Alexander-Sadiku
Fundamentals of Electric Circuits

Chapter 10
Sinusoidal Steady-State Analysis

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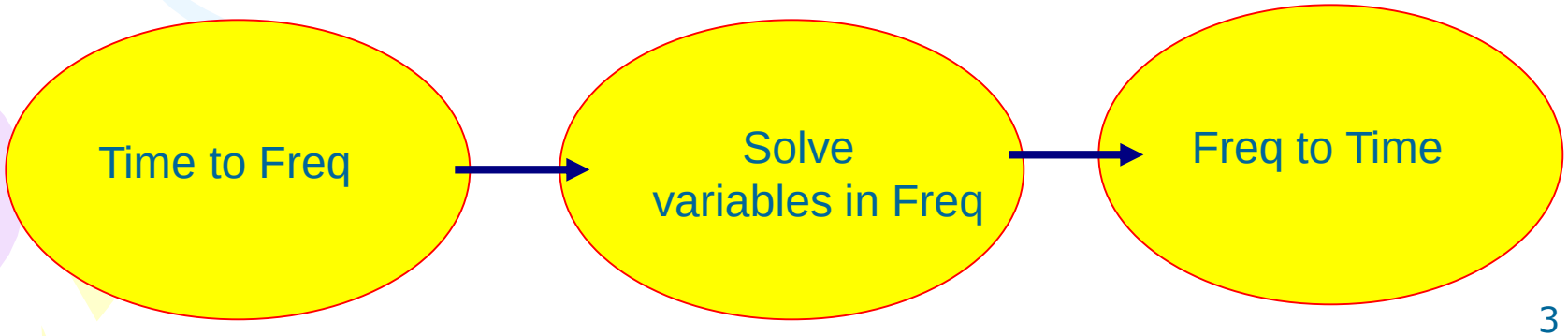
Sinusoidal Steady-State Analysis
Chapter 10

10.1 Basic Approach
10.2 Nodal Analysis
10.3 Mesh Analysis
10.4 Superposition Theorem
10.5 Source Transformation
10.6 Thevenin and Norton Equivalent Circuits

10.1 Basic Approach (1)

Steps to Analyze AC Circuits:

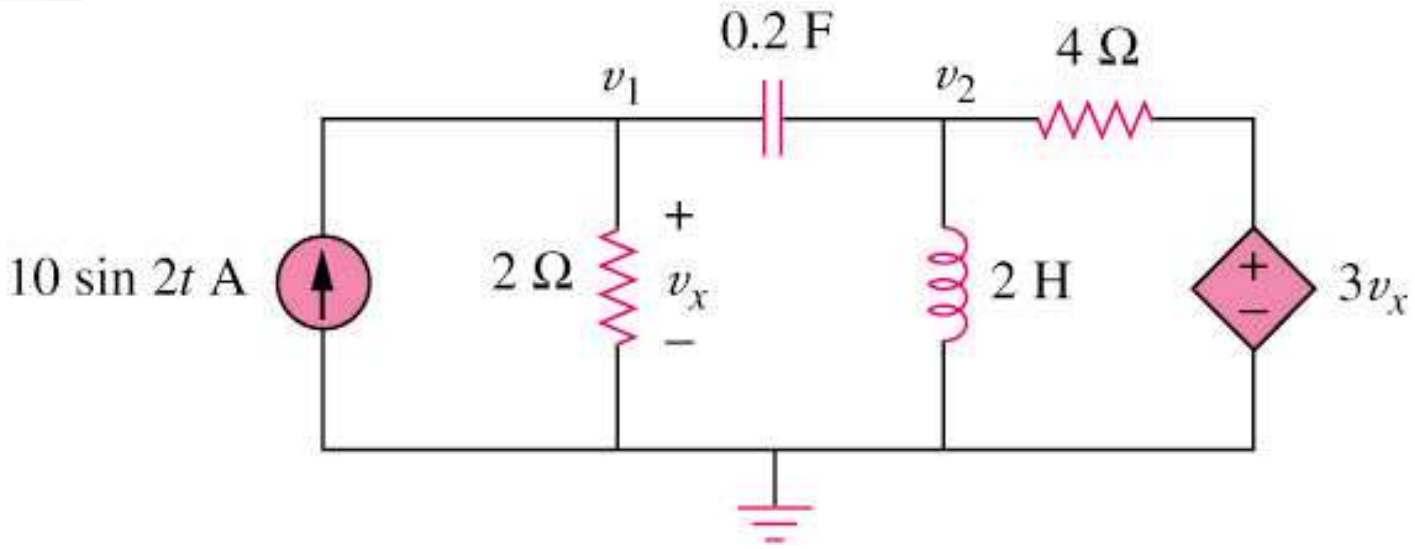
1. Transform the circuit to the phasor or frequency domain.
2. Solve the problem using circuit techniques (nodal analysis, mesh analysis, superposition, etc.).
3. Transform the resulting phasor to the time domain.



10.2 Nodal Analysis (1)

Example 1

Using nodal analysis, find v_1 and v_2 in the circuit of figure below.



Answer:

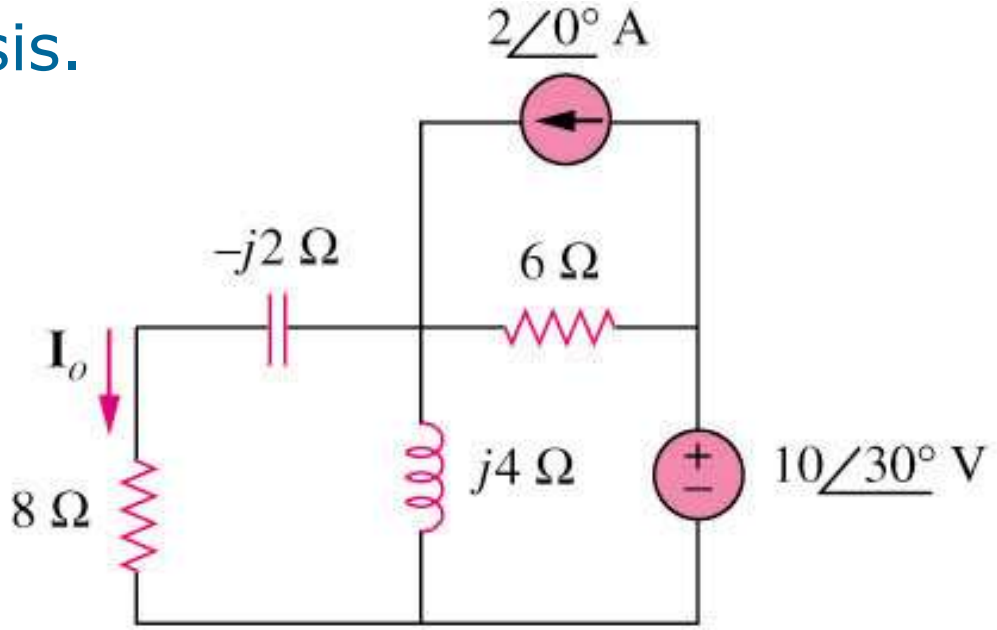
$v_1(t)$ = **11.32 sin(2t + 60.01°) V**

$v_2(t)$ = 33.02 sin(2t + 57.12°) V

10.3 Mesh Analysis (1)

Example 2

Find I_o in the following figure using mesh analysis.



Answer: $\mathbf{I_o = 1.194\angle 65.44^\circ\ A}$

10.4 Superposition Theorem (1)

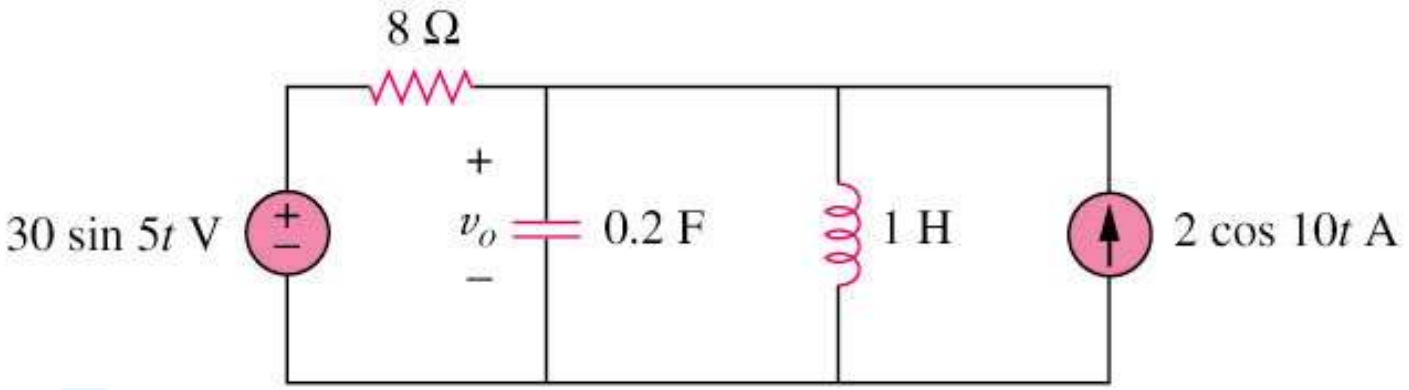
When a circuit has sources operating at different frequencies,

- The separate phasor circuit for each frequency must be solved independently, and
- The total response is the sum of time-domain responses of all the individual phasor circuits.

10.4 Superposition Theorem (2)

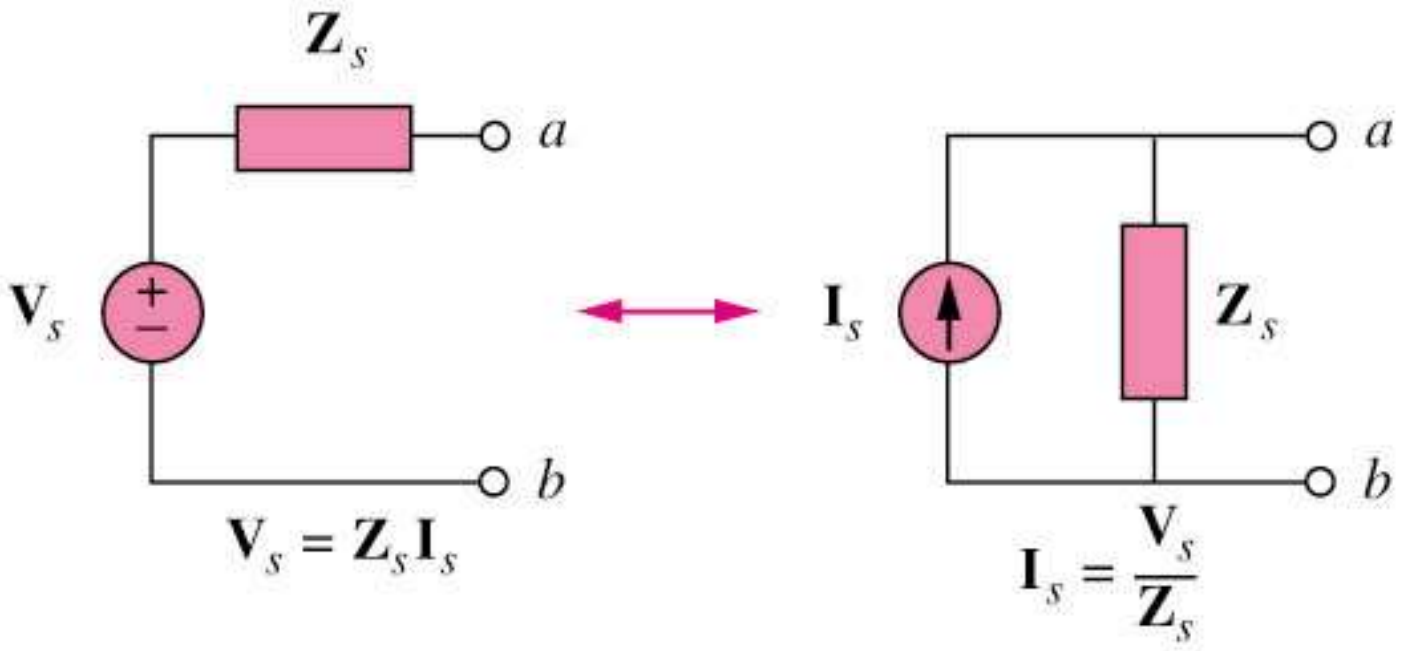
Example 3

Calculate v_o in the circuit of figure shown below using the superposition theorem.



V_o = **4.631 sin(5t – 81.12°) + 1.051 cos(10t – 86.24°) V**

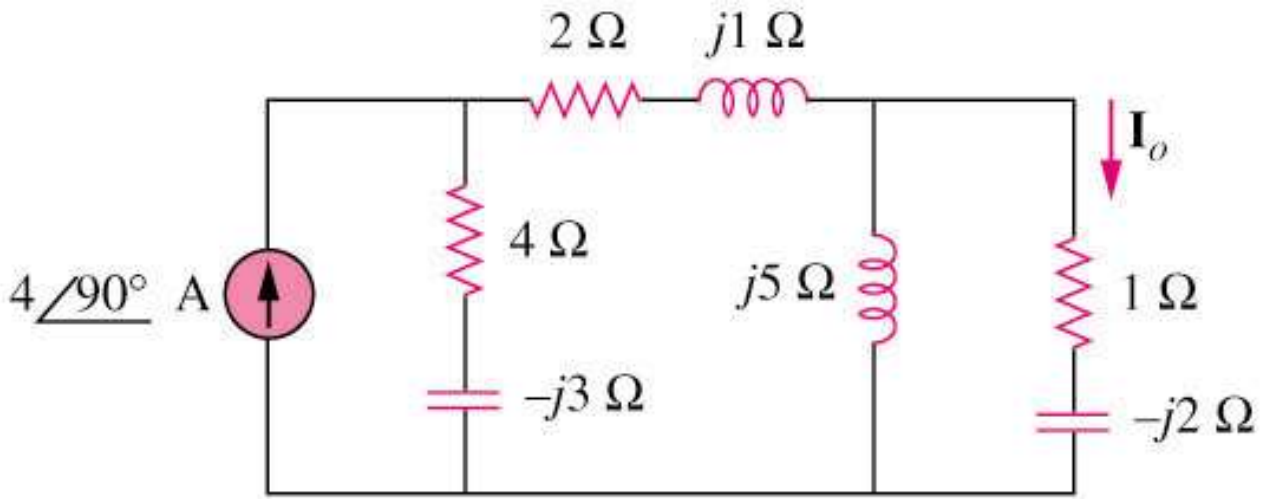
10.5 Source Transformation (1)



10.5 Source Transformation (2)

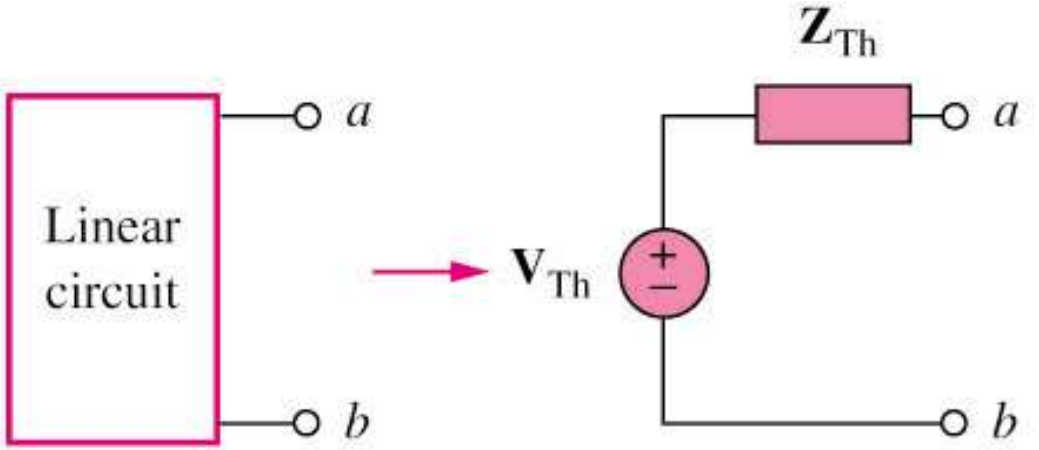
Example 4

Find Io in the circuit of figure below using the concept of source transformation.

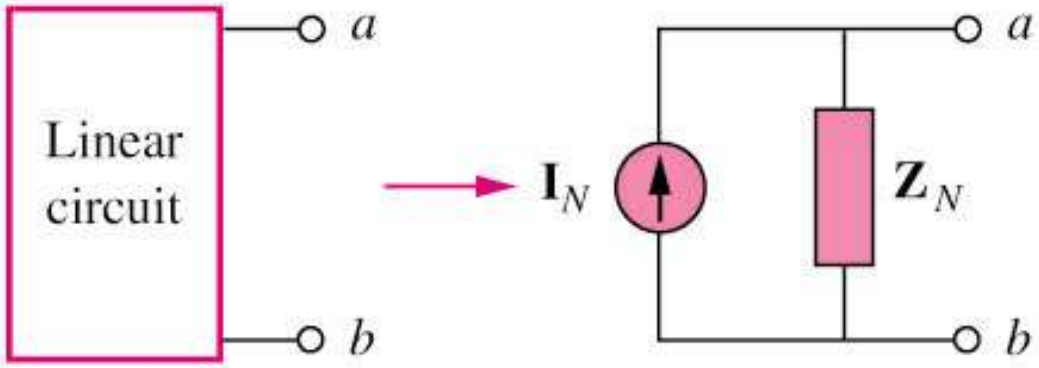


I_o = **3.288∠99.46° A**

10.6 Thevenin and Norton Equivalent Circuits (1)



Thevenin transform

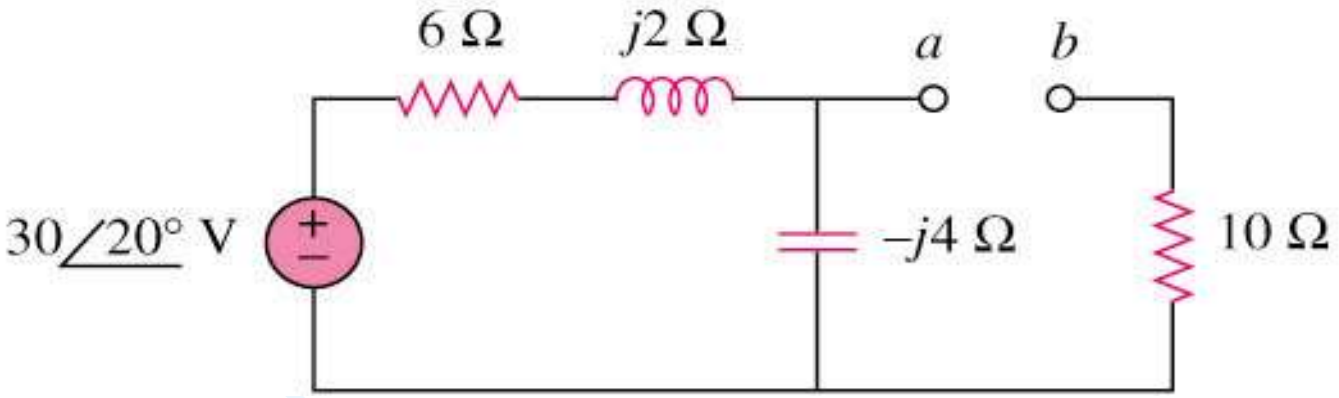


Norton transform

10.6 Thevenin and Norton Equivalent Circuits (2)

Example 5

Find the Thevenin equivalent at terminals a–b of the circuit below.



Z_{th} = **12.4 – j3.2 Ω**

V_{TH} = **18.97∠-51.57° V**