

UNIVERSITY OF CALIFORNIA AT BERKELEY
College of Engineering
Department of Electrical Engineering and Computer Science

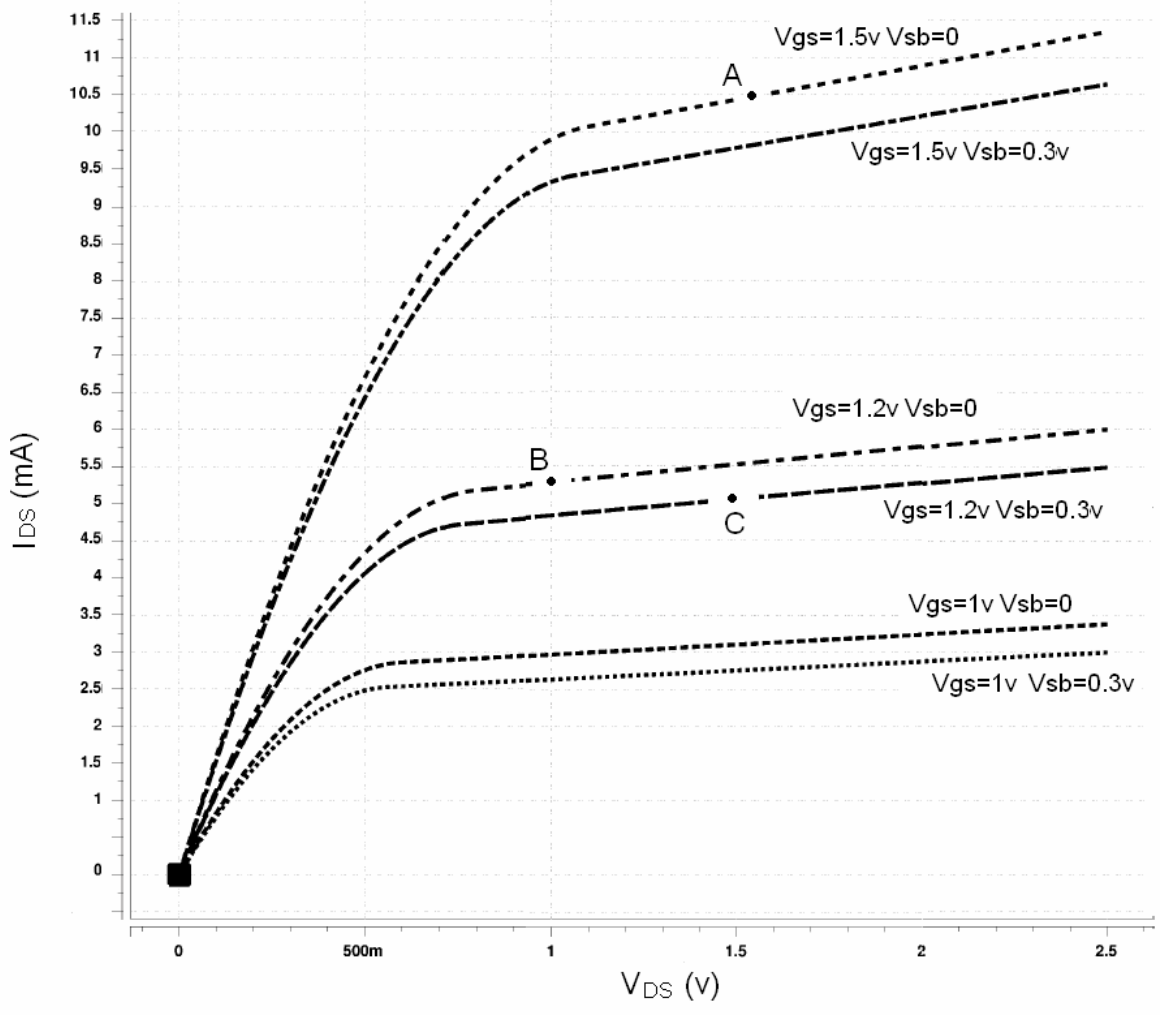
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Homework #1
(Due 9/3/03)

EECS 140
Fall 2003

1. An NMOS transistor has parameters $W=10\mu\text{m}$, $L=1\mu\text{m}$, $k'=194\mu\text{A}/\text{V}^2$, $\lambda = 0.024\text{V}^{-1}$, $t_{\text{ox}} = 8\text{nm}$, $\Phi_f = 0.3\text{V}$, $V_{t0} = 0.6\text{V}$, and $N_a = 5 \times 10^{15} \text{ atoms}/\text{cm}^3$. Ignore velocity saturation.
 - (a) Sketch the I_D - V_{DS} characteristics for V_{DS} from 0 to 3V and $V_{GS} = 0.5\text{V}$, 1.5V and 3V. Assume $V_{SB} = 0$.
 - (b) Sketch the I_D - V_{GS} characteristics for $V_{DS} = 2\text{V}$ as V_{GS} varies from 0 to 2V with $V_{SB} = 0$, 0.5V, and 1V.

2. Use the figure on the next page to estimate the model parameter V_{t0} , γ , k' , and λ . Then calculate the small signal parameter (g_m , g_{mbs} , and r_o) associate with the operating points A, B, and C on the graph. Assume $W/L = 50$ and $\Phi_f = 0.3\text{V}$.



3. Getting familiar with HSPICE.

- (a) Make sure your account is correctly setup. Follow the instruction below to setup your instructional account.

<http://bwrc.eecs.berkeley.edu/classes/ee140/howtos.htm#hspice>

- (b) Create the same file below in your home directory

<http://bwrc.eecs.berkeley.edu/classes/ee140/notes/disc2/demo1.sp>

- (c) Simulate the demo circuit file.

```
>hspice demo1.sp >! demo1.lis
```

Upon proper completion of the simulation, you should see the following:

```
>info:          *****hspice job concluded
```

- (d) View the results of the AC analysis. Load awaves and examine the results of the AC analysis by entering the following:

```
>awaves&
```

Once awaves loads, click on **Design/Open**. Double-click **demo1.sp** which should open the **Results Brower**. To view the AC analysis, click on **AC: A simple ac run**. Select the waveforms that you want to display.

- (e) Print out the waveform of $v(1)$, $v(2)$, $i(r2)$, $i(c1)$ on the same graph.