EE330
Section 5, 8:00 am
Homework 11

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1) $I_D = (\mu C_{ox})\left(\frac{W}{2L}\right)(V_{GS} - V_T)^2$ $\quad A_V = -\frac{2 \cdot R_1 \cdot I_D}{V_{EB}}$

$V_O = OV = 1 - R_1 \cdot I_D \Rightarrow 1 - 20k \cdot I_D \Rightarrow I_D = .1mA$

$A_V = -8 = -\frac{2 \cdot 20k \cdot .0001}{V_{EB}} \Rightarrow V_{EB} = .5$

$I_D = (350 \cdot 10^{-6}) \cdot \left(\frac{W}{2L}\right) \cdot (.5)^2 \Rightarrow$ Pick $L = 1UM$, $W = 2.29UM$

2a) $R_{GG} = \frac{V_{xx} - V_{GTMax}}{I_{GT}}$ Given: $V_{GTMax} = .9\,V$, $I_{GT} = 200uA$ =>>

$R_{GG} = \frac{12 - .9}{200u} = \boxed{55{,}500\,\Omega}$

2b) $I_{max} = \frac{50 - 1.6}{40\,\Omega} = 1.21\,A$ => $P = IV = 1.21A \cdot 1.6V = \boxed{1.936\,W}$

2c) $I_G = \frac{12 - V_{GT}}{R_{GG}}$ $V_{GT}$ given $= .8V$ => $I_G = \frac{12 - .8}{55k\Omega} = 201.8\,uA$

$P = IV = 201.8u \cdot .8V = \boxed{1.61\,W}$

3a) $(1 - .1) \cdot 500\,\Omega = 450$

$(.1) \cdot 500\,\Omega = 50$

] Potentiometer

4) Turn on voltage $= .8 = \frac{R_1}{R_1 + 10k} \cdot (170\sin(\pi/4))$ =>

$\frac{.8R_1 + 8000}{170\sin(\pi/4)} = R_1$ => $.00565 \cdot R_1 + 56.55 = R_1$

$-.9933\,R_1 = -66.55$ $\boxed{R_1 = 67\Omega}$

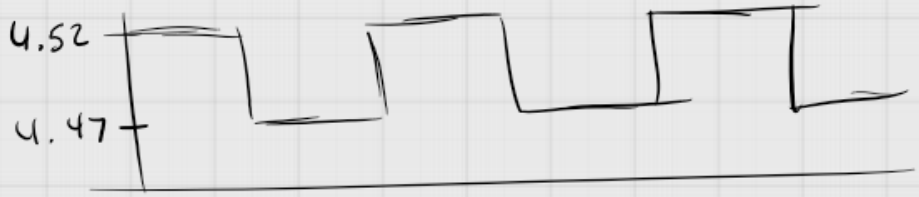
5) $V_o = I_{DSS} \cdot 6k = 100\,uA \cdot 6k = \boxed{.6}$

6a) $I_D = I_{DSS} \cdot \left(1 - \frac{V_{GS}}{V_P}\right)^2$ $\quad I_{DSS} = 100\,uA \quad V_P = -1V$

$V_o = V_{DD} - I_D \cdot R$ $\quad V_{DD} = 5v \quad R = 5k$

@ $V_{GS} = 25mV$, $V_o = 5 - I_{DSS}\left(1 - \frac{V_{GS}}{V_P}\right)^2 \cdot 5k = \boxed{4.47\,v}$

@ $V_{GS} = -25mV$, $V_o = 5 - I_{DSS}\left(1 - \frac{V_{GS}}{V_P}\right)^2 \cdot 5k = \boxed{4.52\,v}$




b) $V_{in_{Max}} = .3v$

7) $I_D = \mu C_{ox}\left(\frac{W}{2L}\right)(V_G - V_o - V_{TN})^2 = I_{DSS}\left(1 - \frac{V_{in}}{V_P}\right)^2$

$(350 \cdot 10^{-6})\left(\frac{W}{2.8}\right)(5 - 3 - .75)^2 = (100\,uA)\left(1 - \frac{.5}{-1}\right)^2 \Rightarrow$

$W \cdot (34.18 \cdot 10^{-6}) = 225 \cdot 10^{-6} \Rightarrow \boxed{W = 6.58\,um}$

8) $g_M = \frac{\partial I_D}{\partial V_{DS}}$ $\quad g_o = \frac{\partial I_D}{\partial V_{DS}}$ $\quad I_{DSSp} = \frac{W}{L} \cdot I_{DSSp0}$

$$g_M = \left( 2\left(\frac{W}{L}\right) I_{DSSp0}\left(1 - \frac{V_{GS}}{V_p}\right)\right)/V_p$$

$$g_o = \left(\frac{W}{L}\right) I_{DSSp0}\left(1 - \frac{V_{GS}}{V_p}\right)^2 \cdot \lambda$$

9) $g_M = \left(2\left(\frac{W}{L}\right) I_{DSSp0} \cdot \left(1 - \frac{V_{GS}}{V_p}\right)\right)/V_p$ $\quad I_{DSSp0} = 300\mu A$

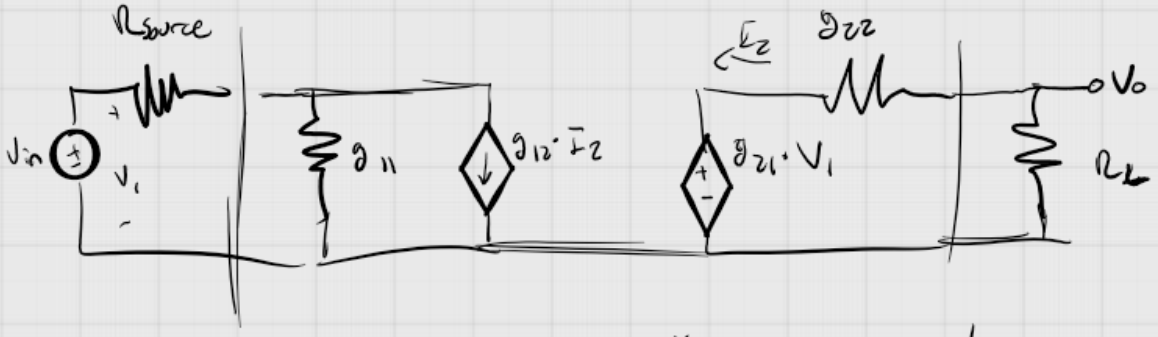
$I_D = I_{DSSp0} \cdot \left(\frac{W}{L}\right)\left(1 - \frac{V_{GS}}{V_p}\right)^2(1 - \lambda V_{DS})$ $\Rightarrow$

$(300\mu A)\left(\frac{10}{15}\right)(1)^2 = 200\mu A = I_D$ $\quad I_D = 200\mu A$

$V_o = 2 \cdot 50k - 5 = -4V$ $\quad V_o = -4V$

$A_v = \frac{V_o}{V_{in}} = -g_M \cdot 50k$ $\quad g_M = \left(2 \cdot \left(\frac{10}{15}\right)(300\mu A)\left(1 - \frac{V_{in}}{V_p}\right)\right)/V_p$

10)




$g_{11}\ \frac{\Delta y}{y_{22}}$ $\quad g_{12} = \frac{y_{12}}{y_{22}}$ $\quad g_{21} = \frac{-y_{21}}{y_{22}}$ $\quad g_{22} = \frac{1}{y_{22}}$

$\Delta y = y_{11}y_{22} - y_{12}y_{21}$

a) $A_v = \frac{V_o}{V_{in}}$ $\quad V_o =$ $\quad$ I'm confused

12) $A_{V_{Tot}} = \left(\frac{R_{in_1}}{R_{in_1} + R_{imp}}\right) \cdot A_{V_1} \cdot \left(\frac{R_{in_2}}{R_{in_2} + R_{o_1}}\right) \cdot A_{V_2} \cdot \left(\frac{R_{load}}{R_{load} + R_{o_2}}\right) \Rightarrow$

$\left(\frac{10k}{10k + 500}\right) \cdot (-10) \cdot \left(\frac{5k}{5k + 1k}\right) \cdot (-20) \cdot \left(\frac{1k}{1k + 2k}\right) = \boxed{52.9}$