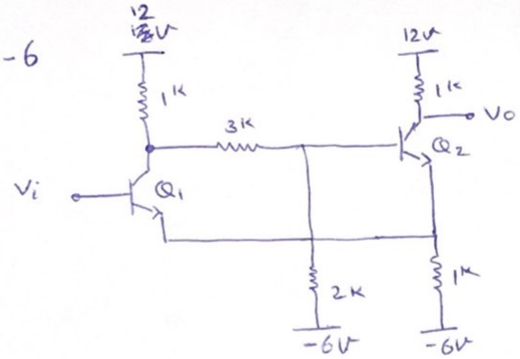
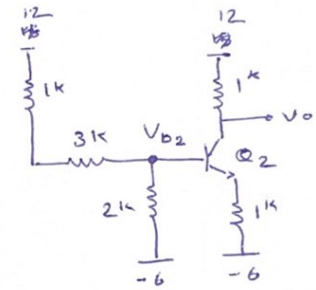
یا لطیف

رضا ادیب پور
۹۸۱۲۴۳۰۳

تمرین سری ۳ سایس

#5-6





if V_i کوچک باشد → | Q_1 : off, Q_2 : ON ↳ بافرض فعال بودن =>

$\Rightarrow V_{b2} + 6 = 2^k I_R \Rightarrow V_{b2} = 2^k I_R - 6^V$

$\Rightarrow I_R = \frac{V_{b2}+6}{2^k} = \frac{12+6}{1^k + 2^k + 3^k} = 3^{mA}$

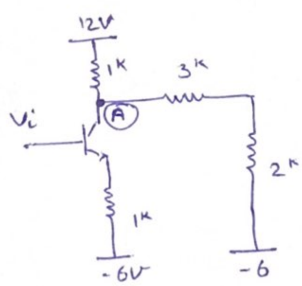
$\Rightarrow V_{b2} = 2^k(3^m) - 6 = 0 \Rightarrow V_{E2} = V_{b2} - 0.7 = -0.7$

$\Rightarrow I_{E2} = \frac{-0.7+6}{1^k} = \boxed{5.3^{mA}} \Rightarrow I_{C2} = \alpha I_2 = \frac{\beta}{\beta+1} I_{E2} = \frac{100}{101} I_E \simeq \boxed{5.25^{mA}}$

$\Rightarrow V_o = 12 - 1^k I_C = 12 - 1^k(5.25^m) = \boxed{6.75^V}$

$V_{CE} = V_{C2} - V_{E2} = 6.75 + 0.7 = 7.45 > 0.2$ ⟶ فرض درست است

$UTL = V_E + V_{be} = -0.7 + 0.6 = \boxed{-0.1}$



if $V_i > -0.1$: | Q_1 : ON, Q_2 : off

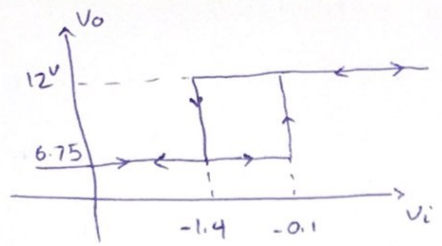
$I_{C1} \simeq I_{E1} = \frac{V_i - V_{be,on} - V_{EE}}{1^k} = \frac{V_i - 0.7 + 6}{1^k}$

KCL in A : $\frac{V_{CC} - V_{C1}}{1^k} = I_{C1} + \frac{V_{C1} - V_{EE}}{R_4 + R_5} \Rightarrow \frac{12 - V_{C1}}{1^k} = \frac{V_i + 5.3}{1^k} + \frac{V_{C1} + 6V}{5^k}$

$\Rightarrow V_{C1} = 4.58 - 0.83 V_i$ $\xrightarrow[V_i > V_{E2} + 0.6]{\text{زمانی روشن می شود که } Q_1}$ $V_i = V_{E2} + 0.6 = V_{B2} - 0.7 + 0.6 = \boxed{V_{b2} - 0.1}$

$\Rightarrow V_{b2} = 0.4V_{C1} - 3.6 \Rightarrow V_i = 0.4V_{C1} - 3.7 \Longrightarrow V_i = 0.4(4.58 - 0.83V_i) - 3.7$

$= -1.868 - 0.332V_i \Rightarrow LTP : V_i = 0 - 1.4 = \boxed{-1.4} \Rightarrow V_o = 12V$



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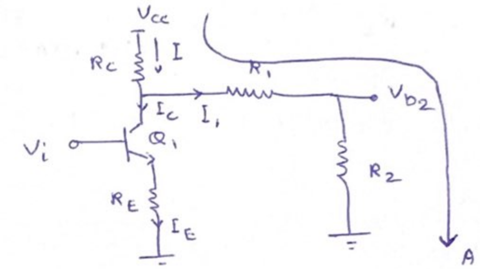
LTP = 5V



if Q_1 : ON , $V_i = LTP = V_{b2} = 5V$:

$$I_1 = \frac{V_{B2}}{R_2} = \frac{LTP}{R_2} = \frac{5}{62^k} = 80.6\,\mu A$$

$$I_{C1} \simeq I_e = \frac{V_i - V_{be}}{R_E} = \frac{5-0.7}{5.1^k} = 843.1\,\mu A$$

$$I = I_1 + I_{C1} = 923.7\,\mu A$$

KVL in A : $-V_{cc} + R_c I + (R_1 + R_2) I_1 = 0 \Rightarrow 15 = (923.7\,\mu A) R_{C1} + (R_1 + 62^k)\, 80.6\,\mu A$

$\Rightarrow (923.7\,\mu A) R_{C1} + R_1 (80.6\,\mu A) = 10 \Rightarrow R_1 + R_{C1} = 83.43\,k\Omega$

$\Rightarrow R_{C1} = 3.89\,k\Omega$ $\qquad R_1 = 83.43^k - R_{C1} = 83.43 - 3.89 = 79.54^k$

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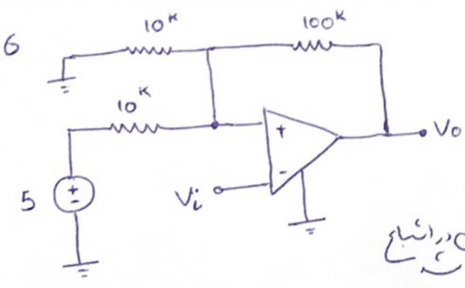


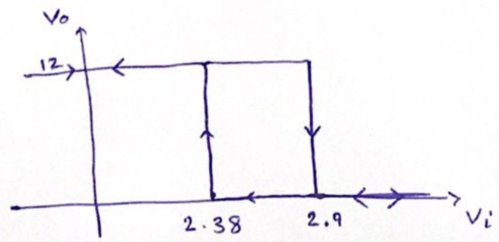
$$V_{in(+)} = \frac{10^k \| 100^k}{(10^k \| 100^k) + 10^k} \times 5^v + \frac{10^k \| 10^k}{(10^k \| 10^k) + 100^k} \times V_o$$

$$V_{in(+)} = \frac{9.1^k}{19.1^k} \times 5 + \frac{5^k}{105^k} V_{cc}$$

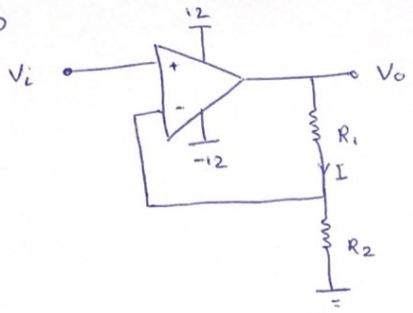
اگر خروجی در اشباع مثبت باشد

$V_{cc} = 12^v$ با فرض $\rightarrow V_{in(+)} = UTL = 2.9$

if خروجی در اشباع منفی باشد : $V_{in(+)} = \frac{9.1^k}{19.1^k} \times 5 = 2.38 = LTP$



#13-6



$LTP = UTP = \pm 2V$

$I = 100\, I_{B,max} = 100 \times 500^{nA} = 50\,\mu A$

$R_2 = \frac{UTP}{I} = \frac{2}{50\mu A} = 40^{k} \longrightarrow R_2 = 39^{k}$

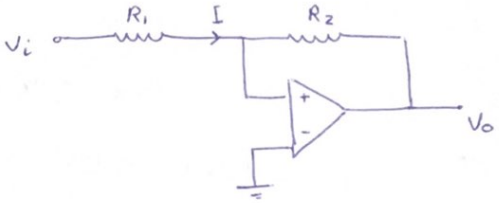
$I = \frac{UTP}{R_2} = \frac{2}{39^{k}} = 51.28\,\mu A$

$V_o = 12^{V} \longrightarrow R_1 + R_2 = \frac{V_{cc} - 1}{I} = \frac{11}{51.28\mu A} = 214.5^{k}$

$R_1 = 214.5^{k} - R_2 = 175.5^{k} \longrightarrow R_1 = 180^{k}$

$UTP = \frac{R_2}{R_1 + R_2}(V_{cc} - 1) = \frac{39^{k}}{39^{k} + 180^{k}}(11) = 1.96V \longrightarrow UTP = LTP = \pm 1.96$

None inverting :



$I = 100\, I_{B,max}$

$I = 100 \times 500^{nA} = 50\,\mu A$

غیرخطی: $V_o = \pm (V_{cc} - 1) = \pm 11V \Rightarrow R_2 = \frac{V_o}{I} = \frac{11V}{50\mu A} = 220^{k}$

$R_1 = UTP \frac{R_2}{V_{EE}} = 2 \times \frac{220^{k}}{11V} = 40^{k} \longrightarrow R_1 = 39^{k}$

$UTP = \frac{R_1}{R_2} V_{EE} = \frac{39^{k}}{220^{k}} \times 11 = 1.95V \Rightarrow UTP = LTP = \pm 1.95V$