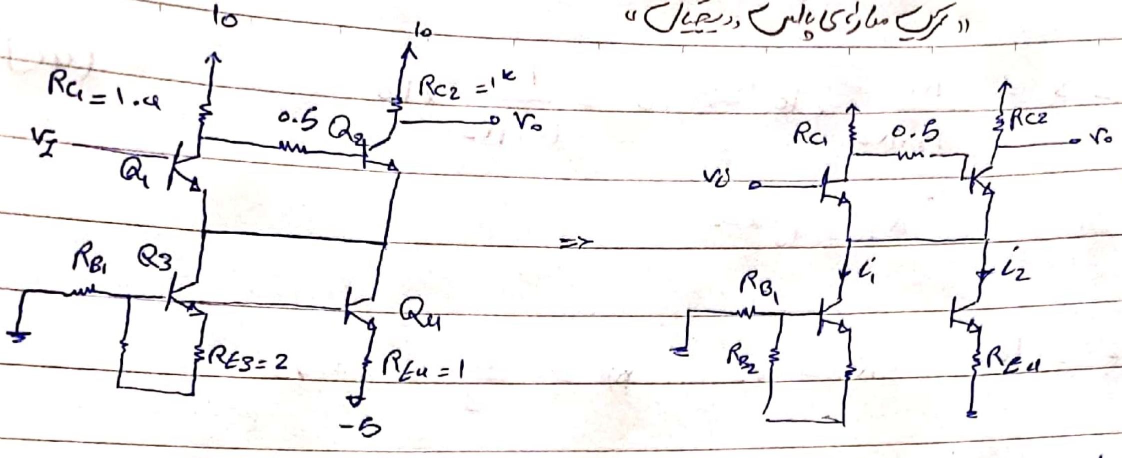
زهرا حسنی
9721983

«تمرین مدارهای پالس و دیجیتال»

سوال ۱)

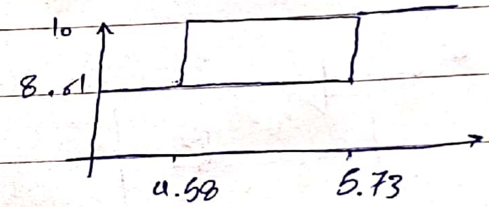


$$v_{B2} = v_{CC} - R_{C1}(0.5)(i_2 + \frac{i_1}{\beta+1}) \rightarrow 10 - 1.4 \times 0.5(-5.8 + \frac{1.4}{101})$$
$$= 5.933$$

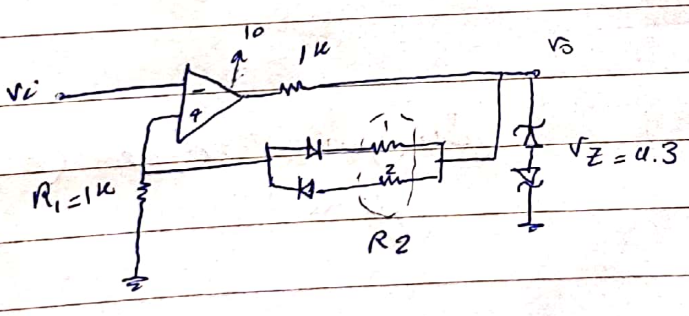
$$v_o = v_{CC} - \alpha R_{C2} i_1 \rightarrow v_o = 10 - \frac{\beta}{\beta+1} 1 \times 1.4 = 8.61$$

$$UTP = v_\gamma - v_{BEon} + v_{B2} \rightarrow 0.5 - 0.7 + 5.933 = 5.733$$

$$LTP = 0.7 - 0.5 + 5.933 = 4.58$$



سوال ۳)



$$R_2 = \frac{2}{2} = 1$$

$$UTP = \frac{v_{out}}{R_1 + R_2} \times R_1 = \frac{1}{1+1} \times 1 \, v_{out}$$

$$UTP = \frac{1}{2} v_{out} \rightarrow v_{oH} = 2UTP$$

$$LTP = \frac{v_{oL}}{2} \rightarrow v_{oL} = 2LTP$$

سوال ۴)

$v^+_{\text{آستانه}} = 3 = \frac{R_1}{R_1+R_2} \times 10 \rightarrow 3 = \frac{10}{10+R_2} \times 10$

$I_{R_1} >> I_B^+ \rightarrow R_1 = 10\,k\Omega$

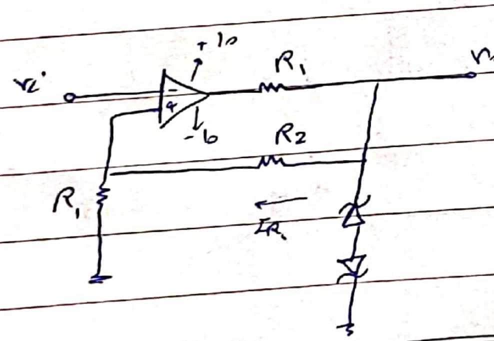
$30 + 3R_2 = 100 \rightarrow 3R_2 = 70 \rightarrow R_2 = \frac{70}{3} = 23.33$

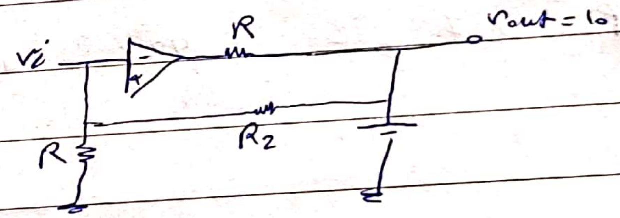
$LTP = \frac{5}{23.33+10} \times 10 = \frac{50}{33.33} = 1.53$

$I_R = \frac{v_o}{R_1 + R_2} = 13.45\,mA >> 10\,\mu A$

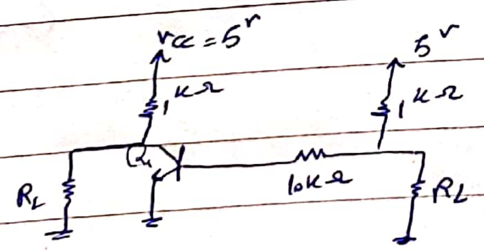
$I_o > I_z + I_{R_1} \rightarrow \frac{10-5}{R} > 5 + 0.3 \rightarrow R < 1.13$

$R = 1\,k\Omega$





سوال 8) فرض: Q1 در حالت اشباع، Q2 قطع



قطع $Q_2 \rightarrow I_{B_2} = 0$

اشباع Q_1: $V_{CE(sat)} = 0.2^v$, $V_{BE(on)} = 0.7^v$

$V_{B_2} = V_{C_1} = 0.2^v$

$V_{B_1} = 0.7^v$

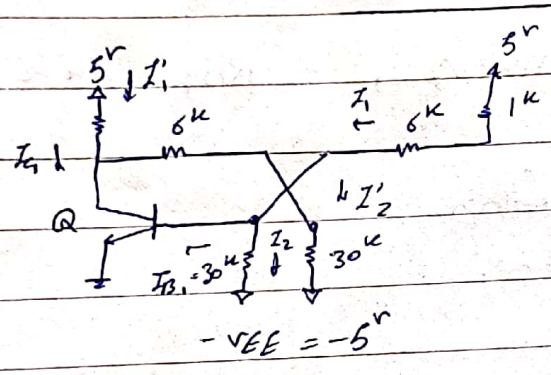
$R_L \gg \rightarrow I_{C_1} = \frac{V_{CC} - V_{CE(sat)}}{R_C} = 4.8\ mA$ (ادامه سوال 8)

$I_{C_2} = I_{B_1} = \frac{V_{CC} - V_{BE(on)}}{R_B + R_C} = 391\ \mu A$

$\beta_{min} = \frac{I_{C_1}}{I_{B_1}} = 12.28$, $\beta > 13$

$V_{C_2} = V_{BE(on)} + R_B \frac{V_{CC} - V_{BE(on)}}{R_B + R_C} = 4.81^V$

سوال 10) فرض: Q_1 وصل (قطع) و Q_2 وصل (قطع)



Q_1 : $V_{CE_1(sat)} = 0.2^V$, $V_{C_1} = 0.2^V$

$V_{BE(on)} = 0.7^V$, $V_{B_1} = 0.7^V$

$V_{B_2} = -V_{EE} + R_2 \times \frac{V_{CE_1(sat)} - (-V_{EE})}{R_1 + R_2} = -0.49^V$

$V_{C_2} = V_{BE_1(on)} + R_1 \times \frac{V_{CC} - V_{BE_1(on)}}{R_1 + R_C} = 4.38$

$I_1 = \frac{V_{CC} - V_{B_1}}{R_1 + R_C} = 614\ \mu A$ $I_2 = \frac{V_{B_1} - (-V_{EE})}{R_2} = 146\ \mu A$

$I_{B_1} = I_1 - I_2 = 468\ \mu A$ $I_1' = \frac{V_{CC} - V_{C_1}}{R_C} = 4.8\ mA$

$I_2' = \frac{V_{C_1} - (-V_{EE})}{R_1 + R_2} = 118\ \mu A$ $I_{C_1} = I_1' - I_2' = 4.68\ mA$

سوال 15)

$i_D = \frac{v_{DD}-v_D}{R_D}$

$i_D = 2k[(v_{GS}-v_T)v_{DS} - \frac{1}{2}v_{DS}^2]$

$\frac{5-v_D}{R_D} = 2\times 0.5[(5-1)v_D - \frac{1}{2}v_D^2]$

$\xrightarrow{v_D<v_T} R_D > \frac{8}{7} = 1.143^{k\Omega}$

جریان عبوری در ناحیه اشباع : $i_D = k(v_{GS}-v_T)^2 = 8^{mA}$

$\to \frac{5-v_D}{R_D} = 8^{mA}$, $v_D = 5-8\times R_D < v_T = 1 \to R_D > 0.5^{k\Omega}$

اگر $0.5^{k\Omega} < R_D < 1.143^{k\Omega}$ ناحیه اشباع

اگر $R_D > 1.143^{k\Omega}$ ناحیه خطی

سوال 23)

A	Q
0	0
1	1

مطابق تحلیل مدار

عملکرد یک D فلیپ فلاپ را نشان می‌دهد که با لبه مثبت پالس تریگر می‌شود

سوال 27)

فلیپ فلاپ SR

R	S	Q_{n+1}
0	0	غیر مجاز
0	1	1
1	0	0
1	1	Q_n