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303H Fall 2015 – Homework 3 Due Th 09/24/15

The transistors are ones used in teaching labs here; some useful data is on the course web page.

1. (50 points, BJT curves & equivalent)
   For the 2N3904 =(npn) and the 2N3906 =(pnp)
   a) Obtain in Spice the transistor curves given on the course web page except do in separate plots, one for the npn in the first quadrant and one for the pnp in the third quadrant.
   b) Give for each transistor the hybrid-pi equivalent circuit when operating at I_C=5mA and V_{CE}=3V. Do this analytically (using equations) and discuss how you could use the Spice curves to check the analytic results

2. (25 points, Y matrix)
   a. For the NMOS (common source) give the low frequency admittance matrix
   b. Repeat for the PMOS (common source)
   c. Repeat for the NPN (common emitter).
   d. Compare numerically for an NMOS 4007 and a comparable npn 2N3904 both biased at the same (output) current level, $I_C = I_D$ = 5mA.

3. (25 points, CS amplifier)
   Assume an NMOS 4007 is biased at I_C=12mA for R_L=120 Ohms, find the range of gains available by varying the load resistance (assume a signal source resistance of R_S=0 and a 9V power supply).