Electrical Transformer

1. Purpose of the experiment

The aim of this experience is to highlight the transformation by raising or lowering tensions.

2. Notions et préparation

Figure 1 shows a transformer schematically. The parameters on the left side are those of the primary, while the one on the right represents the secondary. By applying a sinusoidal voltage to the primary circuit consisting of a winding of (n_1) turns, what happens on the secondary of (n_2) turns?

Let the primary voltage $U_0 \sin(\omega t + \theta)$. The current passes through the primary winding around the ferromagnet, it will create a magnetic flux Φ in the iron which will in turn induce an electromotive force "e.m.f" given by the relation:

$$E_{in} = -n_1 \frac{d\Phi}{dt}$$

For an ideal transformer, the primary voltage U_1 is equal to the induced "e.m.f".

$$E_{in} = -U_1 = -U_0 \sin(\omega t + \theta)$$

For reasons of high efficiency, the iron is made up of a stack of varnished sheets.

Under these conditions, the flux Φ is completely channeled in the iron and will be recovered in the secondary, where it will create an e.m.f. which, in the case of a no-load transformer, will be equal to the voltage which will be delivered by the secondary winding.

$$U_2 = V_0 \sin(\omega t + \beta)$$

What's more

$$U_2 = n_2 \frac{d\Phi}{dt}$$

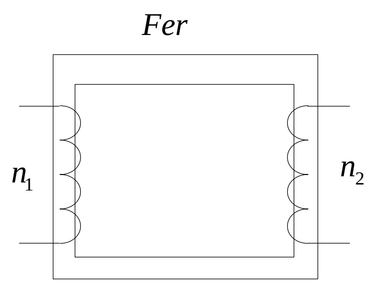


Figure 1

1. Since the flow is conserved. Find the following relationship

$$\frac{U_1}{n_1} = \frac{U_2}{n_2}$$

……………………………………………………………………………………………………
……………………………………………………………………………………………………

As a result, we find the expression for the output voltage (that of the secondary) given by:

$$U_2 = \frac{n_2}{n_1} U_1 = m U_1$$

(m) this is the transformation ratio

1. What is the condition on "m" for the transformer to be step-up m=……
2. What is the condition on "m" for the transformer to be step-down m=……
3. What is a diode?

……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………

3. Handling

3.1

- Create the assembly shown in Figure 2.
- Power the circuit with a voltage V = 4.5 V, so that it remains constant throughout the experiment.
- For a fixed primary winding of $n_1 = 300$ turns, raise the secondary voltage.

$n_2 (turns)$	14	42	84	112	140
$U_2 (Volts)$					
$\frac{U_2}{U_1}$					
$\frac{n_2}{n_1}$					

1. Complete the table below.
2. Compare the voltage ratios and those of the windings

……………………………………………………………………………………
……………………………………………………………………………………

3. Comment

……………………………………………………………………………………………………
……………………………………………………………………………………………………

3.2

A- Take a fixed primary winding $n_1 = 300$ turns.

- Take a fixed secondary winding $n_2 = 42$ turns.

- Raise the secondary voltage, $U_2 = ...V$; give the value of « m =……… »

B- Now reverse the windings so that the primary becomes the secondary.

- Raise the secondary voltage $U_2 = ...V$; give the value of « m=……… »

- What do you see in both cases (**A** and **B**) ?

………………………………………………………………………………………………
………………………………………………………………………………………………

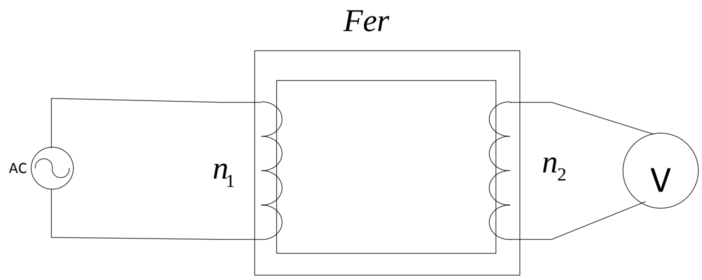
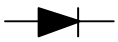


Figure 2

3.3

To transform the outgoing AC signal into a DC signal, a rectifier is mounted at the output of the transformer, as shown in Figure 3

- Take a fixed primary winding $n_1 = 300$ turns.
- Take a fixed primary winding $n_2 = 42$ turns.
- Using an oscilloscope to view the outgoing signal before and after rectification, observe and plot the signals.

Note :  is the electronic symbol for the diode..

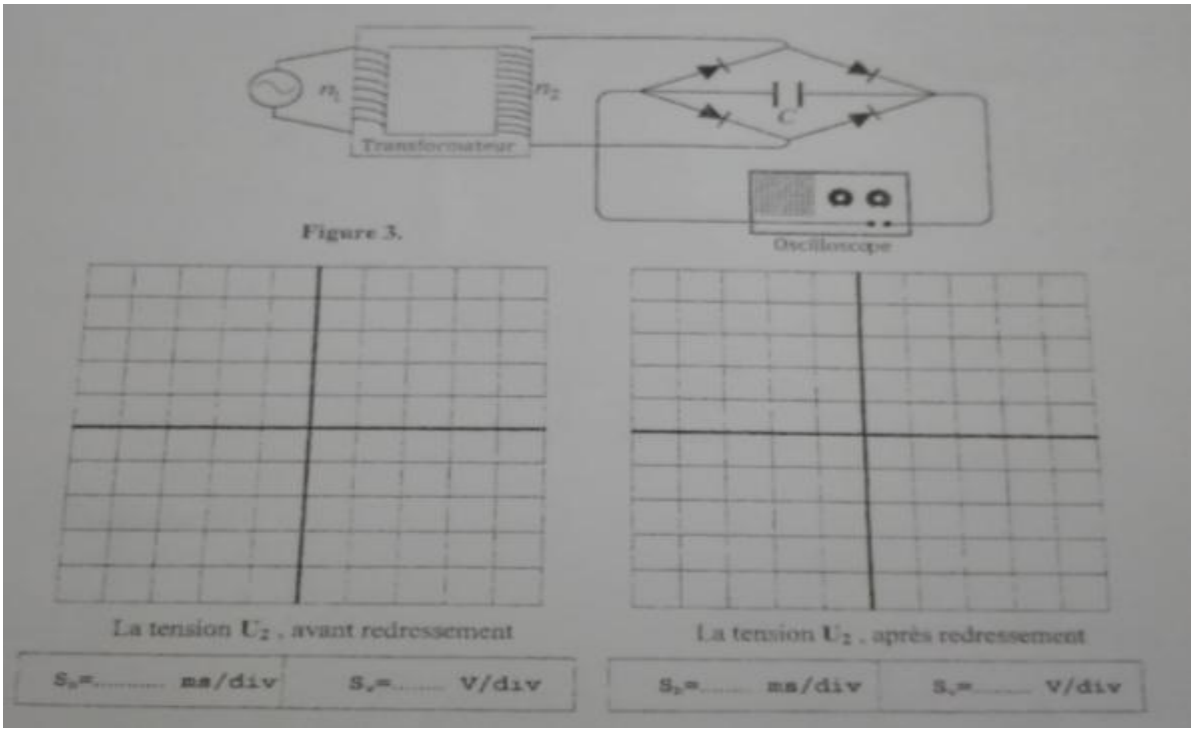


Figure 3.

4- Conclusion

…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………
……………………………………………………………………………………..….