problem 6.x (b) Circuit for Problem 6.y

C. MOSFET ohmic region

12.11   Remember to check ohmic region!

12.14   Assume the LED has a forward voltage $V_F = 2V$. You should get $I_D = 27.8$ mA. Check ohmic region!

12.15   Remember to check ohmic region!

D. Power FETs

12.27   Don't forget to check ohmic region!

12.34   Assume $I_{D,ON} = 5A$ when checking for ohmic region.

E. Frequency Response

14.33   "Base-coupling circuit" means C_{IN}. Your answer should be approximately 118 Hz (this assumes $r_e' = .026/I_{EQ}$)

14.34   "Collector coupling circuit" means C_{OUT}. Your answer should be approximately 2.5 Hz

14.35   "Emitter-bypass circuit" means C_E. Your answer should be approximately 273 Hz (this assumes $r_e' = .026/I_{EQ}$)