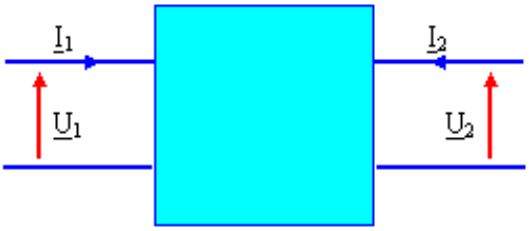
TP :1 *Passive quadrupoles*

I. Theoretical complement :

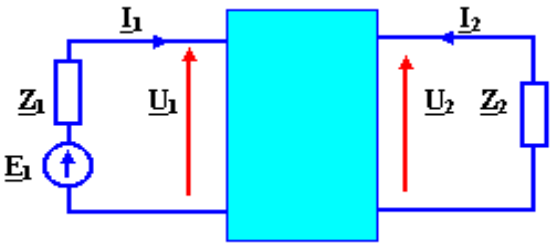
I.1) Definition :

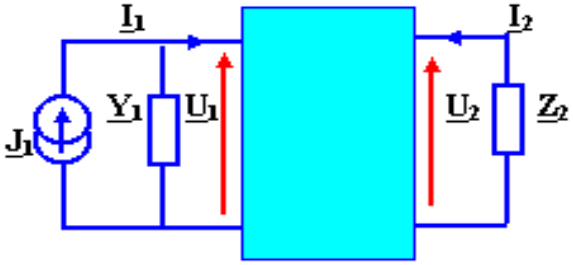
It's an electrical network with two inputs and two outputs, enabling the transfer of energy between two dipoles.

I.2) Representation :



I.3) Transfer function :





Voltage gain: $\underline{F}_u = \underline{U}_2 / \underline{U}_1$ Current gain: $\underline{F}_u = \underline{I}_2 / \underline{I}_1$

Transfer admittance: $Y_T = \underline{I}_2 / \underline{U}_1$ Transfer impedance: $Z'_T = \underline{U}_2 / \underline{I}_1$

Input admittance: $Y_e = \underline{I}_1 / \underline{U}_1$ Input impedance: $Z'_e = \underline{U}_1 / \underline{I}_1$

I 4) Parameters :

1. **Impedances:**

$$\underline{U}_1 = z_{11}\,\underline{I}_1 + z_{12}\,\underline{I}_2 .$$

$$\underline{U}_2 = z_{21}\,\underline{I}_1 + z_{22}\,\underline{I}_2 .$$

2. **Admittances:**

$\underline{I}_1 = y_{11}\,\underline{U}_1 + y_{12}\,\underline{U}_2$.

$\underline{I}_2 = y_{21}\,\underline{U}_1 + y_{22}\,\underline{U}_2$..

3. Hybrides (h):

$\underline{U}_1 = h_{11}\,\underline{I}_1 + h_{12}\,\underline{U}_2$.

$\underline{I}_2 = h_{21}\,\underline{I}_1 + h_{22}\,\underline{U}_2$.

4. Hybrides (g):

$\underline{I}_1 = g_{11}\,\underline{U}_1 + g_{12}\,\underline{I}_2$.

$\underline{U}_2 = g_{21}\,\underline{U}_1 + g_{22}\,\underline{I}_2$.

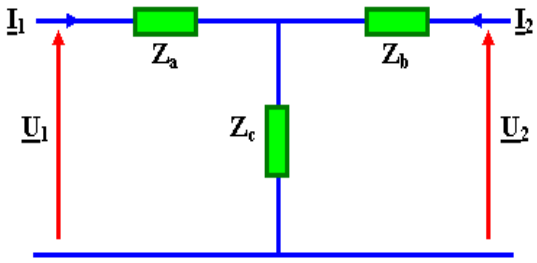
5. Transfert (T):

$\underline{U}_1 = T_{11}\underline{U}_2 + T_{12}\,\underline{I}_2$.

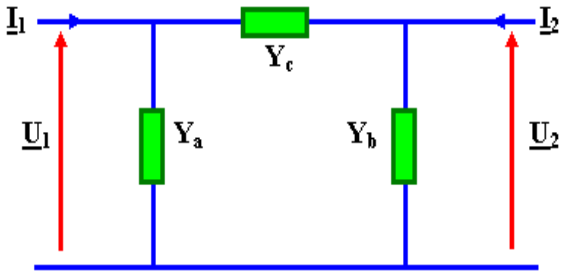
$\underline{I}_1 = T_{21}\underline{U}_2 + T_{22}\,\underline{I}_2$.

I.4) Properietes of a passive quadripole:

Il est caractérisé par 3 paramètres. Il en résulte un diagramme équivalent T ou Π.



the shape T



the shape **II**

Name and First name			***Group***	***Grade***
Name and First name				
Date : ……..***Schedule :*** ……..***Lab. N*** ……				

TP :1 *Passive quadrupoles*

I. Objectives:

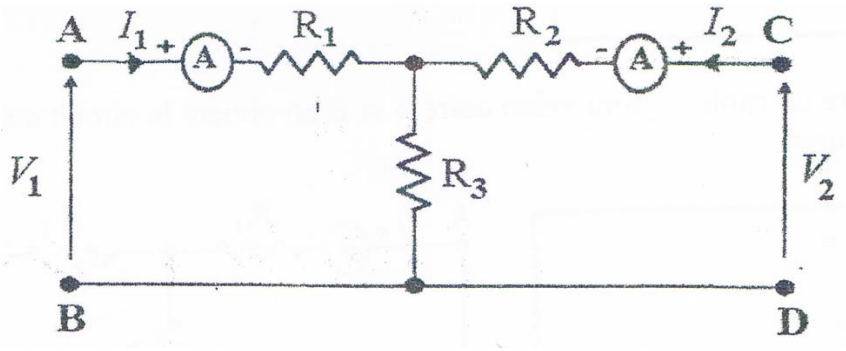
1. 1. Set up the various circuits for measuring the currents and voltages required to determine the parameters of the Z, Y, h, g and T matrices of the two types of quadrupole: the "T" quadrupole and the "II" quadrupole.
2. 2. Calculate these parameters from measured voltages and currents, then compare them with theoretical values.

I. Equipment used : The following equipment is required for this practical work :

- A stabilized power supply.
- A DC voltmeter.
- Two DC ampermeters.
- Connection cables.
- three **1kΩ** resistors.

IV) Experimental study

- ***"T" quadrupole:*** create the following circuit:



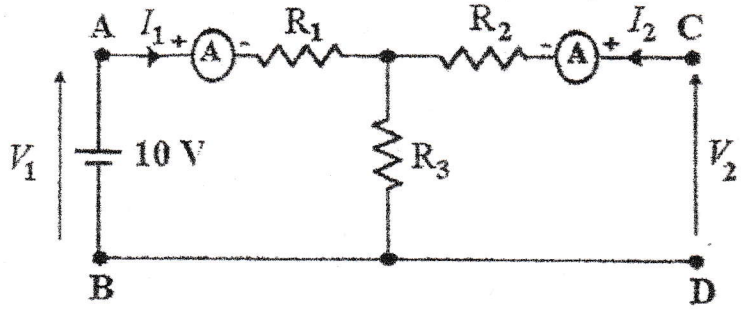
1- Set ampermeters to 20 mA rating.
2- Connect a DC power supply between terminals A and B.
3- Set supply voltage to 10V and measure:

$V_1 =$

$V_2 =$

$I_1 =$

$I_2 =$



4- put a connecting cable between C and D and get the following circuit :

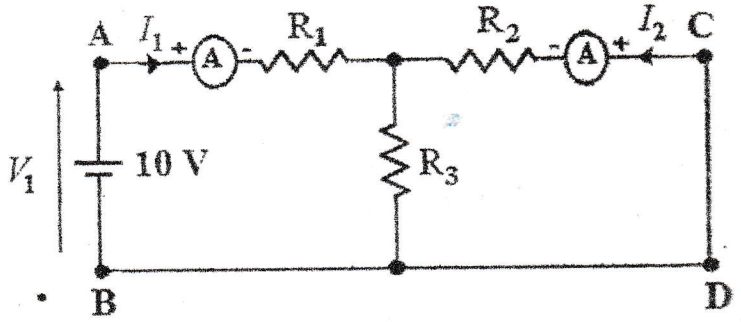
5- measure

$V_1 =$

$I_1 =$

$I_2 =$

$V_2 =$



6- remove the connection cable

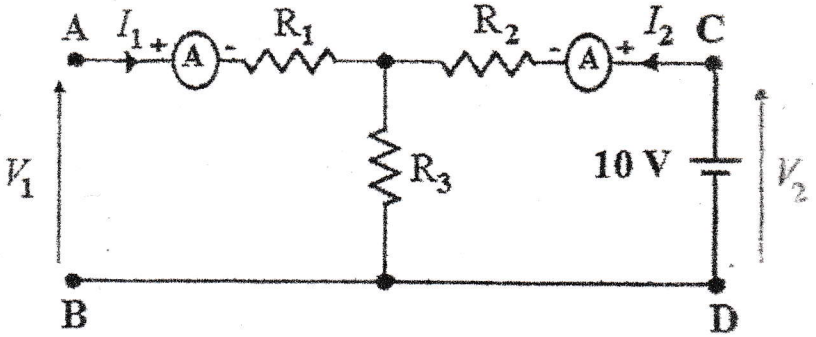
7- disconnect the power supply and connect it between C and D, obtaining the following circuit

$V_1 =$

$V_2 =$

$I_2 =$

$I_1 =$



9- put a connecting cable between A and B and get the following circuit

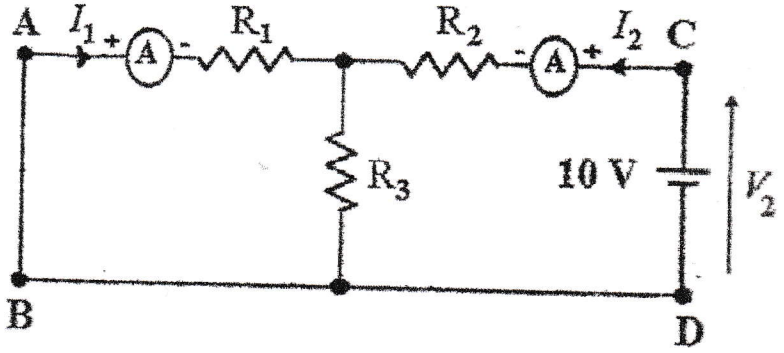
10- measure

$V_2 =$

$I_1 =$

$I_2 =$

$V_1 =$



V) Calculation of matrices Z, Y, h, g and T:

V.1) Theoretical calculation of matrices parameters:

Kirchhoff's laws are applied to determine the parameters of the various matrices as a function of the resistors R1, R2, R3. :

➢ *"T" quadrupole:*

a) Z parameters :

(give the theoretical expression) (calculate numerical value)

$Z_{11} = \frac{V_1}{I_1}\Big|I_2 = 0$ **Z_{11}=**…….. ⇒ **Z_{11}=……**

$Z_{21} = \frac{V_2}{I_1}\Big|I_2 = 0$ **Z_{21}=**…….. ⇒ **Z_{21}=……..**

$Z_{12} = \frac{V_1}{I_2}\Big|I_1 = 0$ **Z_{12}=**……. ⇒ **Z_{12}=……**

$Z_{22} = \frac{V_2}{I_2}\Big|I_1 = 0$ **Z_{22}=**……. ⇒ **Z_{22}=**……

b) Y parameters : ($Y=Z^{-1}$)

$Y_{11} = \frac{I_1}{V_1}\Big|V_2 = 0$ **Y_{11}=**…….. ⇒ **Y_{11}=……**

$Y_{21} = \frac{I_2}{V_1}\Big|V_2 = 0$ **Y_{21}=**…….. ⇒ **Y_{21}=……..**

$Y_{12} = \frac{I_1}{V_2}\Big|V_1 = 0$ **Y_{12}=**……. ⇒ **Y_{12}=……**

$Y_{22} = \frac{I_2}{V_2}\Big|V_1 = 0$ **Y_{22}=**……. ⇒ **Y_{22}=**……

c) Parameters h :

$h_{11} = \frac{V_1}{I_1}\Big|V_2 = 0$ **h_{11}=**……..…….. ⇒ **h_{11}=……**

$h_{21} = \frac{I_2}{I_1}\Big|V_2 = 0$ **h_{21}=**…….. ⇒ **h_{21}=……..**

$h_{12} = \frac{V_1}{V_2}|I_1 = 0$ **h 12=**…… $\Rightarrow$ **h 12=……**

$h_{22} = \frac{I_2}{V_2}|I_1 = 0$ **h 22=**…… $\Rightarrow$ **h 22=**……

d) The parameters g :

$g_{11} = \frac{I_1}{V_1}|I_2 = 0$ **g11=**……..…….. $\Rightarrow$ **g 11=……**

$g_{21} = \frac{V_2}{V_1}|I_2 = 0$ **g 21=** …….. $\Rightarrow$ **g 21=……..**

$g_{12} = \frac{I_1}{I_2}|V_1 = 0$ **g 12=**…… $\Rightarrow$ **g 12=……**

$g_{22} = \frac{V_2}{I_2}|V_1 = 0$ **g 22=**…… $\Rightarrow$ **g 22=**……

e) The parameters T :

$T_{11} = \frac{V_1}{V_2}|I_2 = 0$ **T11=**…1/ g 21…….... $\Rightarrow$ **T 11=……**

$T_{21} = \frac{I_1}{V_2}|I_2 = 0$ **T 21=**…1/ Z 21……..….. $\Rightarrow$ **T 21=……**

$T_{12} = \frac{V_1}{I_2}|V_2 = 0$ **T 12=**…1/ Y21……..…….. $\Rightarrow$ **T 12=……**

$T_{22} = \frac{I_1}{I_2}|V_2 = 0$ **T 22=**…1/ h21……..….. $\Rightarrow$ **T22=……**

V.2) Comparison of values found in practice with those found in theory :

- Using the measurements taken, determine the Z, Y, h, g and T matrices of quadrupole type 'T'.

- Remplir le tableau suivant.

	T-shaped quadrupole	
Matrices	**Theoretical**	**Practice**
Z parameters		
Y parameters		
h parameters		
g parameters		
T parameters		

VII) Discussion: discuss the results obtained

VIII Conclusion: draw an appropriate conclusion about this TP.