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# EE1101: Circuits and Network Analysis

## Lecture 10: DC Circuit Analysis

August 19, 2025

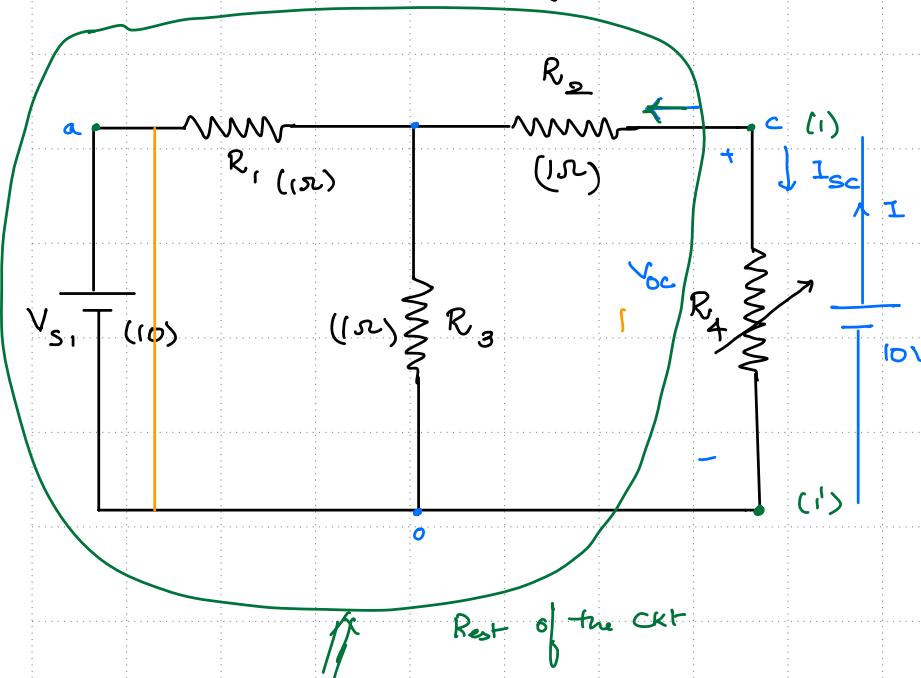
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### Topics :

1. Equivalent Circuits
  2. Source Transformation
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## 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.



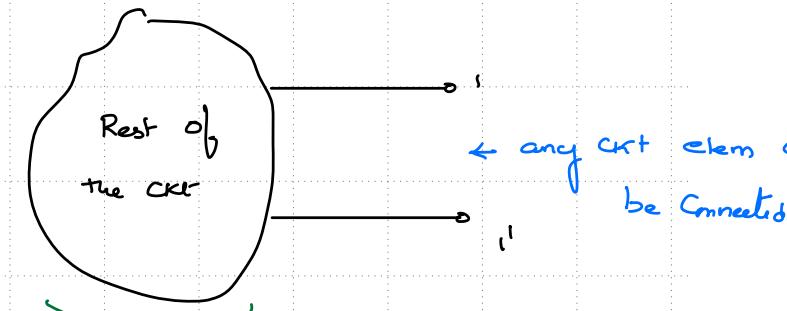
for the example

$$\text{Open ckt Voltage} = 5V$$

$$\text{Short ckt Current} = 10/3 A.$$

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

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

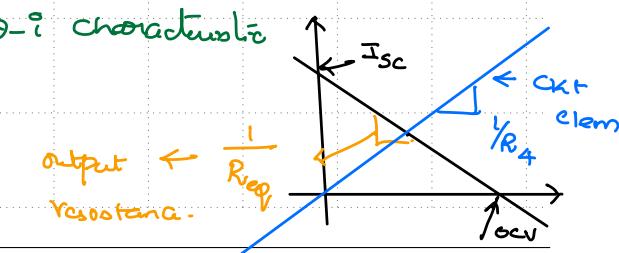


- a) open ckt Voltage (ocv)  $\rightarrow$  b/w 1-1'
- b) Short ckt Current (sc)  $\rightarrow$  from 1 to 1'

c) Eq. Resistance ( $R_{eq}$ )

Current ref into node 1  
Current ref out of node 1.  
 $R_{eq}$  Seeing into Port  
 $R_{eq}$  Seeing out of Port.

get the  $V-I$  characteristic



## 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)  $I_{sc}$  &  $R_{eq}$

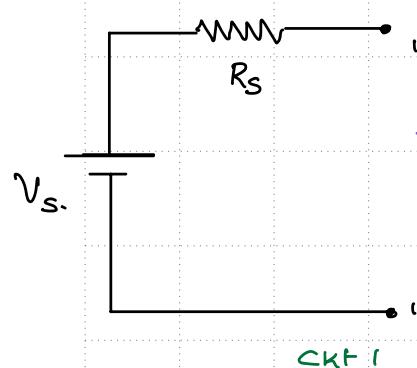
→ c)  $V_{oc}$  &  $I_{sc}$ .

b) Norton Equivalent

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

c) Source Transformation

## Source Transformation

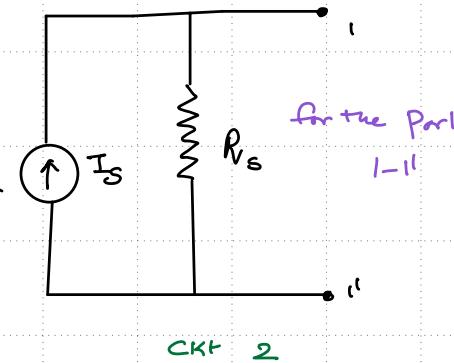


$$V_{oc} = V_s$$

for the Port 1-11

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

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



$$V_{oc} = R_s I_s$$

for the Port 1-11

$$I_{sc} = I_s$$

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

CKT ② is equivalent to CKT ① if  $I_s = \frac{V_s}{R_s}$

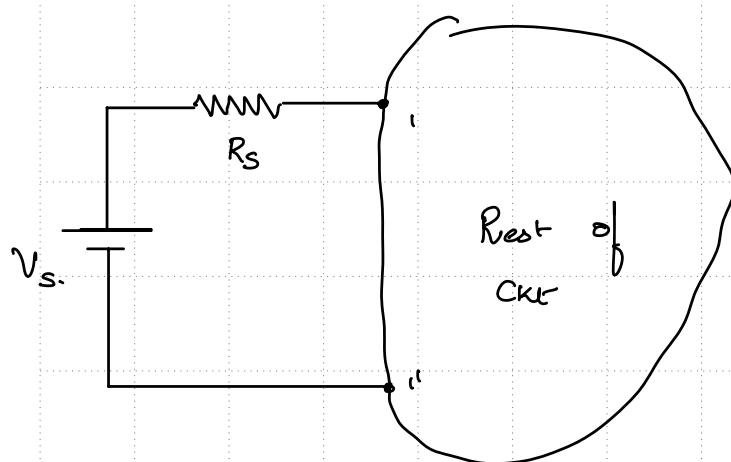
Voltage Source + Series Resistor can be replaced by a Current Source +

useful when the

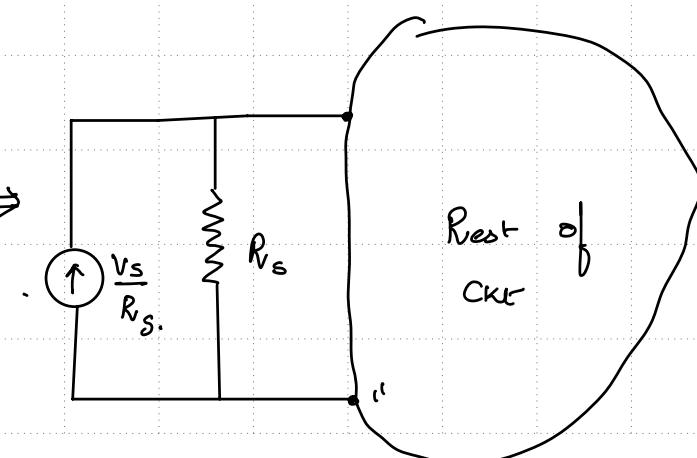
parallel resistor

goal is to find the response in external elements

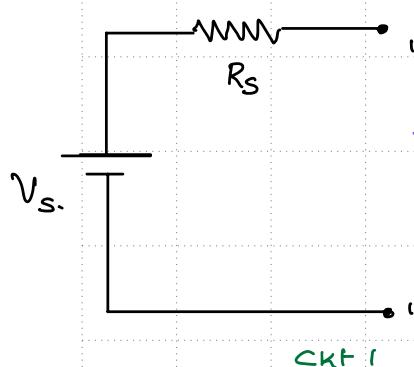
Mag of Current Source  
=  $V_s/R_s$



$\Leftrightarrow$



## Source Transformation

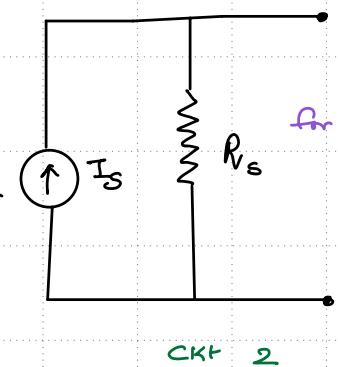


$$V_{oc} = V_s$$

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$$V_{oc} = R_s I_s$$

for the Port 1-11

$$I_{sc} = I_s$$

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

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

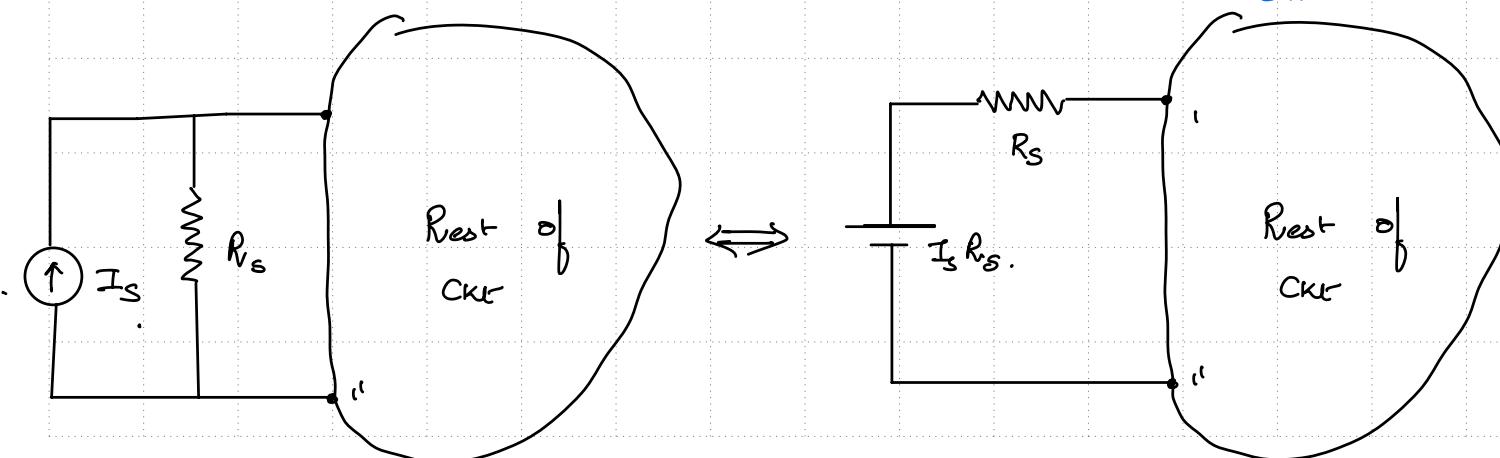
Current Source + Parallel Resistor can be replaced by a Voltage Source +

useful when the

goal is to find the response in external elements

Series Resistor

Mag of Voltage Source  
=  $I_s R_s$



## Equivalent Circuit

