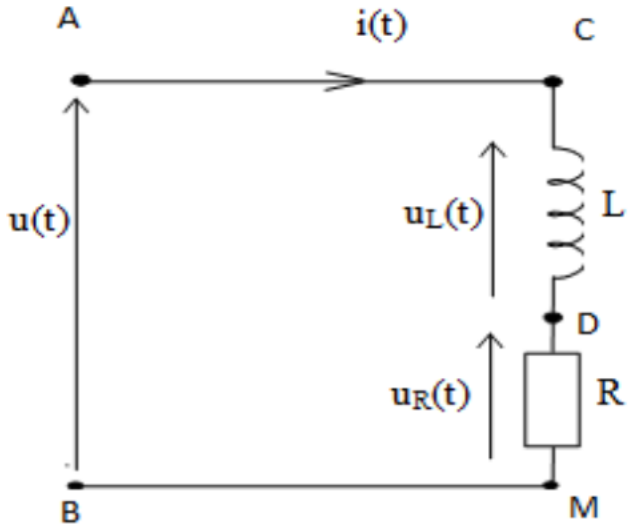
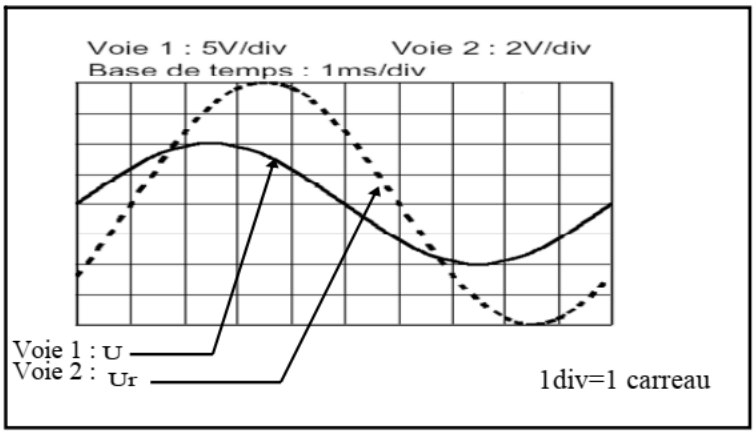
TD 3

Exercise No. 1:

A resistor R = 15 Ω and an inductor L are connected in series and supplied by a low-frequency generator providing a sinusoidal voltage U, as shown in the following figure.



The oscilloscope observation of voltages U and Ur gives the readings shown in the following figure.



Determine:

a) The period (T) of U(t). Deduce its frequency and angular frequency (ω);
b) The peak and rms values of the voltages u(t) and Ur(t);
c) The rms value I of the current i(t);

d) The value of τ , what does this quantity represent?
e) The phase shift φ between u(t) and i(t);
f) What is the nature (behavior) of the circuit?

Exercise No. 2:

Calculate the value and phase shift of the current I resulting from two currents:
I1 = 10 A with a phase lag of 60° relative to the phase origin, and
I2 = 6 A with a phase lead of 45° relative to the phase origin, using the Fresnel diagram method.

Exercise No. 3:

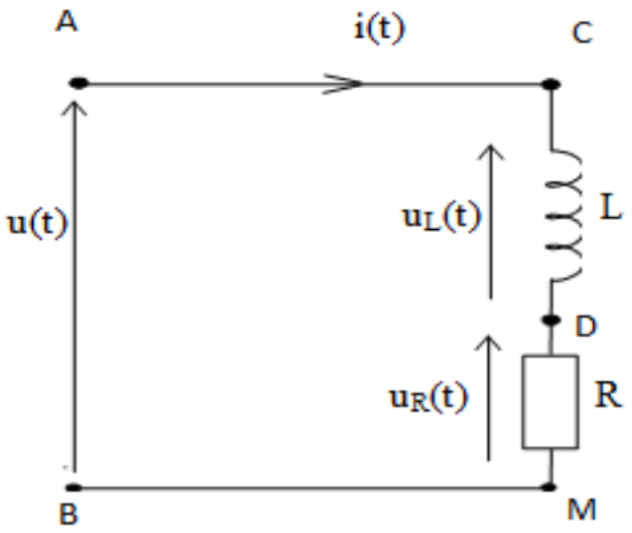
Given three current intensities:

$i1 = 4\sqrt{2}\sin(\omega t)$, $i2 = 5\sqrt{2}\sin(\omega t + \pi/2)$, $i3 = 5\sqrt{2}\sin(\omega t - \pi/4)$

1. Represent these currents using Fresnel vectors.
2. Construct the following vectors: $I = I1 + I2 + I3$ and $I' = I2 - I3$.
3. Using the complex form of these currents, determine the rms values and phases, and write the expressions for I and I′.

Exercise No. 4:

An inductor of inductance L = 1 H and a resistor R = 100 Ω are connected in series. A voltage $u(t) = 220\sqrt{2}\sin(100\pi t)$ is applied to the circuit.



1) Calculate:
- The impedance ZL of the inductor;
- The total impedance Z;
- The rms current Ieff in the circuit;
- The phase shift of u with respect to i;

2) Express i as a function of time.

Exercise No. 5:

A single-phase electrical installation supplied with 220 V / 50 Hz includes:
- Ten lamps of 100 W each;
- An electric heater of 1.5 kW;
- Three identical electric motors, each absorbing a power of 2 kW with a power factor of 0.7.

All these devices operate simultaneously.

1. Determine the active and reactive powers consumed by the installation.
2. What is its power factor?
3. What is the rms value of the line current and the phase shift relative to the voltage?
4. It is desired that the installation's power factor be corrected to 0.9.
   - What should be the capacitance value of the capacitor connected in parallel with the installation to achieve this?