Chapter 3

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Objectives
Learn to:
- Apply the node-voltage and mesh-current methods to analyze an electric circuit of any configuration, so long as it is linear and planar.
- Apply the by-inspection methods to circuits that satisfy certain conditions.
- Use the source-superposition method to evaluate the sensitivity of a circuit to the various sources in the circuit.

The basic laws of Chapter 2 are used in the present chapter to develop standard solution methods that can be applied to analyze any linear circuit, no matter how complex.

- Determine the Thévenin and Norton equivalent circuits of any input circuit and use them to evaluate the response of an external load (or an output circuit) to the input circuit.
- Establish the conditions for maximum transfer of current, voltage, and power from an input circuit to an external load.
- Learn the basic properties of the bipolar junction transistor.
Thévenin’s Theorem

Linear two-terminal circuit can be replaced by an equivalent circuit composed of a voltage source and a series resistor

\[ v_{\text{Th}} = v_{\text{oc}} \]

voltage across output with no load (open circuit)

\[ R_{\text{Th}} = R_{\text{in}} \]

Resistance at terminals with all independent circuit sources set to zero

(a) Measuring \( v_{\text{oc}} \) on actual circuit

(b) Measuring \( v_{\text{Th}} \) of equivalent circuit
How Do We Find Thévenin/Norton Equivalent Circuits?

**Method 1: Open circuit/Short circuit**

1. Analyze circuit to find $v_{oc}$
2. Analyze circuit to find $i_{sc}$
3. $v_{Th} = v_{oc}$
4. $R_{Th} = \frac{v_{Th}}{i_{sc}}$

**Note:** This method is applicable to any circuit, whether or not it contains dependent sources.
Example 3-11: Thévenin Equivalent

(a) Original circuit

\[ V_L = V - 2I = V \]

\[ 6 \Omega \quad 2 \Omega \quad 7 \Omega \]

\[ 24 \text{ V} \]

\[ 12 \Omega \]

\[ V_L = V \]

\[ I_L = \frac{V}{R_L} \]

\[ b \]

\[ b = 0 \]

\[ I = 0 \]

\[ 7 \text{ A} \]

\[ K_{be} = V_{Th} \]

\[ V_{oc} \]

\[ V_{Th} = -12 \text{ V} \]

\[ V_{oc} = 12 \text{ V} \]

\[ V_c = -12 \text{ V} \]

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