

Homework 3

ECE 5411 – CMOS Analog IC Design (Spring 2011)

Due on Monday, Feb 7, 2011.

Note: Use Cadence schematic capture, layout and Spectre simulation tools, available on the AMS servers for the homework problems.

Problems 1-3: Do problems A9.20, A9.27-A9.28 from the extra problem set available on the textbook website.

Problem 4: For a MOSFET,

- a) Show that the transition frequency (f_T) is given by (use square law equations)

$$f_T = \frac{g_m}{2\pi(C_{gd} + C_{gs})} = \frac{\mu_n}{2\pi} \frac{V_{GS} - V_{THN}}{L^2}$$

and interpret the dependence of f_T on the overdrive voltage and transistor length.

- b) Let the gate resistance, R_G , be significant and the device is modeled as a distributed set of n transistors each with a gate resistance equal to R_G/n . Prove that the f_T of the device is independent of R_G and is still equal to the expression given above.
- c) Calculate the f_T of the MOSFET in the subthreshold region and compare the results with the one in part (a).

Problem 5: For an NMOS device operating in saturation, plot W/L versus $V_{GS} - V_{THN}$ if (a) I_D is constant, (b) g_m is constant.