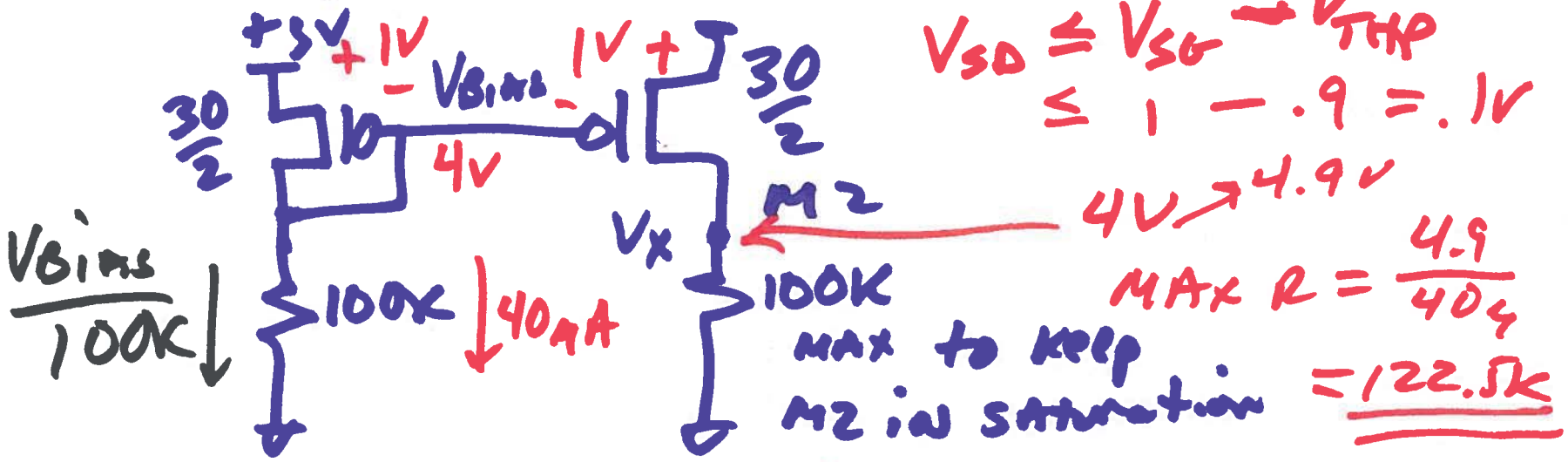
EE 420/ECG 620
Analog IC Design
Lecture 8
Feb. 13, 2017



$$\frac{V_{BIAS}}{100K} = \frac{\frac{40\mu A/V^2}{2} \cdot \frac{30}{2}\left(5 - V_{BIAS} - 0.9\right)^2}{\frac{300\mu A}{V^2}}$$

$$\frac{10^5 \cdot 3\times10^{-4}}{30}$$

$$4.1 - V_{BIAS}$$

$$\begin{array}{r} 4.1 \\ \times\ 4.1 \\ \hline 41 \\ 164 \\ \hline 16.81 \end{array}$$

$$480 \quad 24$$

$$V_{BIAS} = 30\left(16.81 - 8.2V_{BIAS} + V_{BIAS}^2\right)$$

$$V_{BIAS} = 504 - 246V_{BIAS} + 30V_{BIAS}^2$$

$$0 = 504 - 247V_{BIAS} + 30V_{BIAS}^2$$

$$0 = 16.81 - 8.2V_{BIAS} + V_{BIAS}^2$$

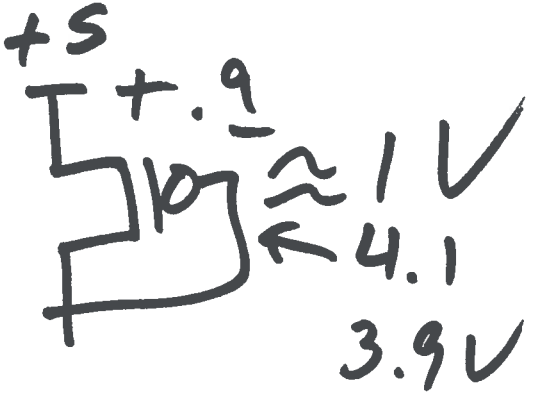
2)

$$V_{BIAS} = \frac{8.2 \pm \sqrt{67.21 - 4 \cdot 16.81}}{2}$$

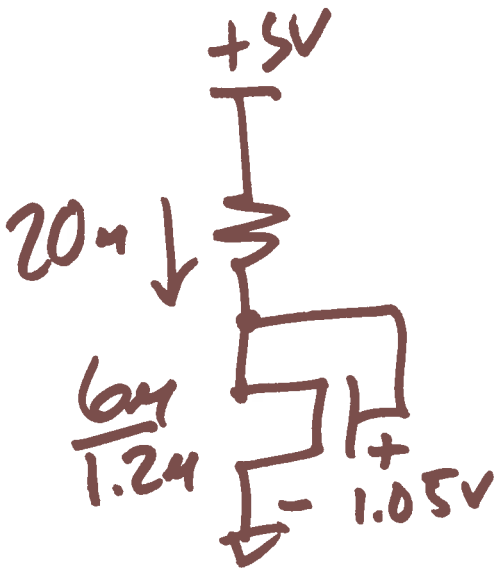
$$= 4.1 \pm .2$$

67.21
67.04
.17

$\frac{.4}{2} = .2$

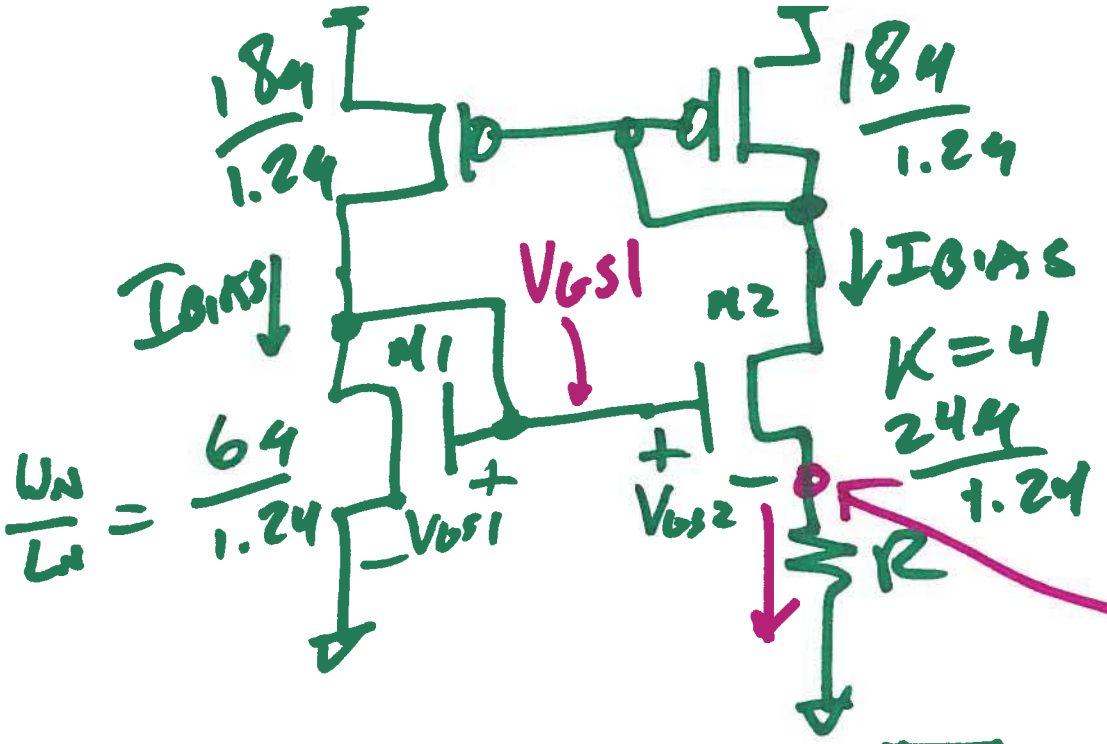


$V_{BIAS} = 4V$



$$\frac{5-1.05}{20\mu} = R = \frac{3.95}{20\mu} = 200K$$

4)



$$I_{BIAS} = \frac{V_{GS1} - V_{GS2}}{R}$$

$$= \frac{1}{R}\left(V_{THN} + \sqrt{\frac{2I_{BIAS}}{K_{PN}\cdot\frac{W_N}{L_N}}} - V_{THN} - \sqrt{\frac{2I_{BIAS}}{K K_{PN}\cdot\frac{W_N}{L_N}}}\right)$$

$V_{GS1} - V_{GS2}$

$$V_{GS1} = V_{THN} + \sqrt{\frac{2I_{BIAS}}{K_{PN}\cdot\frac{W_N}{L_N}}}$$

$$I_{BIAS} = \sqrt{\frac{2I_{BIAS}}{R^2\cdot K_{PN}\frac{W_N}{L_N}}}\cdot\left(1-\frac{1}{\sqrt{K}}\right)$$

$$V_{GS2} = V_{THN} + \sqrt{\frac{2I_{BIAS}}{K\cdot K_{PN}\cdot\frac{W_N}{L_N}}}$$

$$\sqrt{I_{BIAS}} = \sqrt{\frac{2}{R^2 K_P \frac{W_N}{L_N}}}\left(1-\frac{1}{\sqrt{K}}\right)$$

$$I_{BIAS} = \frac{2}{R^2\cdot K_P\cdot\frac{W_N}{L_N}}\left(1-\frac{1}{\sqrt{K}}\right)^2$$

$$I_{BIAS} = \frac{2}{R^2 \cdot K_P \cdot \frac{W_N}{L_N}} \cdot \left(1 - \frac{1}{\sqrt{K}}\right)^2$$

$$g_m = \sqrt{2 I_{BIAS} \cdot K_P \frac{W_N}{L_N}}$$

SAY $K = 4$

$$I_{BIAS} = \frac{1}{2R^2 \cdot K_P \cdot \frac{W_N}{L_N}}$$

$$g_m = \sqrt{\frac{2}{2R^2 \cdot K_P \frac{W_N}{L_N}} \cdot K_P \frac{W_N}{L_N}} = \frac{1}{R}$$

$$R = \frac{1}{130\mu} = \underline{\underline{7.7K}}$$

6)