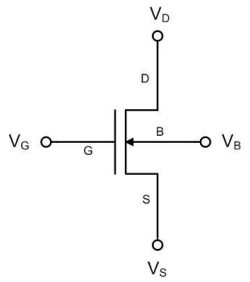
EELE 414 – Introduction to VLSI Design
Homework #3 (show work for full credit)

Name: _____
Grade: _____ /10

1) Ideal N-Channel MOSFET IV Characteristics:
(4 Point Each)

For the following N-Channel, enhancement-type MOSFET.



V_{T0}	= 0.37 v
k'	= 178 *u*A/V^2 (notice the *u*A *and the* ')
W	= 2.5 *u*m
L	= 0.25 *u*m
λ	= 0.05

a) Find I_{DS} if:

$V_G = 1.0v$
$V_S = 0v$
$V_D = 0.3v$
$V_B = 0v$

b) Find I_{DS} if:

$V_G = 1.0v$
$V_S = 0v$
$V_D = 2.0v$
$V_B = 0v$

c) Find I_{DS} if:

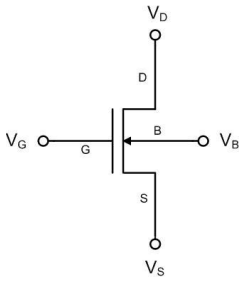
$V_G = 1.5v$
$V_S = 0v$
$V_D = 0.3v$
$V_B = 0v$

d) Find I_{DS} if:

$V_G = 1.5v$
$V_S = 0v$
$V_D = 2.0v$
$V_B = 0v$

e) Run a DC simulation using S-Edit & T-SPICE using the Generic 0.25um Level 1 model to verify your calculations in parts 1.a-1.d. The parameters for your hand calculations above were taken from the SPICE model so the simulations should match your solutions. You are to produce a **single** IV plot that indicates the solutions for all 4 of your calculations (i.e., Vds vs. Ids). This can be done by sweeping VDS from 0v-2.5v in linear steps of 0.1v while sweeping VGS from 1v-1.5v in a linear step of 0.5v. Indicate clearly on your plot the current from parts a-d. Also turn in a print of your final S-edit schematic.

2) N-Channel MOSFET IV Characteristics with Body Effect
(3 Points)



Now consider how a voltage on the body of the transistor effects I_{DS}:

γ = 0.029 $V^{½}$
$2\cdot|\phi_F|$ = 0.279 v

a) Find I_{DS} if:

V_G = 1.0v
V_S = 0v
V_D = 0.3v
V_B = 0.5v

b) Find I_{DS} if:

V_G = 1.0v
V_S = 0v
V_D = 2.0v
V_B = 0.5v

c) Find I_{DS} if:

V_G = 1.5v
V_S = 0v
V_D = 0.3v
V_B = 0.5v

d) Find I_{DS} if:

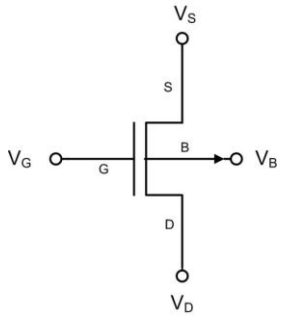
V_G = 1.5v
V_S = 0v
V_D = 2.0v
V_B = 0.5v

e) Run a DC simulation using S-Edit & T-SPICE to verify your calculations in 2.a-2.d. Consider using an ideal DC voltage source to set the body terminal of the NMOS to 0.5v. You are to produce a **single** IV plot that indicates the solutions for all 4 of your calculations. Indicate clearly on your plot the current from parts 2.a-2.d. Also turn in a print of your final S-edit schematic.

3) Ideal P-Channel MOSFET IV Characteristics:
(3 Points)

For the following P-Channel, enhancement-type MOSFET.

V_{T0}	= -0.49 v
k'	= 63 *u*A/V^2 (notice the *uA and the '*)
W	= 5 *u*m
L	= 0.25 *u*m
λ	= 0.05



a) Find I_{DS} if:

$V_G = 1.5v$
$V_S = 2.5v$
$V_D = 2.2v$
$V_B = 2.5v$

b) Find I_{DS} if:

$V_G = 1.5v$
$V_S = 2.5v$
$V_D = 0.5v$
$V_B = 2.5v$

c) Find I_{DS} if:

$V_G = 1.0v$
$V_S = 2.5v$
$V_D = 2.2v$
$V_B = 2.5v$

d) Find I_{DS} if:

$V_G = 1.0v$
$V_S = 2.5v$
$V_D = 0.5v$
$V_B = 2.5v$

e) Run a DC simulation using S-Edit & T-SPICE using the Generic 0.25um Level 1 model to verify your calculations in parts 3.a-3.d. The parameters for your hand calculations above were taken from the SPICE model so the simulations should match your solutions. You are to produce a **single** IV plot that indicates the solutions for all 4 of your calculations (i.e., Vds vs. Ids). Indicate clearly on your plot the current from parts a-d. Also turn in a print of your final S-edit schematic.