Université A/MIRA
Faculté des technologies
Dpt 2AST

Lundi 02 Juillet 2012

EMD ELN

Exercice 1 : (4pts)

Trouver la valeur du courant I de la fig.1.

Exercice 2 : (10 pts)

Soit la fig.2. Le but est de calculer la valeur du courant I traversant la résistance R5. On donne $R1= 1\Omega$, $R2=2\Omega$, $R3=3\Omega$,$R4=4\Omega$,$R5= 5\Omega$, $Eg=20V$, $Rg=5\Omega$.

1) Poser les équations aux mailles et déterminer la valeur du courant I.

2) Déterminer cette fois I en utilisant le Théorème de Thévenin.

Exercice 3 : (6pts)

Soit le circuit de la fig.3. a) Calculer les paramètres Impédances Z
b) Calculer les paramètres Admittances Y

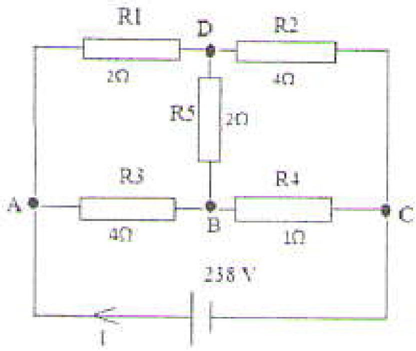


fig.1

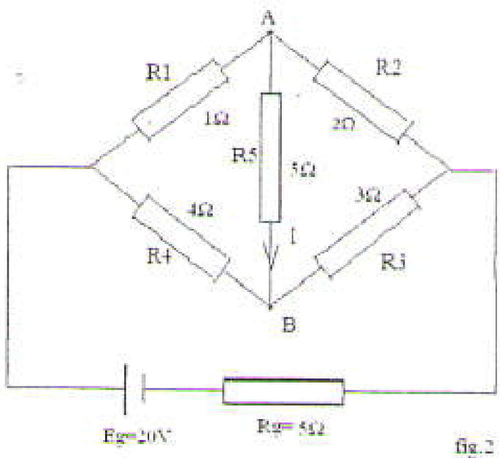


fig.2

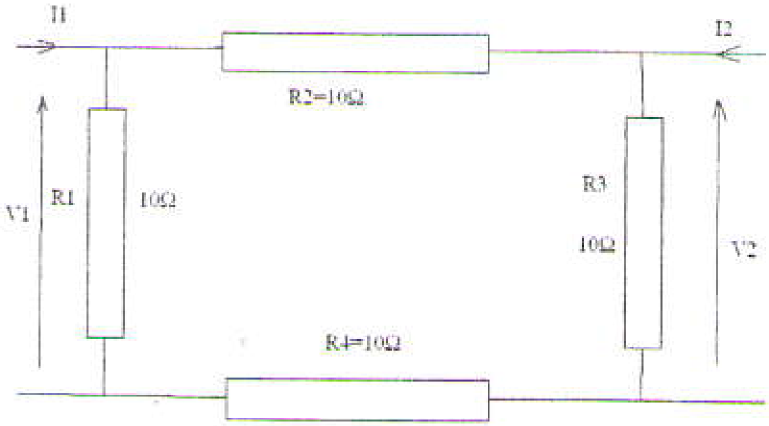
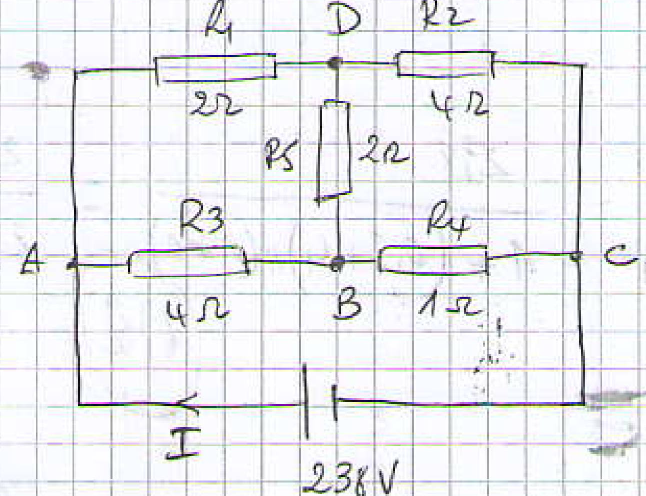


fig 3

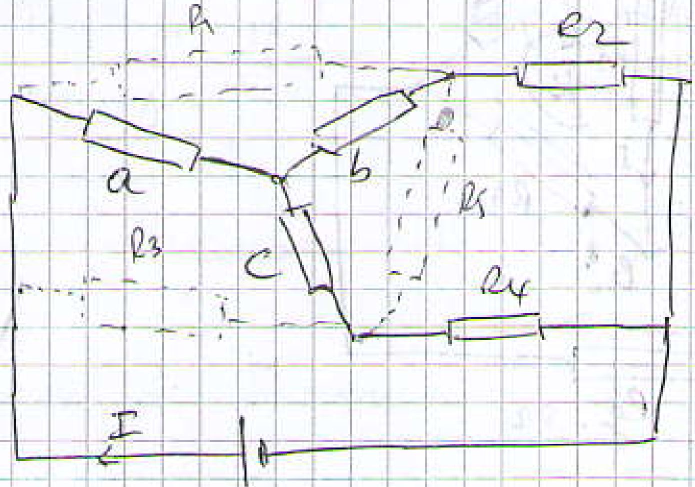
2012

Solution Rattrapage ELN

Exercice 1 :



on fait une transformation Triangle → Etoile.



$$a = \frac{R_1 R_3}{R_1 + R_3 + R_5}$$

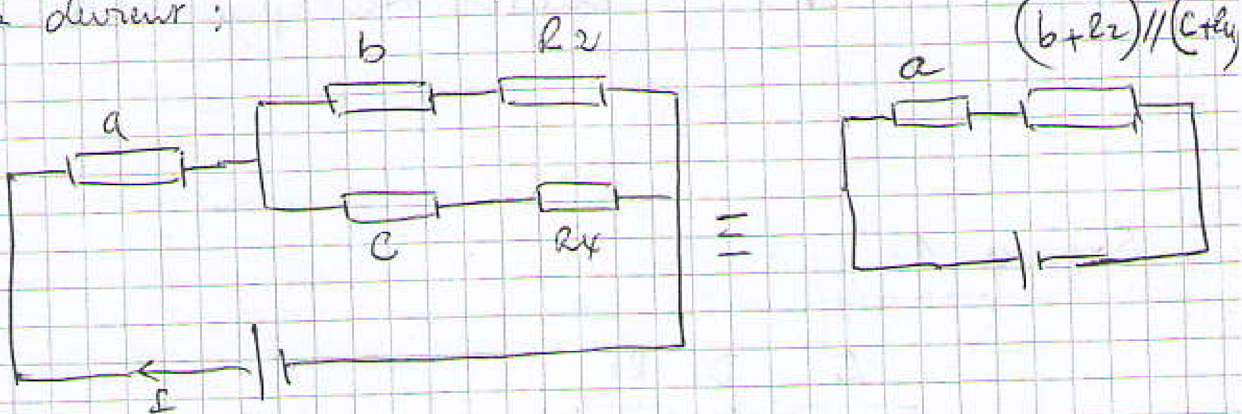
$$a = \frac{2 \cdot 4}{2 + 4 + 2} = 1\,\Omega$$

02

$$b = \frac{R_1 R_5}{R_1 + R_3 + R_5} = \frac{2 \cdot 2}{8} = 0{,}5\,\Omega$$

$$c = \frac{R_3 \cdot R_5}{R_1 + R_3 + R_5} = \frac{4 \cdot 2}{8} = 1\,\Omega$$

le schéma devient :

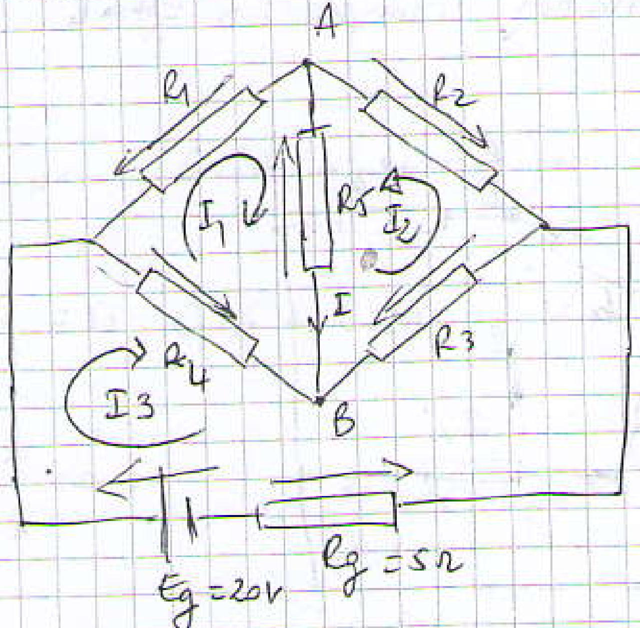


$$I = \frac{E}{a + (b+R_2)//(c+R_4)} = \frac{238}{1 + (0{,}5+4)//(1+1)} = \frac{238}{2{,}38}$$

02

$I = 100\ A$.

Exercice N° 2 :



a) Méthode des Mailles. (05 pts)

$$R_1 I_1 + R_5 (I_1 + I_2) + R_4 (I_1 - I_3) = 0$$

$$R_2 I_2 + R_3 (I_2 + I_3) + R_5 (I_1 + I_2) = 0$$

$$E_g + R_4 (I_1 - I_3) - R_3 (I_2 + I_3) - R_g I_3 = 0$$

$(R_1+R_4+R_5)I_1 + R_5 I_2 - R_4 I_3 = 0$. (01) $\quad 10I_1 + 5I_2 - 4I_3 = 0$

$R_5 I_1 + (R_2+R_3+R_5) I_2 + R_3 I_3 = 0$. (01) $\quad 5I_1 + 10I_2 + 3I_3 = 0$

$-R_4 I_1 + R_3 I_2 + (R_3+R_4+R_g) I_3 = E_g$ (01) $\quad -4I_1 + 3I_2 + 12I_3 = 20$

$$\Delta = \begin{vmatrix} 10 & 5 & -4 \\ 5 & 10 & 3 \\ -4 & 3 & 12 \end{vmatrix} = 10(120-9) - 5(60+12) - 4(15+40)$$

$$= 1110 - 360 - 220 = 530.$$

$$I_1 = \frac{\begin{vmatrix} 0 & 5 & -4 \\ 0 & 10 & 3 \\ 20 & 3 & 12 \end{vmatrix}}{\Delta} = \frac{20(15+40)}{\Delta} = 2{,}07\,A$$ (0,5)

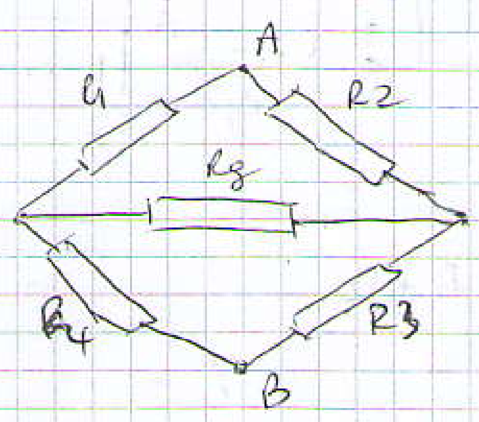
$$I_2 = \frac{\begin{vmatrix} 10 & 0 & -4 \\ 5 & 0 & 3 \\ -4 & 20 & 12 \end{vmatrix}}{\Delta} = \frac{-20(30+20)}{530} = -1{,}89\,A$$ (0,5)

le Courant traversant R_5 est $I_1 + I_2 = 2{,}07 - 1{,}89 = 0{,}18\,A$ (01)

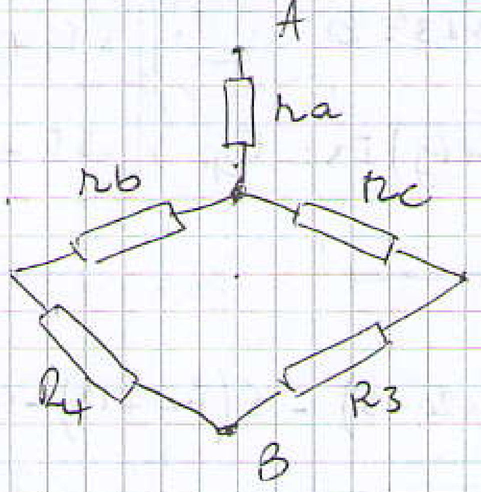
b) Methode de Thevenin (05 pts)

on deconnecte la charge ~~R_g~~ $R_5 = R_{AB}$

Calcul de R_{th}:



on fait une transformation triangle → Etoile.



$$R_{AB} = r_a + \left[(r_b + R_4) \,//\, (R_c + R_3)\right]$$

avec $r_a = \dfrac{R_1 R_2}{R_1 + R_2 + R_g} = \dfrac{2}{8} = \dfrac{1}{4}$

$$r_b = \frac{R_1 R_g}{R_1 + R_2 + R_g} = \frac{5}{8}$$

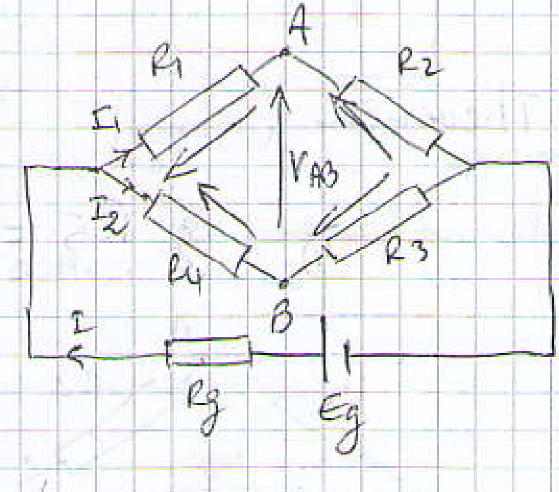
$$r_c = \frac{R_2 . R_g}{R_1 + R_2 + R_g} = \frac{10}{8}$$

01

donc $R_{AB} = 0{,}25 + \left(4 + \frac{5}{8}\right) // \left(3 + \frac{10}{8}\right) = 0{,}25 + \left(\frac{37}{8} // \frac{34}{8}\right)$

$R_{th} = R_{AB} = 0{,}25 + 2{,}21 = 2{,}46\ \Omega$ 01

Calcul de E_{th} :



on a $I = I_1 + I_2$

$$E_{th} = V_{AB} = R_4 I_2 - R_1 I_1$$

$$= R_2 I_1 - R_3 I_2$$

avec $I_1 = \frac{R_4 + R_3}{R_4 + R_3 + R_1 + R_2} I$ (R.D.C) $= \frac{7}{10} I$.

$$I_2 = I - I_1 = \frac{R_1 + R_2}{R_1 + R_2 + R_3 + R_4} I = \frac{3}{10} I$$

on a aussi $E_g = \left(R_g + \left[(R_1 + R_2) // (R_3 + R_4)\right]\right) I$.

$$= (5 + 3 // 7) I$$

$$I = \frac{20}{5 + 2{,}1} = 2{,}82\ A \quad (2{,}817)$$

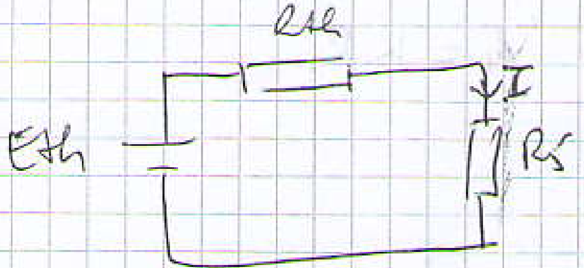
$$I_1 = \frac{7}{10} \cdot 2{,}82 = 1{,}97\ A$$

$$I_2 = \frac{3}{10} \cdot 2{,}82 = 0{,}845\ A$$

$$V_{AB} = E_{th} = 4 \cdot 0{,}84 - 1{,}97 = 1{,}39\ V$$

$$= 2 \cdot 1{,}97 - 3 \cdot 0{,}845 = 1{,}40\ V$$

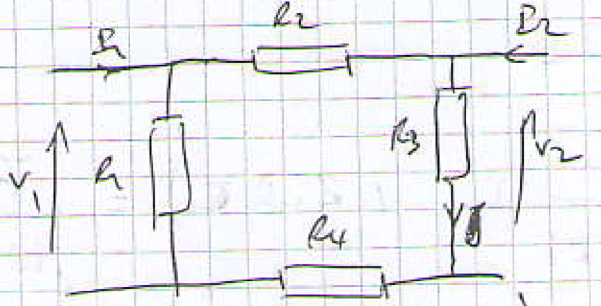
02



$$I = \frac{E_{th}}{R_{th} + R_5} = \frac{1{,}40}{7{,}46} = 0{,}18\ A$$

01

Exercice 3 :



(037/3)

Paramètres Impédances : $V_1 = Z_{11} I_1 + Z_{12} I_2$

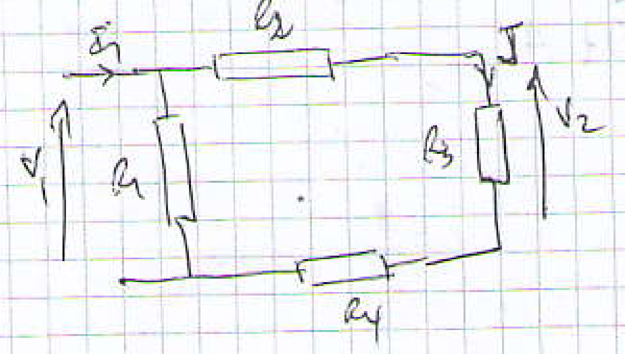
$V_2 = Z_{21} I_1 + Z_{22} I_2$

+ A $I_2 = 0$.

$$Z_{11} = \frac{V_1}{I_1}\Big|_{I_2=0} \Rightarrow V_1 = \left[R_1 // (R_2+R_3+R_4)\right] I_1$$

$$Z_{11} = \frac{V_1}{I_1} = 10 // 30 = \frac{300}{40} = 7,5\ \Omega$$

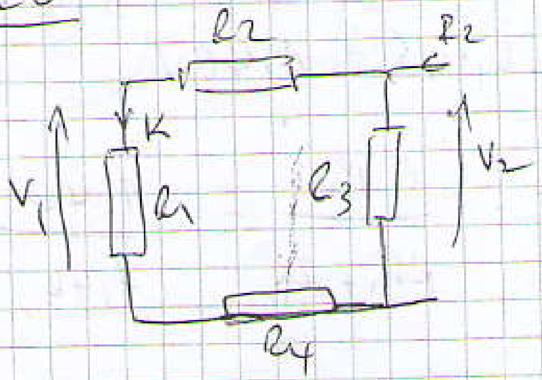
$$Z_{21} = \frac{V_2}{I_1}\Big|_{I_2=0} \Rightarrow V_2 = R_3 J \quad \text{avec} \quad J = \frac{R_1}{R_1+R_2+R_3+R_4} I_1$$



$$V_2 = \frac{R_3 \cdot R_1}{R_1+R_2+R_3+R_4} I_1$$

$$Z_{21} = \frac{V_2}{I_1}\Big|_{I_2=0} = \frac{100}{40} = 2,5\ \Omega$$

* à $I_1 = 0$



$V_1 = K \cdot R_1$

$$z_{12} = \left.\frac{V_1}{I_2}\right|_{I_1=0} \Rightarrow V_1 = R_1 K.$$

$$\text{avec} \quad K = \frac{R_3}{R_1+R_2+R_3+R_4} I_2.$$

$$V_1 = \frac{R_1 \cdot R_3}{R_1+R_2+R_3+R_4} I_2 = \frac{100}{40} I_2 = 2{,}5\, I_2$$

$$\left.\frac{V_1}{I_2}\right|_{I_1=0} = z_{12} = 2{,}5\ \Omega$$

$$z_{22} = \left.\frac{V_2}{I_2}\right|_{I_1=0} \Rightarrow V_2 = \left[R_3 \,//\, (R_2+R_1+R_4)\right] I_2.$$

$$\left.\frac{V_2}{I_2}\right|_{I_1=0} = z_{22} = 10 \,//\, 30 = \frac{300}{40} = 7{,}5\ \Omega$$

$$[z] = \begin{bmatrix} z_{11} & z_{12} \\ z_{21} & z_{22} \end{bmatrix} = \begin{bmatrix} 7{,}5 & 2{,}5 \\ 2{,}5 & 7{,}5 \end{bmatrix}.$$

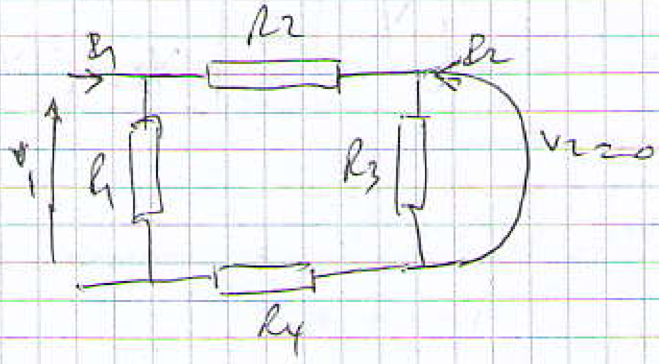
Parametres Admittances : (03 pts)

$$I_1 = Y_{11} V_1 + Y_{12} V_2$$

$$I_2 = Y_{21} V_1 + Y_{22} V_2.$$

(1) Sortie en Court-Circuit ($V_2 = 0$)

$$Y_{11} = \left.\frac{I_1}{V_1}\right|_{V_2=0}$$



(8)

$$V_1 = \left[R_1 \,//\, (R_2 + R_4)\right] I_1 \Rightarrow V_1 = (10 \,//\, 20) I_1 = 6{,}67\, I_1$$

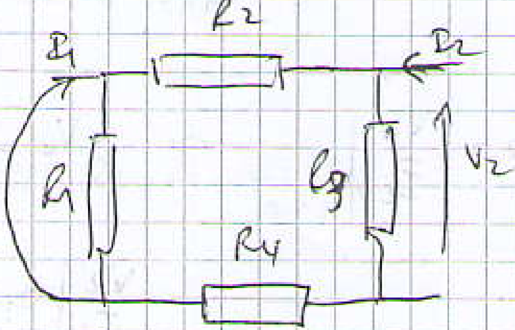
$$\left.\frac{I_1}{V_1}\right|_{V_2=0} = Y_{11} = \frac{1}{6{,}67} = 0{,}15 \text{ S}$$

- $Y_{21} = \left.\dfrac{I_2}{V_1}\right|_{V_2=0}$ on a $V_1 = -(R_2 + R_4) I_2$

$$\frac{I_2}{V_1} = -\frac{1}{R_2+R_4} = -\frac{1}{20} = -0{,}05 \text{ S}$$

(+) entrée en Court-Circuit $(V_1 = 0)$

- $Y_{12} = \left.\dfrac{I_1}{V_2}\right|_{V_1=0}$



- $V_2 = -(R_2 + R_4) I_1$

$$\frac{I_1}{V_2} = -\frac{1}{R_2+R_4} = -\frac{1}{20} = -0{,}05 \text{ S}$$

- $Y_{22} = \left.\dfrac{I_2}{V_2}\right|_{V_1=0} \Rightarrow V_2 = \left[R_3 \,//\, (R_2 + R_4)\right] I_2$

$$V_2 = (10 \,//\, 20) I_2 = 6{,}67\, I_2$$

$$Y_{22} = \left.\frac{I_2}{V_2}\right|_{V_1=0} = \frac{1}{6{,}67} = 0{,}15 \text{ S}$$

$$[Y] = \begin{bmatrix} Y_{11} & Y_{12} \\ Y_{21} & Y_{22} \end{bmatrix} = \begin{bmatrix} 0{,}15 & -0{,}05 \\ -0{,}05 & 0{,}15 \end{bmatrix}$$