Assignment #5 Due Wed Feb.19 by 1 PM

Midterm #2 Feb. 20 (1 week from today)
Equation notesheet, sample exam & topics posted
More on it Tue

Midterm Review Session Sunday 12-2 pm
announcement to be posted on Canvas

Previous Class
Source transformations

Previous Class
Thevenin Equivalent Circuit

\[
V_{\text{oc}} = \text{open circuit (} R_L = \infty \text{)} \text{ voltage} \quad \Rightarrow \quad V_{\text{Th}} = V_{\text{oc}} \quad ; \quad I_s = \frac{V_{\text{Th}}}{R_{\text{Th}}} \quad \Rightarrow \quad R_{\text{Th}} = \frac{V_{\text{Th}}}{I_s}
\]

\[
\begin{align*}
V_{\text{oc}} &= 32V \\
I &= 2A \\
\frac{V_{\text{oc}}}{12} &= a + b \\
\frac{V_{\text{oc}}}{4} &= b
\end{align*}
\]

\[
\begin{align*}
V_1 - \frac{32}{4} + \frac{V_1}{12} - 2 &= 0 \quad \Rightarrow \quad V_1 = 36V
\end{align*}
\]
\[ V_{th} = V_{oc} = V_1 = 30V \]

\[ 32V \]

\[ 12V \]

\[ 2A \]

\[ l_{sc} \]

\[ R_{th} = \frac{V_{th}}{I_{sc}} = \frac{30}{7.5} = 4 \Omega \]

Need at least one independent source.

This method is the short-circuit method for calculating \( R_{th} \).

Alternate methods to calculate \( R_{th} \):

1) Equivalent-resistance method
   Set all independent sources to zero (i.e. all independent sources are deactivated).
   \[ V_S \rightarrow 0 \Rightarrow \text{short circuit} \]
   \[ I_S \rightarrow 0 \Rightarrow \text{open circuit} \]

Then calculate the resistance \( R_{ab} \) seen across terminals \( a-b \):

\[ R_{th} = R_{ab} \]

There can be no dependent source in the circuit.

2) External-source method
   Set all independent sources to zero and apply an external (test) voltage (current) source at \( a-b \). Measure the corresponding current (voltage) and calculate \( R_{th} \) from this information.
\[ R_{Th} = \frac{V_{ex}}{I_{ex}} \]

Works with dependent sources!

\[ R_{Th} = 4 \Omega \]

- Norton Equivalent Circuit

\[ R_N = \frac{R_{Th}}{I_{Th}} \]

\[ I_N = \frac{V_{Th}}{R_{Th}} = I_{SC} \]
Maximum Power Transfer

Given a circuit that is represented by its Thevenin equivalent circuit, we would like to find the load resistance \( R_L \) for which maximum power is delivered to the load.

\[ P = \text{Power delivered to } R_L = V_L^2 R_L \]

\[ V_L = \frac{V_{Th}}{R_{Th} + R_L} \]

\[ P = \left( \frac{V_{Th}}{R_{Th} + R_L} \right)^2 R_L \]

Maximum power transfer takes place when \( R_L = R_{Th} \)

\[ P_{max} = \left( \frac{V_{Th}}{R_{Th} + R_{Th}} \right)^2 R_{Th} = \left( \frac{V_{Th}}{2R_{Th}} \right)^2 R_{Th} = \frac{V_{Th}^2}{4R_{Th}} \]

Ex

\[ R_L \text{ for max power transfer} = 5 \Omega \]

\[ P_{max} = \frac{10^2}{4 \times 5} = 5 \text{ W} \]