

ECS 203 (CPE2)

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CHAPTER 8

Sinusoidal Steady State Analysis

8.1. General Approach

In the previous chapter, we have learned that the steady-state response of a circuit to sinusoidal inputs can be obtained by using phasors. In this chapter, we present many examples in which nodal analysis, mesh analysis, Thevenin's theorem, superposition, and source transformations are applied in analyzing ac circuits.

8.1.1. Steps to analyze ac circuits, using phasor domain:

Step 1. Transform the circuit to the phasor or frequency domain.

- Not necessary if the problem is specified in the frequency domain.

Step 2. Solve the problem using circuit techniques (e.g., nodal analysis, mesh analysis, Thevenin's theorem, superposition, or source transformations)

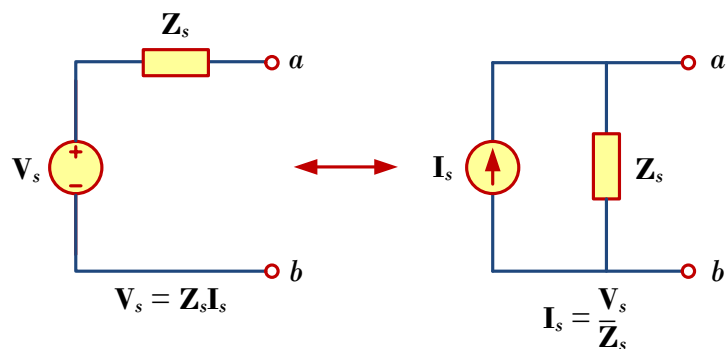
- The analysis is performed in the same manner as dc circuit analysis except that complex numbers are involved.

Step 3. Transform the resulting phasor back to the time domain.

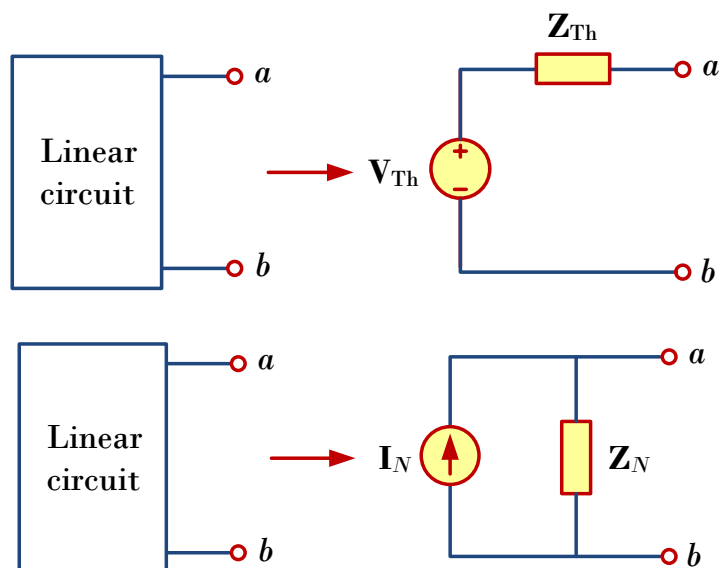
8.1.2. The **superposition theorem** applies to ac circuits the same way it applies to dc circuits. This is the case when all the sources in the circuit operate at the same frequency.

8.1.3. Source transformation:

$$\mathbf{V}_s = \mathbf{Z}_s \mathbf{I}_s, \quad \mathbf{I}_s = \frac{\mathbf{V}_s}{\mathbf{Z}_s}.$$

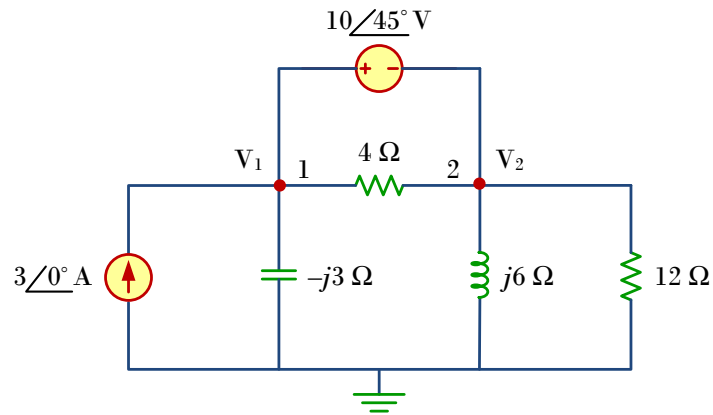


8.1.4. Thevenin and Norton Equivalent circuits:

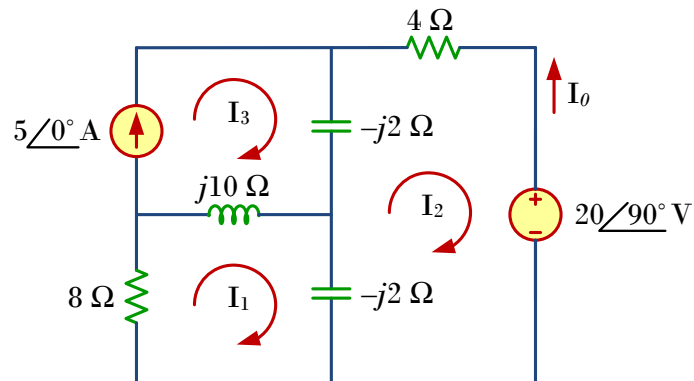


$$\mathbf{V}_{Th} = \mathbf{Z}_N \mathbf{I}_N, \quad \mathbf{Z}_{Th} = \mathbf{Z}_N$$

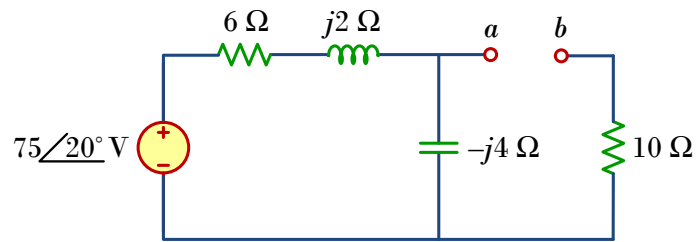
EXAMPLE 8.1.5. Compute \mathbf{V}_1 and \mathbf{V}_2 in the circuit below using nodal analysis.



EXAMPLE 8.1.6. Determine current \mathbf{I}_o in the circuit below using mesh analysis.



EXAMPLE 8.1.7. Find the Thevenin equivalent at terminals a - b of the circuit below.



EXAMPLE 8.1.8. **Op Amp AC Circuits:** Find the (closed-loop) gain of the circuit below.

