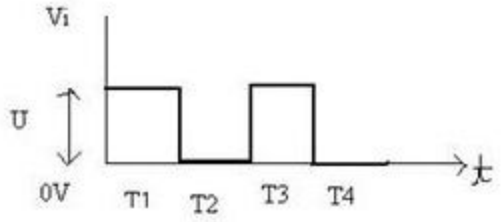
Varianta B

1 a)Raspunsul circuitului RC trece sus la un semnal ,impuls repetitive:diagrama de timp,expresia matematica.

b)Sa se determine raspunsul circuitului RC trece sus la intrarea caruia se aplica semnalul din figura de mai jos.T1=T2=T3=T4=100μs.R=5KΩ,C=10nF,U=10V.



2 a) Caracteristica statica de intrare la circuiteke integrate TTL

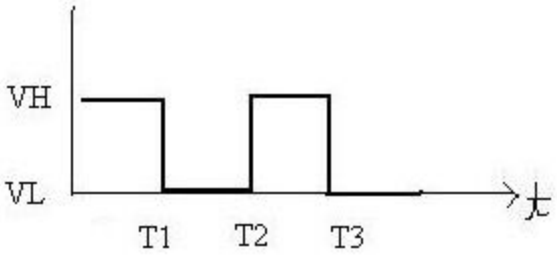
b) Definirea curentului de intrare pt nivel logic inferior

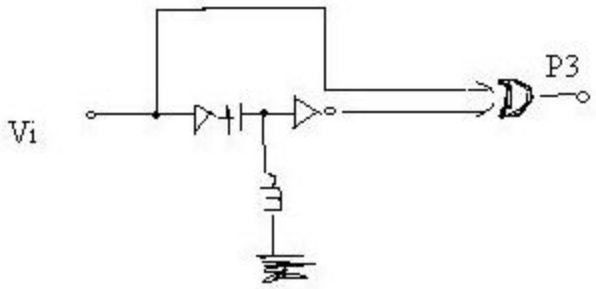
c) Definirea curentului de intrare pt nivel logic superior

3 Se da circuitul din figura,la intrarea caruia se aplica semnalul din figura.

a)Ridicarea diagramelor de timp in pctele Vi,V1,Vx,V2,V0,Vh=3,5V si Vl=0.2V T1=T2=T310μs

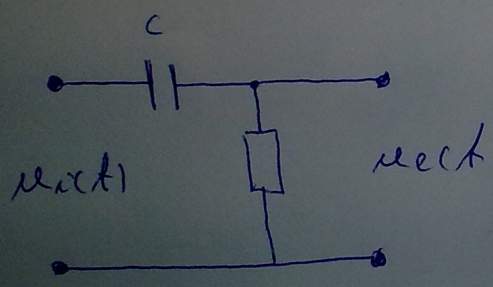
b)Perioada de timp a semnalului de iesire,Se neglijeaza timpi de intarziere pe porti.

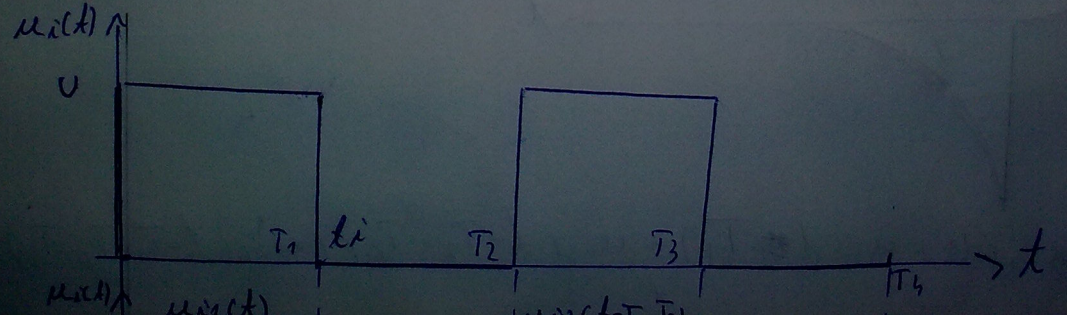


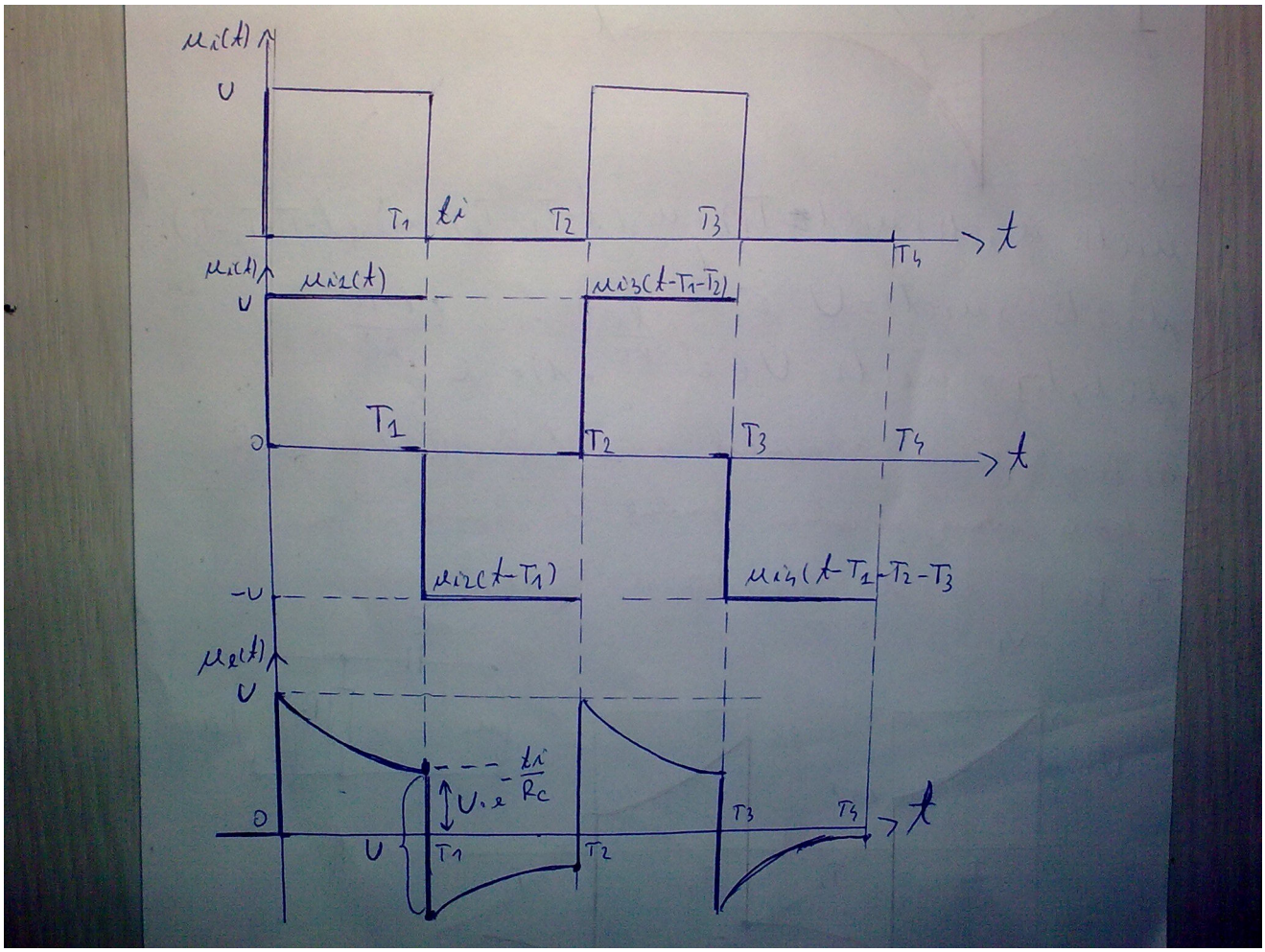


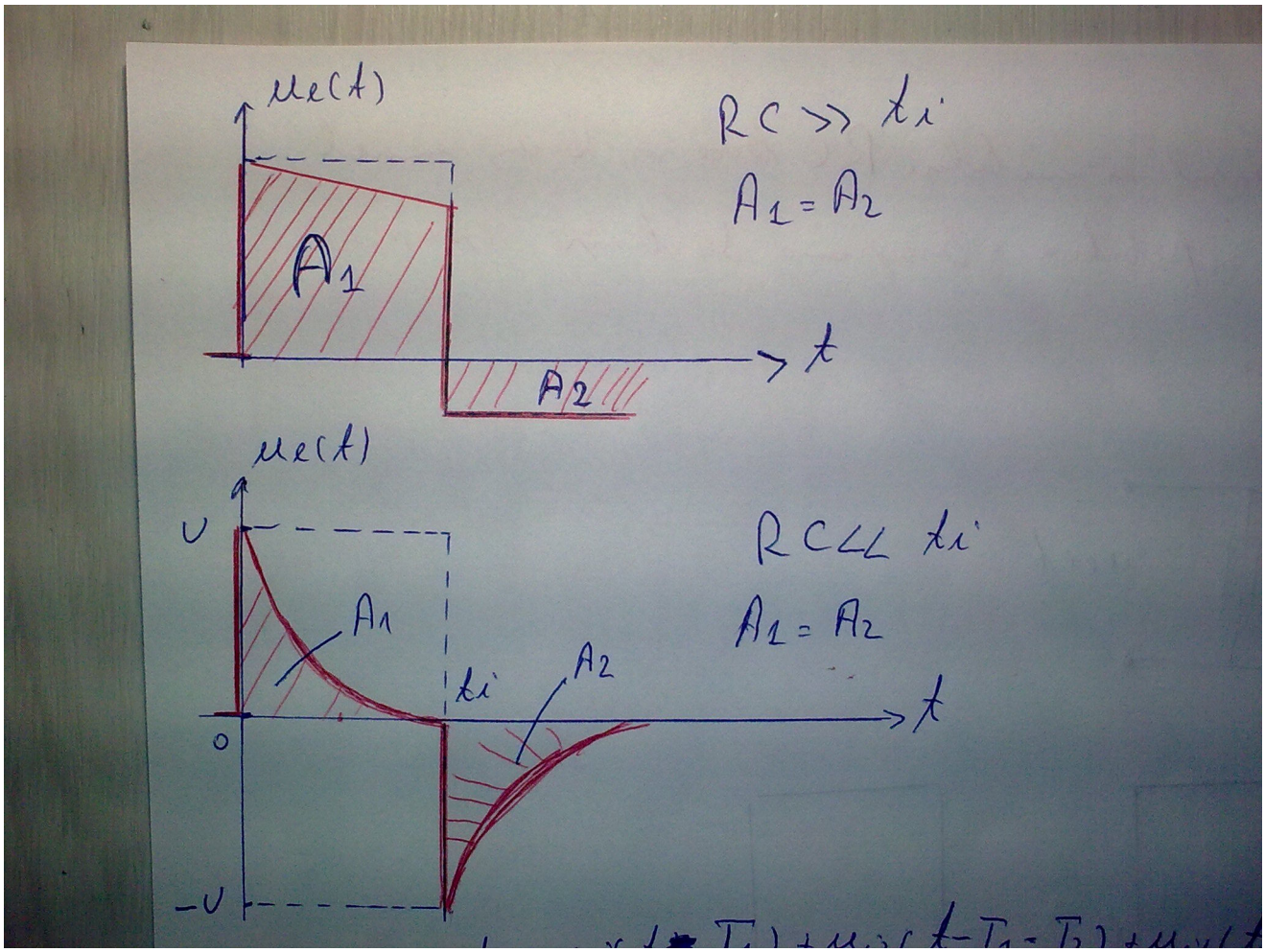
B

1. a) Răspunsul circuitului RC trece un semnal, impuls repetitiv: diagrama de timp, expresie matematică.






$u_i(t)$
U
T_1
t_i
T_2
T_3
T_4
t
$u_i(t)$
$u_{i1}(t)$
$u_{i3}(t-T_1-T_2)$
U
T_1
0
T_2
T_3
T_4
t
$u_{i2}(t-T_1)$
$u_{i4}(t-T_1-T_2-T_3$
-U
$u_R(t)$
U
$\frac{t_i}{R_C}$
$U_{1,2}$
0
U
T_1
T_2
T_3
T_4
t


$u_e(t)$
A_1
A_2
t
$RC \gg t_i$
$A_1 = A_2$
$u_e(t)$
U
A_1
t_i
A_2
t
0
$-U$
$RC \ll t_i$
$A_1 = A_2$

$-U$ ——————

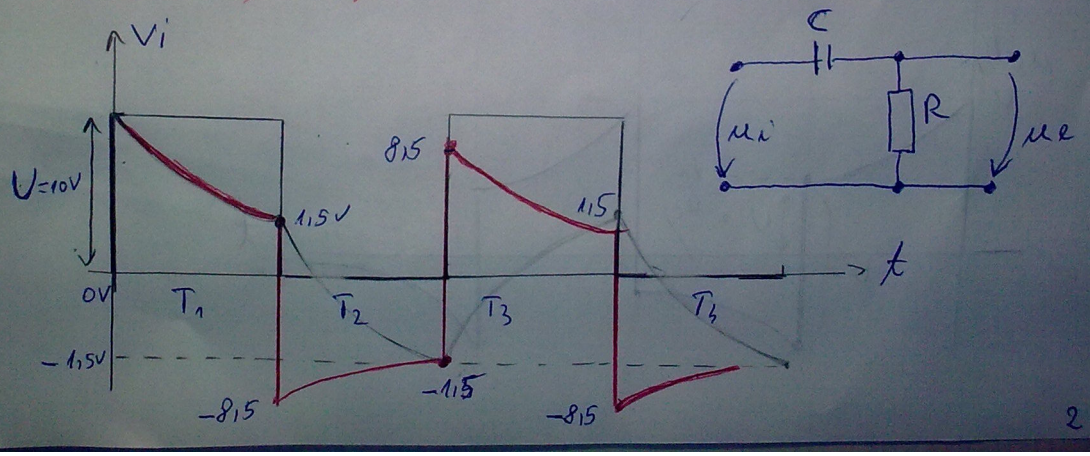
$u_i(t) = u_{i1}(t) + u_{i2}(t - T_1) + u_{i3}(t - T_1 - T_2) + u_{i4}(t - T_1 - T_2 - T_3)$

$pt.\ [0, t] \Rightarrow u_e(t) = U \cdot e^{-\frac{t}{RC}}$

$pt\ [t > t_i] \Rightarrow u_e(t) = U(e^{-\frac{t_i}{RC}} - 1) \cdot e^{\frac{(t - T_i)}{RC}}$

b) Să se determine răspunsul circuitului RC trecut la intrarea căruia se aplică semnalul din figura de mai jos

$T_1 = T_2 = T_3 = 100\,\mu s$; $R = 5\,k\Omega$, $C = 10\,nF$, $V = 10V$



a) pentru $t=0 \Rightarrow u_e(0) = U = 10V$

b) $t \in (0, T_1) \Rightarrow u_e(t) = U \cdot e^{-\frac{t}{RC}}$

$t = T_1 \Rightarrow u_e(T_1) = U \cdot e^{-\frac{T_1}{RC}} = U \cdot e^{-\frac{100 \cdot 10^{-6}}{50 \cdot 10^{3} \cdot 10^{-9}}} = U \cdot e^{-2} = 10 \cdot 0,15 =$

$= 1,5V$

c) $t \in [T_1, T_1 + T_2]$

$u_e(t) = U \cdot e^{-\frac{t}{RC}} - U \cdot e^{-\frac{t - T_1}{RC}}$

$t = T_1 + T_2 \Rightarrow u_e(T_1 + T_2) = U \cdot e^{-\frac{T_1 + T_2}{RC}} - U \cdot e^{-\frac{T_2}{RC}} =$

$= U \cdot e^{-\frac{200 \cdot 10^{-6}}{50 \cdot 10^{3} \cdot 10^{-9}}} - U \cdot e^{-2} =$

$= U \cdot e^{-4} - U \cdot e^{-2} = -10 \cdot 0,15 = -1,5V$

$= 0$

d) $t \in [T_1 + T_2, T_1 + T_2 + T_3]$

$$u_e(t) = U \cdot e^{-\frac{t}{RC}} - U \cdot e^{-\frac{t - T_1}{RC}} + U \cdot e^{-\frac{t - T_1 - T_2}{RC}}$$

$t = T_1 + T_2 + T_3 \Rightarrow u_e(T_1 + T_2 + T_3) =$

$$= U \cdot e^{-\frac{T_1 + T_2 + T_3}{RC}} - U \cdot e^{-\frac{T_2 + T_3}{RC}} + U \cdot e^{-\frac{T_3}{RC}} =$$

$$= U \cdot e^{-\frac{300 \cdot 10^{-6}}{50 \cdot 10^{-6}}} - U \cdot e^{-\frac{200 \cdot 10^{-6}}{50 \cdot 10^{-6}}} + U \cdot e^{-\frac{100 \cdot 10^{-6}}{50 \cdot 10^{-6}}} =$$

$$= U \cdot e^{-6} - U \cdot e^{-4} + U \cdot e^{-2} = 10{,}01 \cdot 5 = 1{,}5\,V$$

($e^{-6} \approx 0$, $e^{-4} \approx 0$)

e) $t \in [T_1 + T_2 + T_3, T_1 + T_2 + T_3 + T_4]$

$$u_e(t) = U \cdot e^{-\frac{t}{RC}} - U \cdot e^{-\frac{t - T_1}{RC}} + U \cdot e^{-\frac{t - T_1 - T_2}{RC}} - U \cdot e^{-\frac{t - T_1 - T_2 - T_3}{RC}} =$$

$t = T_1 + T_2 + T_3 + T_4 \Rightarrow u_e(T_1 + T_2 + T_3 + T_4) =$

$$= U \cdot e^{-\frac{T_1+T_2+T_3+T_4}{RC}} - U \cdot e^{-\frac{T_2+T_3+T_4}{RC}} + U \cdot e^{-\frac{T_3+T_4}{RC}} - U \cdot e^{-\frac{T_4}{RC}} =$$

$$= U \cdot e^{-\frac{400 \cdot 10^{-6}}{50 \cdot 10^{-6}}} - U \cdot e^{-\frac{300 \cdot 10^{-6}}{50 \cdot 10^{-6}}} + U \cdot e^{-\frac{200 \cdot 10^{-6}}{50 \cdot 10^{-6}}} - U \cdot e^{-\frac{100 \cdot 10^{-6}}{50 \cdot 10^{-6}}} =$$

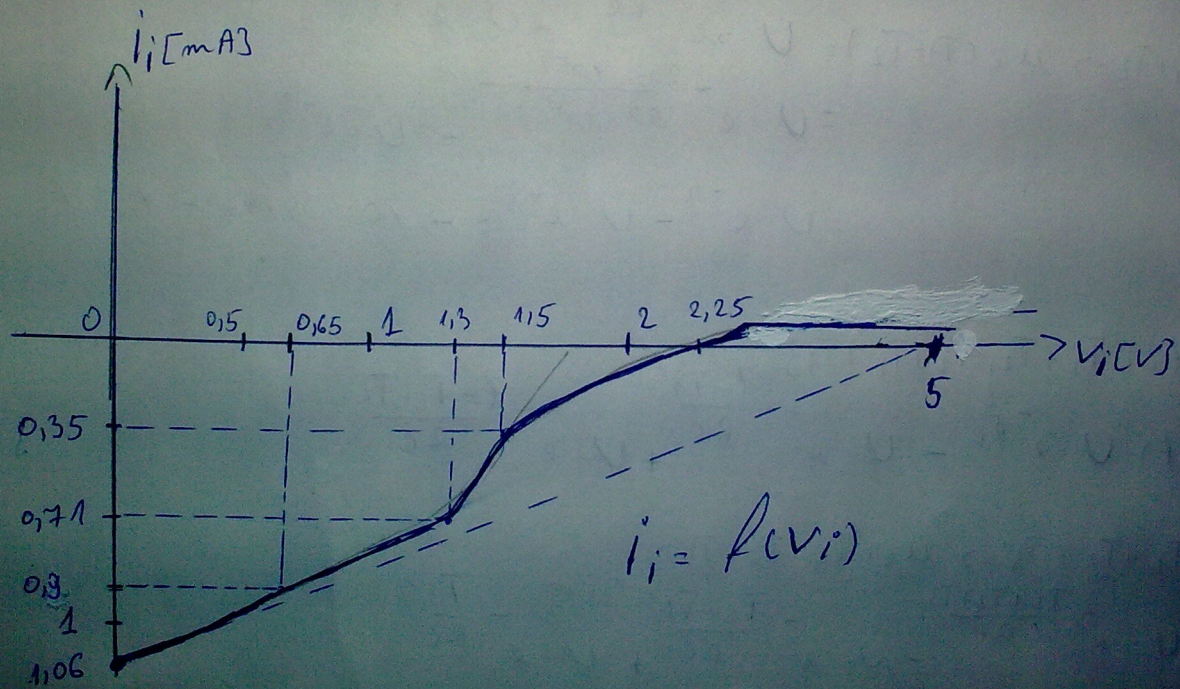
$$= U \cdot \underset{=0}{e^{-8}} - U \cdot \underset{=0}{e^{-6}} + U \cdot \underset{=0}{e^{-4}} - U \cdot e^{-2} = -U \cdot e^{-2} = -10 \cdot 0{,}15 = -1{,}5\,V.$$

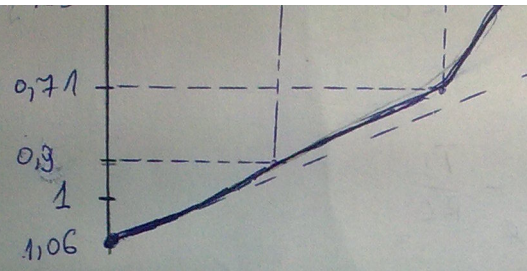
2.a) Caracteristica statica de intrare a circuitelor integrate TTL

$=0$ $=0$ $=0$

2.a) Caracteristica statică de intrare la circuitele integrate

TTL





$i_i = f(V_i)$

b) Definirea curentului de intrare pentru nivel logic inferior

c) Definirea curentului de intrare pentru nivel logic superior.

a) $V_i = 0V$

T_1 saturat, T_2 blocat, T_3 blocat, T_4 conductie.

$$V_0 = V_{CC} - i_{R_2} \cdot R_2 - V_{BE_4} - V_D$$

$$i_{R_2} = i_{C_2} + i_{B_4}$$

$$i_{C_2} = i_{CO} \ll i_{B_4}$$

$$i_{E_4} = i_{C_3} + i_{OH}$$

$$i_{C_3} = i_{CO} \ll i_{OH}$$

$$V_0 = V_{CC} - \frac{i_{OH}}{\beta+1} \cdot R_2 - V_{BE_5} - V_D$$

$\beta = 20$, $i_{OH} = 0{,}8\,mA$, $V_{CC} = 5V$, $T_0 = 25^\circ C$

$\ldots = 3{,}4V$ (3,5V)

$V_0 = 5 - 0,1 - 0,75 - 0,75V = 3,4V\ (3,5V)$

b) $V_i = 0 \div V_T = 0,65\,V$

$V_i = 0,65V$

$V_{B1} = 0,65 + 0,75 = 1,3V$

$V_{B2} = V_{B1} - V_{BC1} = 1,3 - 0,75 = 0,65V$

$V_{B2} = V_i \rightarrow T_2$ blocat, T_3 blocat, T_4 conductie

$V_0 = V_{CC} - iR_2 R_2 - V_{BE4} - V_D \approx 3,4V$

c) $V_i > V_T = 0,65V$

$V_{B2} = V_i \Rightarrow T_2$ blocat $\rightarrow$ conductie

$V_0 = V_{CC} - iR_2 R_2 - V_{BE4} - V_D$

$$i_{R_2} = i_{C_2} + i_{B_4}$$

$$i_{C_2} = i_{E_2} \cdot \frac{\beta}{\beta+1}$$

$$i_{E_2} \approx -i_{CO} \text{ - neglijăm} \quad i_{B_3} + i_{R_3} \Rightarrow i_{E_2} \approx i_{R_3}$$

$$i_{R_3} = \frac{V_{B_3}}{R_3} = \frac{V_i + V_{BE1} - V_{BC1} - V_{BE2}}{R_3}$$

$$i_{B_4} = \frac{i_{OH}}{\beta+1}$$

$$V_o = V_{CC} - \left[\frac{i_{OH}}{\beta+1} + \frac{\beta}{\beta+1} \cdot \frac{V_i + V_{BE1} - V_{BC1} - V_{BE2}}{R_3} \right] \cdot R_2 - V_{BE_4} - V_D$$

$$\frac{\Delta V_o}{\Delta V_i} = -\frac{\beta}{\beta+1} \cdot \frac{R_2}{R_3} = -\frac{R_2}{R_3} = -1{,}6$$

$\frac{\beta}{\beta+1} \approx 1$

$V_i = 1{,}3\,V\ (2V_T)$

d) $V_i = 1,3V \ (2V_T)$

$V_{B_2} = 1,3V$

$V_{B_3} = V_{B_2} - V_{BE_2} = 1,3 - 0,65 = 0,65V$

T_3 - blocat.

$$V_0 = 5 - \left[\frac{0,8 \cdot 10^{-3}}{20+1} + \frac{20}{20+1} \cdot \frac{1,3 + 0,75 - 0,75 - 0,65}{10^3} \right] \cdot 1,6 \cdot 10^3 - 0,75 - 0,75 =$$

$= 2,4V$

$$V_0 = -\Delta \underline{V_i} \cdot \frac{R_2}{R_3} \simeq 1V \ ; \ \Delta V_i = 1,3 \div 0,65 = 0,65$$

e) $V_i > 1,3V$

T_2 activ -> saturat ; T_3 blocat -> saturat.

$V_0 = V_{cc} - i_{R_2} R_2 - V_{BE_4} - V_D$

e) $1,3 < V_i < 1,5\,V$

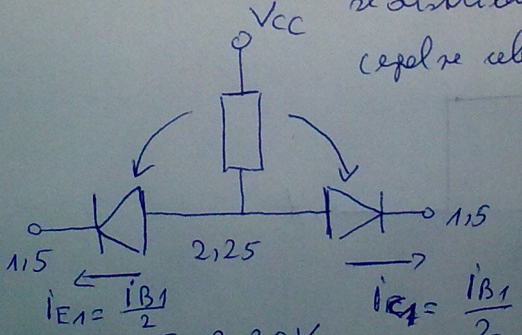
T_1 saturat, T_2 activ → saturat, T_3 blocat → saturat, T_4 activ → blocat.

$$i_i = i_{E1} = \frac{V_{cc} - (V_i + V_{BE1})}{R_3} - i_{B2}$$

$$i_{B2} = \frac{i_{E2}}{\beta + 1} \; ; \; i_{E2} = i_{R3} + i_{B3}$$

Cele 2 joncțiuni sunt polarizate direct, curentul se distribuie normal (egal pe cele 2 joncțiuni)

f) $V_i = 1,5\,V$



$V_{B1} = V_i + V_{BE1} = 1,5 + 0,75 = 2,25\,V$

$V_{B2} = V_{B1} - V_{BC1} = 2,25 - 0,75 = 1,5\,V$

$V_{B2} = V_{B1} - V_{BC1} = 2,25 - 0,75 = 1,5\,V$

$i_i = \frac{1}{2} \cdot i_{B1} = \frac{1}{2} \frac{V_{CC} - (V_i + V_{BE1})}{R_1} = \frac{1}{2} \cdot \frac{5 - (1,5 + 0,75)}{4 \cdot 10^3} =$

$= 0,35\,mA.$

g) $V_i = 2,25\,mA$

T_1 - invers, T_2 - saturat, T_3 - saturat, T_4 - blocat.

h) $V_i = 5V$

T_1 - invers, T_2 - saturat, T_3 - saturat, T_4 - blocat.

$i_i = i_{E1} = \beta_i \cdot i_{B1} = 0,05 - 0,7\,mA = 35\,\mu A$

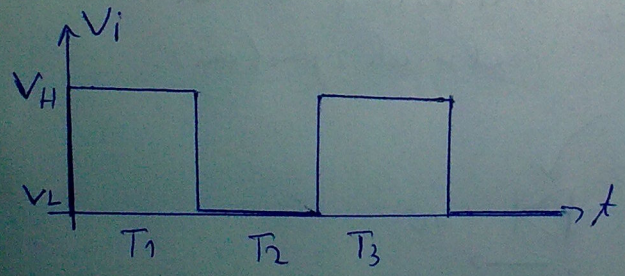
$\beta_i = 0,05 \div 0,05$ (β invers)

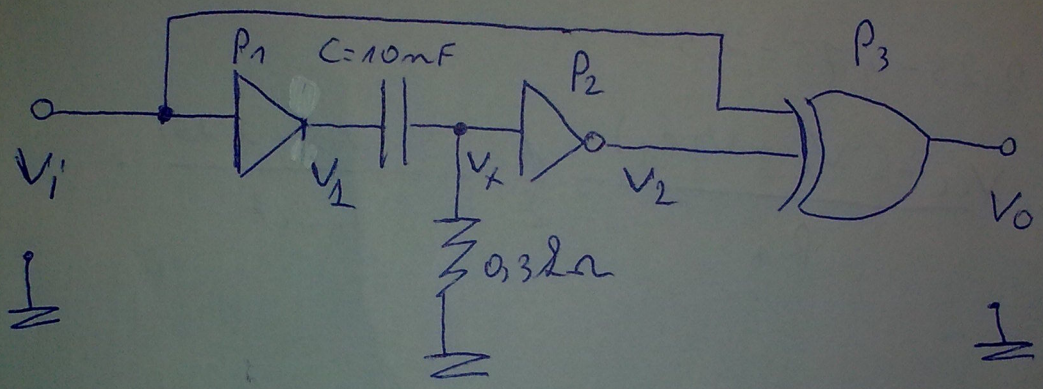
$i_{B1} = \frac{V_{CC} - 2,25}{R_1} = \frac{5 - 2,25}{4 \cdot 10^{-3}} = 0,7\,mA$; $V_{B1} = V_{BE3} + V_{BE2} + V_{BC1} \approx 0,7\,m$

3. Se dă circuitul din figură, la intrare căruia se aplică semnalul din figură.

a) Ridicarea diagramelor de timp în punctele V_i, V_1, V_x, V_2, V_0, $V_H = 3{,}5V$, $T_1 = T_2 = T_3 = 3 \times 0\mu s$; $V_L = 0{,}2V$

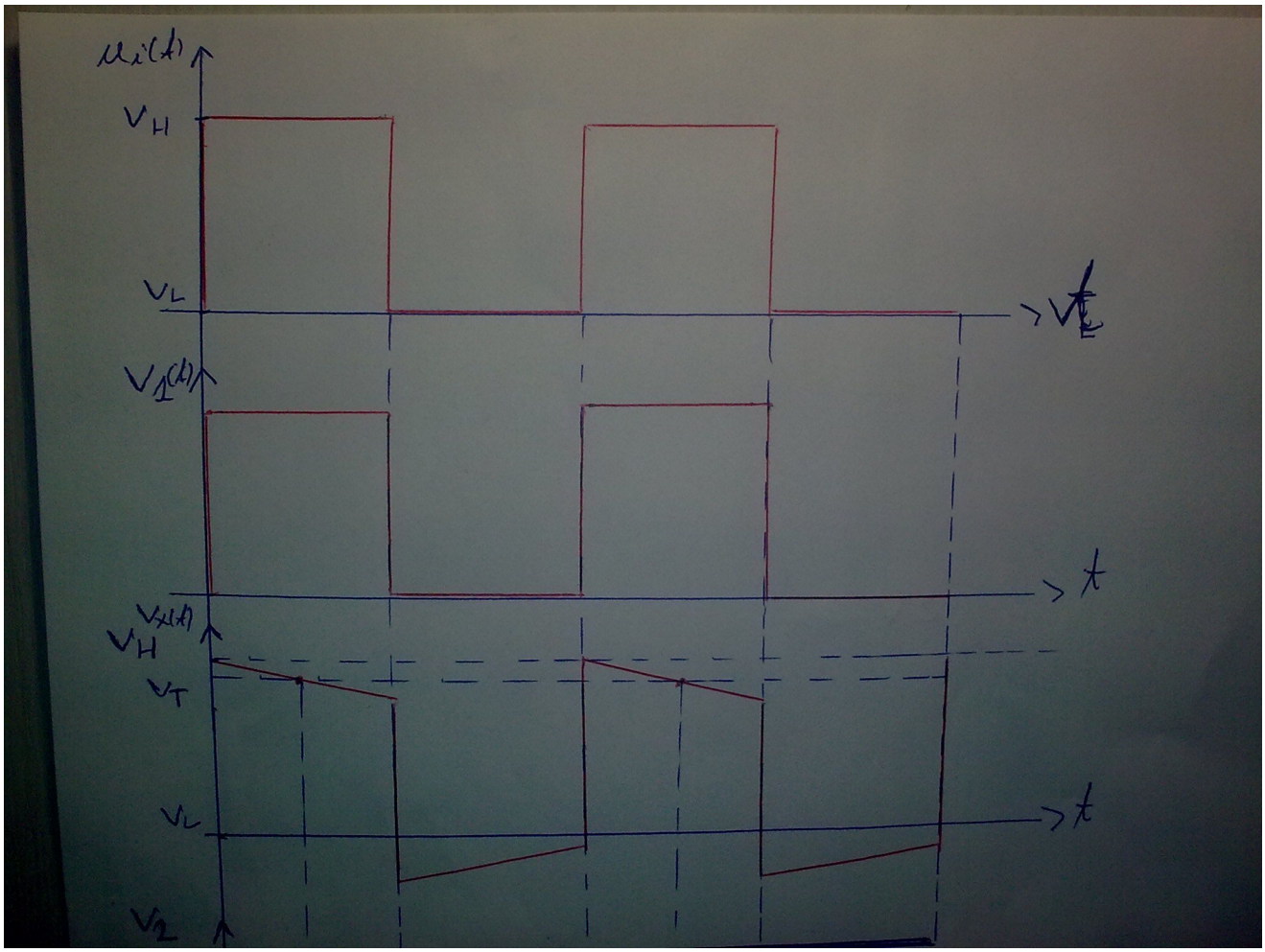
b) Perioada de timp a semnalului de ieșire, Se neglijează timpii de întârziere ai porții.

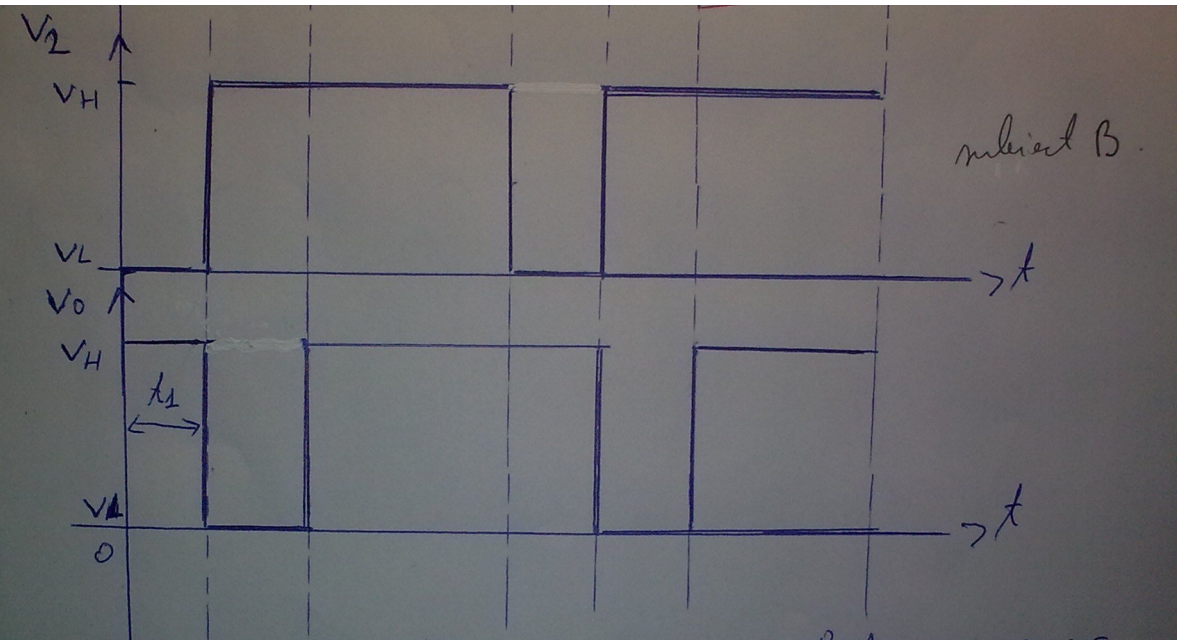




$RC = 0{,}3 \cdot 10^{3} \cdot 10 \cdot 10^{-9} = 30 \cdot 10^{-6}\ s$ ~~30~~ μs

$T_1 = T_2 = T_3 = 10 \cdot 10^{-6}\ s. = 10\mu s.$


$u_i(t)$
V_H
V_L
$V_1(t)$
$V_{x1}(t)$
V_H
V_T
V_L
V_2
t
t



suivant B.

$$t_1 = RC \ln \frac{V_L - 0{,}9V}{V_L - 0{,}1V} = 0{,}3 \cdot 10^3 \cdot 10 \cdot 10^{-9} \ln \frac{0{,}2 - 0{,}9 \cdot 3{,}5}{0{,}2 - 3{,}5 \cdot 0{,}1}$$

$$t_f = RC \ln \frac{V_L - 0{,}9V}{V_L - V_T} = 0{,}3 \cdot 10^3 \cdot 10 \cdot 10^{-9} \ln \frac{0{,}2 - 0{,}9 \cdot 3{,}5}{0{,}2 - 1{,}5}$$