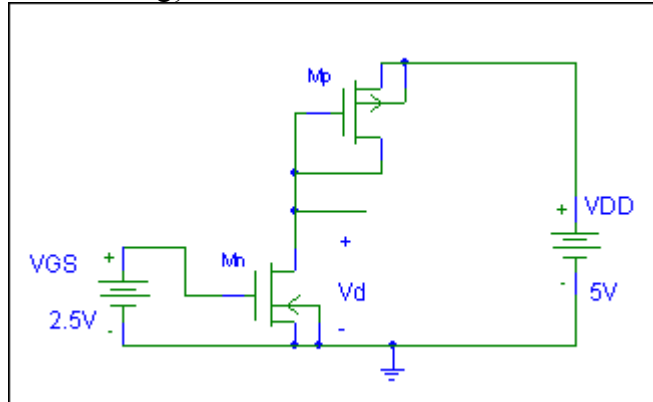


ENEE 303 Take Home Midterm Add On: Due Monday, April 3, 2006, at start of class. Open book, open notes. Show your work for partial credit. 50 points. Guarantee that all of the submitted work is your own.

[25 points] {CMOS-biasing}



For the above circuit assume that $V_{TOn} = -V_{TOp} = V_{th} = 0.5V$, $K_{Pn} = K_{Pp} = K_P = 0.00002A/V^2$, $LAMBDA_n = LAMBDA_p = 0.01$.

- For $V_d = V_{DD}/5 = 1V$, give the region of operation of the transistors to attain this condition and find the ratio $(W_n/L_n)/(W_p/L_p)$
- for the ratio of part a) sketch the curve of i_D versus v_{DS} for M_n with its load curve, labeling important points (including Q point values).

2. [25 points] {BJT-current mirror}

For the following current sink circuit assume that both transistors have different emitter areas but otherwise are identical including having the same forward beta.

- show that $R_{e1} * (-I_{e1}) - R_{e2} * (-I_{e2}) = V_{be2} - V_{be1}$ and from that find the ratio of emitter areas for which $V_{be2} = V_{be1}$
- show that by adjusting the ratio of R_{e2}/R_{e1} (of part a)) the ratio $a = I_2/I_1$ can be adjusted; find $a = I_2/I_1$ versus R_{e2}/R_{e1} . For $\beta = 50$ determine R_{e2}/R_{e1} for $a = 0.2$ [that is $I_2 = (0.2)I_1$] and again for $a = 3$.

