Electric load

Alen Begović, full professor
Džemal Bijedić University of Mostar– Faculty of mechanical engineering

Electrical engineering 15.04.2025

Description and types

- An electrical load is an electrical component or portion of a circuit that consumes electric power, i.e. elements that take electrical energy from the source and convert it into another form of energy.

- We classify them into:

- resistive, they irreversibly and permanently convert electrical energy obtained from a source into thermal energy;

- capacitive, they convert electrical energy obtained from a source into electrostatic field energy;

- inductive, they convert electrical energy obtained from a source into electromagnetic field energy.

Direct current resistance

- Electrical loads behave differently in DC circuits, in terms of providing resistance to the current:

- a resistor behaves as a load that permanently and irreversibly converts the electrical energy of the source into heat; its resistance is finite;

- a capacitor behaves as an open circuit; its resistance is infinitely large;

- a coil behaves as a short circuit of the circuit; its resistance is zero.
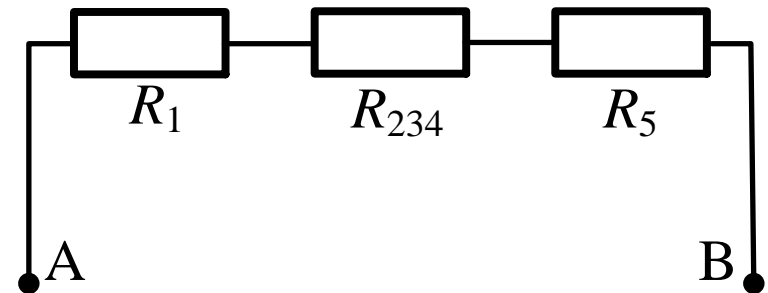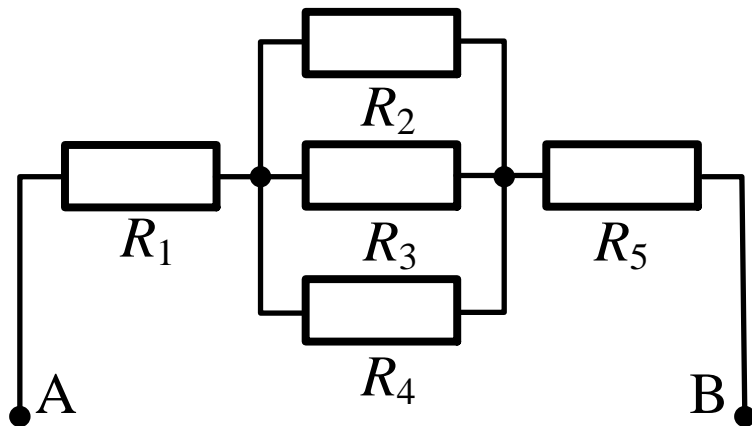
Resistors connected in series
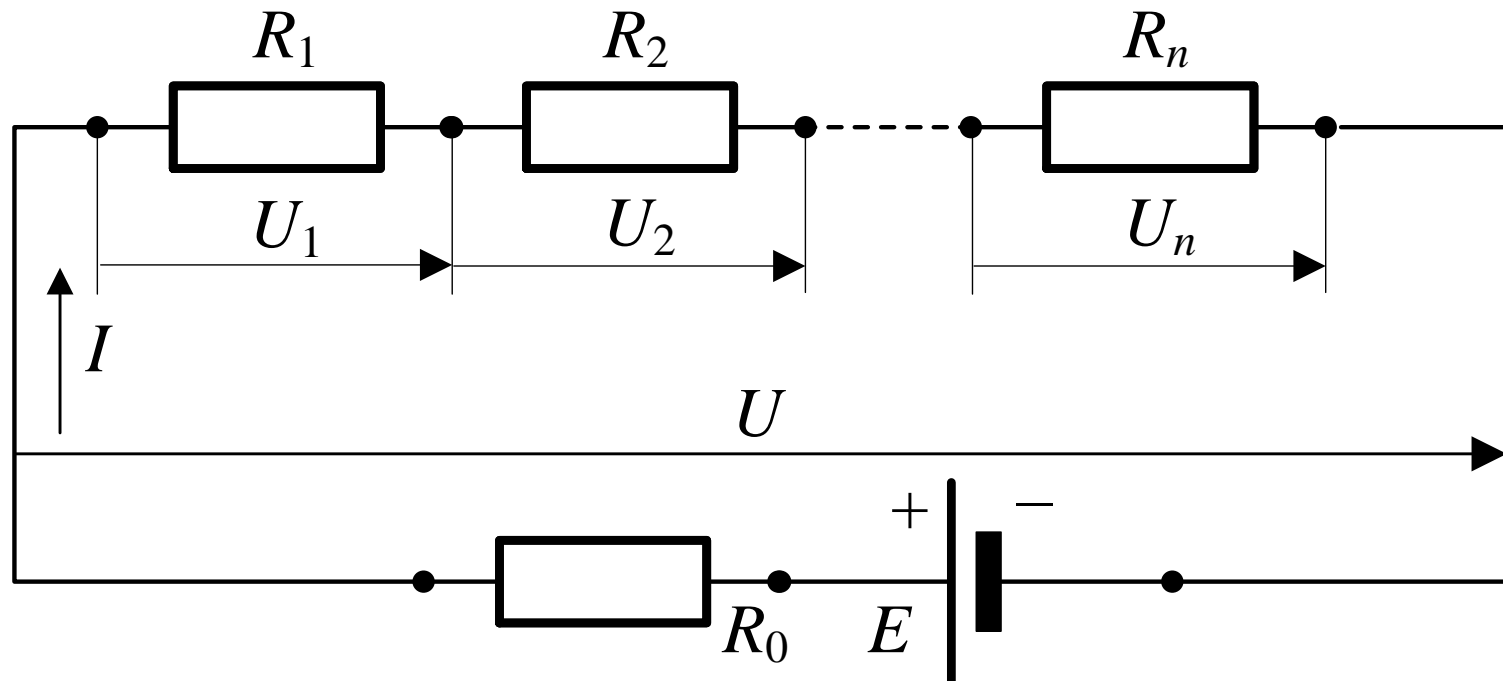
$$R_{\mathrm{ek}} = \sum_{k=1}^{n} R_k = R_1 + R_2 + ... + R_n$$

Resistors connected in parallel
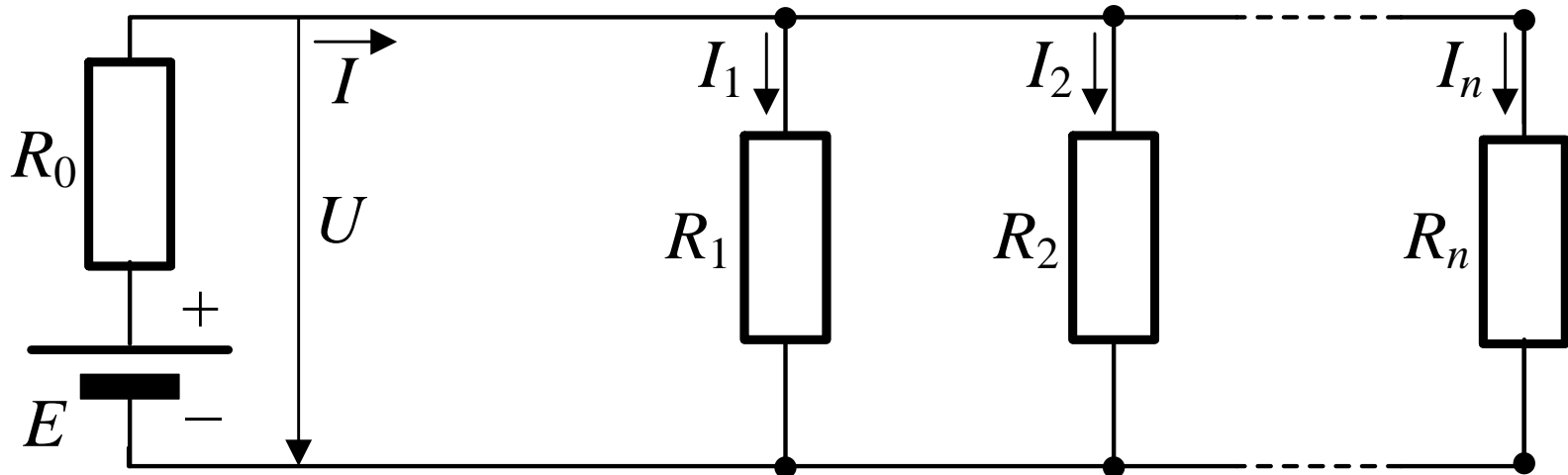
$$\frac{1}{R_{ek}} = \sum_{k=1}^{n} \frac{1}{R_k} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots + \frac{1}{R_n}$$
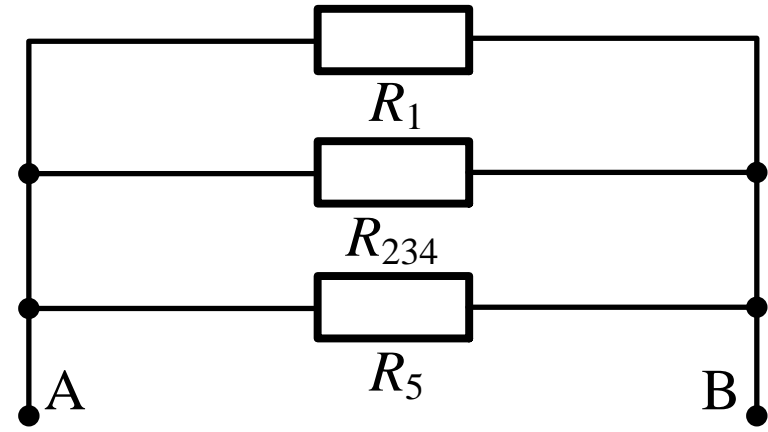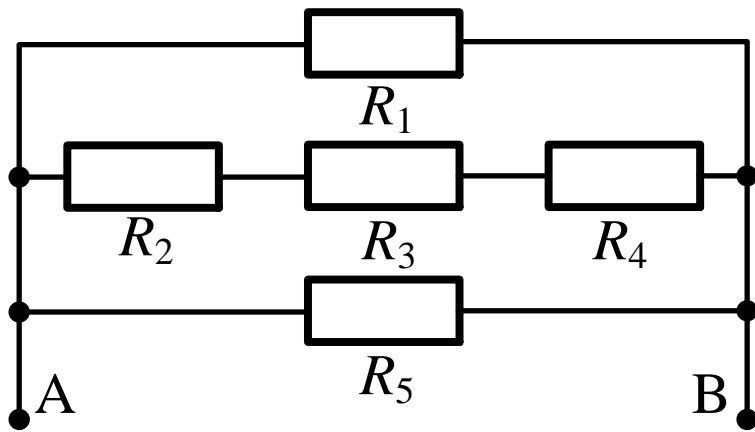
Resistors connected arbitrarily – example 1

$$\frac{1}{R_{234}} = \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4}$$
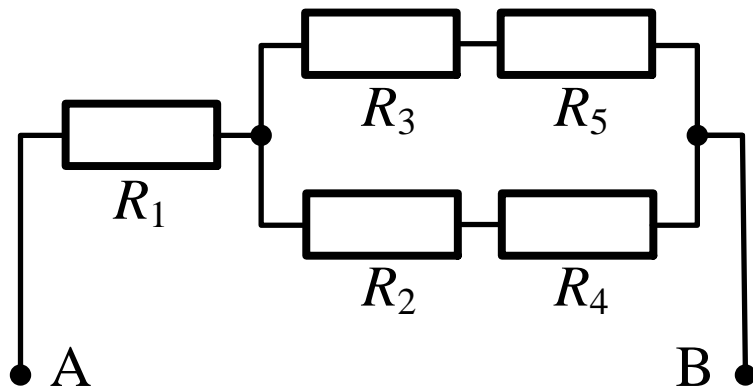
$$R_{AB} = R_1 + R_{234} + R_5$$
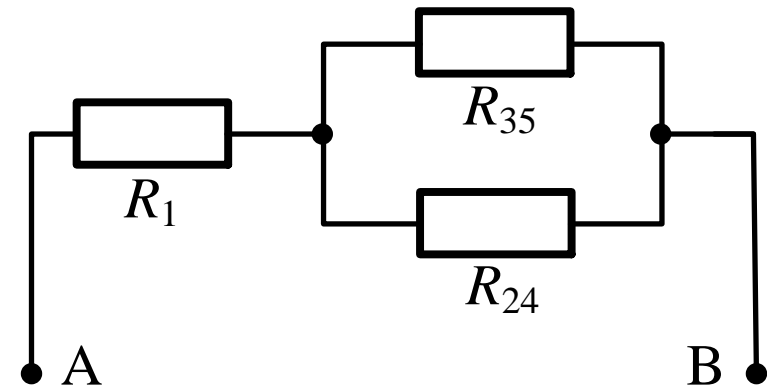
Resistors connected arbitrarily – example 2

$$R_{234} = R_2 + R_3 + R_4$$

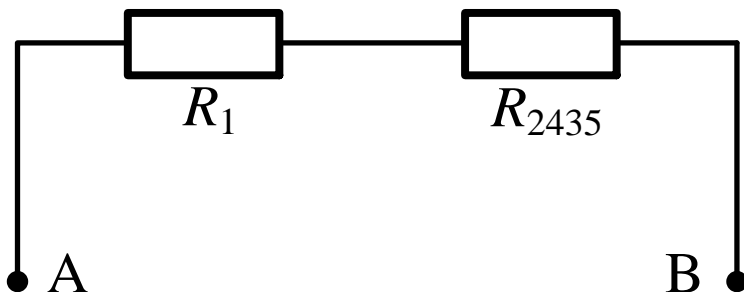$$\frac{1}{R_{AB}} = \frac{1}{R_1} + \frac{1}{R_{234}} + \frac{1}{R_5}$$

Resistors connected arbitrarily – example 3

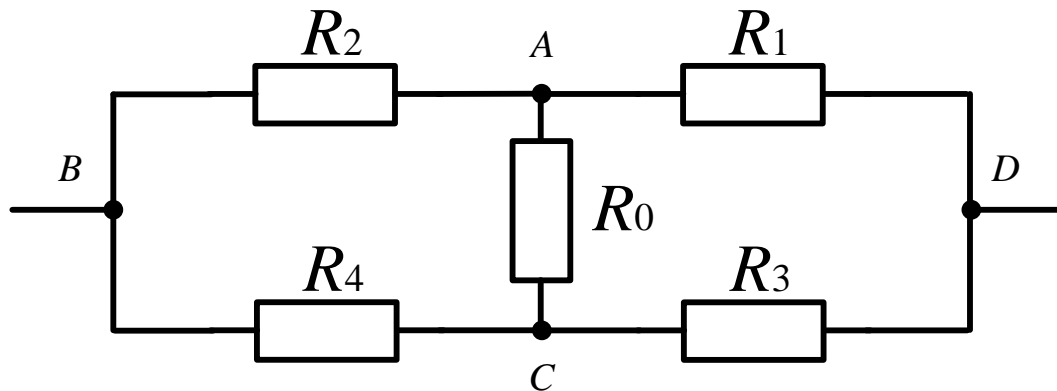$$R_{24} = R_2 + R_4 \qquad R_{35} = R_3 + R_5$$

$$\frac{1}{R_{2435}} = \frac{1}{R_{24}} + \frac{1}{R_{35}}$$

$$R_{AB} = R_1 + R_{2435}$$
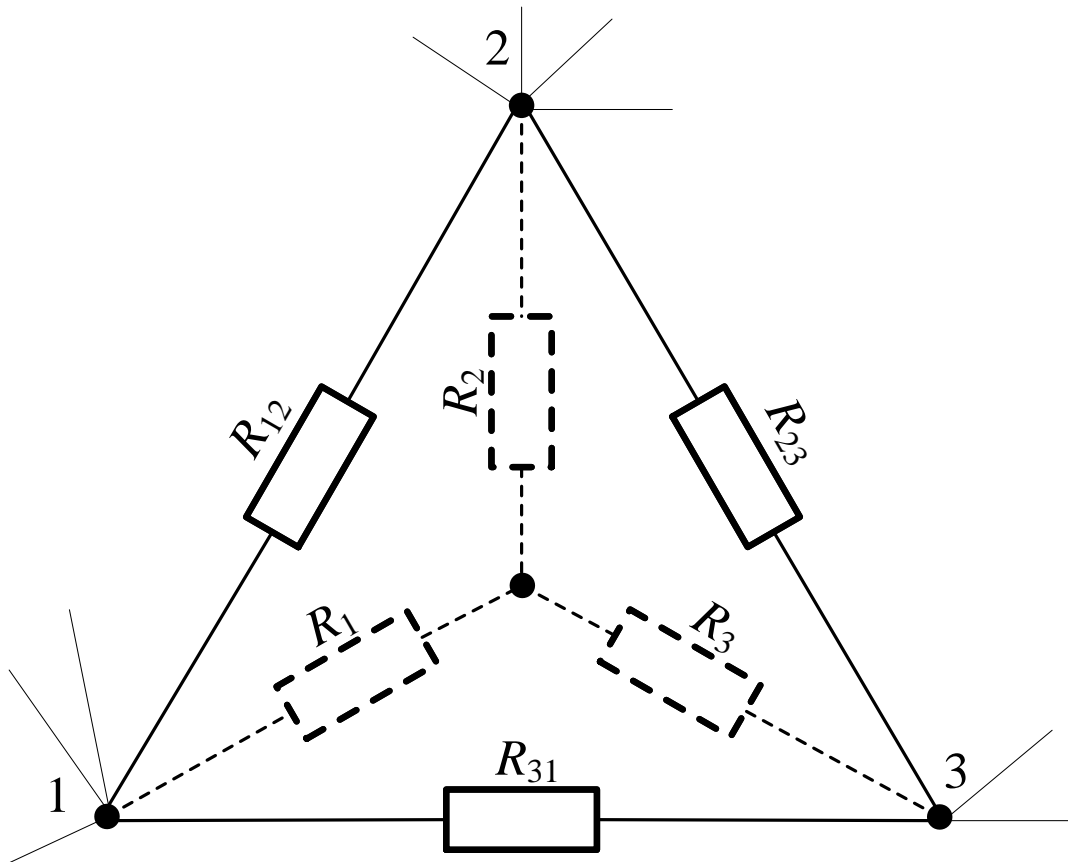
Resistors connected arbitrarily – example 4

$$R_{24} = R_2 + R_4 \qquad R_{13} = R_1 + R_3$$

$$\frac{1}{R_{AC}} = \frac{1}{R_0} + \frac{1}{R_{13}} + \frac{1}{R_{24}} = \frac{1}{R_0} + \frac{1}{R_1 + R_3} + \frac{1}{R_2 + R_4}$$

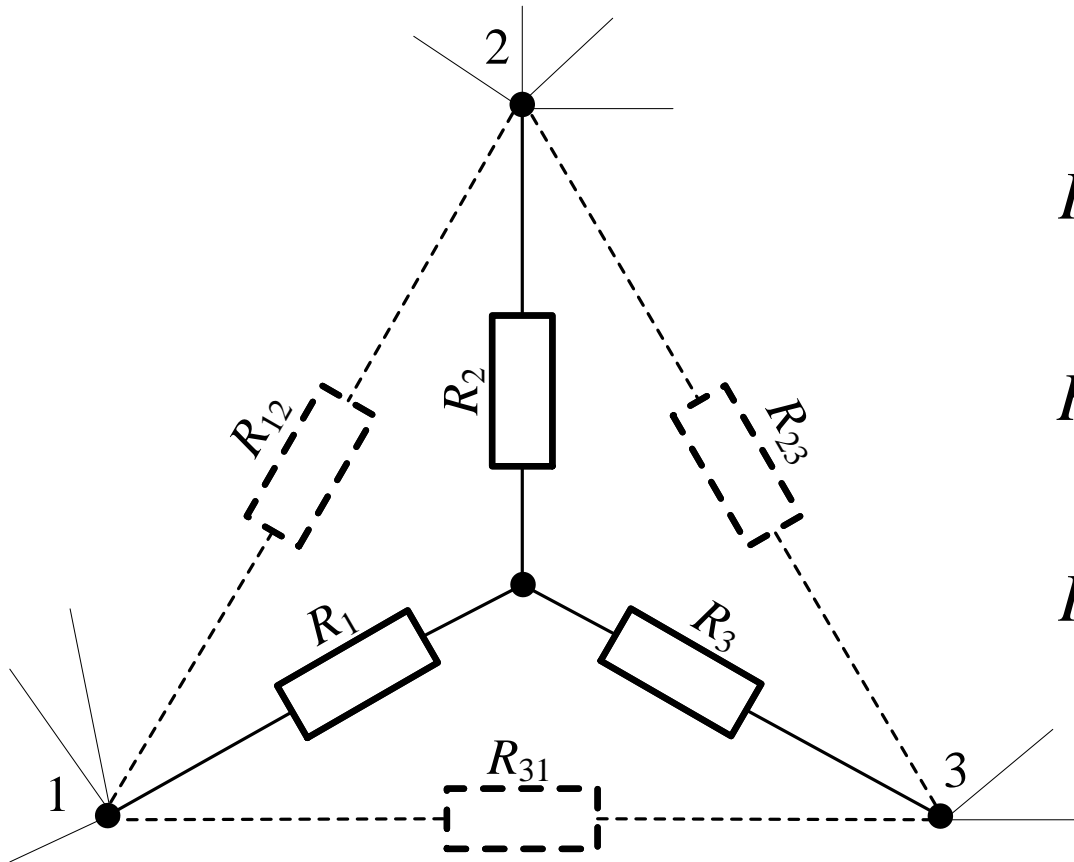- Izračun otpornosti R_{BD} nije tako jednostavan.

Transform delta-star

$$R_1 = \frac{R_{31}R_{12}}{R_{12} + R_{23} + R_{31}}$$

$$R_2 = \frac{R_{12}R_{23}}{R_{12} + R_{23} + R_{31}}$$

$$R_3 = \frac{R_{23}R_{31}}{R_{12} + R_{23} + R_{31}}$$
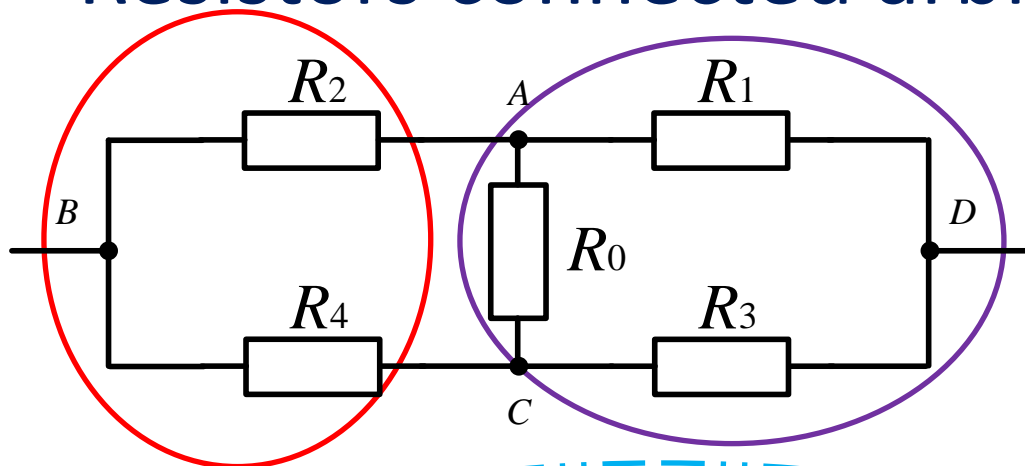
Transform star-delta

$$R_{12} = \frac{R_1 R_2 + R_2 R_3 + R_3 R_1}{R_3}$$

$$R_{23} = \frac{R_1 R_2 + R_2 R_3 + R_3 R_1}{R_1}$$

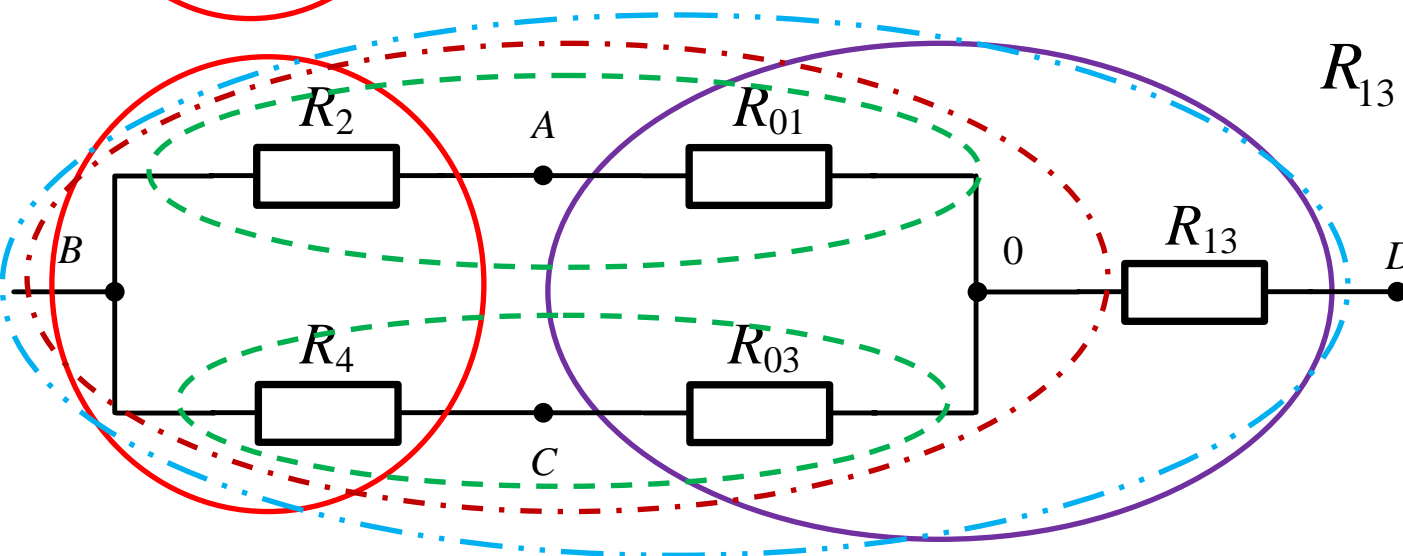$$R_{31} = \frac{R_1 R_2 + R_2 R_3 + R_3 R_1}{R_2}$$

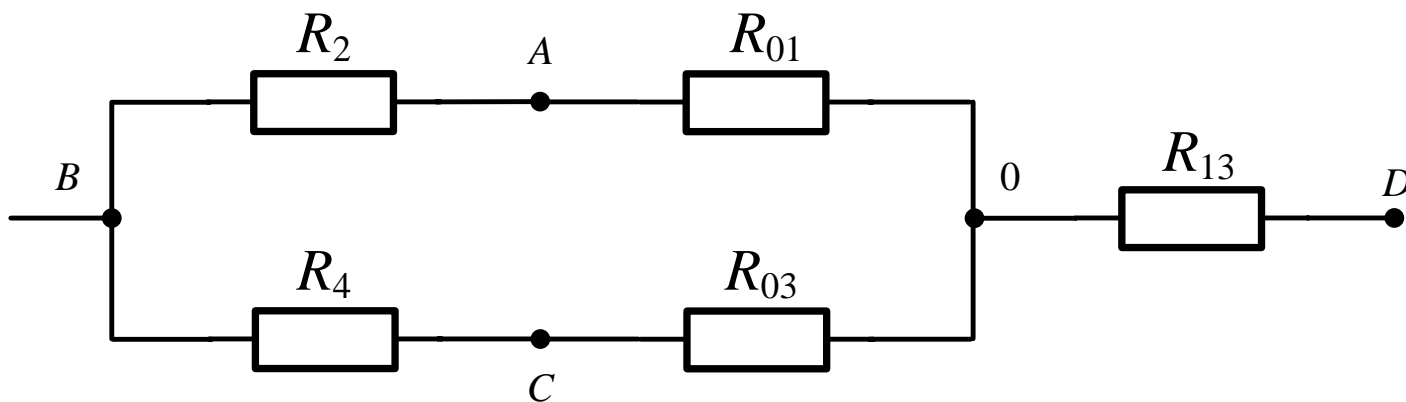# Resistors connected arbitrarily – example 5

$$R_{01} = \frac{R_0 R_1}{R_0 + R_1 + R_3}$$

$$R_{03} = \frac{R_0 R_3}{R_0 + R_1 + R_3}$$

$$R_{13} = \frac{R_1 R_3}{R_0 + R_1 + R_3}$$

Resistors connected arbitrarily – example 5

$$R_{201} = R_2 + R_{01} \qquad R_{403} = R_4 + R_{03}$$

$$\frac{1}{R_{B0}} = \frac{1}{R_{201}} + \frac{1}{R_{403}}$$

$$R_{BD} = R_{B0} + R_{13} = \frac{\left(R_2 + R_{01}\right)\left(R_4 + R_{03}\right)}{R_2 + R_{01} + R_4 + R_{03}} + R_{13}$$