یا لطیف

رضا دیناروند
۹۸۱۴۳۰۳
تمرین سری ۴ پالس

#14 $\begin{cases} \text{دامنه پالس} = \pm 3V \\ f = 2^{KHz} \\ \pm 12V = V_{cc} \end{cases}$

$I_{R5} \gg I_{B,max} = 500^{nA}$

$I_{R5} = 100\, I_{B,max} = 100 \times 500^{nA} = 50\,\mu A$

$R_5 = \frac{UTP}{I_{R5}} = \frac{3}{50\,\mu A} = 60^{K} \longrightarrow \boxed{R_5 = 56^{K}}$

$UTP = \frac{R_5}{R_4+R_5} V_o = \frac{R_5}{R_4+R_5}(V_{cc}-1) \Rightarrow R_4 = 149.3^{K} \Rightarrow \boxed{R_4 = 150^{K}}$

if $I_C = 3\mu A$: $I_{C1} = 100\, I_{R1} = 100(3\mu A) = 300\mu A$

$T = \frac{1}{f} = \frac{1}{2^{KHz}} = 500\,\mu S \Rightarrow C_1 = \frac{I_{C1}\Delta t}{\Delta V} = \frac{300^{\mu A} \times 455^{\mu S}}{6^{V}} = 22750^{pF}$

$R_1 = \frac{V_{R1}}{I_{C1}} = \frac{V_{cc} - V_{\gamma_1} - V_{CE,sat} + V_{EE}}{I_{C1}} = \frac{12V - 0.7 - 0.7 - 0.2 + 12}{300\mu A} = 74.67^{K\Omega} \longrightarrow \boxed{R_1 = 75^{K}}$

$C_2 = \frac{I_{C4}\Delta t}{\Delta V_{C_2}} = \frac{300\mu A \times 455^{\mu S}}{0.12} = 1.14\,\mu F \longrightarrow \boxed{C_2 = 1^{\mu F}}$

$I_{disscharg} = 10\, I_{charge} = 10(300^{\mu A}) = 3^{mA} \xrightarrow{\beta = 100} I_B = \frac{I_C}{\beta_{min}} = \frac{3^{mA}}{100} = 30\mu A$

$R_2 = \frac{-V_\gamma + V_{be} - LTP}{I_B} = \frac{4.4}{30\,\mu A} = 146.7^{K} \longrightarrow \boxed{R_2 = 150^{K}}$

#16 $\begin{cases} V_{max} = 3^{V} \\ T = 1.3^{ms} \\ PW = 1.2^{ms} \end{cases}$ chose 741 opAmp.

$I_1 = 100\, I_{Bias} = 100(500^{nA}) = 50\,\mu A$

$C_1 = \frac{I\Delta t}{\Delta V} = \frac{50^{\mu A} \times 1.2^{ms}}{3^{V}} = 0.02^{\mu F} \longrightarrow \boxed{C_1 = 0.022^{\mu F}}$

$\frac{C_1 \Delta V}{\Delta t} = \frac{V_i}{R} : \frac{0.022 \times 3}{1.2} = \frac{8}{R_1} \Rightarrow R_1 = 145.45^{K} \longrightarrow \boxed{R_1 = 150^{K}}$

dc رفتار خازن : $1.2^{ms} \times 8 = 0.1^{ms} \times V_{in} \Rightarrow \boxed{V_{in} = 96^{V}}$

#19

$A_{min} = A - 0.2 = 0.8^{A} = 0.8 \times 2.5^{V} = 2^{V}$

$A_{max} = A + 0.2 = 1.2^{A} = 1.2 \times 2.5 = 3^{V}$

$UTP = \frac{R_4 + R_5}{R_3}(V_{ce-1}) \xrightarrow{R_3 = 11^{K}} UTP = 2^{V} \xrightarrow{\text{if } R_5 = 0} R_4 = \frac{2(11^{K})}{11} = 2^{K}$

if $UTP = 3^{V} \Rightarrow 3^{V} = \frac{2^{K} + R_5}{11^{K}}(11) \Rightarrow R_5 = 1^{K}$

$f_{min} = f - 0.2f = 0.8f = 0.8(500^{HZ}) = 400^{HZ}$

$f_{max} = f + 0.2f = 1.2f = 1.2(500^{HZ}) = 600^{HZ}$

$I = \frac{C_1 \Delta V}{\Delta t} \xrightarrow{\Delta V_{min} = 4} \Delta t_{max} = \frac{1}{2} \times \frac{1}{f_{min}} = 1.25^{ms}$, $I = 5^{\mu A} \Rightarrow C_1 = \frac{I \Delta t}{\Delta V} = \frac{50 \times 1.25}{4}$

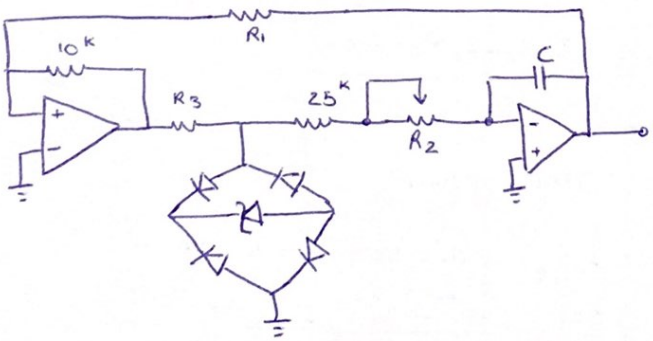
$= 0.0156\ \mu F \longrightarrow \boxed{C_1 = 0.022\ \mu F}$

$\frac{C_1 \Delta V}{\Delta t} = \frac{V_i}{R_1 + R_6} \Rightarrow R_1 + R_6 = \frac{V_i \Delta t}{C_1 \Delta V} \xrightarrow{\Delta V_{max} = 6} \Delta t_{min} = \frac{1}{2} \times \frac{1}{f_{max}} = \boxed{0.833^{ms}}$

$R_1 = \frac{11^{V} \times 0.833}{0.022(6)} = 69.4^{K} \longrightarrow \boxed{R_1 = 68^{K}} \xrightarrow{\Delta V_{min} = 4^{V}} \Delta t_{max} = \frac{1}{2} \times \frac{1}{f_{min}} = 1.25^{ms}$

$R_6 = \frac{V_i \Delta t}{C_1 \Delta V} - R_1 = \frac{11^{V} \times 1.25^{ms}}{0.022 \times 4} - 68 = \boxed{156.25^{K}} \longrightarrow \boxed{R_6 = 160^{K}}$

#27



$V_{o,sch} = \pm(V_\gamma + V_Z + V_\gamma) = \pm 5^{V} \Rightarrow UTP = \frac{R_1}{10^{K}} V_{o,sch} \Rightarrow R_1 = 10^{K} \times \frac{UTP}{V_{o,sch}} = \frac{5}{5} = 1^{V}$

$\because$) $I_{Bias,max} = 500^{nA} \xrightarrow{\text{if } R_2 = 0} I = \frac{5^{V}}{25^{K}} = 0.2^{MA} = 200^{\mu A}$

$T_{min} = \frac{1}{f_{max}} = \frac{1}{100^{HZ}} = 10^{ms}$, $\Delta t_{min} = \frac{T}{2} = 5^{ms}$

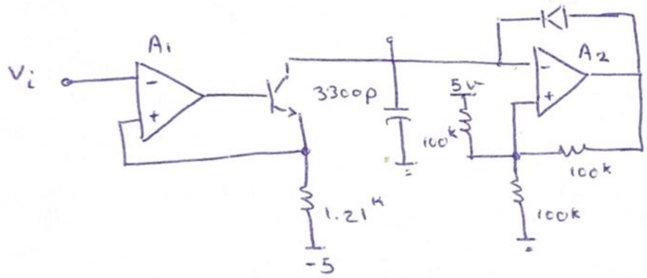
$$\frac{C\Delta V}{\Delta t} = \frac{V_i}{R} \Rightarrow \frac{C \times 10}{5^{ms}} = \frac{5}{25^{k}} \Rightarrow \boxed{C = 0.1\,\mu F}$$

$$T_{max} = \frac{1}{f_{min}} = \frac{1}{20^{Hz}} = 50^{ms} \quad , \quad \Delta t_{max} = \frac{T}{2} = \boxed{25^{ms}}$$

$$\frac{0.1^{\mu F} \times 10}{25^{m}} = \frac{5}{25^{k} + R_2} \Rightarrow \boxed{R_2 = 100^{k\Omega}}$$

ج) براساس جریان و ولتاژ ماکزیمم خروجی انتخاب می‌شود.

#29

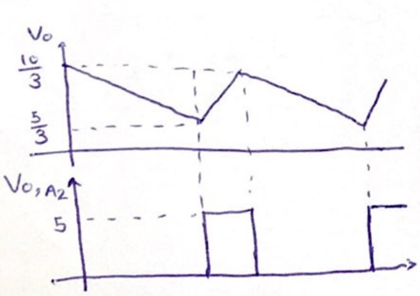


الف) آپ امپ A_1 و مقاومت 1.21^{k} یک منبع جریان است که خازن را دشارژ می‌کند و آپ امپ A_2 به همراه مقاومت 100^{k} یک اشمیت تریگر است که مقدار دامنه خروجی را تنظیم می‌کند. V_s مقدار فرکانس را تنظیم می‌کند.

در ابتدا خازن دشارژ است، و ولتاژ سر وارونساز صفر است. از آنجا که ولتاژ سر ناوارونساز مثبت است، خروجی A_2 به اشباع مثبت رفته و دیود روشن می‌شود و خازن را شارژ می‌کند و خروجی افزایش می‌یابد تا زمانی که به UTP برسد. با رسیدن خروجی به UTP خروجی A_2 صفر می‌شود و دیود خاموش می‌شود. و خازن توسط منبع جریان دشارژ می‌شود تا زمانی که به مقدار LTP برسد سپس دیود وصل شده و مجدد مراحل بالا تکرار می‌شود.

$$V^{+} = \frac{100^{k} \| 100^{k}}{100^{k} + (100^{k} \| 100^{k})}(5) + \frac{100^{k} \| 100^{k}}{100^{k} \| 100^{k} + 100^{k}} V_o \Rightarrow \begin{cases} UTP = \frac{10}{3} , & V_{oA_2} = 5^{v} \\ LTP = \frac{5}{3}\,v , & V_{oA_2} = 0 \end{cases}$$

ب)

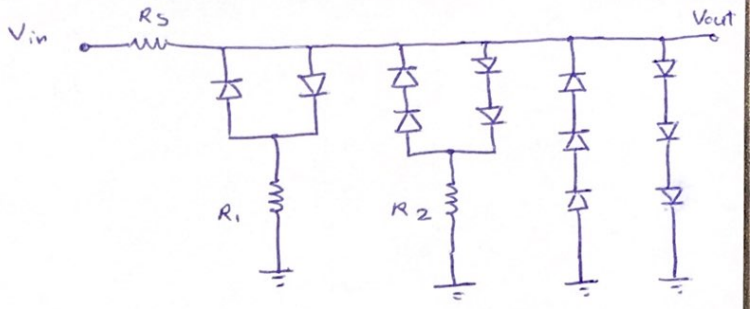


ج) $$\frac{V_c - V_{EE}}{R_E} = \frac{C\Delta V}{\Delta t}$$

$$\frac{V_c - (-5)}{1.2^{k}} = \frac{3300^{p}\left(\frac{10}{3} - \frac{5}{3}\right)}{T}$$

$$\Rightarrow f = \frac{V_c + 5}{6.6}\ MHz$$

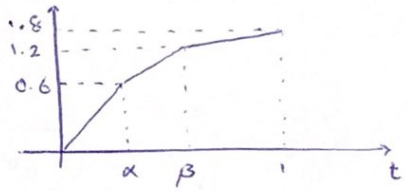
#30 $V_o = V_s \cdot \sin\left(\frac{\pi}{2} \cdot \frac{V_{tr}}{V_{tr}}\right)$



a) $V_{o,max} = V_s = 3V_\gamma = 3(0.6) = 1.8^V$

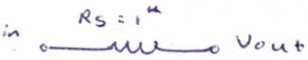
b) $V_{tr} = 2.77^V$

c) $V_{in} = t\,V_{tr}$ $\Rightarrow$ $0 < V_{in} < 0.6$, $0.6 < V_{in} < 1.2$, $1.2 < V_{in} < 1.8$ $\Rightarrow$



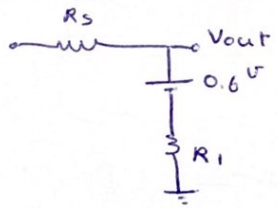
$\frac{\pi}{2}\alpha = \sin^{-1}\left(\frac{0.6}{1.8}\right) = \sin^{-1}\left(\frac{1}{3}\right) = 0.34^{rad} \Rightarrow \alpha = 0.2165^{rad}$

$\frac{\pi}{2}\beta = \sin^{-1}\left(\frac{1.2}{1.8}\right) = \sin^{-1}\left(\frac{2}{3}\right) = 0.73^{rad} \Rightarrow \beta = 0.4647^{rad}$

if $0 < V_{in} < 0.6$ $\Rightarrow$ 

$\Rightarrow V_{out} = V_{in} = V_{tr}\,t$

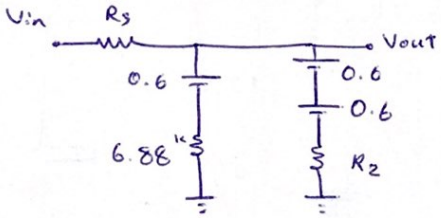
$\Rightarrow V_{tr} = \frac{0.6}{0.2165} = 2.77$

if $0.6 < V_{in} < 1.2$: 

$V_{out} = 0.6 + \frac{R_1}{R_1 + R_s}(V_{in} - 0.6)$

$\xrightarrow{V_{tr} = 2.77}$ $0.12 = 0.6 + \frac{R_1}{R_1 + 1^K}(2.77 \times 0.4647 - 0.6)$

$\Rightarrow \boxed{R_1 = 6.88^K}$

if $1.2 < V_{in} < 1.8$: 

$V_{out} = \dfrac{V_{in} + \frac{0.6}{6.8} + \frac{1.2}{R_2}}{1 + \frac{1}{6.8^K} + \frac{1}{R_2}}$

$\Rightarrow R_2 = 0.756^K \Rightarrow \boxed{R_2 = 750^\Omega}$

#36

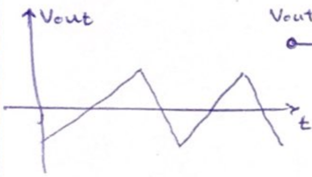
چون : $V_{o,max} = 0.33^{V} \Rightarrow V_s = 3 \times 3^{V} = 9^{V} \Rightarrow \boxed{V_{cc} = \pm 4.5^{V}}$

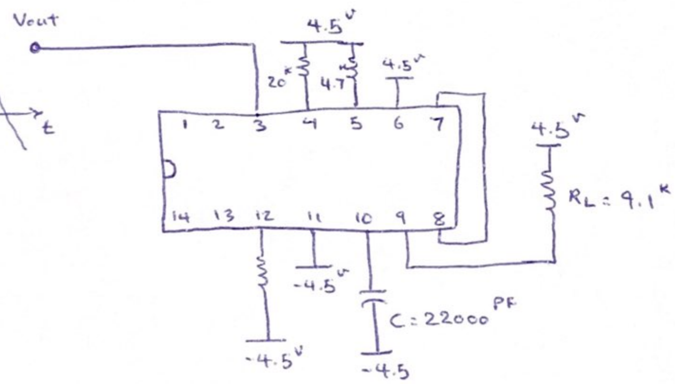
if $I_A = 100^{\mu A} \Rightarrow R_A = \frac{0.22 V_s}{100^{\mu A}} = \frac{0.22 \times 9}{100} = 19.8^{k} \Rightarrow \boxed{R_A = 20^{k}}$

$C = \frac{2T_2}{3R_A} = \frac{2 \times 750^{\mu s}}{3 \times 20^{k}} = 25^{nF} = 25000^{PF} \longrightarrow \boxed{C = 22000^{PF}}$

$R_B = 2R_A \frac{T_1}{T_1 + T_2} = 2 \times 20^{k} \times \frac{100^{\mu s}}{100 + 750} = \boxed{4.7^{k}}$

$\boxed{R_C = 82^{k}}$ $R_L = \frac{V_s}{1^{mA}} = \frac{9}{1^{mA}} = 9^{k} \longrightarrow \boxed{R_L = 9.1^{k}}$





#38

$1^{KHz} < f_{out} < 12^{KHz}$ $V_{cc} = 18^{V}$, $I = 100\mu A$

$R_A = \frac{0.1 V_s}{I_A} = \frac{0.1 \times 18}{100 \mu A} = 19.8^{k\Omega} \longrightarrow \boxed{R_A = 20^{k}}$

$C = \frac{1}{6 R_A f} = \frac{1}{6 \times 20^{k} \times 1^{k}} = \boxed{8.33^{nF}} \longrightarrow \boxed{C = 8200^{PF}}$

$R_A (f = 1^{KHz}) = \frac{1}{6fC} = \frac{1}{6 \times 1^{k} \times 8200} = \boxed{20.3^{k}}$

$R_A \big|_{f = 12^{k}} = \frac{1}{6fC} = \frac{1}{6 \times 12^{k} \times 8200} = \boxed{1.7^{k}}$

$\longrightarrow$ مقدار پتانسیومتر انتخابی : $\boxed{20^{k}}$

#43 { LM566
$f = 500^{KHz}$

$$f = \frac{2(V_{cc} - V_c)}{R_1 C_1 V_{cc}} \xrightarrow{\text{if } V_c = 0}$$

$$500^{KHz} = \frac{2}{R_1 C_1} \Rightarrow R_1 C_1 = 4\,\mu s$$

انتخاب : $R_1 = 33^{K}$, $C_1 = 120^{PF}$ → با تغییر V_c می توان فرکانس را در محدوده 500^{KHz} تنظیم کرد.

#50 spice