

ECE 3042 Spring 2013

Homework Problem Set No. 7 for Experiment No. 7

Due Week of March 4

Calculations

1. The following data of drain current versus gate-to-source voltage has been obtained for an N Channel Enhancement Mode MOSFET. Determine the least squares curve fit estimate of the SPICE parameters KP (the transconductance parameter) and V_{TO} (zero-bias threshold voltage). Assume that the device is operating in its saturation mode and that the channel length modulation factor may be neglected.

$V_{GS}(\text{Volts})$	$I_D(\text{mA})$
2.0	0.059
2.5	0.235
3.0	0.409
3.5	1.709
4.0	2.506
4.5	2.039
5.0	4.191
5.5	7.582

Hint: If the device is operating in the saturation region and the channel length modulation factor can be neglected, the drain current, I_D , is related to the gate-to-source voltage, V_{GS} , by

$$I_D = K [V_{GS} - V_{TO}]^2$$

where $K = K'/2$ where K' is the SPICE parameter KP and V_{TO} is the SPICE parameter V_{TO} . Taking the square root of both side of this equation yields

$$\sqrt{I_D} = \sqrt{K}V_{GS} - \sqrt{K}V_{TO}$$

which has the form of a straight line with a slope of \sqrt{K} and a y intercept of $-\sqrt{K}V_{TO}$. Thus a linear LSQ regression analysis may be used to estimate these parameters. Many pocket calculators and software such as Mathcad perform such analyses.

2. The following data of collector current and base-to-emitter voltage has been obtained for an NPN BJT. Assuming that the collector-to-base voltage is zero, determine the saturation current.

$V_{be}(\text{Volts})$	$I_C(\text{mA})$
0.45	0.0044
0.5	0.030
0.55	0.202
0.60	1.400
0.65	9.8
0.70	68