Université A/MIRA

Faculté des technologies

Dpt ST2

16 Juin 2014

Rattrapage ELN

(3 Exercices sont à traiter. Les deux premiers sont obligatoires. Choisir entre le 3ème et le 4ème)

Exercice 1 : (8 pts)

Soit le montage de la fig. 1.
Calculer le générateur de Thévenin à gauche des points A et B.

Exercice 2 : (6 pts)
Soit le montage déjà vu en TP (fig.2).
Poser les équations aux mailles. Calculer le courant traversant la résistance R3.
(Prendre $E1=E2=10$ V, $R1=R2=R3=R4=10\Omega$)

Exercice 3 : (6 pts)
Calculer les paramètres chaines directes Aij de la figure 3.

Exercice 4 : (6 pts)

Soit toujours le montage de la fig.3. Calculer la fonction de transfert $T(jw)=v2/v1$.
Tracer le diagramme de Bode de cette fonction.

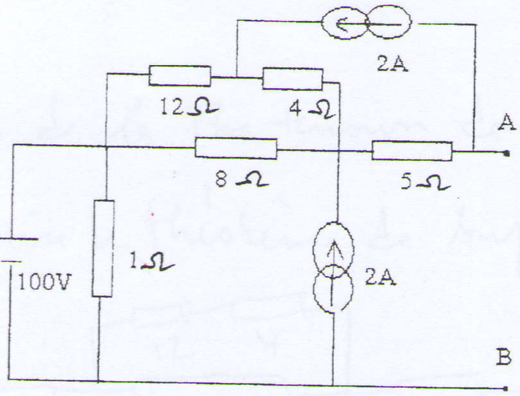


fig 1.

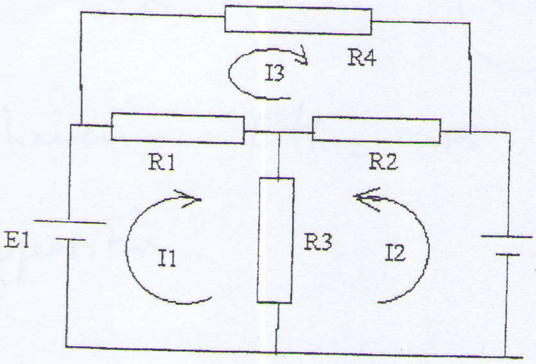


fig.2.

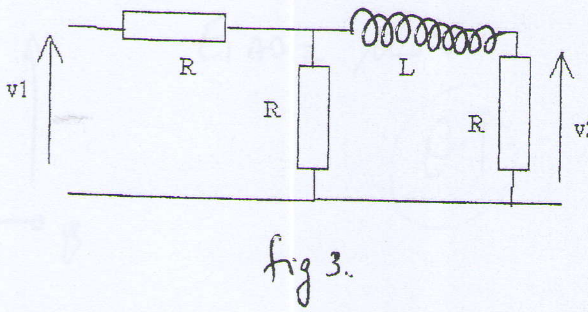
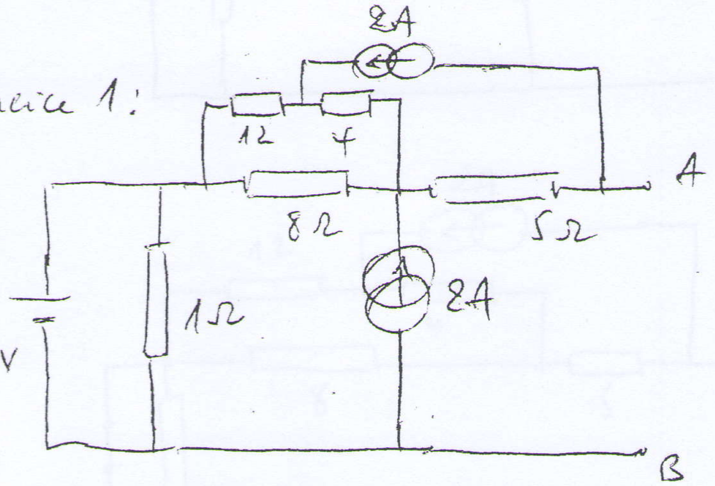


fig 3.

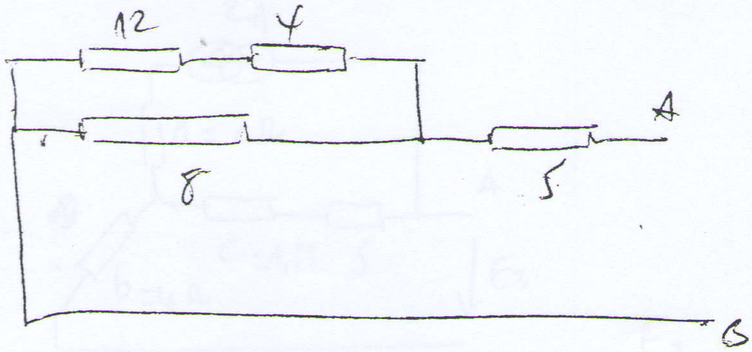
Solution Rattrapage 2014

ELN

Exercice 1 :



~~RAB~~ = Calcul de la Résistance de Thevenin : R_{AB}



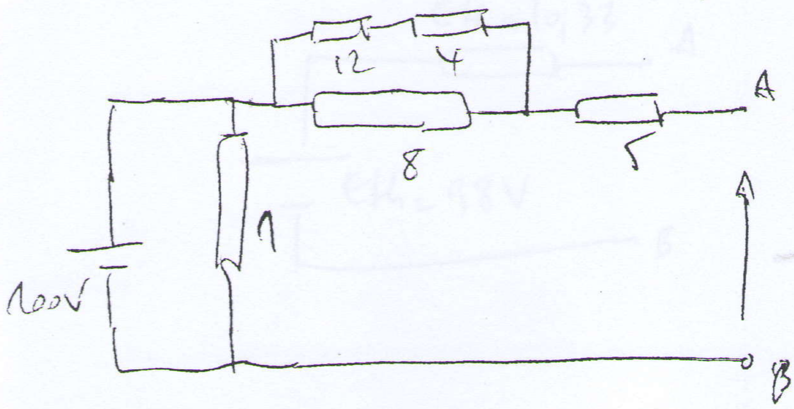
$R_{AB} = \left(8 \,//\, (12+4)\right) + 5 =$

$= 10,33\ \Omega$

02

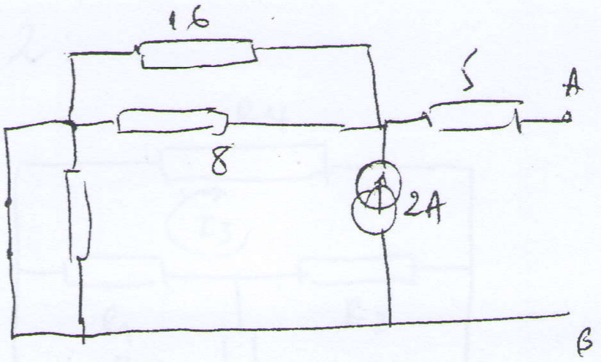
Calcul de la ~~Th~~ tension de Thevenin $E_{th} = E_{AB}$

on utilise le théorème de superposition :



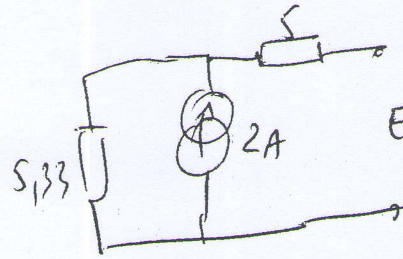
$E_{AB} = 100V$.

01



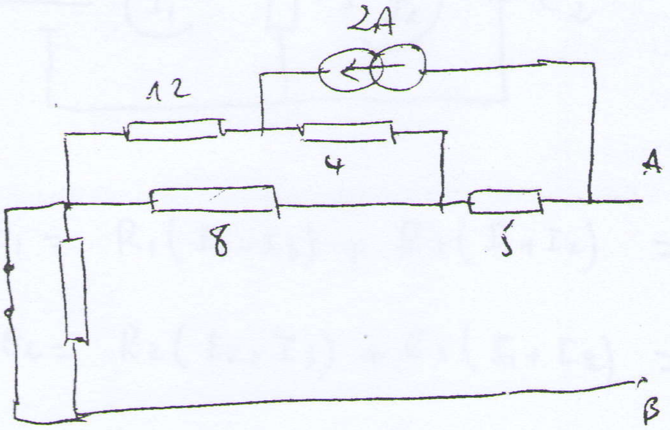
$$16 \mathbin{/\!/} 8 = 5{,}33\,\Omega$$

$\Rightarrow$

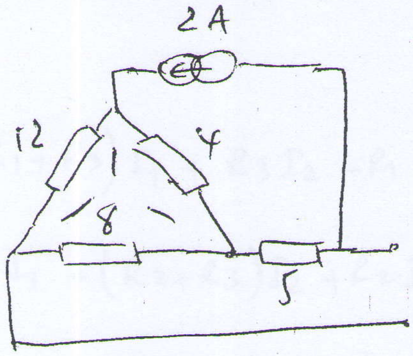


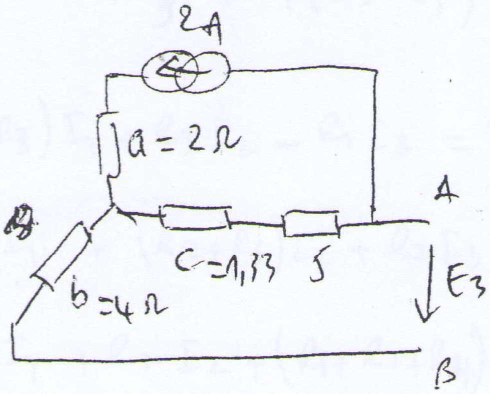
$E_2 = 10{,}66\,V$

c1



$=$





$$a = \frac{12 \cdot 4}{24} = 2\,\Omega$$

$$b = \frac{12 \cdot 8}{24} = 4\,\Omega$$

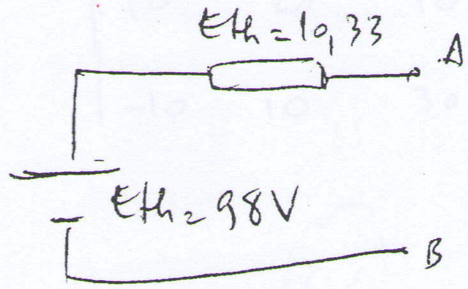
$$c = \frac{4 \cdot 8}{24} = 1{,}33\,\Omega$$

$$E_3 = 6{,}33 \cdot 2 = 12{,}66\,V$$

c1

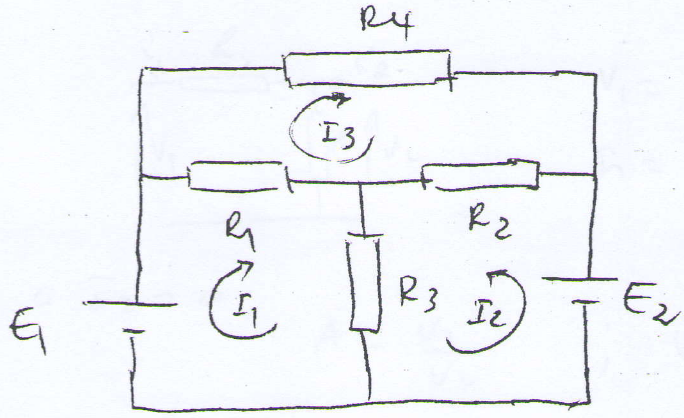
finalement

$$E_{th} = E_{AB} = E_1 + E_2 - E_3 = 100 + 10{,}66 - 12{,}66 = 98\,V$$



c1

Exercice 2 :



$$E_1 = R_1(I_1 - I_3) + R_3(I_1 + I_2) = (R_1 + R_3) I_1 + R_3 I_2 - R_1 I_3$$

$$E_2 = R_2(I_2 + I_3) + R_3(I_1 + I_2) = R_3 I_1 + (R_2 + R_3) I_2 + R_2 I_3$$

$$0 = R_4 I_3 + R_1(I_3 - I_1) + R_2(I_2 + I_3) = -R_1 I_1 + R_2 I_2 + (R_1 + R_2 + R_4) I_3$$

$$(R_1 + R_3) I_1 + R_3 I_2 - R_1 I_3 = E_1 \quad 01 \qquad 20 I_1 + 10 I_2 - 10 I_3 = 10$$

$$R_3 I_1 + (R_2 + R_3) I_2 + R_2 I_3 = E_2 \quad 01 \qquad 10 I_1 + 20 I_2 + 10 I_3 = 10$$

$$-R_1 I_1 + R_2 I_2 + (R_1 + R_2 + R_4) I_3 = 0 \quad 01 \qquad -10 I_1 + 10 I_2 + 30 I_3 = 0$$

$$\Delta = \begin{vmatrix} 20 & 10 & -10 \\ 10 & 20 & 10 \\ -10 & 10 & 30 \end{vmatrix} = 3000.$$

01

$I_1 = 0,33 A$

01

$I_2 = 0,33 A$

01

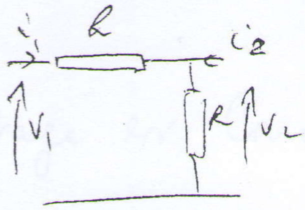
$I_3 = 0 A$

le Courant traversant R_3 est $I_{R_3} = 0,66 A$

(3)

(4)

Exo 3



$V_1 = A V_2 - B I_2$

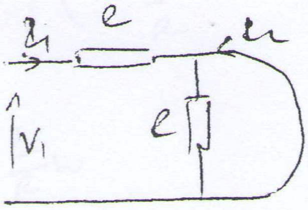
$I_1 = C V_2 - D I_2$

à $I_2 = 0$

$A = \frac{V_1}{V_2}$; $V_2 = \frac{R}{2R} V_1 = \frac{1}{2} V_1 \Rightarrow A = 2$

$C = \frac{I_1}{V_2}$; $V_2 = R I_1 \Rightarrow C = \frac{1}{R}$

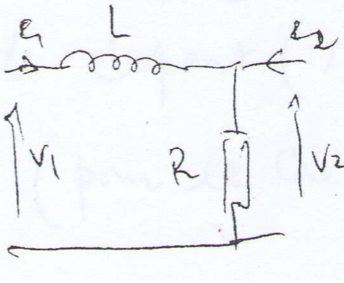
à $V_2 = 0$.



$I_1 = -I_2$, $V_2 = 0$.

$B = -\frac{V_1}{I_2} \Rightarrow V_1 = R I_1 = -R I_2 \Rightarrow B = R$.

$D = -\frac{I_1}{I_2} \Rightarrow D = 1$ Matrice $\begin{pmatrix} 2 & R \\ 1/R & 1 \end{pmatrix}$

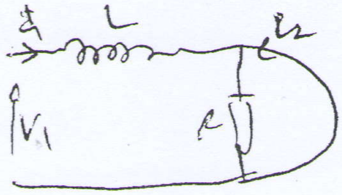


à $I_2 = 0$ $A = \frac{V_1}{V_2} \Rightarrow V_2 = \frac{R}{R + jL\omega} V_1 \Rightarrow A = \frac{R + jL\omega}{R}$

$A = 1 + j\frac{L}{R}\omega$

$C = \frac{I_1}{V_2} \Rightarrow V_2 = R I_1 \Rightarrow C = \frac{1}{R}$

à $V_2 = 0$



$I_1 = -I_2 \Rightarrow \boxed{D = 1}$ $\boxed{B = jL\omega}$

$B = -\frac{V_1}{I_2} \Rightarrow V_1 = jL\omega I_1 = -jL\omega I_2$

La Matrice est donc $\begin{pmatrix} \dfrac{R+jL\omega}{R} & jL\omega \\ \dfrac{1}{R} & 1 \end{pmatrix}$

le Montage est Constitué d'une association Cascade des 2 Montages, donc la Matrice Resultante est le produit des 2 Matrices Calculées.

$$\begin{pmatrix} 2 & R \\ 1/R & 1 \end{pmatrix}\begin{pmatrix} \dfrac{R+jL\omega}{R} & jL\omega \\ \dfrac{1}{R} & 1 \end{pmatrix} = \begin{pmatrix} 2\left(1+j\frac{L}{R}\omega\right)+1 & 2jL\omega+R \\ \dfrac{R+jL\omega}{R^2}+\dfrac{1}{R} & \dfrac{jL\omega}{R}+1 \end{pmatrix}$$

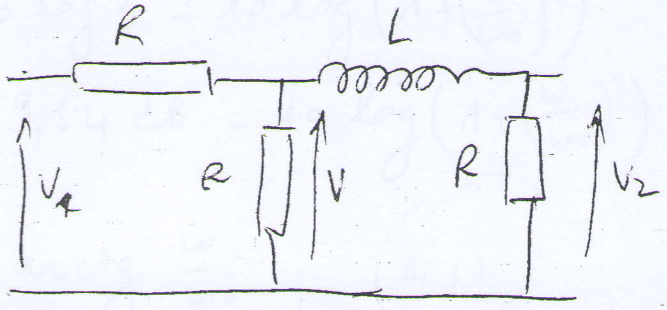
$$= \begin{pmatrix} 3+2j\frac{L}{R}\omega & R+2jL\omega \\ \dfrac{2R+jL\omega}{R^2} & \dfrac{R+jL\omega}{R} \end{pmatrix}$$

Cette Matrice peut être retrouvée en utilisant la Methode des Circuits ouverts et Court-circuit sur le Montage de depart (initial)

(pour le Calcul de $A = \dfrac{V_1}{V_2} = \dfrac{1}{T(j\omega)}$ de la fonction de Transfert du 4^e Ex.

etc...

Exercice 4.



$T(jw) = \frac{V_2}{V_1}$. on a $V_2 = \frac{R}{R+jLw} V$ avec

$$V = \frac{R // (R+jLw)}{(R//(R+jLw)) + R} V_1$$

$$R // (R+jLw) = \frac{R \cdot (R+jLw)}{R+R+jLw} = \frac{R(R+jLw)}{2R+jLw}$$

$$V = \frac{\frac{R(R+jLw)}{2R+jLw}}{\frac{R(R+jLw)}{2R+jLw} + R} V_1 = \frac{R(R+jLw)}{R(R+jLw) + R(2R+jLw)} V_1$$

$$V_2 = \frac{R}{(R+jLw)} \cdot \frac{R(R+jLw)}{R[R+jLw+2R+jLw]} V_1$$

$$T(jw) = \frac{V_2}{V_1} = \frac{R}{3R+2jLw} = \frac{R}{3R} \cdot \frac{1}{1+j\frac{2Lw}{3R}} = \frac{1}{3} \cdot \frac{1}{1+j\,w/w_0}$$ 02

avec $w_0 = \frac{3}{2}\frac{R}{L}$.

$$|T(jw)| = G_v(w) = \frac{1}{3}\frac{1}{\sqrt{1+\left(\frac{w}{w_0}\right)^2}}$$ 0,5

0,5

$$G_{v\,dB} = 20 \log G_v(w) = 20 \log \frac{1}{3} - 10 \log\left(1+\left(\frac{w}{w_0}\right)^2\right)$$

6

7

$$G_{v\,dB} = -20\log 3 - 10\log\left(1+\left(\frac{w}{w_0}\right)^2\right)$$

$$= -9{,}54\ dB - 10\log\left(1+\left(\frac{w}{w_0}\right)^2\right) = G_1 + G_2.$$

$$\varphi(w) = -\operatorname{arctg}\frac{w}{w_0}$$

Etude du gain

G_1 est une constante.

à $w \to 0$ $\quad G_2 \to 0\ dB$.

à $w \to \infty$ $\quad G_2 \simeq -20\log\frac{w}{w_0}$ droite asymptotique de pente $-20\ dB/$décade.

Etude de la phase.

à $w \to 0$ $\quad \varphi(w) \to 0$

à $w \to \infty$ $\quad \varphi(w) \to -\frac{\pi}{2}$

A $w = w_0$, $G_v(w_0) = -9{,}54 - 10\log 2 = -12{,}54\ dB$

$\varphi(w_0) = -\frac{\pi}{4}$.