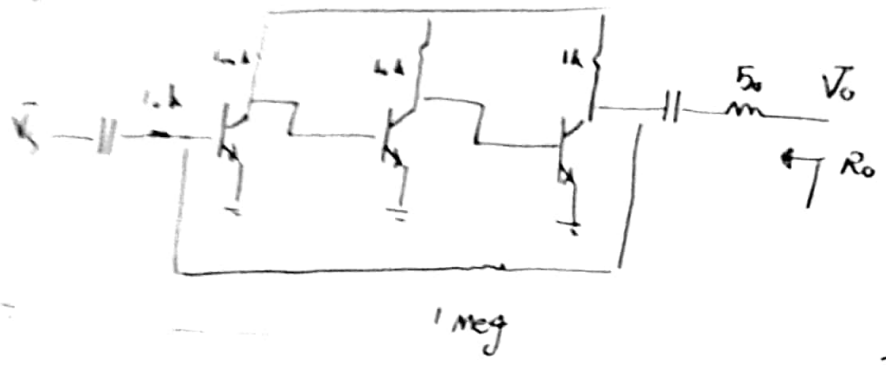
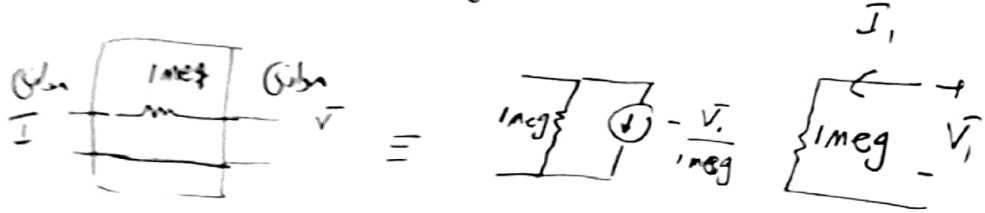
سوال ۱۱





$$I = -\frac{1}{1meg}$$

مدار معادل سیگنال کوچک

$$I_{C_1} = 0.53\,mA \quad V_{CE_1} = 0.7\,V$$

$$I_{C_2} = 0.53\,mA \quad V_{BE_2} = 0.7$$

$$I_{C_3} = 4.7\,mA \quad V_{CE_3} = 1.23\,V$$

$$5.3 - I_{C_1} \cdot 10k = 0.7$$

	①	②	③
r_π	47.17k	4.72k	0.532k

$$A_{V_1} = -\frac{100k \parallel R_{\pi_2}}{0 + \frac{10k + R_{\pi_1}}{100}} = -7.9 \qquad A_{V_2} = -\frac{10k \parallel R_{\pi_3}}{\frac{R_{\pi_2}}{100}} \qquad A_{V_3} = \frac{-1k}{\frac{R_{\pi_3}}{100}}$$

$$\rightarrow A_V = -47.9 \times 67.9 \times 188.10 = -100845 = \frac{V_o}{V_s}$$

$$R_{in} = 51.17k \rightarrow \frac{V_o}{V_s} = -158.8\,M\Omega$$

بهره ولتاژ حلقه بسته

$$A = \frac{a}{1 + af} = -1M\Omega \rightarrow \frac{V_o}{V_s} = -1M \times \frac{1}{10k} = -100$$

از اول واضح بود بهره $\frac{1}{f}$ است !!!

$$R_{in} = \frac{51.7k}{1 + af} = 52\,\Omega$$

$$R_o = \frac{1k\Omega \parallel 21k\Omega \parallel 1meg}{1 + af} = 5.98 \simeq 6\,\Omega$$

$$\rightarrow R_o = 50 + 6 = 56\,\Omega$$

Scanned by CamScanner

سوال 12 (ا)

$$V_o = A \frac{V_i R_{in}}{R_{in} + R_S} \rightarrow a_1 \frac{v_o}{v_i} = \frac{A R_{in}}{R_{in} + R_S}$$

$$\rightarrow a_2 \frac{v_o}{v_s} = A$$ با تقسیم a بر a_2 و جایگذاری R_S

$$\frac{a}{a_2} = \frac{R_{in}}{R_{in} + R_S}$$

=

ب)

$$R_{if} = (1 + af)(R_i + R_S) - R_S$$

$$= (1 + af)(R_i + R_S) = \left(1 + \frac{AR_if}{R_S + R_i}\right)(R_i + R_S) - R_S$$

$$= R_i + AR_if = R_i(1 + Af)$$ ← همین

=

$a_2 = A$ (ج

$$R_{if} = R_i(1 + a_2 f)$$ → همین

=

$$R_{of} = \frac{R_o}{1 + \frac{AR_if}{R_S + R_i}}$$ → R_S متصل

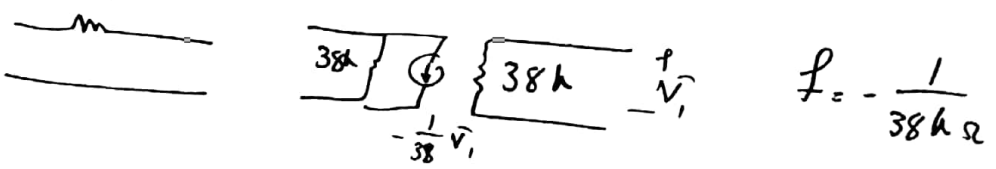
=

د)

$$R_{of} = \frac{R_o}{1 + \frac{a_2 R_i}{R_i + R_S}}$$ → R_S متصل

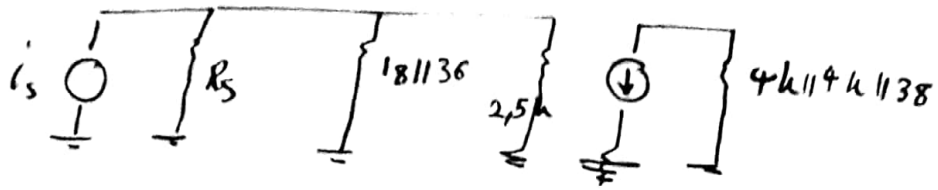
=

ه)



$$V_E = \frac{18}{18 + 36} \times 6 - 0.7 = 1.3 \rightarrow I_C = 1mA$$

Scanned by CamScanner



$R_S = 3k$ $\quad a = \dfrac{-100 \times 3 \parallel 18 \parallel 36 \parallel 38}{+2,5k} \times 1,9 = -90,16k$

$R_{in} = 1,22\,k\Omega \rightarrow R_{in_f} \parallel 3k = \dfrac{1,22}{1+af} = 0,382\,k\Omega$

$R_{out} \parallel 4k = \dfrac{1,9}{1+af} = 0,56\,k\Omega$

$\rightarrow \begin{cases} R_{in_f} = 0,41\,k\Omega \\ R_{in} = 0,1656\,k\Omega \end{cases}$

$R_S = 30k$ $\quad a_2 = -100 \times \dfrac{30 \parallel 18 \parallel 36 \parallel 38}{+2,5} \times 1,9 = -140$

$R_{i_2} = 1,94k\Omega \rightarrow R_{in_f} \parallel 30k = \dfrac{1,94}{1+af_2}$

$R_{out} = \dfrac{1,9}{1+a_2 f} \rightarrow \begin{cases} R_{in_f} = 0,41\,k\Omega \\ R_{out_f} = 0,457\,k\Omega \end{cases}$

بطور کلی انتظار داریم R_{in_f} به R_S وابسته نیست ولی R_{out_f} وابستگی دارد

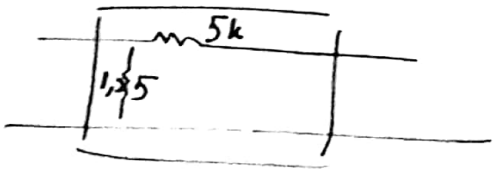
Scanned by CamScanner

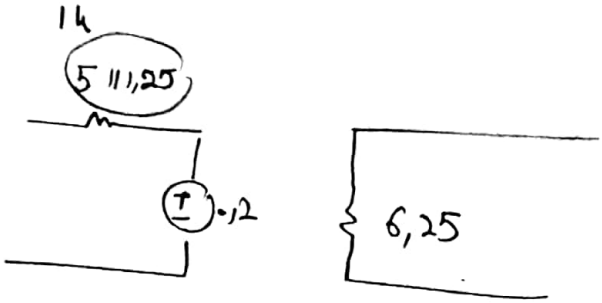
سوال ۳

	①	②	③	④	⑤
I_C	۰٫۲	۰٫۲	۱	۱	۲
V_G	۴٫۷	۴٫۷	-۹٫۷	-۴	۵
r_π	۱۲۵	۱۲۵	۲۵	۲۵	۱۲۵

$5 - 5\times 0.2 + 0.7 = 4.7$

۱-





$f_{c.2}$

$$A_{v_1} = \frac{5k \parallel R_{\pi 9}}{1 + 12{,}5k} \times \frac{5{,}65}{5{,}7 \parallel r_\pi + 6{,}25 \times 1{-}0} \times \frac{۰٫۹۹۸}{1 + \frac{r_\pi}{\beta\, 6{,}25}}$$

$$= 1395{,}1 \simeq \underline{1395} \quad \text{بهره ولتاژ}$$

$$A = \frac{1395}{1 + 0.2 \times 1395} = \underline{4{,}98} = \frac{v_0}{v_i}$$

$R_{in} = 2 \times (r_\pi + 1) = 27k$ بهره

$R_{in_f} = \underline{7{,}56M\Omega}$

$R_{out} = (6{,}25 \parallel \frac{50k}{2}) = 5{,}55k$ f_{o_c}

$R_{out_f} = \frac{5{,}55k}{\#\,of} = \underline{19{,}8\Omega}$

سوییچ

$V_o^+ = 1 \times 5{,}7 = 5$

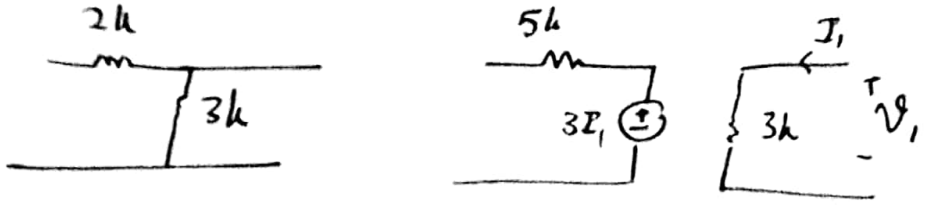
$V_o^- = 4 - 0{,}2 = 3{,}8$

$\rightarrow 3{,}8 \times 2 = \underline{7{,}6\Omega}$

حین طبقه آخر cc است باید طبقه قبل را نگاه نه

Scanned by CamScanner

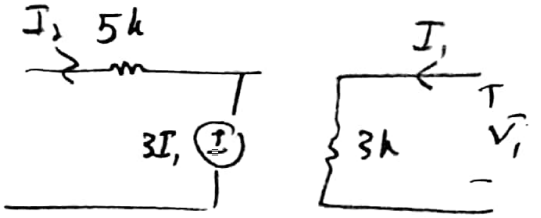
سوال ۱۴



	N ①	N ②	N_3	P_1	P_2	P_3
I_c	1	1	2	1	1	2
V_B	6	1,4	3	-,7	-,53	-3

,750 kΩ ,375

الف)



ب) سلف مشترک جریان - ولتاژ

ج)

$$i_{out} = \frac{V_{in}}{\underbrace{5+r_{\pi_1}}_{I_{in}}} \times 30 \times \left(\frac{50 \parallel 50 \parallel \overbrace{45,7}^{(r_{\pi_2}+\beta_2 R_4)\parallel r_{\pi_3}}}{16,2} \right) \times \frac{15,1}{15,1 \times 3 + r_{\pi_3}}$$

$$a = \frac{i_{out}}{v_m} = 27,9 \ \frac{1}{k\Omega} \quad \rightarrow \quad A = \frac{27,9}{1+af} = ,329$$

$$A_v = \frac{v_{out}}{v_m} = ,329 \times \frac{-25}{1+\frac{1}{14+1}} = -7,7$$

$$R_{in} = 11,5 \times (1+af) = 970\ k$$

$$R_{out} = 25\ k$$

د)

$$G_m = \frac{,75}{5,75} \times 40 \cong 5,2\ mS$$

ه)

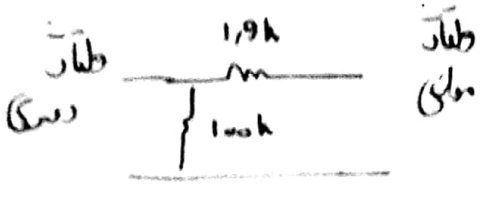
$$\begin{cases} R_{C_1} = 25\ k\Omega \\ R_{01} = 19,6\ k\Omega \end{cases}$$

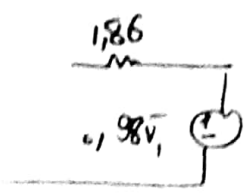
$G_m \rightarrow 0$

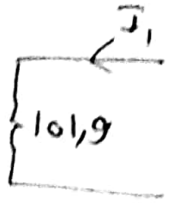
$R_{out} = 12,5\ k\Omega$

Scanned by CamScanner

سوال 5

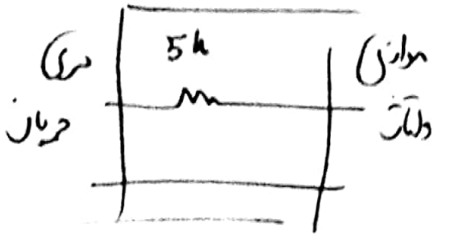


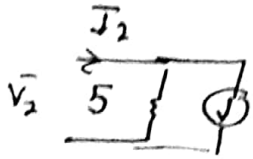


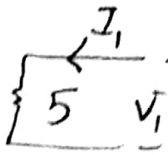


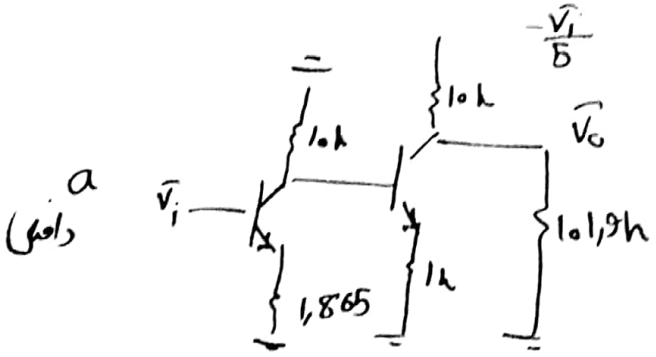
$f = 0,9814$

	1	2	3	4
I_C	0,1	0,2	0,2	0,5
r_π	25	12,5	12,5	5





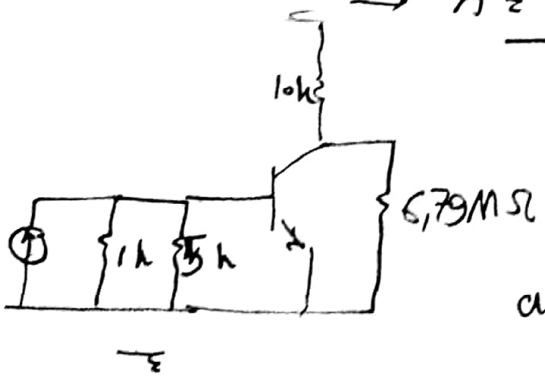




$$a = \frac{v_o'}{v_i'} = \frac{-\dfrac{9,18}{10k \parallel r_{\pi_3} + 100 \times 1}}{\dfrac{r_{\pi_2} + 1,865}{\beta}} \times \frac{-10k \parallel 101,9}{\dfrac{r_{\pi_1} + \beta 1}{100}} = 33,7$$

$$\rightarrow A = 0,9895 \qquad r_{in} = r_{\pi_2} + \beta\, 1,865 \approx 199k$$

$$R_{th} = 6,79M\Omega$$



$$a = \frac{V_o}{V_s} = \frac{1115}{1115 + r_{\pi_1}} \times 100 \times -10 \times 0,9895 \times \frac{1115 \times 10}{115 \times 100 + r_{\pi_4}} = -36,1k\Omega$$

$$A_v' = -4,29 \qquad \rightarrow A' = -4,29k\Omega$$

$$R_i' = \frac{1115 \parallel 125}{7,02} = 0,1148 \rightarrow R_i = R_1 \parallel R_i' = 130\,\Omega$$

$$R_{out} = \frac{47}{7,02} = 7\Omega$$

Scanned by CamScanner

سوال 16

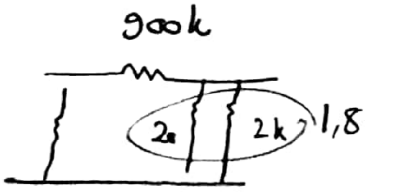
$I_{D_1} = I_{D_2} = 0,5\,mA$

$\frac{1}{2}(5)(V_{GS} - 1)^2 = 0,5$

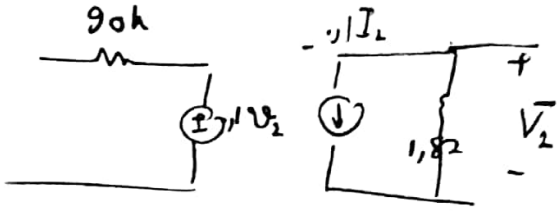
$V_{GS} = 2\,V$

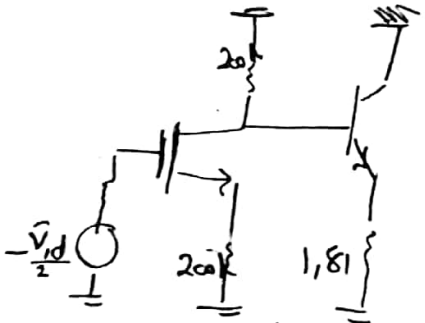
$\begin{cases} I_{C_3} = 5mA \\ r_{\pi_3} = 0,5k\Omega \end{cases}$

$\begin{cases} g_{m_1} = 1mV \\ I_D = 0,5 \end{cases}$

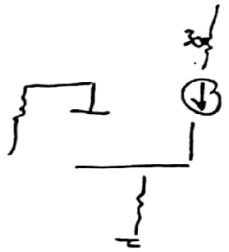


→





$a = \frac{R_G}{181,5} \times 300 \| 200 \| 181 = 36,44$



→ $a_A = \frac{1}{2} \times 64,4 = 32,1$

→ $a_t = 3,2$

$A_V = \frac{32,1}{4,2} = \boxed{7,6}$ $\quad R_{in} = \boxed{\infty}$

$R_o = \frac{1,81k}{4,2} = \boxed{546\Omega}$

Scanned by CamScanner