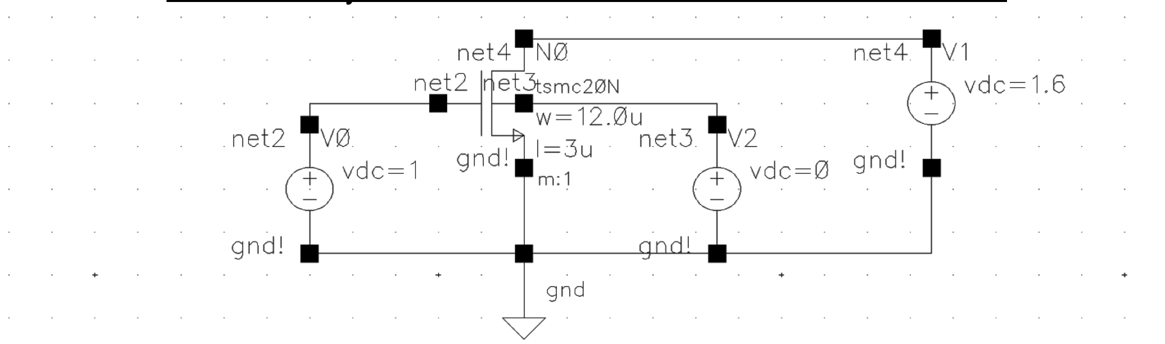
EE330 Lab6
Section 5, 8:00 am
Models for MOS Devices

Sean Gordon
Sgordon4

This circuit layout was used for all measurements taken below



Part 3: Square-Law Parameter Extraction

Scratch paper attached for calculations (correct or otherwise)

(a)

V_{T0} = .37 V

Gamma = -.307

uC_{ox} = -65.73 ?

Lambda = -1.069

(b)

V_{T0} = .33 V

Gamma = -.274

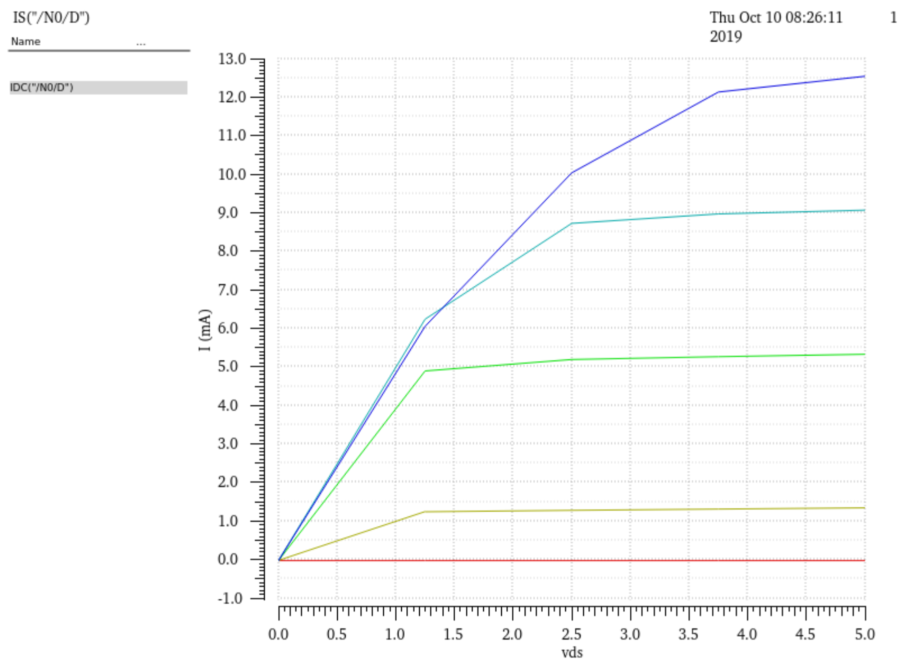
uC_{ox} = 1.058

Lambda = .057

Part 4: Comparison with BSIM Model

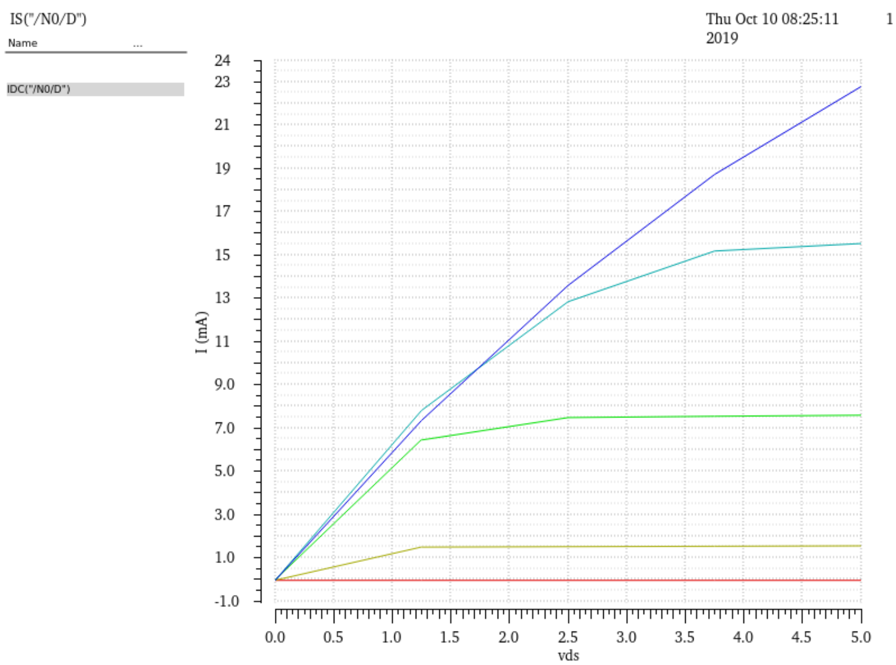
The added lab 6 guide was a great help for this section of the lab, clearly defining the work that needed to be done to create these graphs.
Scratch paper for the calculations done is attached.

(a) W=12u, L=.6u, Vgs=2V, Vds=3V, Vbs=0V



Using the sets of parameters extracted in part 3:
At Vgs = 2V and Vds = 3V...
Id_1 = 770 mA and Id_2 = 4.31 mA, compared to the graph output of Id = ~6 mA
It appears I didn't know how to do math when I calculated the first set of parameters, but the second set appears to be fairly close to the transistor modeled here.

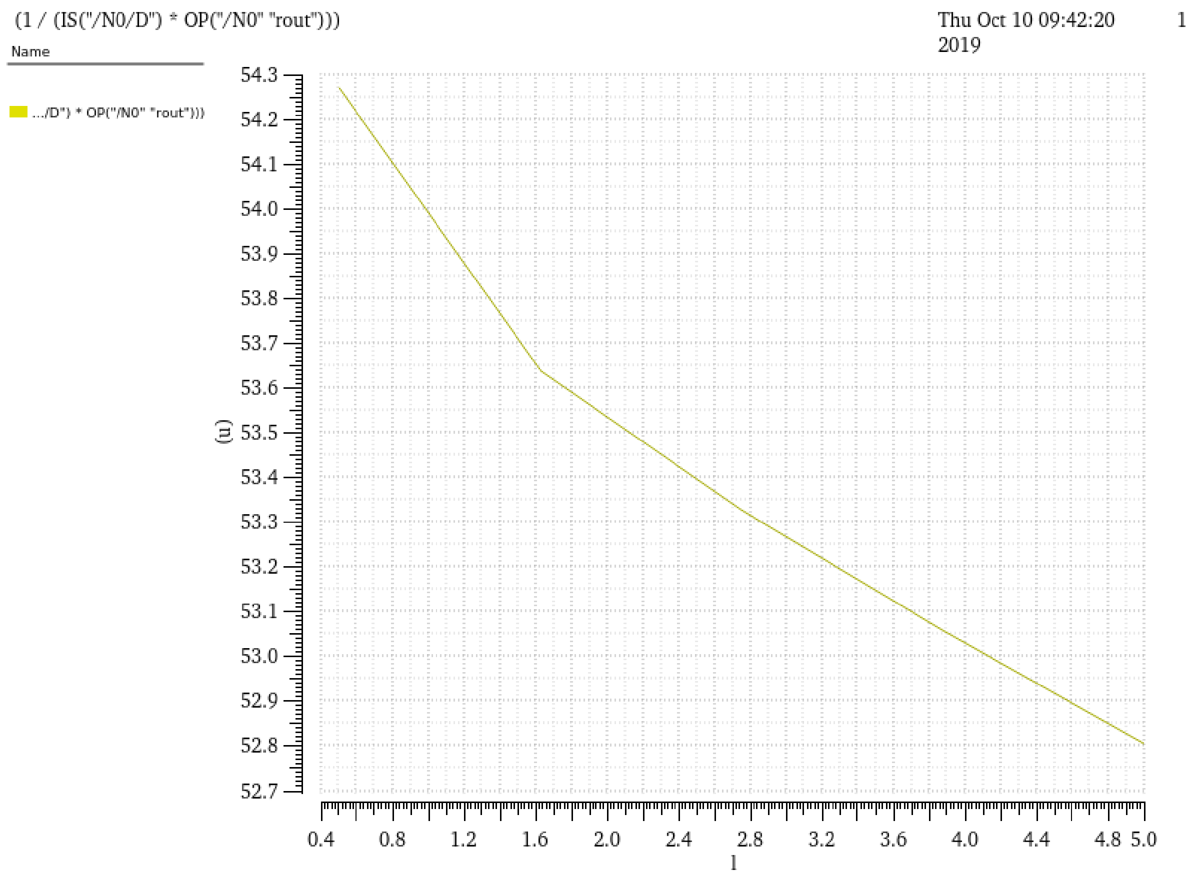
(b) W=60u, L=3u, Vgs=2V, Vds=3V, Vbs=0V



Using the sets of parameters extracted in part 3:
At Vgs = 2V and Vds = 3V...
Id_1 = 770 mA and Id_2 = 4.31 mA, compared to the graph output of Id = ~9 mA
Again, the first set of parameters is very off, but the second matches up similarly, with the difference in transistor sizes becoming more apparent.

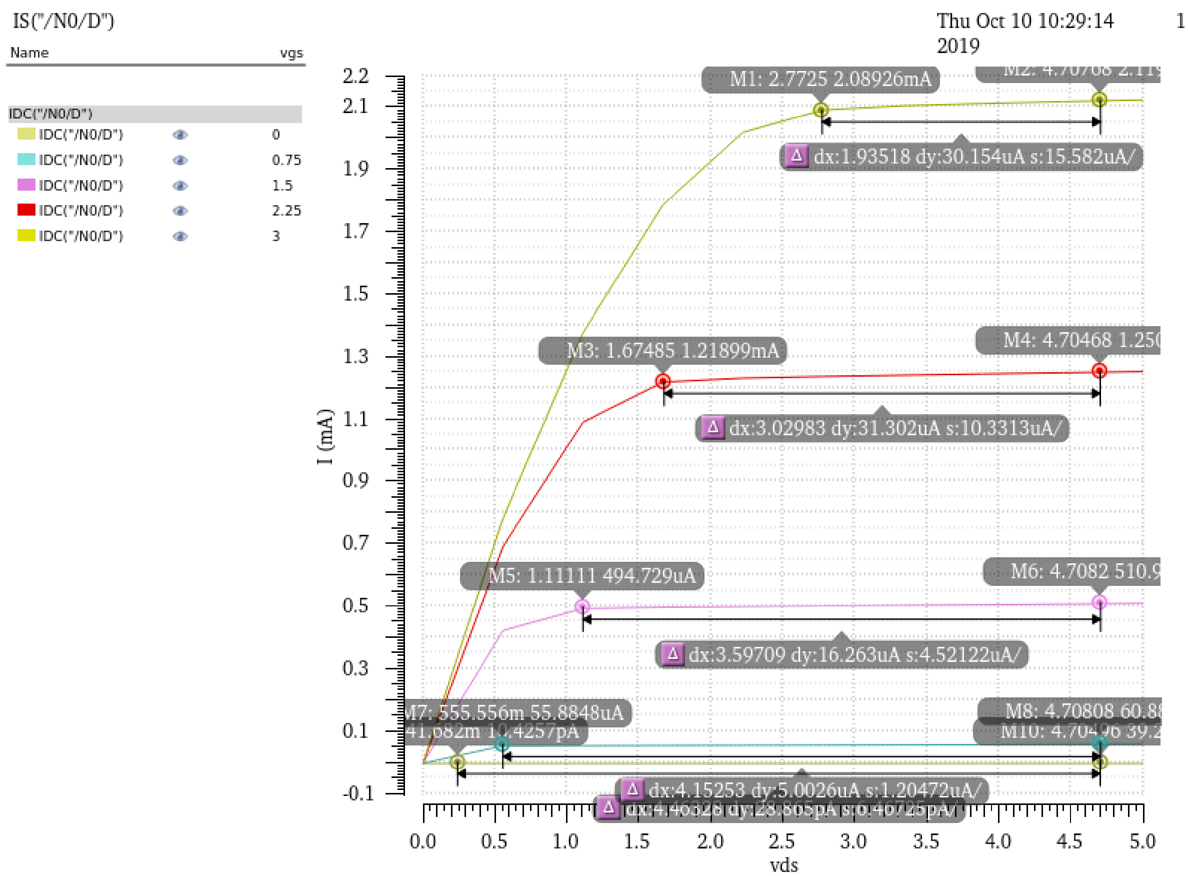
Part 5: Output Conductance Extraction

Plotting the equation *lambda = gds / Id = 1 / (Id * ro)* at Vgs = 1V and Vds = 2V.
The equation created in the calculator is *1/(IDC("/N0/D")*OP("/N0","rout"))*



Part 6: Early Voltage

Early voltage was extracted by plotting the current of the transistor as in part 4, using a transistor of size W = 12u and L = 3u:



The slopes of each line will be measured and, using that and a chosen y value, the x-intercepts of each will be measured. Those intercepts will then be averaged to produce the estimated early voltage.

If S = dy/dx…

1) S = 15.58 → x = -200 when y = 0
2) S = 10.33 → x = -122 when y = 0
3) S = 4.52 → x = -108.8 when y = 0
4) S = 1.20 → x = -45.87 when y = 0
5) S = 6.47 → x = 55.07 when y = 0

Avg = -84.32 = Early voltage

The x-intercepts for a line are seemingly greater than that of the line above it. |Early voltage| should be |1/Lambda|.