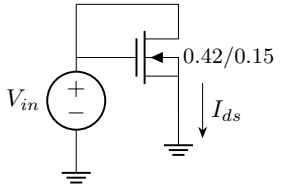
EC 5311 Digital IC Design: Assignment 1
Output and transfer characteristics of transistors

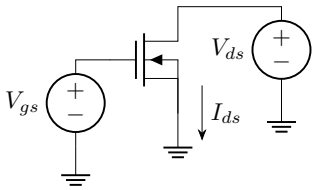
$V_{Tn} = 0.7$V,	$\mu_n = 0.025m^2$/V-s,	$C_{oxn} = 0.00834\ F/m^2$,	$vsat_n = 8. \times 10^4$ m/s,	$\lambda_n = 0.2$
$\lvert V_{Tp}\rvert = 0.7$V,	$\mu_p = 0.009m^2$/V-s,	$C_{oxp} = 0.00816\ F/m^2$,	$vsat_p = 3. \times 10^4$ m/s,	$\lambda_p = 0.2$.

1. (a) Consider the nMOS transistor connected as shown below.



Is it in the saturation or linear region? Using ngspice, obtain the transfer characteristics I_{ds} *vs* V_{gs} assuming $L = 0.15$µm and $W = 0.42$µm. Plot the simulated and analytical model in the same plot and find the mean percentage error.

(b) Connect sources to the nMOS transistor as shown and obtain the output characteristics for $V_{gs} = 0.6\text{V}, 1\text{V}, 1.4\text{V}$ and 1.8V. Plot the analytical model and obtain the mean percentage error.



(c) Simulate the I_{ds} *vs* V_{ds} for $V_{gs} = V_{DD}$ for transistors of different W/L keeping W/L ratio constant while increasing the sizes. Note how the velocity saturation effect decreases as overall length increases.

2. Repeat the exercise for the pMOS transistor.