

## MOSFET EXERCISES 2017-08-31

1. a) A MOSFET delivers a maximum current of  $500 \mu\text{A}/\mu\text{m}$  at a supply voltage of 1 V. What would be the effective resistance  $R_{\text{eff}} = V_{\text{DD}}/I_{\text{DSAT,max}}$  of a 1 mm wide MOSFET?  
b) What if the MOSFET is  $5 \mu\text{m}$  wide. How much current would it be able to deliver and what would be its effective resistance?  
c) What if the MOSFET was 280 nm wide, what would be its maximum current and what would be its effective resistance?
2. a) Calculate the gate capacitance for a 1 mm wide MOSFET in the 65 nm CMOS process if the effective channel length is 60 nm and if the MOS capacitance per unit area is given as  $20 \text{ fF}/\mu\text{m}^2$ ?  
b) What would be the gate capacitance of a  $5 \mu\text{m}$  wide MOSFET if the channel length is 45 nm and  $C_{\text{ox}}$  is  $10 \text{ fF}/\mu\text{m}^2$ ?  
c) Calculate the gate capacitance for the device above if its channel width is 280 nm!
3. a) The figure shows the regions of operation for an n-channel MOSFET. What are the borderline equations?  
b) Draw the corresponding diagram for a p-channel MOSFET!
4. The model parameters  $k$  and  $V_T$  for a certain MOSFET technology are given by  $k=900 \mu\text{A}/\text{V}^2$  and  $V_T=0.3 \text{ V}$ .  
a) Calculate the gate voltage overdrive  $V_{\text{GT}}$  if the supply voltage is 1.2 V!  
b) Calculate the saturation current when the gate voltage is equal to the supply voltage, i.e.  $V_{\text{GS}}=V_{\text{DD}}$ .  
c) Calculate the saturation voltage,  $V_{\text{DSAT}}$ , according to the classic square-law MOSFET model. What is the corresponding saturation voltage in the piecewise linear model?