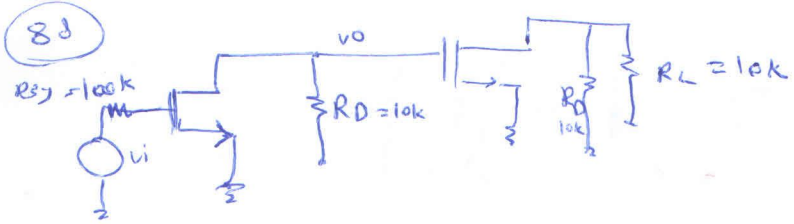
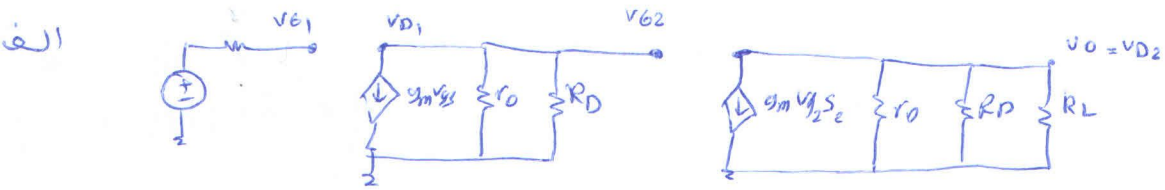
(88)



$I_D = 0.25mA$

$V_{OV} = 0.2S$

مهملة r_o



ب) طبعاً $v_o = v_{G2}$ مهملة r_o

$$A_V = -g_m(r_o \| R_D) = \frac{v_{G2}}{v_i}$$

$$A_{V2} = -g_m(r_o \| R_D \| R_L) = \frac{v_o}{v_{G2}}$$

$$\Rightarrow \frac{v_o}{v_i} = +g_m^2 (r_o \| R_D)(r_o \| R_D \| R_L)$$

$$g_m = \frac{2I_D}{V_{ov}} = \frac{2 \times 0.25mA}{0.25} = 2m\,\text{℧}$$

$$A_{V1} = -2m(R_D) = -2m \times 10k = -20$$

$$A_{V2} = -2m(10k \| 10k) = -10$$

$$\rightarrow G_V = -20 \times -10 = 200$$

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(89) CS $\rightarrow G_v = \frac{R_{in}}{R_{in}+R_{sig}} \cdot g_m \cdot (r_o \| R_L \| R_D)$

if $(R_L \| R_D) \rightarrow \infty \Rightarrow G_v = \frac{R_{in}}{R_{in}+R_{sig}} \cdot g_m \cdot \overbrace{(r_o \| \infty)}^{r_o} = g_m r_o \frac{R_{in}}{R_{in}+R_{sig}}$

g_m في $|V_A|$

$$g_m = \frac{2I_D}{V_{ov}}, \quad r_o = \frac{|V_A|}{I_D} \rightarrow G_v = \frac{2I_D}{V_{ov}} \times \frac{|V_A|}{I_D} \times \frac{R_{in}}{R_{in}+R_{sig}} \Rightarrow G_v = \frac{2|V_A|}{V_{ov}} \frac{R_{in}}{R_{in}+R_{sig}}$$

---

(94) CG $\rightarrow G_v = \frac{g_m(R_D \| R_L)}{1+g_m R_{sig}}$

$$\frac{G_{v1} = \frac{g_m(R_D \| R_L)}{1+g_m R_{sig}}}{G_{v2} = \frac{g_m(R_D \| R_L)}{1+g_m(R_{sig}+R)}} = \frac{1_o}{8}$$

$R_{sig} = 200\Omega$

$R = 200\Omega$

$\Rightarrow$ لازم يتغير R_G

$$\frac{G_{v1}}{G_{v2}} = \frac{1_o}{8} = \frac{1+g_m(400)}{1+g_m(200)} \Rightarrow g_m = 1.6m\,\text{℧}$$

$$g_m = \frac{2I_D}{V_{ov}} = \frac{2 \times 0.2mA}{v_{ov}} = 1.6m \Rightarrow V_{OV} = 0.25\,V$$

سوال 95

تغییرات ولتاژ خروجی نسبت به R_L ← یعنی $\frac{dv_o}{dR_L}$ با توجه به اینکه $v_o = \frac{R_L}{R_L + \frac{1}{g_m}} v_i$

الف) وطبق سوال $\frac{dv_o}{v_o} = \pm 0.2$, $dR_L = 2k$ داریم:

$$\frac{dv_o}{dR_L} = \left(\frac{R_L}{R_L + \frac{1}{g_m}}\right)'_{R_L} v_i = \frac{\frac{1}{g_m}}{(R_L + \frac{1}{g_m})^2} v_i \quad (1)$$

$$\frac{dv_o}{v_o} = \frac{\left(\frac{R_L}{R_L + \frac{1}{g_m}}\right)' v_i}{\left(\frac{R_L}{R_L + \frac{1}{g_m}}\right) v_i} dR_L \quad (2)$$

$$(1),(2) \Rightarrow \frac{dv_o}{v_o} = \frac{dR_L}{g_m R_L^2 + R_L} \Rightarrow 0.2 = \frac{2k}{g_m (2k)^2 + 2k} \Rightarrow g_m = 2m$$

$$\frac{1}{g_m} = R_D = 500\,\Omega$$

ب) if $k_n = 16\,mA/V^2$ → $I_D = \frac{1}{2} k_n V_{ov}^2$, $g_m = \frac{2 I_D}{V_{ov}}$ → $I_D = \frac{g_m^2}{2k_n} = 125\mu A$

ج) $V_{ov} = \frac{2 I_D}{g_m} = \frac{2 \times 125\mu}{2 \times m} = 125\,mV$

طبق نقطه سوال ← بازای مقادیر ۳ و ۵ کیلو باید v_o بین $0.8 v_o$ و $1.2 v_o$ تغییر کند

$v_{o2} = \frac{R_L}{R_L + \frac{1}{g_m}} v_i$ ↓ کم می شود v_o

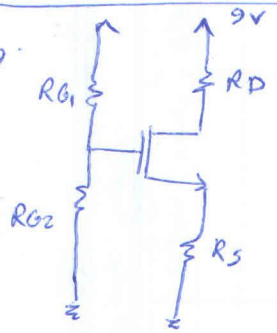
$$\frac{1k}{1k + \frac{1}{g_m}} v_i < \frac{2k}{2k + \frac{1}{g_m}} v_i < \frac{3k}{3k + \frac{1}{g_m}} v_i \xrightarrow{\forall g_m \geq 2m} 0.64 < v_o < 0.96$$

$$\frac{1}{1.5} < \frac{2}{2.5} < \frac{3}{3.5}$$

$$\frac{8.75 < 10.5 < 11.25}{1.5 \times 2.5 \times 3.5}$$ ✓

ادامه مثال 12 - 2

(98)



$V_t = 1\,V$
$k_n = 2\,mA/V^2$
$\lambda = 0$
R_{G1} و R_{G2} بزرگترین $= 22\,M\Omega$

$I_D = 1mA$
$V_{RS} = V_{RD} = \frac{1}{3} \times 9V = 3V$

R_{G1}, R_{G2}, R_S, R_D ؟

نحوه ابتدا از سمت اشباع!

$V_{RD} = 3V \rightarrow V_D = 9 - 3 = 6V \Rightarrow R_D = \frac{V_{RD}}{I_D} = \frac{3}{1m} = 3k\Omega$

$V_{RS} = 3V \rightarrow V_S = 3V \Rightarrow R_S = \frac{V_{RS}}{I_D} = \frac{3}{1m} = 3k\Omega$

$V_G = V_{DD} \times \frac{R_{G2}}{R_{G2}+R_{G1}} = ?$

فرض اشباع $\rightarrow I_D = \frac{1}{2} k_n V_{OV}^2 \Rightarrow V_{OV} = 1V = V_{GS} - V_t \Big|_{\substack{V_t=1 \\ V_S=3}} \Rightarrow V_G = 5V$

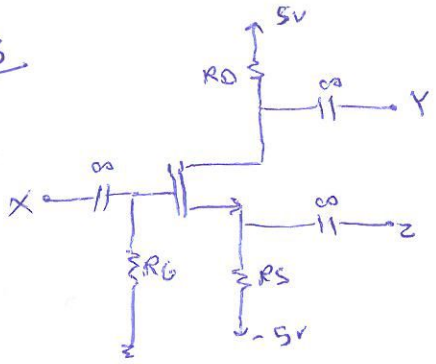
$\Rightarrow V_G = 9 \times \frac{R_{G2}}{R_{G2}+R_{G1}} = 5 \Big|_{R_{G2}=22M\Omega} \Rightarrow R_{G1} = 17.6\,M\Omega$

مقاومت بزرگتر که R_{G1} در نظر گرفته شد
مقدار R_{G2} برابر 27.5 میشود
که از مقدار مقاومت بزرگتر، مناسب است که قابل قبول نیست

ولتاژ درین $= V_D = 6V$

$V_{DS} = 6 - 3 = 3V \Big| \Rightarrow 3 - 1 = 2V$
$V_{DS} \gg V_{OV}$

فاصله ولتاژ V_{DS} از ناحیه اشباع



$V_t = 1$
$k_n = 0.8\ mA/V^2$
$V_A = 40\ V$

الف) $I_D = 0.1\ mA$

$I_D = \frac{1}{2} k_n V_{ov}^2 \Rightarrow V_{ov} = 0.5\ V$

$V_{GS} = V_{ov} + V_t \Rightarrow V_{GS} = 1.5\ V \Rightarrow V_S = -1.5\ V$

$V_G = 0$

$\frac{V_S - V_{SS}}{R_S} = I_D \Rightarrow 0.1mA = \frac{-1.5 - (-5)}{R_S} \Rightarrow R_S = 35\ k\Omega$

برای پایداری

$V_{DS} \geq V_{ov} \Rightarrow V_{DS} \geq 0.5 \Rightarrow V_D \geq 0.5 - 1.5 \Rightarrow V_D \geq -1\ V$

$\forall V_D = -1 + 0.5 \rightarrow \boxed{V_D = -1.5}$

$R_D = \frac{5 - (-1.5)}{I_D} = \frac{6.5}{0.1} = 65\ k\Omega$

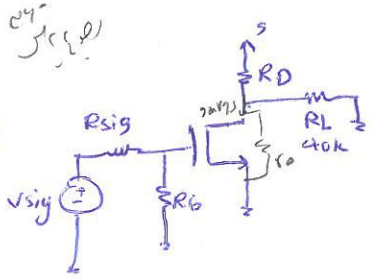
$R_{in} = R_G = 10\ M\Omega$

ب) $g_m = \frac{2I_D}{V_{ov}} = \frac{2 \times 0.1m}{0.5} = 0.4\ mA/V$

$\frac{1}{g_m} = \frac{1000}{0.4} = 2500$

$r_o = \frac{|V_A|}{I_D} = \frac{40}{0.1m} = 400\ k\Omega$

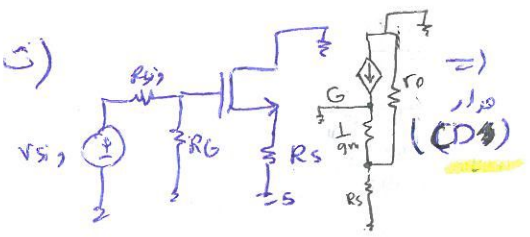
پ) مدار



$\Rightarrow A_v = -\frac{R_G}{R_G + R_{sig}} \cdot g_m \cdot (r_o \| R_D \| R_L) = -6.5\ V/V$

مدار CS

ت)

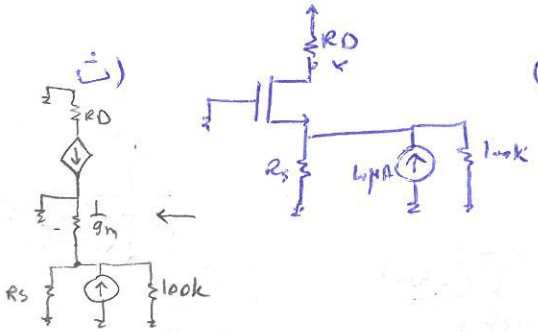


مدار (CD)

$\Rightarrow R_o = \frac{1}{g_m} \| r_o = 2.48\ k$

$G_v = \frac{r_o}{r_o + \frac{1}{g_m}} = 0.99\ V/V$

ث)



مدار (CG)

$\Rightarrow \begin{cases} i_D = I_S \cdot (100k \| R_S) = (100k \| 135k \| 12.5k) \times 1\mu A \| \frac{1}{g_m} \\ V = R_D I_D = 65k \times 22.8\mu A = 0.99\ V \end{cases}$

$35k \times 22.8$

با صرف نظر از r_o