3) PART 1 $\beta = 320 \frac{mA}{V^2}$, ASSUME $V_{I_{TAIL}} = 200mV$, $V_A = 2.5V$,

FIG 11:

$A_d = -g_m R_o$

$R_o = R_L \| r_o$

WANT $V_{ov} = 200mV$, $V_{DS_1} = 900mV$

$I_{TAIL}/2 = \frac{\beta}{2}\left(\frac{W}{L}\right)_1 V_{ov}^2\left(1 + \frac{V_{DS_1}}{V_A}\right)$

$I_{TAIL} = 348\,\mu A$

$r_o = \frac{V_A}{I_{TAIL}/2}$

$R_L = 0.7V / \left(\frac{I_{TAIL}}{2}\right) \Rightarrow R_L = 4.02\,k\Omega$

$r_o = 14.37\,k\Omega$

$g_m = \sqrt{2\left(\frac{I_{TAIL}}{2}\right)\beta\frac{W}{L}}$

$g_m = 1.49\,mS$

$R_o = 3.143\,k\Omega$

$A_d = -4.68\,V/V$

FIG. 12:

* ASSUME VOLTAGE ACROSS R_S IS 50mV (TO MODEL TRANSISTOR IN TRIODE)

$V_{ov} = 200mV$

$V_{DS_1} = 975mV$

$I_{TAIL}/2 = \frac{\beta}{2}\left(\frac{W}{L}\right)_1 V_{ov}^2\left(1 + \frac{V_{DS_1}}{V_A}\right)$

$I_{TAIL} = 355\,\mu A$

$R_S = 50mV / I_{TAIL}$

$R_S = 140.85\,\Omega$

$R_L = 775mV / \left(\frac{I_{TAIL}}{2}\right) \Rightarrow R_L = 4.366\,k\Omega$

$r_o = V_A / (I_{TAIL}/2) \Rightarrow r_o = 14.08\,k\Omega$

$g_m = \sqrt{2\left(\frac{I_{TAIL}}{2}\right)\beta\frac{W}{L}}$

$g_m = 1.51\,mS$

$R_o = 3.332\,k\Omega$

$A_d = -5.03\,V/V$