EEE104
Circuit Analysis I

Ankara University

Faculty of Engineering

Electrical and Electronics Engineering Department

Circuit Analysis Techniques

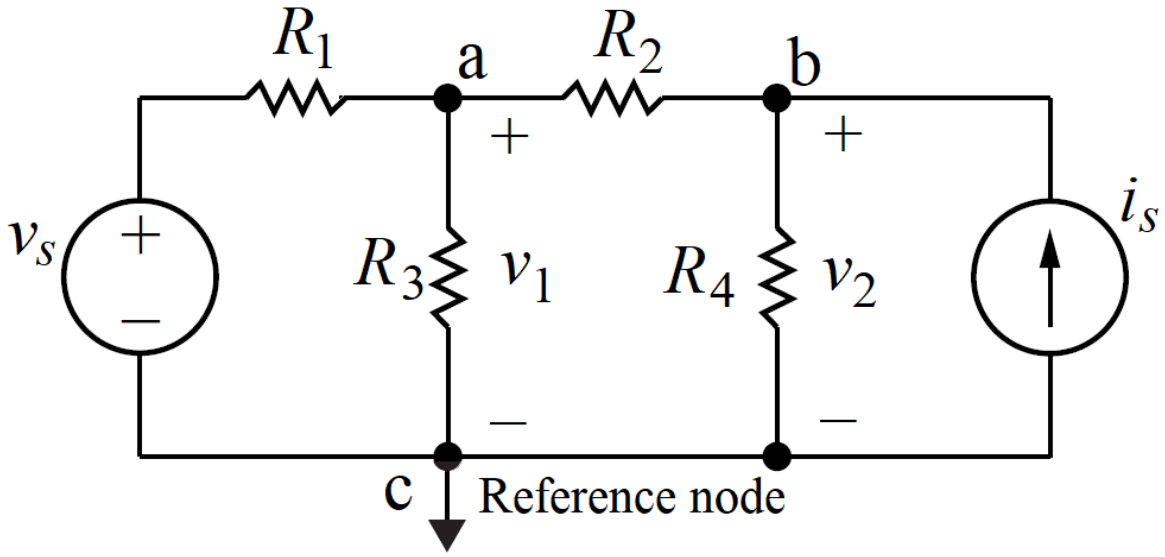
EEE104 Circuit Analysis I

Lecture 6

Agenda

- Node-Voltage Method
- Mesh-Current Method
- Source Transformations
- Thevenin and Norton Equivalent Circuits
- Maximum Power Transfer
- Superposition

- Node-Voltage Method



Essential Nodes: a,b c
(c is chosen as reference node)

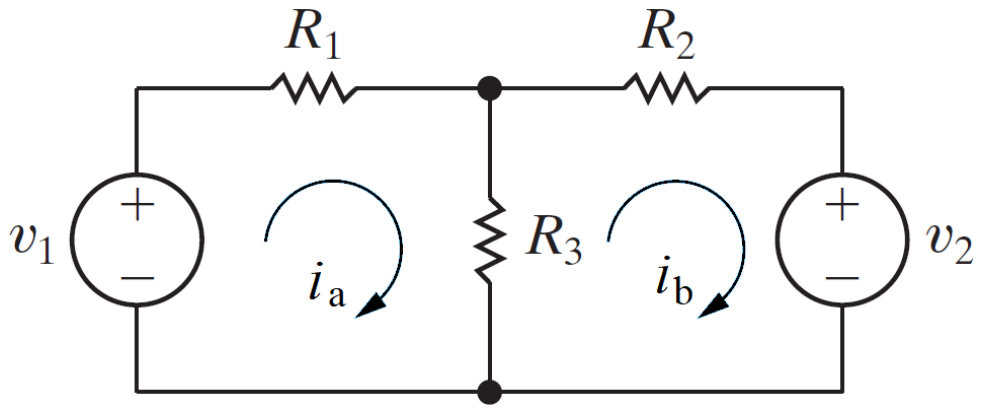
KCL for node a:

$$\frac{v_1 - v_s}{R_1} + \frac{v_1}{R_3} + \frac{v_1 - v_2}{R_2} = 0$$

KCL for node b:

$$\frac{v_2 - v_1}{R_2} + \frac{v_2}{R_4} - i_s = 0$$

- Mesh-Current Method



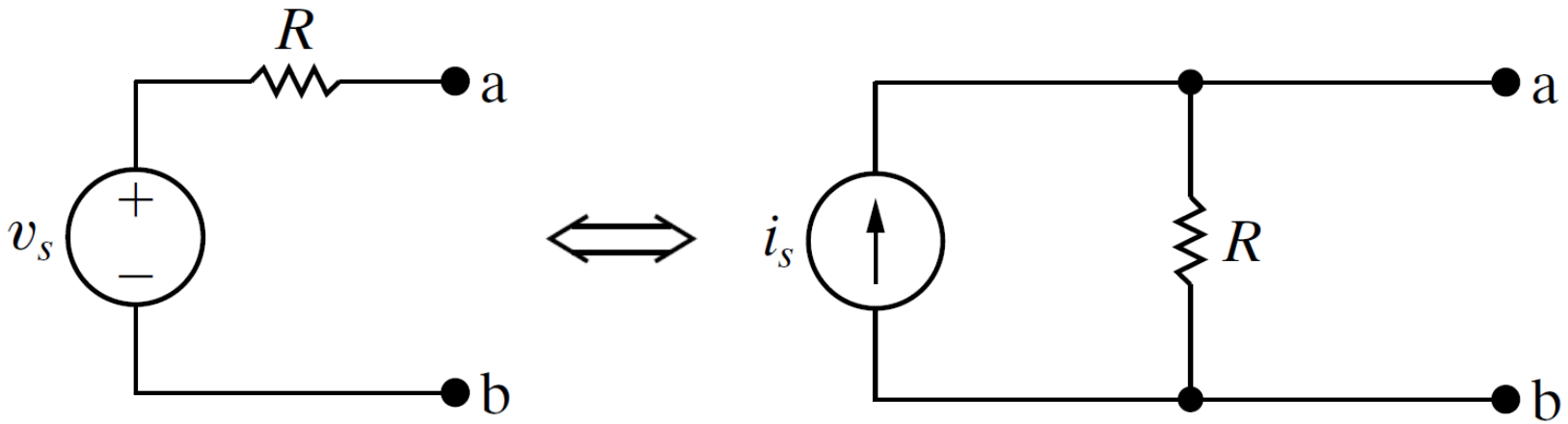
KVL for the mesh @ the left:

$$-v_1 + i_a R_1 + (i_a - i_b)R_3 = 0$$

KLV for the mesh @ the right:

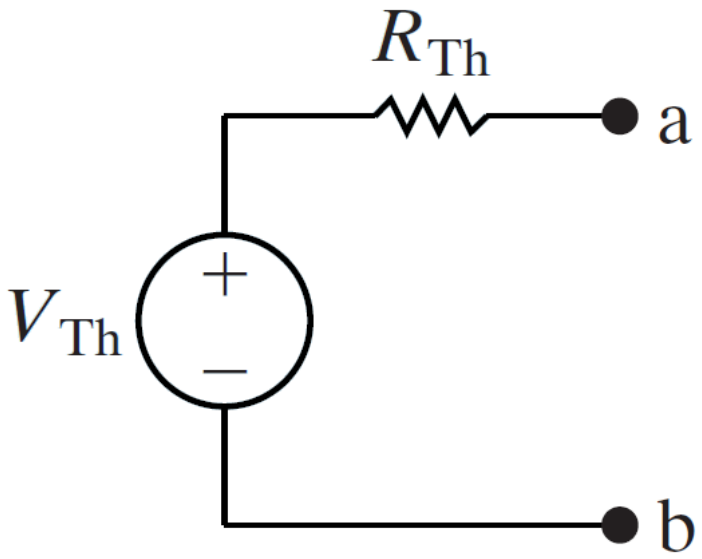
$$v_2 + (i_b - i_a)R_3 + i_b R_2 = 0$$

- Source Transformations

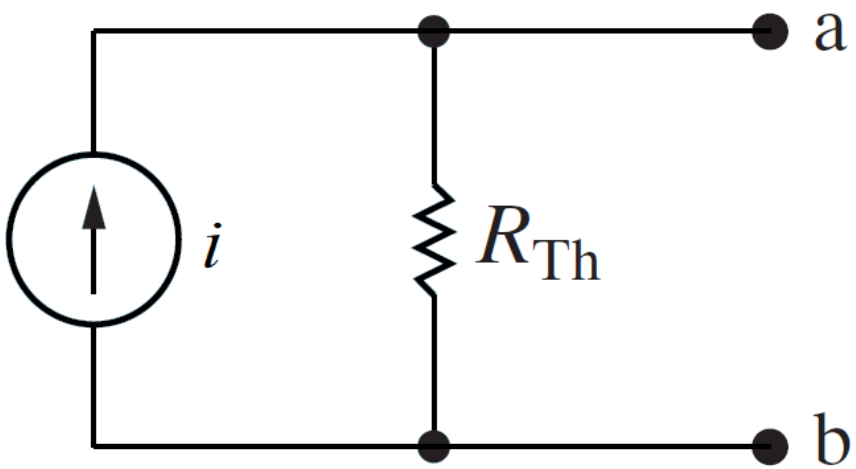


$$i_s = \frac{v_s}{R}$$

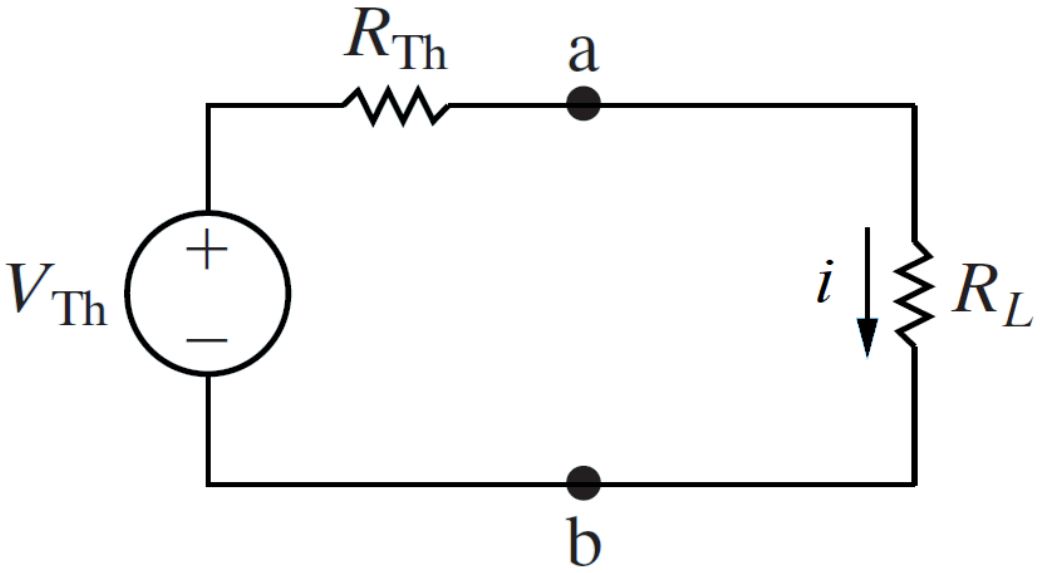
- Thevenin Equivalent Circuit



- Norton Equivalent Circuit



- Maximum Power Transfer



$$R_L = R_{Th}$$

$$p_{\max} = \frac{V_{\text{Th}}^2 R_L}{(2R_L)^2} = \frac{V_{\text{Th}}^2}{4R_L}$$

- Superposition

  Linear Time Invariant System

  * Applied for more then one independent sources
  * Total response is the sum of individual responses

Reference

- Electric Circuits, Tenth Edition, James W. Nilsson, Susan A. Riedel Pearson, 2015