Course Exercises

Power Systems Analysis

Fall 2024

2.1 Fundamental aspects for the study of AC circuits

Problem 2.1.1: Voltage and Current Phasors

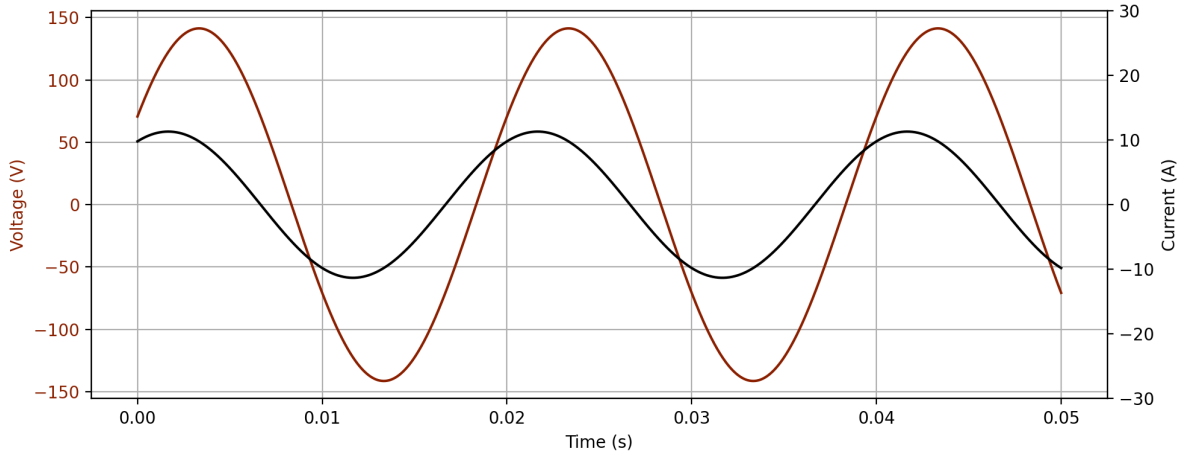
If $v(t) = 141.4\sin(\omega t + 30°)$ V and $i(t) = 11.31\cos(\omega t - 30°)$ A, find for each:

(a) the maximum value,

(b) the RMS value, and

(c) the phasor expression in polar and rectangular form if the voltage is the reference.

(d) Is the circuit inductive or capacitive?



Problem 2.1.2: Impedance Calculation

If the circuit of Problem 2.1.1 consists of a purely resistive and a purely reactive element, find their parameters:

(a) if the elements are in series, and

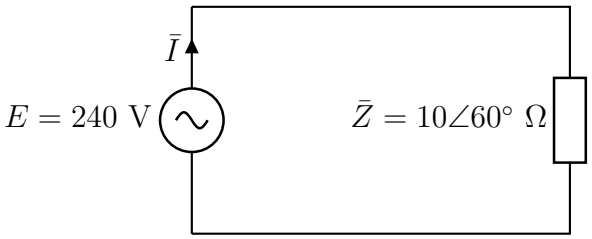
(b) if the elements are in parallel.

Problem 2.1.3: Voltage Difference

In a single-phase circuit $\bar{E}_a = 120\angle 45°$ (V) and $\bar{E}_b = 100\angle(-15°)$ V with respect to a reference node O. Find $\bar{V}_{ba}$ in polar form.

Problem 2.1.4: AC Circuit Power Calculation

A single-phase AC voltage of 240 V is applied to a series circuit whose impedance is $10\angle 60°$ (Ω). Find R, X, P, Q, and the power factor of the circuit.



Problem 2.1.5: Effect of Parallel Capacitor

If a capacitor is connected in parallel with the circuit of Problem 2.1.4, and if this capacitor supplies 1250 VAr, find the P and Q supplied by the 240-V source, and find the resultant power factor.

Problem 2.1.6: Power Factor Correction

A single-phase inductive load draws 10 MW at 0.6 power-factor lagging. Draw the power triangle and determine the reactive power of a capacitor to be connected in parallel with the load to raise the power factor to 0.85.

Problem 2.1.7: Three Phase Power

A balanced three-phase load is connected to a 415 V (line to line), 50 Hz, three-phase power supply. The load draws a line current of 20 A with a power factor of 0.8 lagging. Find the values of P and Q drawn by the load.