University Mohamed Boudiaf of M'Sila
Faculty of Technology
Electrical Engineering Department
Option: **ELT**, **ELM**, **ERE**

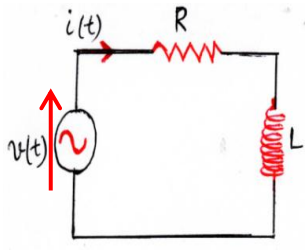
Module: Basic Electrical Engineering 1
Level of study: 2nd year
Academic year: 2025-2026
Semester: 03

Series N°3: Single-phase circuits and electrical powers

Exercise 01

Consider the electrical circuit shown in Fig 1, the source current and voltage are:

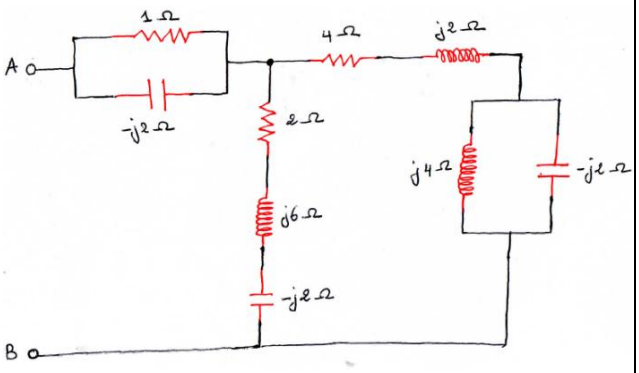
$i(t) = 5\,Sin(314t + \frac{2\pi}{3})$ And $v(t) = 15\,Sin(314t + \frac{5\pi}{6})$



1. Calculate the equivalent impedance $\underline{Z}$ seen by the source.
2. Give the numerical values of: R, L and Z.
3. Calculate the powers of the circuit: active(real) power P, reactive power Q and apparent power S relative to this circuit.
4. Draw the power triangle of the circuit and specify the power factor.

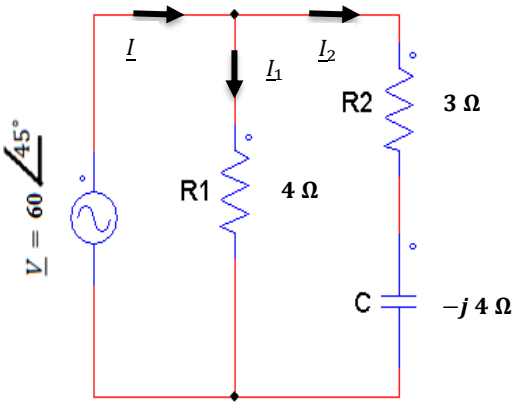
Exercise 02

Calculate the equivalent impedance $\underline{Z_{AB}}$ between the two points A and B.



Exercise 03

Consider the single-phase circuit shown in Figure 3, supplied by a sinusoidal AC voltage source.



1. Write, in complex (phasor) form, the expressions of the current $\underline{\boldsymbol{I_1}}$, $\underline{\boldsymbol{I_2}}$ and $\underline{\boldsymbol{I}}$ for the given circuit.
2. Determine the equivalent impedance $\underline{\boldsymbol{Z_{eq}}}$ seen by the source.
3. Find the phasor expression of the voltage across the capacitor $\underline{\boldsymbol{V_c}}$.
4. Calculate the real power $\boldsymbol{P}$, the reactive power $\boldsymbol{Q}$ and the complex power $\underline{\boldsymbol{S}}$ associated with the circuit.

Exercise 04

A single-phase electrical installation, supplied by **220 V / 50 Hz** comprises:
- **Ten 100 W** lamps;
- A **1,5 kW** electric radiator;
- Three identical electric motors, each absorbing a power of **2 kW** with a power factor of **0.70**.

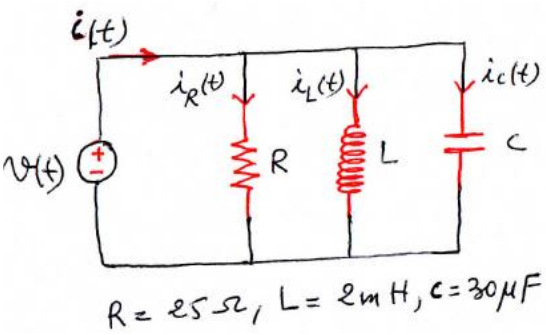
These different devices operate simultaneously.

1- What are the active and reactive powers consumed by the installation?
2- What is its power factor?
3- What is the rms current in the line cable?

Exercise 05:

Consider the circuit in fig 4, supplied by a sinusoidal voltage source:

$$v(t) = 100\,Sin(5000t + 45°)$$



1. Calculate the current in each branch ($i_R(t)$, $i_C(t)$ et $i_L(t)$).
2. Derive the expression for the total current $i(t)$ delivered by the source.
3. Calculate the equivalent impedance of the circuit.
4. Compute the electrical powers using the RMS quantities: active, reactive and apparent power consumed by the circuit.

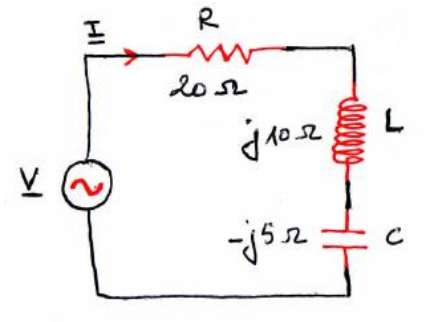
Exercise 06

Consider the circuit shown in the figure 5

The source voltage is a sinusoidal signal whose phasor (RMS) is $\underline{V}$.

with magnitude V = 100V at frequency (f = 50 Hz).

All circuit elements are given directly by their complex impedances (use $\underline{Z}$ values as shown on the schematic).



The components of the circuit are directly characterized by the value of their complex impedance.

1) Calculate the effective value of the current.

2) Calculate the phase of the current if we consider the voltage at the origin of the phases. Then write the instantaneous expressions of v and i.

3) Write the KVL that governs the circuit and give its vector diagram.

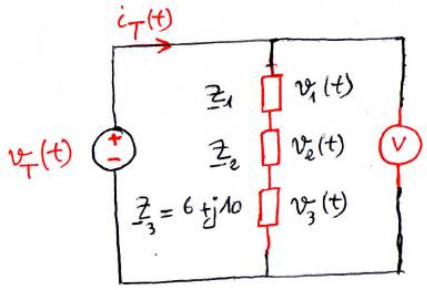
Exercise 07

The voltages at the terminals of each impedance are given in fig 6.

$v_1(t) = 70.7\,Sin(\omega t + 30^\circ)$ $[V]$

$v_2(t) = 28.3\,Sin(\omega t + 120^\circ)$ $[V]$

$v_3(t) = 14.14\,Cos(\omega t + 30^\circ)$ $[V]$



1. Find the expression of $v_T\ (t)$ and $i(t)$.
2. Calculate the equivalent impedance of the circuit.
3. Give the voltmeter reading.