Tema 1

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- 324CC-

Date

m=16

R=(35+0.3m)kΩ=39.8kΩ

C=(20+0.5m)pF=28pF

R’=(30+0.5m)kΩ=38kΩ

R’’=100kΩ

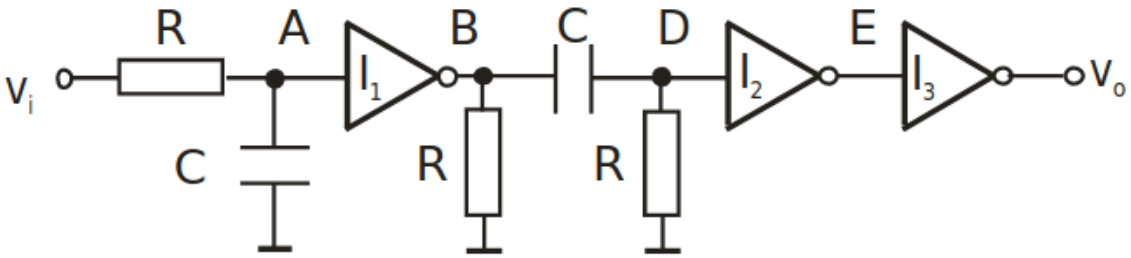
V_{DD}=11V

V_i=E_i=9V

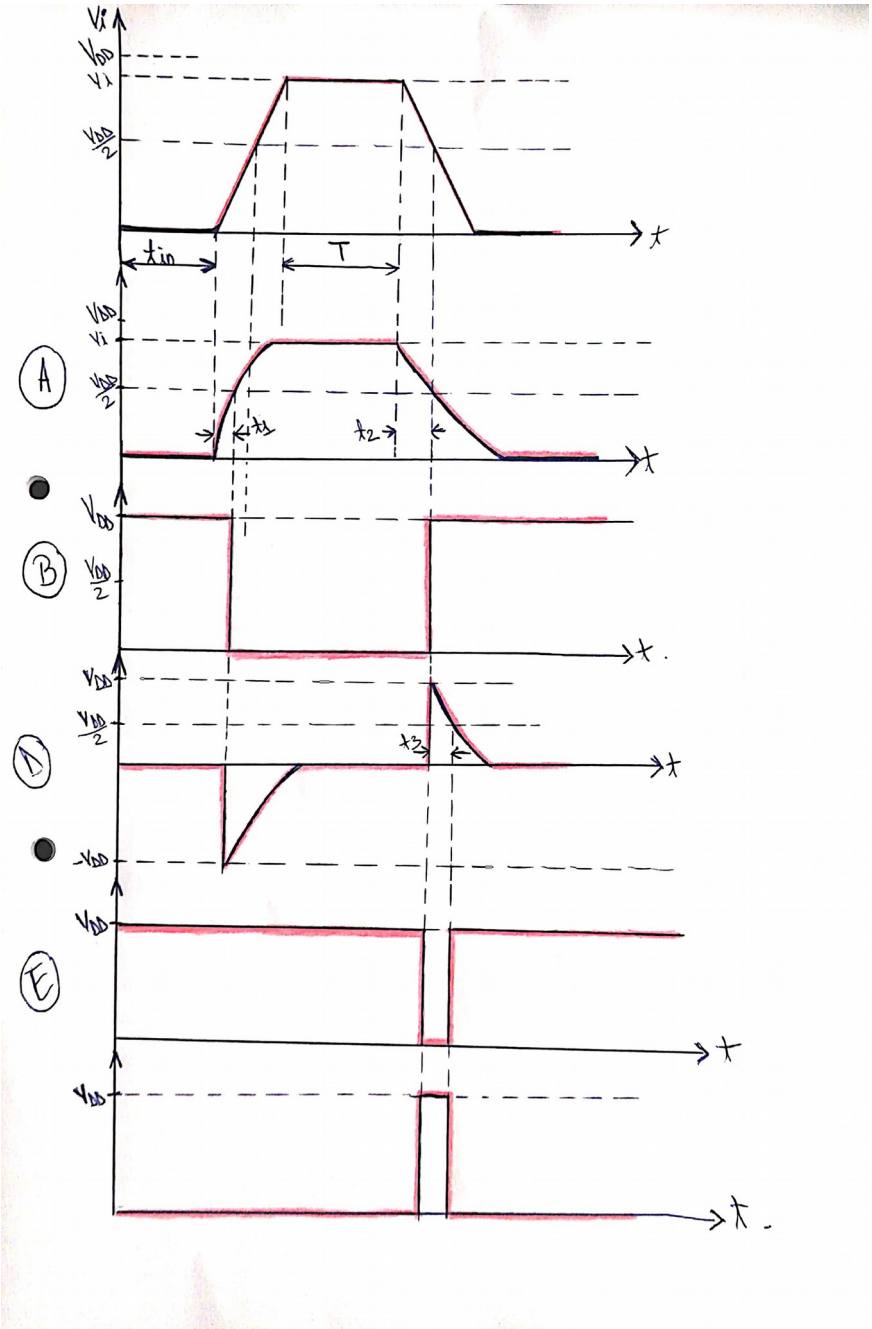
V_D=0.75V

t_r=t_f=10nS

Circuitul I



$\tau=R*C=1114.4$



A.

Comutatie pe front pozitiv $V(t_0^+)=V(t_0^-)=0$

$V_A(t)=V_i(1-e^{-t/\tau})$ => $V_ie^{-t/\tau}=V_i-V_A(t)$ => $e^{(-t/\tau)}=\frac{(Vi-VA(t))}{V}$

Pentru $t=t_1$ => $VA(t)=\frac{VDD}{2}$

=> $t1=\tau*\ln(\frac{VDD-2Vi}{2Vi^{(-1)}})$ = 1052.5ns =>

=> $t_1=105.25*10^{-8}$s

Comutatie pe front negativ

$V(t_0^+)=V(t_0^-)=V_i$

$V(\infty)=0$

$V_A(t)=V_i^{-t/\tau}$

Pentru $t=t_2$ => $VA(t)=\frac{VDD}{2}$ => $\frac{VDD}{2}$ = $V_ie^{-t_2/\tau}$

=> $t_2 = \tau ln2\frac{Vi}{VDD}$ =$551.3*10^{-9}$

B.

V_B=11V cand inversorul este alimentat la V_{DD}.

Asadar dupa $t_{in}+t_1$, V_B=0V iar dupa $t_{in}+ 5\frac{tr}{4}$ +T, V_B = 11V

D.

$V(t_0^-)=V(t_0^+)= -V_{DD}$ (1)

$V(\infty)=0$ (2)

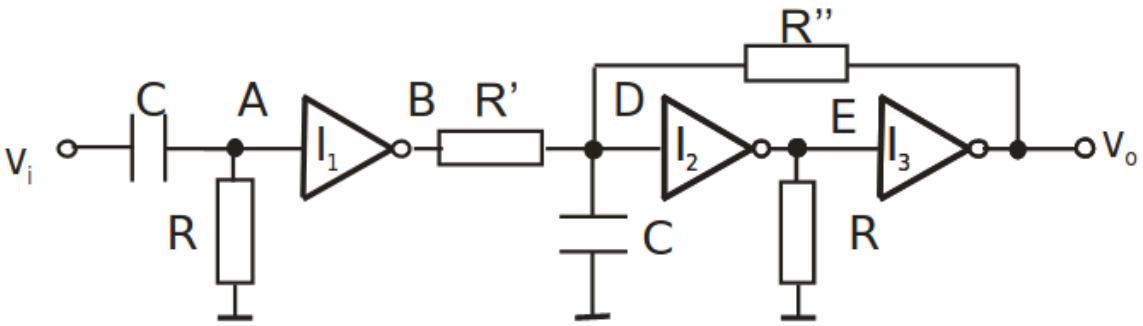
Din (1) si (2) => $V_c(t)= - V_{DD}e^{-t/\tau}$

E.

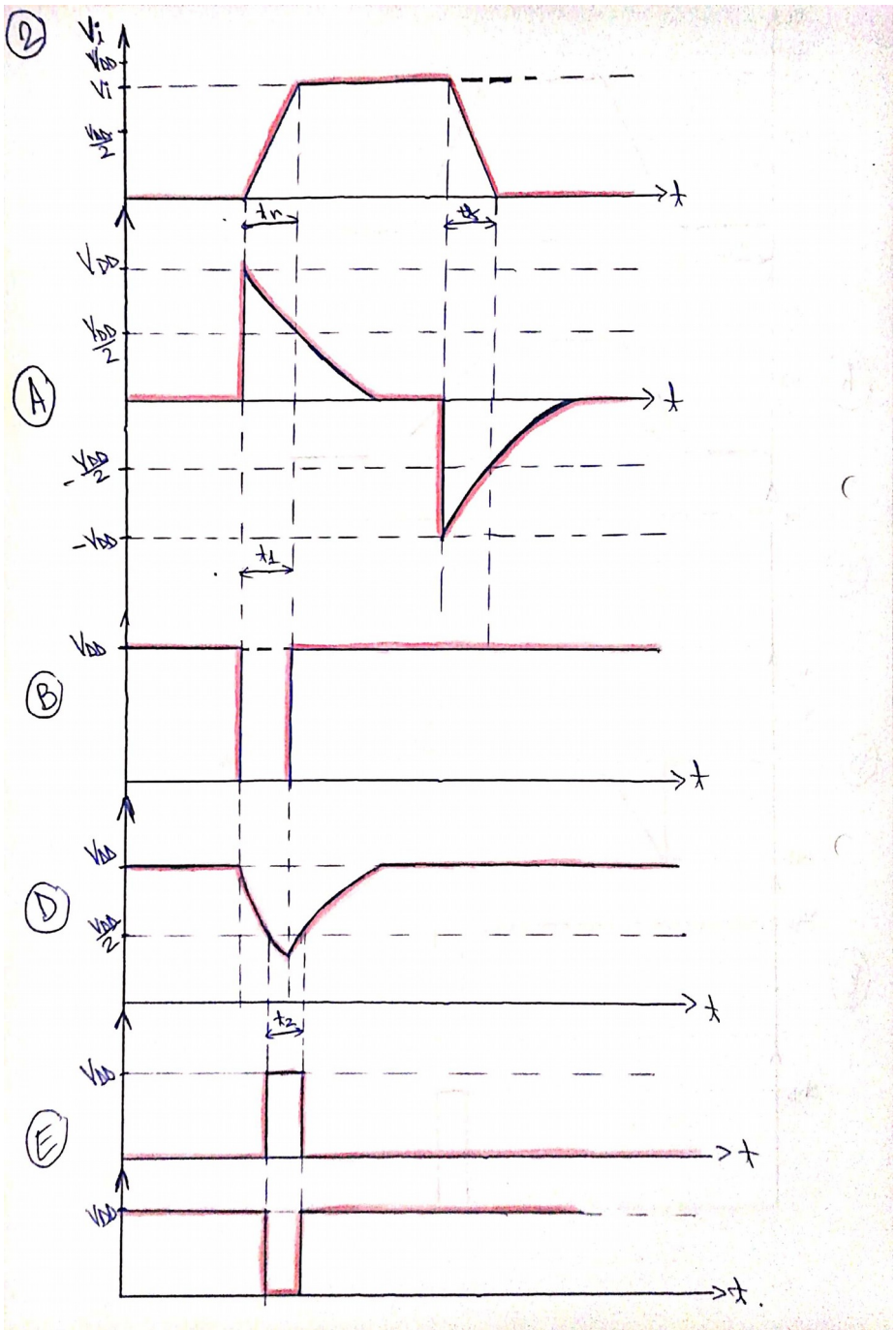
V_E=11V

Timp de t_3 secunde semnalul va comuta la “0”logic iar mai apoi revine la “1”logic.La iesire semnalul ramane pe “1”logic doar in intervalul celor t_3 secunde, apoi revine la “0”logic.

Circuitul II



τ=R*C=1114.4



A.

In momentul initial

$V_A(t^+_0)=V_{DD}=11V$

$V_A(\infty)=0$

$\tau_A=R*C=1114.4 \Rightarrow V_A(t) = \frac{VDD}{2}$

$\frac{t1}{\tau A} = \ln \left(\frac{2Vi}{VDD}\right)$

$t_1= \tau_A \ln \left(\frac{2Vi}{VDD}\right) = 557.2ns \Rightarrow t_1=557.2*10^{-9}s$

La urmatoarea comutatie :$V_A(t^+_0)= -V_i= -9V$

$V_A(t)= -V_i e^{-t/\tau_A}$

B.

$V_B=V_{DD}=11V$

Dupa prima comutatie, timp de t_1 secunde $V_B=0V$. Ulterior, V_B comuta inapoi in

$V_B=V_{DD}=11V$

D.

$$VD=\frac{R''VB}{R'+R''}+\frac{R'V0}{R'+R''}$$

Fiind conectat la iesirea inversorului I_3, V_0 poate avea doar doua valori, 0V sau 11V

Cand $V_0=0V \Rightarrow$

$VD=R''\frac{VB}{R'+R''} \Rightarrow V_D=8.03V$

Cand $V_0=11V \Rightarrow$ $VD=\frac{R''VB+R'VD}{R'+R''}$

$VD=\frac{R''VB+R'VD}{R'+R''} \Rightarrow$ `VD = 11.33 V`

Deoarece τ_A > t1, VD nu apuca sa descreasca pana la VD(∞) = 0 => conform singularitatilor VD descreste suficient.

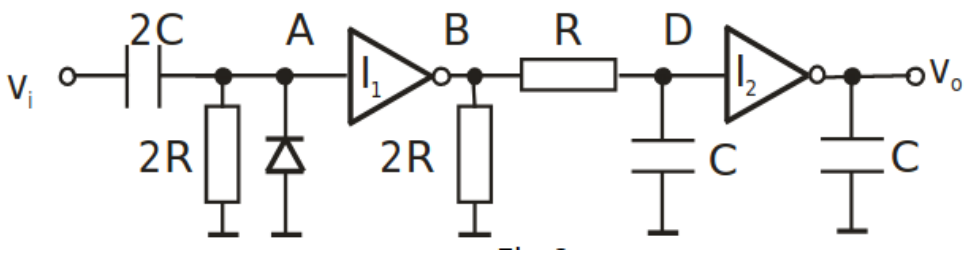
V0(∞) = 0V

$$VD(\infty)=\frac{R''*VB(\infty)}{R'+R''}+\frac{R'*Vo(\infty)}{R'+R''}$$ = 0 => VD(t) = $VDD=V*e^{\frac{-t}{\tau d}}$

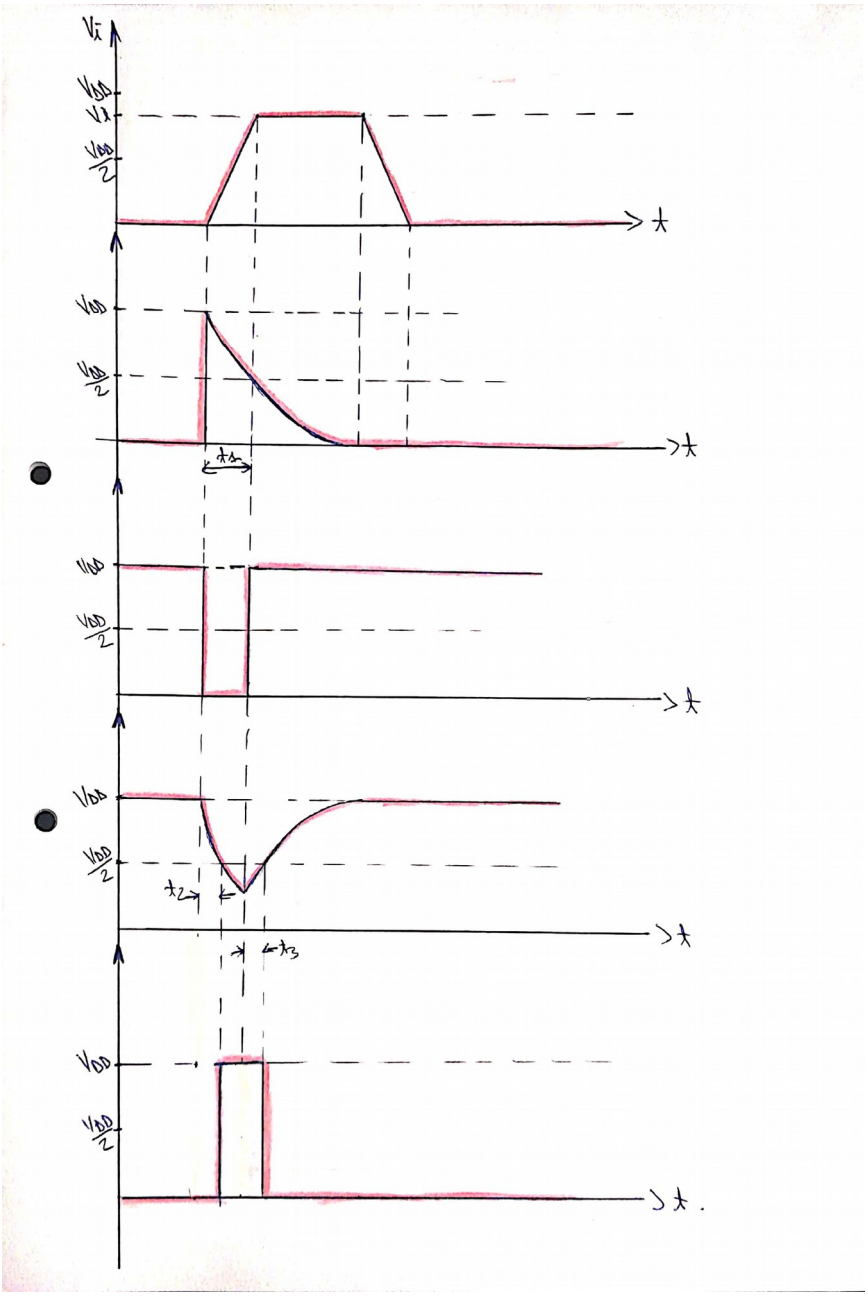
E.

Initial VE = 0V si o sa comute pentru pentru putin timp la VE = VDD = 11V. Dupa o sa revina la 0V. Aceasta comutare se va repeta pe invers, adica VE trece din 11V in 0V, apoi iar in 11V.

Circuitul 3



τ=2R*2C=4457.6



A.

Comutatie pe front pozitiv $VA(t_0^+) = Vi = 9V$; $VA(\infty)=0$

$V_i e^{-t/\tau} = V_A(t) \Rightarrow \quad e^{(-t/\tau)} = \frac{VA(t)}{V}$

Pentru $t=t_1 \Rightarrow \quad VA(t) = \frac{VDD}{2}$

$\Rightarrow \quad Vi\, e^{(\frac{-t}{\tau})} = \frac{VDD}{2} \quad \Rightarrow \quad t1 = \tau * \ln(\frac{2V\ i}{VDD}) \quad = 2228.8ns \Rightarrow$

$\Rightarrow t_1 = 222.88 * 10^{-8} s$

Datorita diodelor conectata la masa, orice potential negativ din A va fi limitat la 0V. Deci nu va exista comutatie pe fron negativ, chiar daca, datorita circuitului CR tensiunea din A scade sub 0V. => VA = 0V

B.

Din grafic, in punctul B, VB va comuta de la VDD = 11V la 0V timp de t1 secunde. Ulterior, va reveni la valoarea de 11V.

D.

$\tau D = R*C = 1114.4 = 1114.4 * 10^{-9} s$

t_1 se calculeaza analog cu circuitul 1, punctul A => $t_1 = 105.25 * 10^{-8} s$

$V_D(t^+_0) = V_{DD} = 11V$

$V_D(\infty) = 0$

$\Rightarrow V_D(t) = \quad VDD\, e^{(\frac{-t}{\tau D})} \quad \Rightarrow \quad \frac{VDD}{2} = VDD\, e^{(\frac{-t}{\tau D})}$

$\Rightarrow t2 \approx \tau D \ln(2) \Rightarrow t2 = 772.5ns$

Deci VD va trece pragul logic si va descreste pana in punctul

$V_D(t1) = \quad VDD\, e^{(\frac{-t}{\tau D})} \quad = 4.05V$

Comutarea pe front pozitiv

$V_D(t^+_0) = 4.05V$

$V_D(\infty) = 0$

=> $VD(t) = VDD + (4.05 - VDD) \quad e^{(\frac{-t}{\tau D})}$

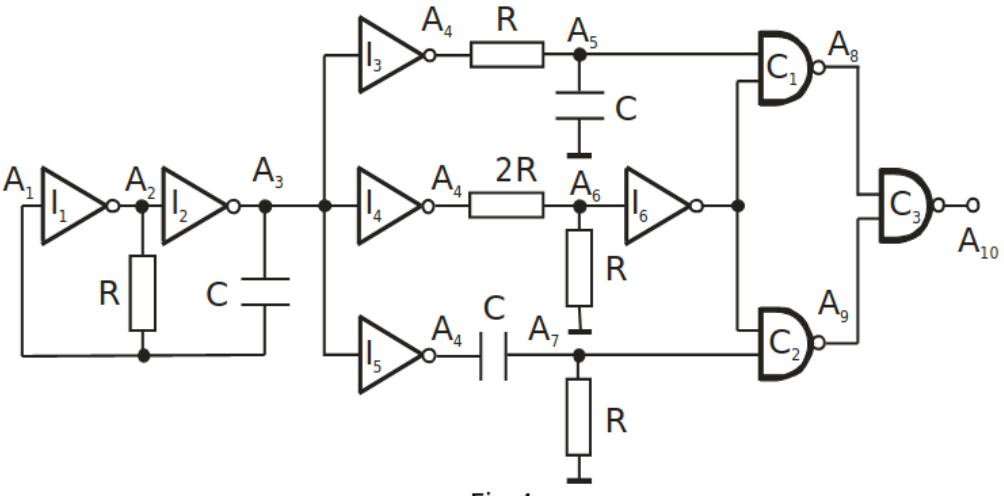
Pentru t = t3

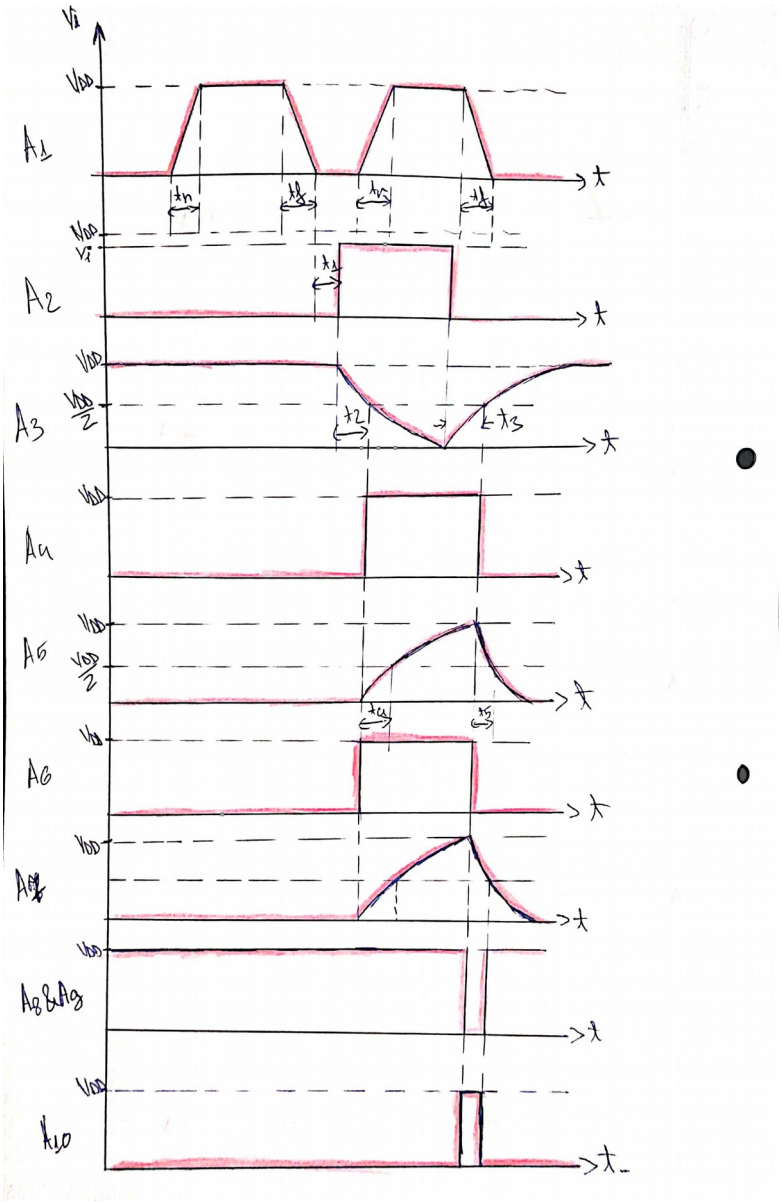
$VD(t) = \quad \frac{VDD}{2} \quad => \quad \frac{VDD}{2} \quad = VDD + (4.05 - VDD) \quad e^{(-t\frac{3}{\tau D})}$

$t3 = \quad \tau D \ln \frac{2\,VDD - 8.1}{VDD} = \tau D * 0.23 \quad$ => t3 = 256.321 ns

Se va comuta de la 0V la 11V timp de (t1 -t2) + t3 = 586 ns., ca mai apoi sa se comute din nou la 0V

Circuitul 4


A1
I1
A2
I2
A3
R
C
I3
A4
R
A5
C
I4
A4
2R
A6
I6
R
I5
A4
C
A7
R
C1
A8
C2
A9
C3
A10


Vi
A1
A2
A3
A4
A6
A7
A8
A8&A9
A10
t