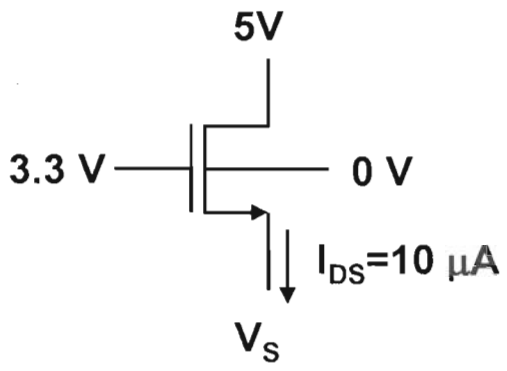
Quiz #1 **EEC210** **Fall 2008**

Name: Solutions

Lab Section: _____

Problem 1 (5 points) For the following transistor, find the value of V_S which produces the indicated I_{DS} given: $W_n = 0.5\ \mu m$, $L_n = 0.1\ \mu m$, $V_{T,n} = 1\ V$, $\mu_n C_{ox} = 0.5 \times 10^{-4}\ A/V^2$, $\lambda = 0$, $\gamma = 0$. Show all work to receive full credit.



$V_{DS} = 5V - V_S > 3.3V - V_S - V_{T,n} = 2.3V - V_S \Rightarrow$ saturation (1 pt.)

$I_{DS} = \frac{k_n'}{2}\frac{W}{L}(V_{GS} - V_{T,n})^2 (1 + \lambda \cancel{V_{DS}}^{0})$ (1 pt.)

$V_{GS} = V_{T,n} + \sqrt{\frac{2 I_{DS}}{k_n' W/L}} = 1V + \sqrt{\frac{2\ (10\mu A)}{0.5 \times 10^{-4} A/V^2\ (5)}}$ (1 pt.)

$V_{GS} = 1.283V$ (1 pt.)

$V_S = V_G - V_{GS} = 2.017\ V$

$\boxed{V_S = 2.02\ V}$ (1 pt.)

Problem 2 (2 points) Suppose $\lambda = 0.1\ V^{-1}$. What is the new current I_{DS} for the V_S you found above?

$I_{DS} = \frac{k_n'}{2}\left(\frac{W}{L}\right)(V_{GS} - V_{T,n})^2 (1 + \lambda V_{DS})$

$= \frac{500\mu A/V^2}{2}\left(\frac{5}{1}\right)(1.283V - 1V)^2 (1 + 0.1\ V^{-1}(5 - 2.02V))$ (1 pt.)

$\boxed{\text{New } I_{DS} = 13\mu A}$ (1 pt.)