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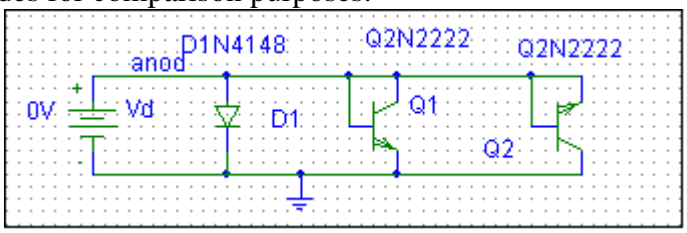
303 Fall 2008 – Homework 2 Due 09/16/08

1. (diode properties)

Draw and run the following circuit in Spice. This has three different junction diodes for comparison purposes.



a) Check the model for the diode D1 and record IS and N. List which of the model parameters are not given in the table 3.3 of page 213 of the text; also read page 212.

b) Do a DC run for –0.8≤Vd≤0.8 and plot the currents going down in all three devices (for Q1 this is –IE and for Q2 this is –IC). Comment on the diode comparisons and also on the "break points" as being 0.7V vs 0.6V. Note that the text uses VBE=0.7V for biasing of the base-emitter junction.

c) Plot again I(D1) and on the same graph plot the diode equation given in Figure 3.51; that is using IS and N found in part a) also plot

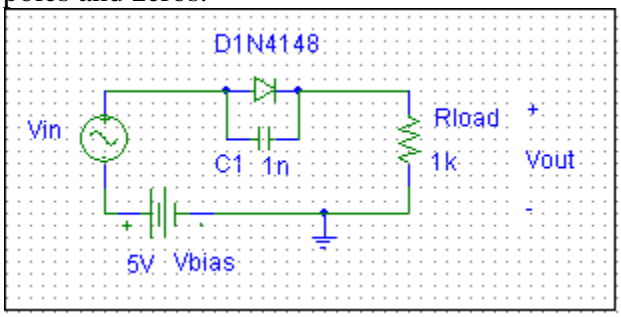
(IS)*(exp((V_Vd/(N*VT))-1).

Compare the two and using different N comment upon the effect of N.

d) Repeat c) for Q1 by using the saturation current as ISE with N=1.

2. (biasing and small signal properties)

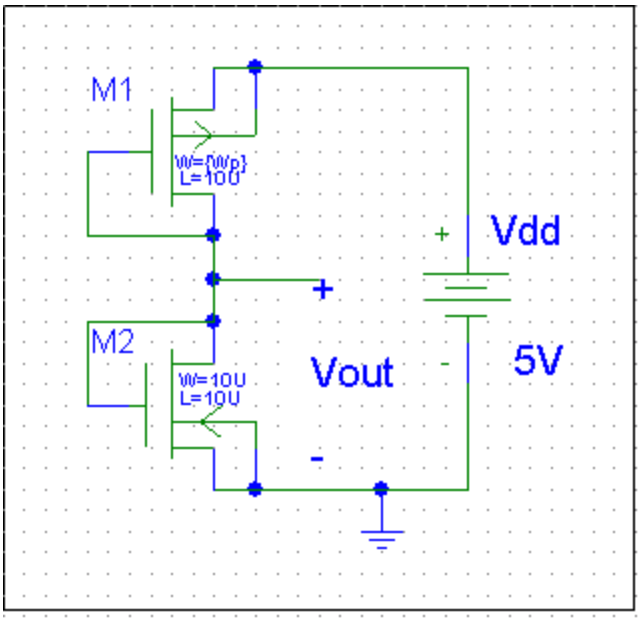
For the following circuit find graphically (via a Spice run) the Q point. Using that Q point find the small signal transfer function, Vout/Vin(s), assuming the external capacitor, C1, swamps the diode junction capacitance (and that Vin=0 at DC [which is s=0]). Plot the poles and zeros.



3. (MOS voltage divider)

For the following CMOS circuit (on the next page) use mnmosis and mpmosis transistors and vary the width, Wp, of the mpmosis transistor such that Vout =2V. Do this using analytically using the transistor laws as well as graphically using Spice; compare the Wp values obtained to give Vout=2V.

Be sure to include the Early effect (via the λ=LAMBDA term [see eqs. (4.22) &(4.32)] λ=1/VA of table 6.3, p. 550; VA is the Early voltage and LAMBDA the Spice entry). Here the transistors are diode connected and, when on, operate in the saturation region.


M1
W={Wp}
L=10U
M2
W=10U
L=10U
+
Vout
-
+
Vdd
-
5V