

ECE 210 (AL2) - ECE 211 (E)

Chapter 2

Analysis of Linear Resistive Circuits

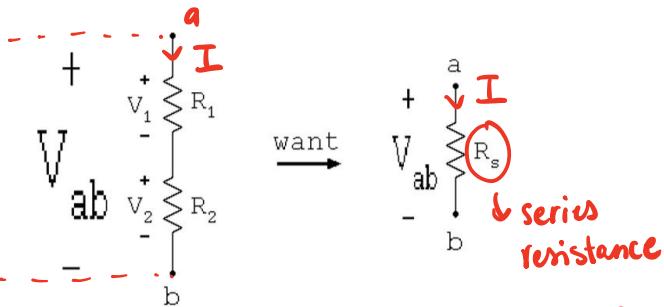


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Spring 2022

Outline

- Series and parallel resistor configurations
- Voltage and current division
- Sources transformations
- Node-voltage method
 - Supernode
- Loop current method
 - Superloop
- Linearity and superposition
- Thevenin and Norton equivalent circuits
 - Test signal method
- Available power

- Resistors in series



$$\text{KVL: } -V_{ab} + V_1 + V_2 = 0$$

$$V_1 + V_2 = V_{ab}$$

$$I \cdot R_1 + I \cdot R_2 = V_{ab}$$

$$V_{ab} = I(R_1 + R_2)$$

$$\Downarrow \\ I = \frac{V_{ab}}{R_1 + R_2} \quad (*)$$

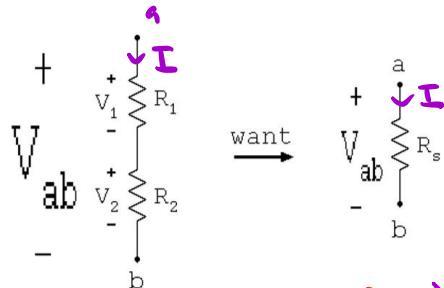
We want V_{ab}
and I to be
the same

$$V_{ab} = R_s \cdot I$$

$$\Rightarrow R_s = R_1 + R_2 \quad \text{for 2 res.}$$

$$\text{For } n \text{ res: } R_s = R_1 + R_2 + \dots + R_n$$

- Voltage division



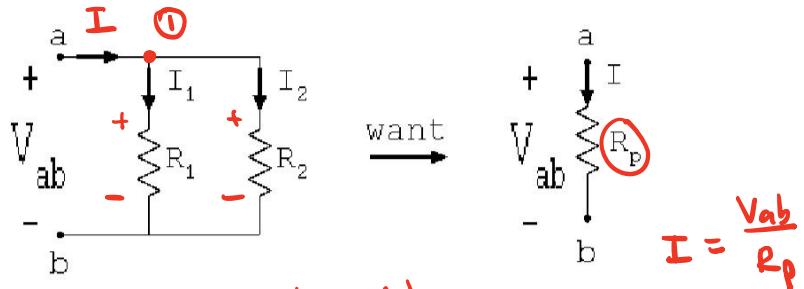
$$V_0 = R_1 \cdot I = R_1 \left(\frac{V_{ab}}{R_1 + R_2} \right) = V_{ab} \left(\frac{R_1}{R_1 + R_2} \right)$$

$$V_2 = R_2 \cdot I = V_{ab} \left(\frac{R_2}{R_1 + R_2} \right)$$

"Rs" only for 2 res!

for 2 or more res $\Rightarrow V_n = \left(\frac{R_n}{R_s} \right) V_{ab}$

- Resistors in parallel



KCL @ (1): $I = I_1 + I_2 = \frac{V_{ab}}{R_1} + \frac{V_{ab}}{R_2} = V_{ab} \left(\frac{1}{R_1} + \frac{1}{R_2} \right)$

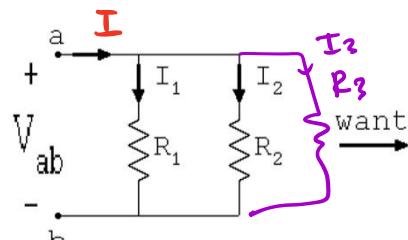
We want V_{ab} and I to be same

$\Downarrow \frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} \Rightarrow R_p = \frac{R_1 \cdot R_2}{R_1 + R_2}$

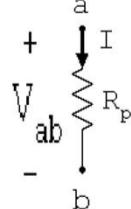
only for 2 res!

For n res: $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \dots + \frac{1}{R_n}$

- Current division



$$I_2 = \left(\frac{R_p}{R_2} \right) I$$



$$V_{ab} = I \cdot R_p \quad (**)$$

(**)

$$I_1 = \frac{V_{ab}}{R_1} = \frac{R_p \cdot I}{R_1} = \left(\frac{R_p}{R_1} \right) I = I \left(\frac{R_2}{R_1 + R_2} \right)$$

$$I_2 = \left(\frac{R_p}{R_2} \right) I = \left(\frac{R_1}{R_1 + R_2} \right) I \quad \text{--- only for 2 res!}$$

For n res: $I_n = \left(\frac{R_p}{R_n} \right) I$

$$R_p = \frac{R_1 \cdot R_2}{R_1 + R_2}$$