

# HOMWORK 6 - PRACTICE FINAL EXAM

## MOS capacitors and MOSFET

### 1 MOSFET

1. Calculate the drain current of a silicon nMOSFET with  $V_T = 1V$ ,  $W = 10\mu m$ ,  $L = 1\mu m$  and  $tox = 20nm$ . The device is biased with  $V_{GS} = 3V$  and  $V_{DS} = 5V$ . Use the quadratic model, a surface mobility of  $300cm^2/Vs$  and set  $\epsilon_{Si} = 3.9$ . Also calculate the transconductance at  $V_{GS} = 3V$  and  $V_{DS} = 5V$  and the output conductance at  $V_{GS} = 3V$  and  $V_{DS} = 0V$ .

The MOSFET is biased in saturation since  $V_{DS} > V_{GS} - V_T$

so  $I_D = 1.04mA$

and  $g_m = 1.04mS$ ,  $g_d = 1.04mS$ ,  $S$  for Siemens

2. Repeat the question above using the variable depletion layer model. Use  $V_{FB} = -0.807V$  and  $N_a = 10^{17}cm^{-3}$ . For the transconductance, you will derive the value of the modified mobility  $\mu_n^*$  and you will comment on the result of the conductance.

To find out whether the MOSFET is biased in saturation, we need first to calculate  $V_{Dsat} = 1.39V$

We then get  $I_D = 0.7mA$

$g_m = 0.52mS$  with  $\mu_n^* = 149cm^2/V - s$

$g_d = 1.04mS$ . which is the same as that of example above since the depletion layer width is constant for  $V_{DS} = 0$ .