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EE1101: Circuits and Network Analysis

Lecture 10: DC Circuit Analysis

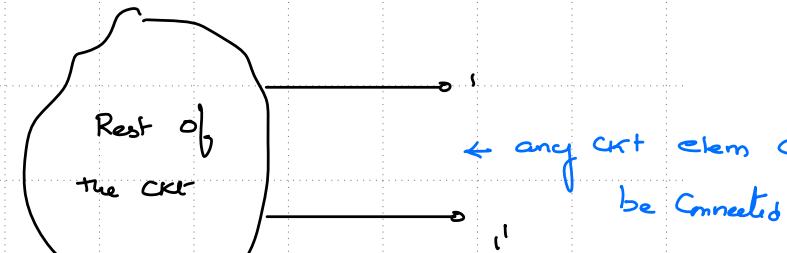
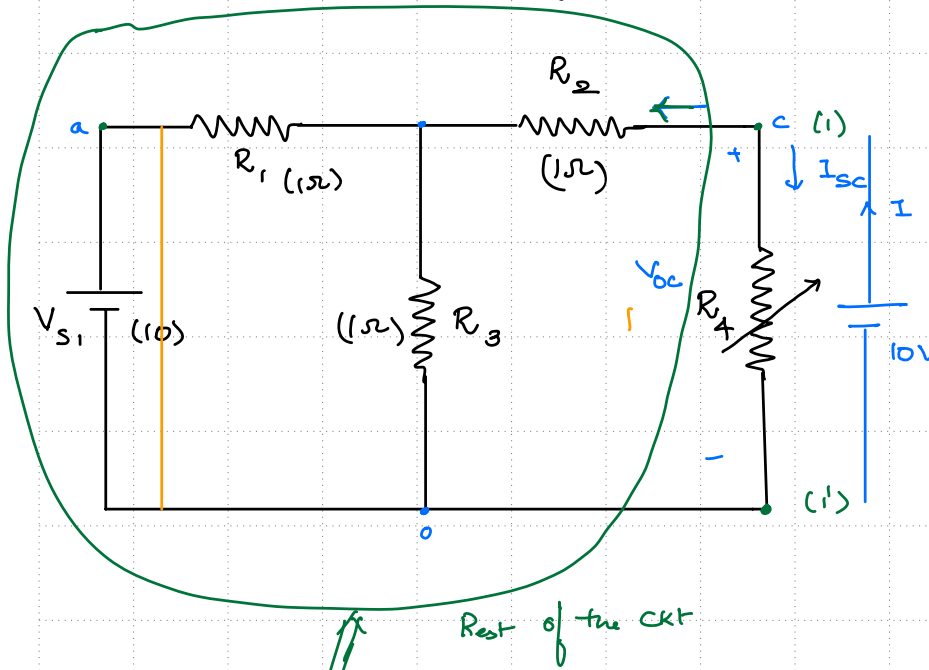
August 19, 2025

Topics :

1. Equivalent Circuits
2. Source Transformation

Using Port Parameters to find Circuit Response

one motivation:- If only one element in the ckt changes \rightarrow Remove the ckt element and def it as a port.

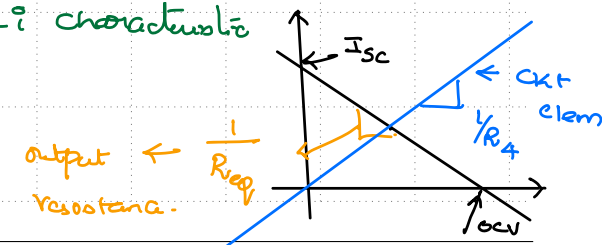


characterize with 3 parameters

- open ckt Voltage (OCV) \rightarrow b/w 1-1'
- Short ckt Current (SCC) \rightarrow from 1 to 1'

- Eq. Resistance (R_{eq})
 - Current ref into node 1
 - Current ref out of node 1.
- using R_{eq} Seeing into Port
- R_{eq} Seeing out of Port.

get the $V-i$ characteristic



for the example

Open ckt Voltage = 5V

Short ckt Current = $10/3$ A.

Eq. (input resistance) or as seeing into port $\left\{ = \frac{3}{2} \Omega \right.$

Eq. (output) resistance or seeing out of the port $= -\frac{3}{2} \Omega$.

Using Port Parameters to find Circuit Response

Two Circuits are Equivalent (as seen from a common port), if their V-i characteristics are the same.

a) Thevenin Equivalent

developing an EQ. circuit
to match V_{oc} & R_{eq} leads to

are same if any of
these match

→ a) V_{oc} & R_{eq}

→ b) I_{sc} & R_{eq}

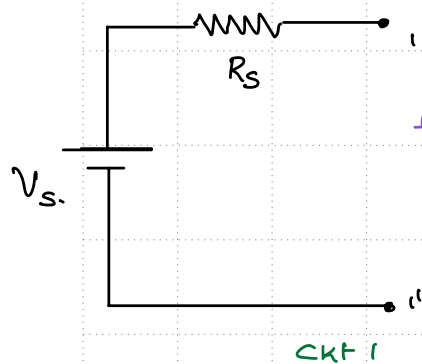
→ c) V_{oc} & I_{sc} .

b) Norton Equivalent

developing an EQ. circuit
to match I_{sc} & R_{eq} leads to

c) Source Transformation

Source Transformation

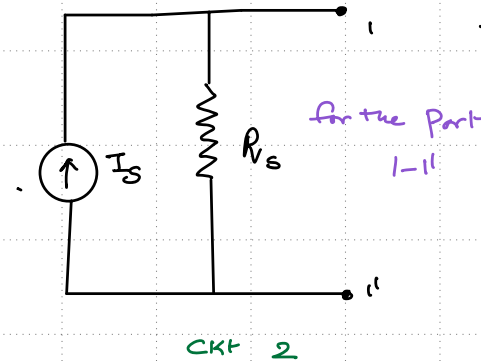


for the Part 1-1'

$$V_{oc} = V_s$$

$$I_{sc} = \frac{V_s}{R_s}$$

$$R_{eq}(out) = -R_s$$



for the Part 1-1'

$$V_{oc} = R_s I_s$$

$$I_{sc} = I_s$$

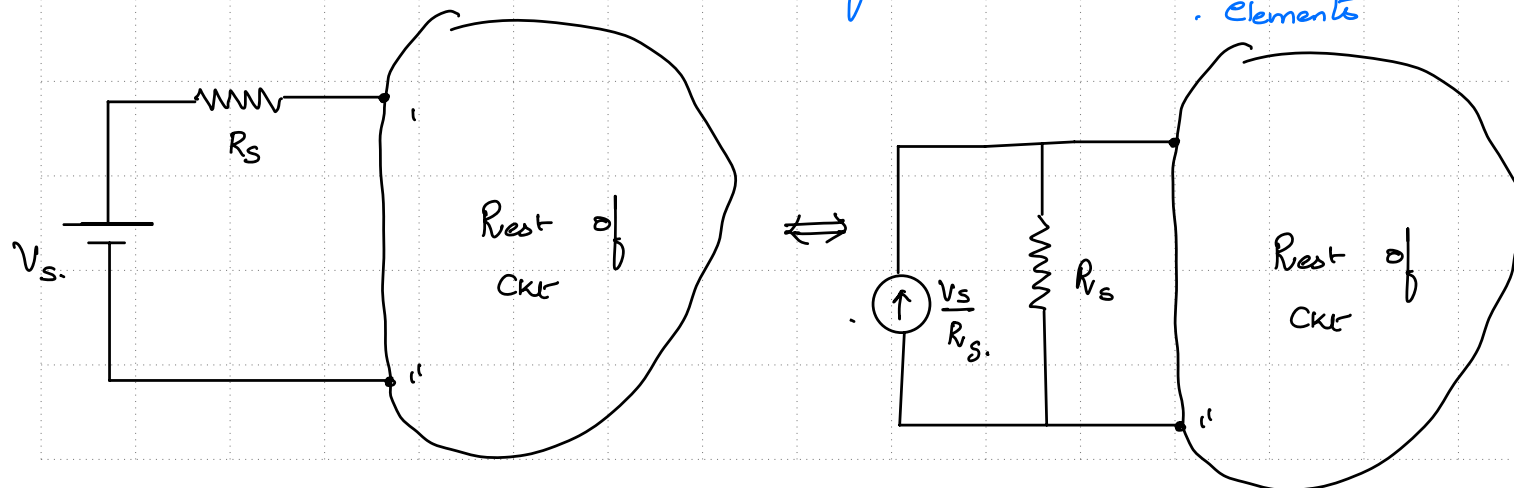
$$R_{eq}(out) = -R_s$$

Ckt ② is Equivalent to Ckt ① if $I_s = \frac{V_s}{R_s}$

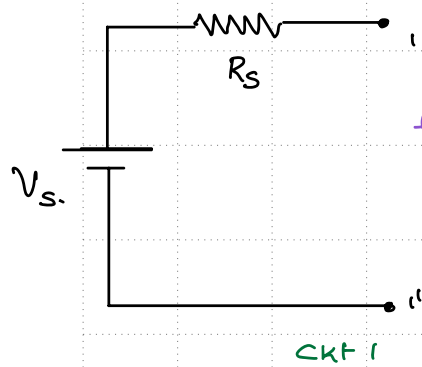
Voltage Source + Series Resistor can be replaced by a Current Source + Parallel Resistor

useful when the goal is to find the response in external elements

Mag of Current Source = V_s/R_s



Source Transformation

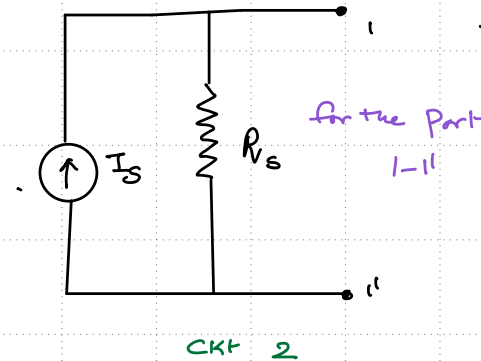


for the Part 1-1'

$$V_{oc} = V_s$$

$$I_{sc} = \frac{V_s}{R_s}$$

$$R_{eq}(out) = -R_s$$



for the Part 1-1'

$$V_{oc} = R_s I_s$$

$$I_{sc} = I_s$$

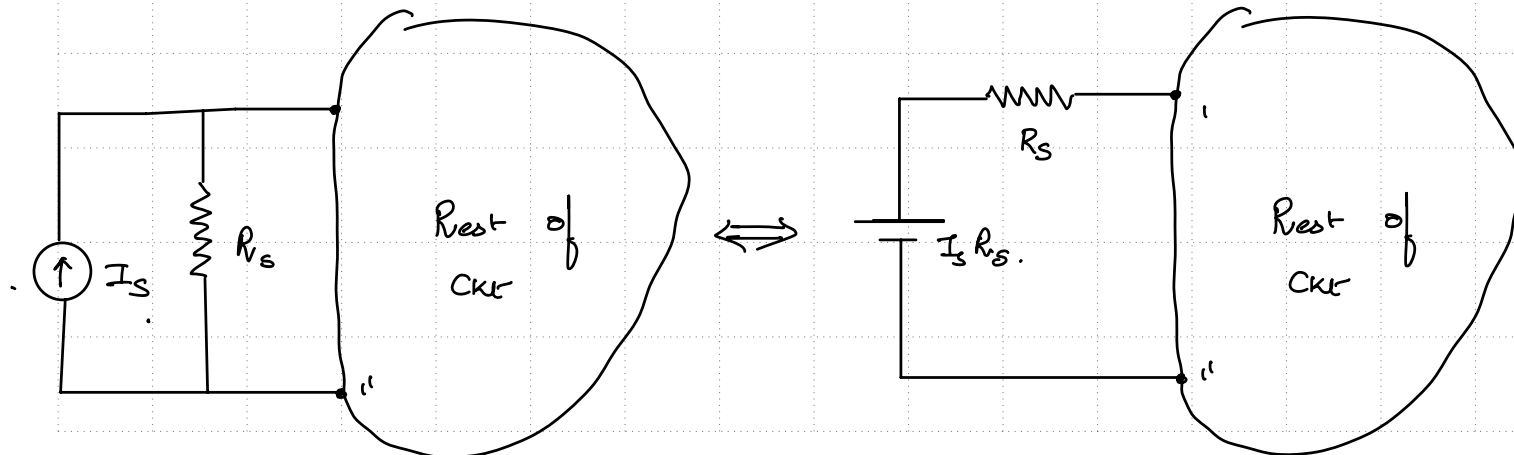
$$R_{eq}(out) = -R_s$$

Ckt ① is equivalent to Ckt ② if $V_s = I_s R_s$

Current Source + Parallel Resistor can be replaced by a Voltage Source + Series Resistor

useful when the goal is to find the response in external elements

Mag of Voltage Source = $I_s R_s$



Equivalent Circuit

