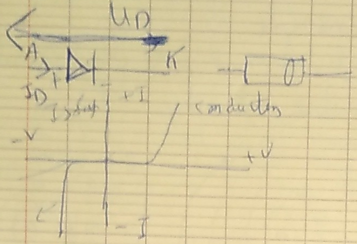
U_g.

arracher : [illegible]

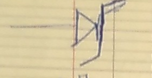
Type de diode :

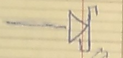
1) Diode

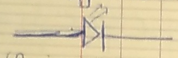


Tension inverse maximal

flux de courant la diode est morte

2)  diode de Zener

3)  Diode de Schottky

4)  LED

NB

si $V > V_{seuil} = [0{,}6 \dots 0{,}7]$

⇒ Passage libre des electrons

⇒ Passage de courant électrique

Équation de Shockley ①

$$I_D = I_S\left(\exp\left(\frac{+V_D}{\eta V_T}\right) - 1\right)$$

$$V_T = \frac{KT}{q} \simeq 26\ mV \ / T = 300K$$

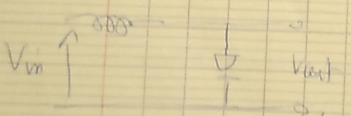
(Temps temps $I = 10^{-10} A$)

(MV) négligeable

- diode idéal $\frac{\Delta V}{\Delta D} \to 0$
- diode réel $\frac{\Delta V}{\Delta D} = ?$

R_D : résistance dynamique du diode

Exp1



$V_{out} = V_D$ ⟨ D conduit $V = 0{,}6V$; $= 0{,}6 + V_D$; bloque $V_D < 0{,}6$

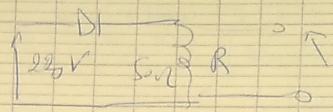
$U_D = V_J + r_d I_D \to 0$

$U_D = V_J$

→ négligeable

D'après la maille $-V_{in} + R I_D + V_{out} = 0 \Rightarrow V_{out} = V_{in}$

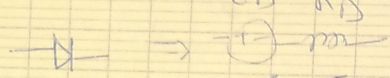
Exp1 $V_{in} = 220V$



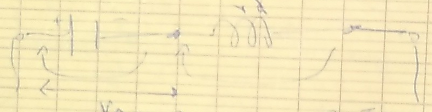
$V_{out} = R I_D = I_D$ ⟨ ON : $I_D = \frac{220\sqrt{2} - 0{,}7}{R}$; $V_{out} = 0$ si $V < 0{,}7$

$V_{diode} = 220 - V_{out}$

Diode réelle



$V_D = V_{D_0}(0{,}7) + r_d(I_D - I_{D_0})$



$V_D = 0{,}7$ $I_{DD} = \ln \frac{I_z}{\alpha}$

$I_D = I_S\left(\exp\left(\frac{V_D}{nV_T}\right) - 1\right)$

$$\boxed{V_D = nV_T \ln(I_D/I_S + 1)}$$ ②

$f(x/x_0) = f(x_0) + f'(x_0)(x - x_0) + D_d \quad / |\Delta| < \varepsilon$

NB :

Thevenin, série Taylor, T. de Laplace (les approximateurs universels)

NB : développement de Taylor est linéaire.

Réseaux Neurons

$U_D = nV_T \ln\left(\frac{I_D}{I_S} + 1\right)$ $V = \frac{V_{dd}}{I_D}$

NB) Problème de l'éq de Shockley c'est exp. (Transformer en Poly)

NB :

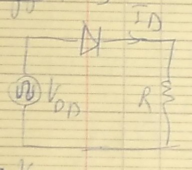
- Thevenin il avait proposé l'équivalence dans ce circuit avec Thevenin. (Modéliser le circuit)
- Negliger (1 - 10 %)

NB : on utilise le modèle idéal pour traiter la diode.

NB

I_S : porteur minoritaire 10^{-10} A

App : D



1) Loi de maille

$-V_{DD} + RI_D + V_D = 0$

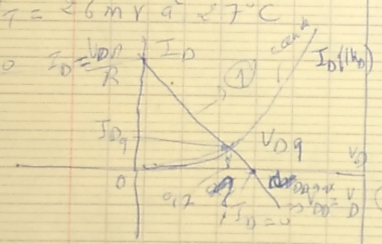
Loi

$I_D = I_S(e^{\frac{V_D}{nV_T}} - 1)$

ηV_T

η : coef de correction technologique $\eta \in \{1, 2\}$

$V_T = 26\,mV$ à $27\,°C$



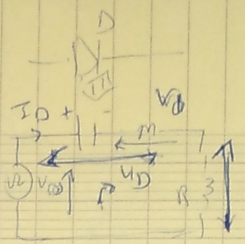
V_{Dq} : Pt de fonctionnement

① : courbe de charge (générateur)

② : courbe de Tension

~~I~~ dico de V_D et I_D

Modèle réel :



$-V_{DD} + 0{,}7 + r_d I_D + RI_D = 0$

$\Rightarrow I_D = \frac{V_{DD} - 0{,}7}{R - r_d}$

$\Rightarrow I_D = \frac{V_{DD} - 0{,}7}{R}$ (1)

(2) $r_d = \frac{\eta V_T}{I_D}$

NB :

$I_D = I_S\left(\exp\left(\frac{V_D}{nV_T}\right) - 1\right) \Leftarrow$

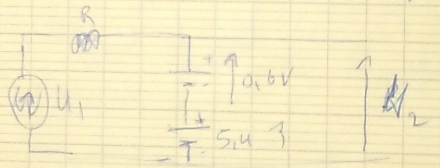
$V_D = 0{,}7 + r_d I_d$

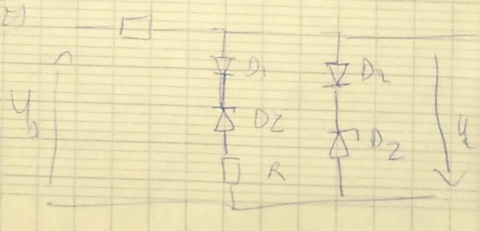
Diode de Zener

$U_2 = \min(6, \max(-9, U_1))$

$\in [-9, 6]$ $\forall U_1$

U_2:
- $ON_1, ON \Rightarrow U_2 = 0{,}6 + 5{,}4 = 6V$, $\forall U_1$
- $OFF_1, OFF \Rightarrow U_2 = U_1 - RI_1 = 0$ si $U_1 < 5{,}4 + 0{,}6 = 6V$
- ON_2, ON_D : $-9V \mp (0{,}6 + 8{,}4) < U_1$





si D_1 ON si $U_2 > 3V$

D_2 ON si $U_2 > 4{,}5 = 0.6 + 3{,}9$

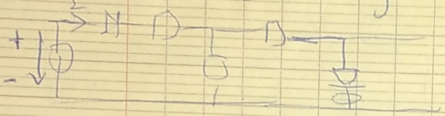
NB :

Un signal est un courant ou une tension.

- le signal sortie monte moins rapidement que le signal d'entrée.

App (63)

$R = 10k\Omega$; $V_{D_C} = 2V$; $V_j = 0{,}6V$



Reponse (63) :

H_1 : D_1 OFF D_2 : OFF

$$U_2 \left\langle \begin{array}{l} V_{D_2} + V_{D_C} \\ V_N = RI = 0 \\ \Rightarrow V_N = RI = 0 \end{array} \right.$$

$$U_2 = V_{D_2} + V_{D_C} \left\langle \begin{array}{l} V_{D_2} = 2V \\ \quad = cte \\ V_{D_C} \geq 0{,}5 \end{array} \right.$$

Ma :

$V_{D_2} = U_2 - V_D = -2V$

or $V_{D_1} = U_1 - (RI + RI)$
$= U_1$

$\Rightarrow U_1 < 0{,}6V$

$U_1 \in]-\infty, +0{,}6[$

$\Rightarrow H_1$ et OK

$U_2 = 0$

H_2 : D_1 ON et D_2 OFF

$\Leftrightarrow V_{D_1} > 0$ et $V_{D_2} < 0{,}6V$

La demarche

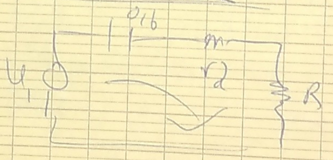
$V_{D_2} = U_2 - V_{D_C} = U_2 - 2V$
$\leq 0{,}6$

$\Rightarrow U_2 < 2{,}6V$

or on a,

$U_2 = V_N = R i_{D_2}$

Calcul i_{D_2} :



$r_D << R$ on neglige le r_d

$\Rightarrow i_{D_1} = \dfrac{U_1 - 0{,}6}{R + R} =$

$U_2 = \frac{1}{2} U_1 - 0{,}3$

H_2 et OK $\forall U_2 < 2{,}6$

$U_2 = \frac{1}{2}(U_1 - 0{,}6) < 2{,}6$

$U_1 < 2 \times 2{,}6 + 0{,}6 = 5{,}8V$

Si $U_1 > 5{,}8$

$\Rightarrow D_1$ ON et D_2 ON

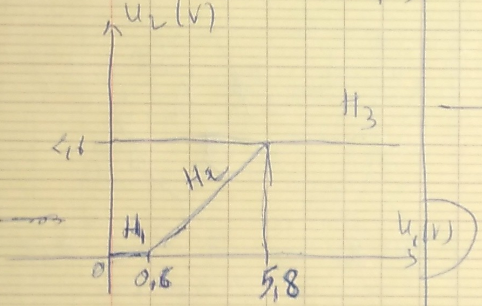
Dans ce cas :

$U_2 = V_{D_{2_{ON}}} + V_{DC}$

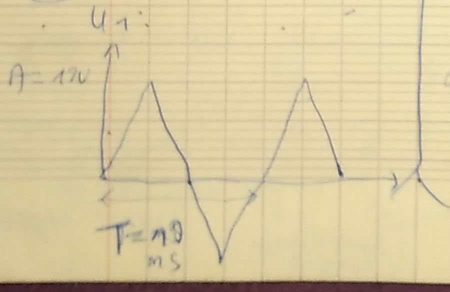
$= 2{,}6V$

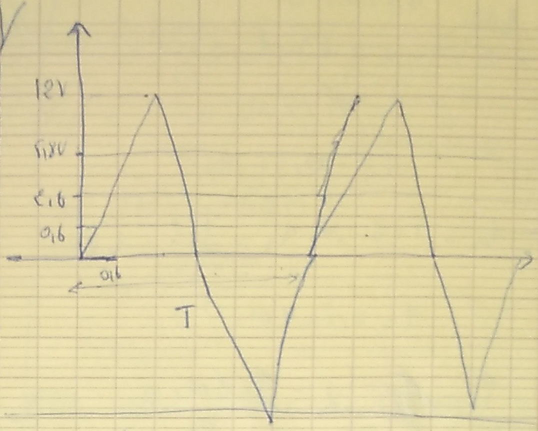
$\Rightarrow \boxed{U_2 = 2{,}6V}$ $U_1 \geq 5{,}8$

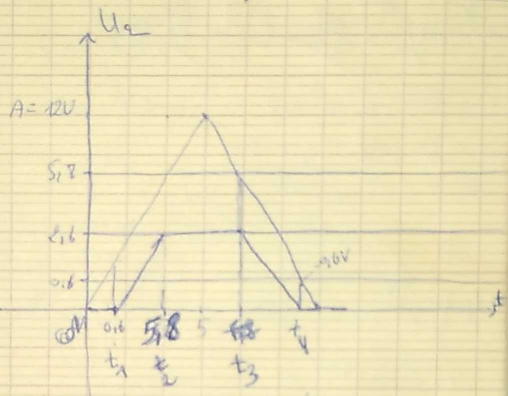
Caractéristique de $U_2 f(U_1)$



2)







NB : $U_2 = 2V$, $U_1 = ?$

$U_2 = \frac{1}{2}U_1 - 0{,}3 \Rightarrow \boxed{U_1 = 4{,}6V}$

App :

t_1 ; t_2 ; t_3 ; t_4 ;

$t_1 \mid U_1 = 0{,}6V$

$U_1 = at \quad t \in [0, 5]$ $t = \frac{T}{2} = 5ms$

On a $12V = a \times 5ms$

$\Rightarrow a = \frac{12}{5} = 2{,}4 V/ms$

$a = 2{,}4 V/ms$

A.N : $u_1 = at$

$2{,}4\,t_1 = 0{,}6 \Rightarrow t_1 = \frac{0{,}6}{2{,}4}$

$= 0{,}25\ ms$

$t_1 = 0{,}25\ ms$

$a\,t_2 = 5{,}8 \Rightarrow t_2 = \frac{5{,}8}{2{,}4} = 2{,}4\ ms$

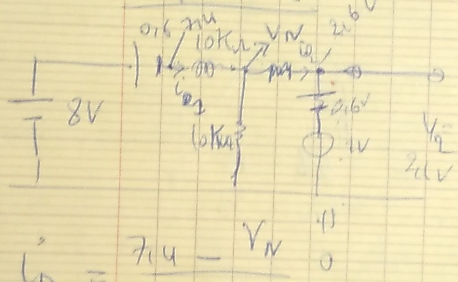
$t_2 = 2{,}4\ ms$

$t_3 = 10 - t_2 = 7{,}6\ ms$

$t_4 = 10 - t_1 = 9{,}75\ ms$

3) Calcul i_{D_1} et i_{D_2}

$u_1 = 8V$:



$i_{D_1} = \frac{7{,}4 - V_N}{10\ k\Omega}$

$i_{D_2} = \frac{V_N - 2{,}6}{10\ k\Omega}$

$V_{N_{milman}} = \frac{\frac{7{,}4}{10.10^3} + \frac{2{,}6}{10^4} + \frac{0}{10^4}}{\frac{1}{10^4} + \frac{1}{10^4} + \frac{1}{10^4}}$

$V_N = 3{,}33\ V$

$i_{D_1} = \frac{7{,}4 - 3{,}33}{10^4} = 0{,}47\ mA$

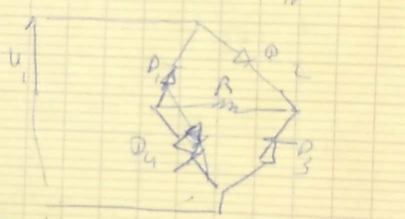
$i_{D_2} = 0{,}073\ mA$

FIN

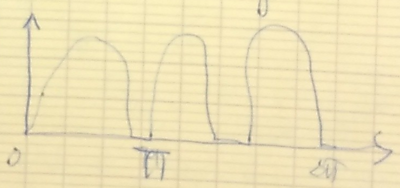
- Régulateur : est un régulateur complexe (diode Zener) suivant en bouclage.

Circuit redresseurs

$u' = 2\,u_{eff}$

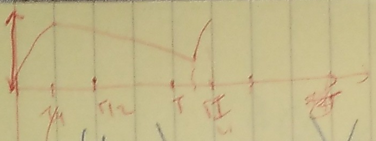


NB : Un composant donne des ... il veut le récupérer

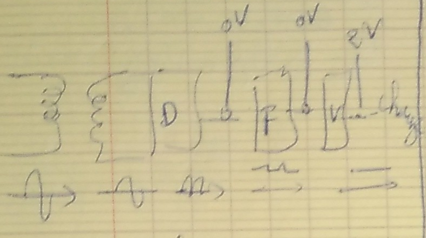


$C \nearrow \Rightarrow U_{min} \nearrow$

$\Rightarrow$ variation du signal ...



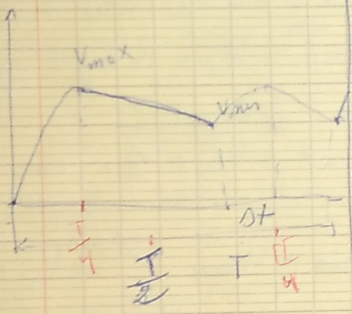
$\Rightarrow C \downarrow \Rightarrow U_{min} \downarrow$,



Diode de rectifier : D. redresse

x) chute de tension de filtre : env. 0V

y) valeur minimal du régulateur env. (2V).



$\Delta t << T$

$\Delta Q_{decharge} = I_L (T - \Delta t) \simeq I_L T$

phase de charge

$\Delta Q_{charge} = C . \Delta V$

$\Delta V = V_{max} - V_{min} = \frac{I_L . T}{C}$

cte (fonctionnement du capacité)

$\Rightarrow \Delta V = \frac{I_L . T}{C}$

$V_r = \frac{I_L . T}{C_f}$; V_r : Tension d'ondulation

Si 220V / 50Hz

$T_{50m} = 20ms$

$T_{redressement} = 10ms$

NB : bobine filtre de courant
capacité filtre de capacité.

Redresseur avec condensateur et diode de Zener (page 55)

$U_{ch} = U_Z = 15V \quad I_{ch} = 15mA$

on suppose : $U_Z = 15$

on $U_{R_S} = U_C - 15$

$U_{R_S} = R_S . I_{R_S} \qquad I_{R_S} = I_Z + I_{ch}$

Condition minimum de $U_{C min}$!

$V_{min} = V_{max} - V_r$

on $V_r = \frac{I_L . T}{C}$

$U_{min} = V_Z + U_{R_S} = V_Z + R_{R_S}(I_Z + 15mA)$

$I_Z = ?$; I_Z hold

$U_{C min} \geq U_Z + R_{R_S} I_{min}$

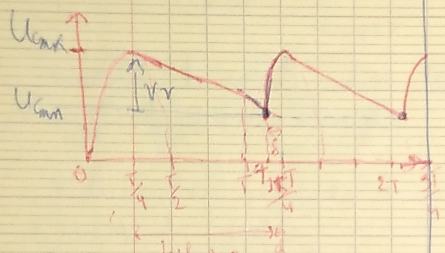
$V_{C min} > 15 + R_S (I_{L max} + I_{Z min})$

$I_{Z_{min}} = I_{Z_{hold}}$ (donnée)

$U_C = R_{RS}(I_L + I_Z) + V_{DZ}$

Diode ON : $V_{DZ} \geq V_Z$

or $V_{DZ} = V_Z + r_Z \cdot I_Z$



on a $t_1 = \frac{5T}{4} - \delta_0$

τ : taux d'ondulation

$$\tau_{ond} = \frac{\Delta U}{U_{moy}}$$

$2\Delta U = U_{max} - U_{min}$

$Q_r = 2C\Delta U$

or $Q_f = i(T - \delta) \simeq iT$

or $Q_r = Q_f \Rightarrow i = i_{moy} = \frac{U_{moy}}{R}$

$2C\Delta U = T\frac{U_{moy}}{R} \Rightarrow \frac{\Delta U}{U_{moy}} = \tau_{ond}$

$= \frac{T}{2RC} = \frac{1}{2RCf}$

si $RC \gg T$ (fort filtrage plus efficace) (faible ondulation)

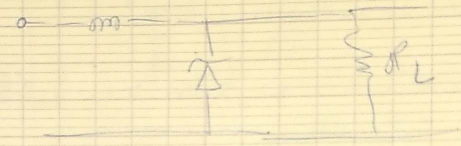
$P = \frac{\partial E}{\partial t}$; $E = \int P(t)\,dt$

$E = P \cdot T$

NB1 $\boxed{U_C > U_D + U_{RS}}$

charge maximale $\Rightarrow R_{ch} \to -\infty$

charge minimale $\Rightarrow R_{ch} \to +\infty$



$U_{C_{max}} = V_{sec}\sqrt{2} - 1{,}4$ (Pont)

tension ON $\Leftrightarrow V_{out} \geq U_Z$

$U_{out} = U_C - R(I_Z + I_{R_L})$

$\geq U_Z$

$U_{out} = U_{Z_0} + r_Z \cdot I_Z$

on va travailler $U_{C_{min}}$

$U_{C_{min}} = U_{C_{max}} - V_r = U_{C_{max}} - \frac{I_L T}{C}$

$V_r = \frac{I_L T}{C}$

Remarque

or $C = ?$

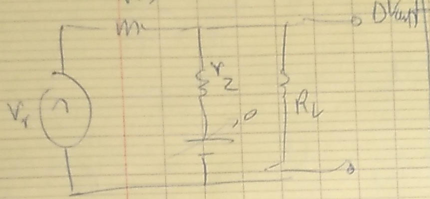
$I_{Z_{min}} \to$ est donner par le data show (I_{hold})

$I_{Z_{min}} \to 0$

on a ΔV_{out}

en $\Delta V_{in} = V_r$

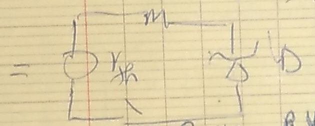
schéma pour le ΔV :



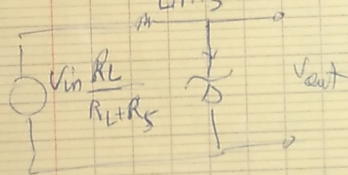
car $\Delta U_Z = 0$ car $U_Z = cte$

$$\Rightarrow \Delta U_{out} = \frac{r_Z // R_L}{r_Z // R_L + R_S} \, dV_{in}$$

$R_{Th} = R_L // R_S \quad U_D = U_3$



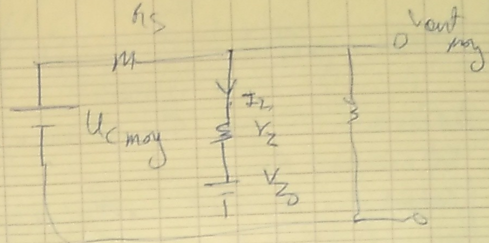
$R_L // R_S = R_{Th}$



Pour le cas moyenne

$R_{out} = V_{Z_0} + r_Z I_Z$

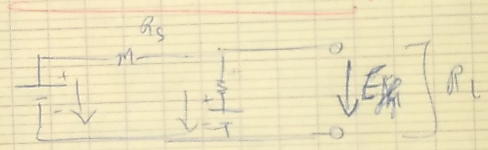
$V_{out_{moy}} = V_{Z_0} + r_Z I_{Z_{moy}}$



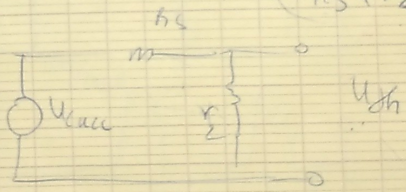
$$I_Z = \frac{V_{R_1} - V_{Z_0}}{R_{Th} + r_Z} \Rightarrow I_Z$$

$$I_{Z_{DC}} = \frac{U_{cmoy} \cdot \frac{R_L}{R_L + R_S} - V_{Z_0}}{R_L // R_S + r_Z}$$

Calcul on Thevenin



$$V_{Th_{DC}} = U_{Z_0} + r_Z \frac{U_{DC} - U_{Z_0}}{R_S + r_Z} = I_{Z_{DC}}$$



$$U_{Th_{ac}} = \frac{r_Z}{r_Z + R_S} \cdot U_{e_{ac}}$$

$R_{Th} = R_S // r_Z$

vue par R_L

On a : $V_B = V_{BDC} + V_{Bac}$

V_{cc} $\quad$ V_j

$f = 0$ $\quad$ $f \gg$

Ex : $\quad V_B = 1 + 0{,}01 \sin(wt)$

. Par le dexieme capacite

$U_c = U_{CDC} + U_{Cac}$ —||—

$\Rightarrow U_c = U_{Cac}$

Par le f.t.s. $V_{BE} = V_B - V_E \geq V_j$.

le mode fonct mathematique

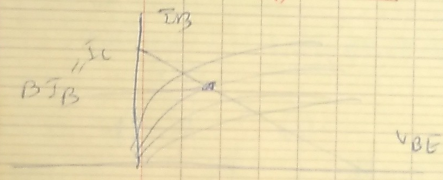
$f(Kx) = K f(x)$

$x \rightarrow f(x)$ a la même frequance.

Remarque :

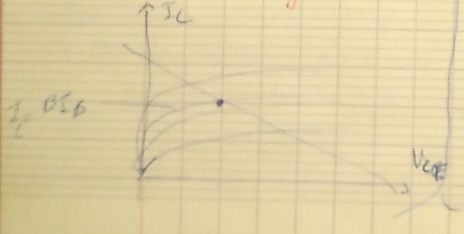
le role R_1 et R_E est assurer la linearité.

Droite de charge entree



$-V_{BD} + R_B I_B + V_{BE} + R_E(\beta+1) I_B$

Droite de charge sortie



$U_1 > 0$

V_{BEDC} ce qui fixe le p.t.s l'operation par fonctionnement.

On a :

$V_{BE} + \Delta U_{BE} \rightarrow I_{BDC} + \Delta I_B$ (V_{BEac}, $\rightarrow I_{Bac}$)

$\dfrac{\Delta V_{BE}}{\Delta I_B} = rd$.

. $I_C = I_{CDC} + \Delta I_C$ or $\Delta I_C = \beta \Delta I_B$

$= \beta I_{BDC} + \beta \Delta I_B$

or $V_{CE} = V_{CC} - R_C . I_{RC}$

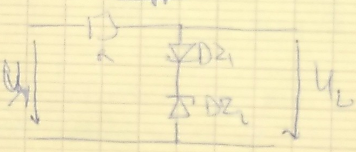
$= V_{CC} - R_C I_{CDC} - R_C I_{Cac}$.

$U_C = -R_C \Delta I_C = -R_C \beta \Delta I_B = -R_C \beta \dfrac{\Delta U_{BE}}{r_b}$

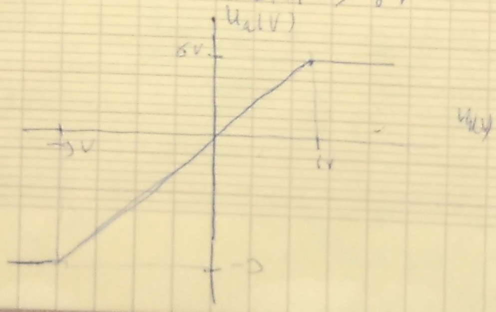
$U_2 = \Delta U_C = \dfrac{-\beta R_C}{r_d} \Delta U_{BE} = U_1$ $\quad$ Amp

R T non lineaire il Amplifit les variations qui veut l'etre lineaire.

App



$U_2 \begin{cases} -9V & \text{si } U_1 < -9V \\ U_1 & \text{si } -9 \leq U_1 \leq +6V \\ 6V & \text{si } U_1 \geq 6V \end{cases}$



$\begin{cases} V_{D_1} : OFF \\ V_{D_2} : OFF \end{cases}$ $\quad u_2 = u_1$, $u_1 < 0,6\,V$

(5) $\begin{cases} V_{D_1} : ON \\ V_{D_2} : OFF \end{cases}$ $\quad u_2 = u_1\,V$, $u_1 > 0,6\,V$

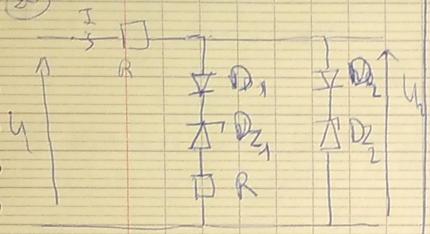
(1) $\begin{cases} V_{D_1} : ON \\ V_{D_2} : ON \end{cases}$ $\quad u_2 = 6\,V$, $u_1 > 6\,V$

Sens inverse du courant u_1 :

(2) $\begin{cases} V_{D_2} : ON \\ V_{D_1} : OFF \end{cases}$ $\quad u_2 = u_1$, $u_1 > -0,6\,V$

(3) $\begin{cases} V_{D_2} : ON \\ V_{D_1} : ON \end{cases}$ $\quad u_2 = -9\,V$, $u_1 > -9\,V$

(20)



$V_{D_1} = 0,6 = V_{D_2}$ $\quad V_{D_{Z_1}} = 2,4\,V$, $V_{D_{Z_2}} = 3,9\,V$

a) $\begin{cases} D_1 , D_2 : OFF \Rightarrow \\ D_{Z_1} : OFF \end{cases}$ $\quad u_2 = u_1$, $u_1 < 0,6$

b) $\begin{cases} D_1 : ON \\ D_{Z_1} : OFF \end{cases}$ $\quad u_2 = \cancel{u_1}$, $u_2 \geq 0,6\,V$

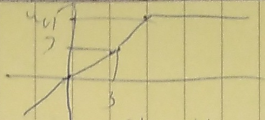
$\begin{cases} D_1 : ON\ D_2 : ON \\ D_{Z_1} : ON \end{cases}$ $\quad \cancel{u_1 = 6\,V}$ 1, $u_1 \geq 3\,V$

$\begin{cases} \cancel{D_1 , D_2 : ON} \\ D_{Z_1} , D_{Z_2} : ON \end{cases}$ $\quad u_1 = 4,5$, $u_1 \geq 4,5$

$u_2 = IR + V_{D_1} + V_{DZ_1}$

or $\cancel{u_1 - RI = u_2}$

$u_1 = RI + V_{D_1} + V_{D_{Z_1}} + IR$



$2RI = u_1 - V_{D_1} - V_{Z_1} \Rightarrow I = \dfrac{u_1 - V_{D_1} - V_{Z_1}}{2R}$

$u_2 = R\left(\dfrac{u_1 - V_{D_1} - V_{Z_1}}{2R}\right) + V_{D_1} + V_{DZ_1}$

$u_2 = \dfrac{1}{2} u_1 + \dfrac{V_{D_1} + V_{DZ_1}}{2} = \dfrac{1}{2} u_1 + 1,5$

$\Rightarrow u_2 = \dfrac{1}{2} u_1 + 1,5$

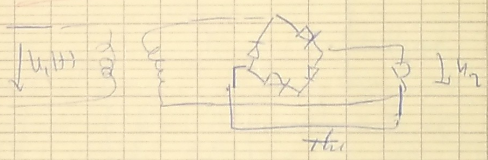
$\begin{cases} D_1 , D_2 : ON \\ D_{Z_1} , D_{Z_2} : ON \end{cases}$ $\Rightarrow u_2 = 4,5$

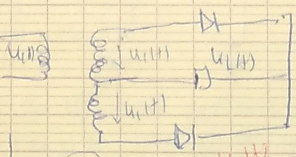
$\Rightarrow 4,5 = \dfrac{1}{2} u_1 + 1,5 \Rightarrow u_1 = 6\,V$

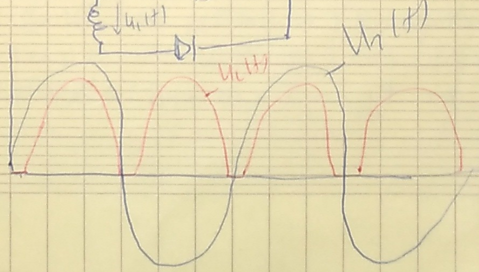
$\Rightarrow u_1 \geq 6\,V$

$\Rightarrow u_2 = \begin{cases} u_1 & \text{si } u_1 < 3\,V \\ \frac{1}{2} u_1 + 1,5 & \text{si } 3 < u_1 < 6 \\ 4,5 & \text{si } u > 6 \end{cases}$

Pont de Graetz :

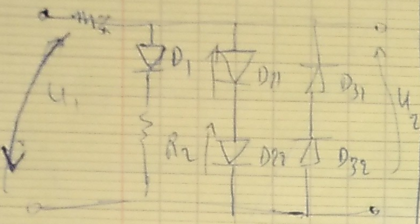






$R_1 = R_2 = 10K\Omega$

$V_j = 0{,}7$



$U_2 = f(U_1)$: $D_1 = 0$

$RI_1 + RI_2 = 0$

$-U_1 + V_{D_1} = 0 \Rightarrow U_{D_1} = U_1 < V_j$

$-U_1 + V_{D21} + V_{22} = 0$

$\Rightarrow V_{D21} + V_{D22} = U_1 < 2V_j$

$\left\{ \begin{array}{l} U_2 = U_1 \\ U_1 < 2V_j \end{array} \right.$

H_1 : D_1 : OFF

$U_2 = U_1 - R_1 I R_1 - V_{D_1} =$

~~si $U_1 < V_j \Rightarrow U_1 <$~~

or $U_2 = 0$ car $V_{D_1} < V_j$

$\Rightarrow U_1 = V_{D_1} < V_j \Rightarrow \boxed{U_1 < V_j}$

$U_1 \in [0, V_j]$

$U_2 = U_1$

$\Rightarrow H_1 \left\{ \begin{array}{l} U_2 = U_1 \\ U_1 \in [0, V_j] \end{array} \right.$

H_2 : D_1 : ON D_{21}, D_{22} : OFF

si $V_j > 0{,}7 \Rightarrow I_{D_1} > 0$

$\Rightarrow V_{D21} < V_j$, $V_{D22} < V_j$

$-U_1 + R_1 I_{D_1} + V_{D_1} + R_2 I_{D_1} = 0$

$\Rightarrow I_{D_1} = \dfrac{U_1 - V_{D1}}{2R} > 0$

or $U_1 = V_{D21} + V_{D22}$ | $V_{21} + V_{D22}$

$\Rightarrow \boxed{U_1 < 2V_j}$

$\Rightarrow U_1 \in [V_j, 3V_j]$

$-U_1 + R_1 I_{D_1} + 2V_{D22} = 0$

$V_{D21} = \dfrac{U_1 - RI_{D1}}{2} = \dfrac{U_1 - U_1 - \frac{U_1 - V_j}{2}}{2}$

$V_{D_1} = \dfrac{U_1 + V_{D1}}{4} \Rightarrow \dfrac{U_1 + V_j}{4} < V_j$

$U_1 + V_j < 4V_j \Rightarrow \boxed{U_1 < 3V_j}$

H_2 : $\left\{ \begin{array}{l} U_2 = V_j \\ U_1 \in [V_j, 3V_j] \end{array} \right.$

H_3 : D_1, D_{21}, D_{22} : ON

$U_1 > 3V_j \Rightarrow U_2 = 2V_j$

$\Rightarrow H_3 = \left\{ \begin{array}{l} U_2 = 2V_j \\ U_3 \in [3V_j, +\infty[\end{array} \right.$

(20)

H_4 : D_1, D_{11}, D_{22} : OFF
D_{31} : ON et D_{32} : ON

on $U_2 = -2V_j$ si $I_{D_3} > 0$

$-U_1 - R_1 I_{D_3} - 2V_j = 0$

$\Rightarrow \boxed{I_{D_3} = \frac{-U_1 - V_j}{R_1}}$

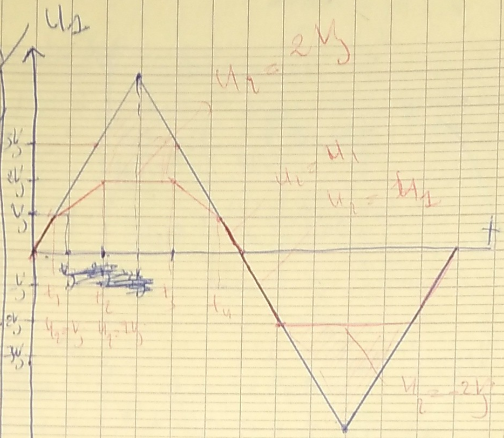
or $U_1 + 2V_j < 0$

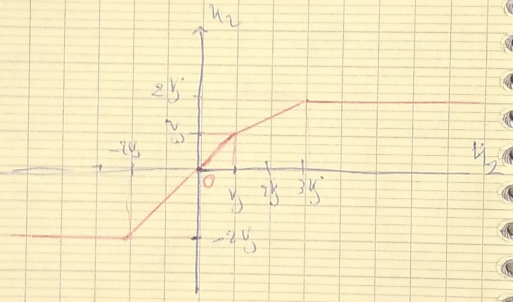
$\Rightarrow \boxed{U_1 < -2V_j}$

H_4 : $\begin{cases} U_2 = -2V_j \\ U_1 \in]-\infty, -2V_j] \end{cases}$

on a :

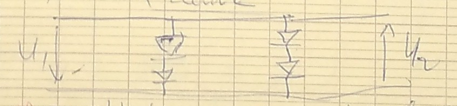
$\begin{cases} U_2 = U_1 \\ U_1 \in]-2V_j, V_j] \end{cases}$



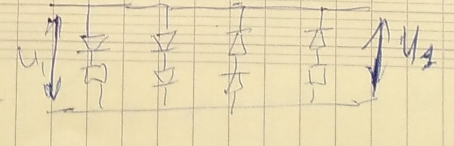


(3) on a deux solution

(1) on supprime la branche qui contient V_{D_1} et R_2 on trouve



(2) on a additionne par une branche V_{D_3} R_3

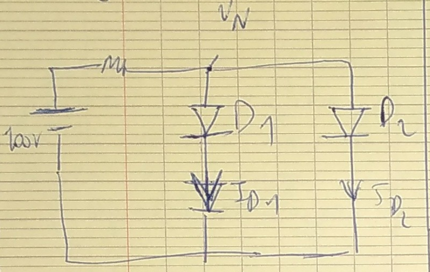


Du 1

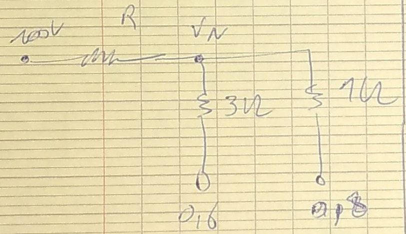
$R_1 \in \{1 \text{ et } 10 K\Omega\}$

$D_1 : V_j = 0{,}6V$, $rd_1 = 3\Omega$

$D_2 : V_j = 0{,}8V$ et $rd_1 = 1\Omega$



calculon VN



$$V_N = \frac{\frac{100}{R} + \frac{0{,}6}{3} + \frac{0{,}8}{1}}{\frac{1}{R} + \frac{1}{3} + \frac{1}{1}}$$

$R = 1K\Omega = 1000\Omega$

$$V_N = \frac{0{,}1 + 0{,}2 + 0{,}8}{0{,}001 + 0{,}333 + 1}$$

$$V_N = \frac{1{,}1}{1{,}334} = 0{,}82V$$

$$i_{D_1} = \frac{0{,}82 - 0{,}6}{3} = 0{,}07A$$

$$i_{D_2} = \frac{0{,}82 - 0{,}8}{1} = 0{,}02A$$

2) $R = 10K\Omega = 10^4\Omega$

$$V_N = \frac{0{,}01 + 0{,}2 + 0{,}8}{0{,}0001 + 0{,}3333 + 1}$$

$$= \frac{1{,}01}{1{,}3334} = 0{,}75V$$

$$i_{D_1} = \frac{0{,}75 - 0{,}6}{3} = 0{,}05$$

$$i_{D_2} = \frac{0{,}75 - 0{,}8}{1} < 0$$

Donc $i_{D_2} < 0 \Rightarrow V_{D_2} = 0$

on a supprime le diode 2

Donc loi de Millman n'est pas valable on va recalculer.

- Dans ce cas on a un celle courant égale i_{D1}

$$\boxed{i_{D_1} = \frac{100 - 0{,}6}{10^4 + 3} = 0{,}01}$$