

Industrijsko inženjerstvo

Osnovi elektrotehnike

Električna struja 4

1. Merenje struje, napona i otpornosti
2. Tevenenova teorema
3. Prenos maksimalne snage
4. Teorema superpozicije

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kabinet 132 NTP

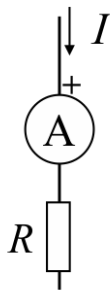
miodragm@uns.ac.rs

Merni instrumenti

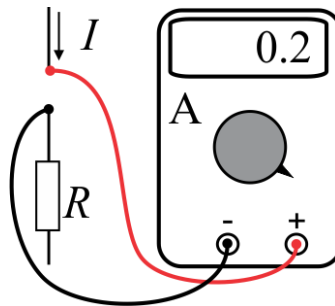
- Ampermetar – instrument za merenje struje
- Meri struju u grani u kojoj je povezan.
 - Isključe se generatori
 - Grana/kolo se prekine
 - Spoji se preko ampermetra



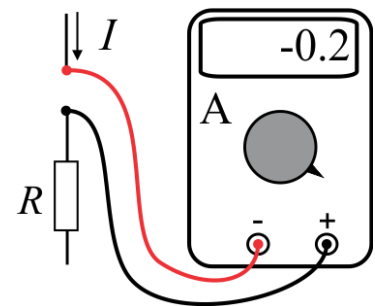
a)



b)

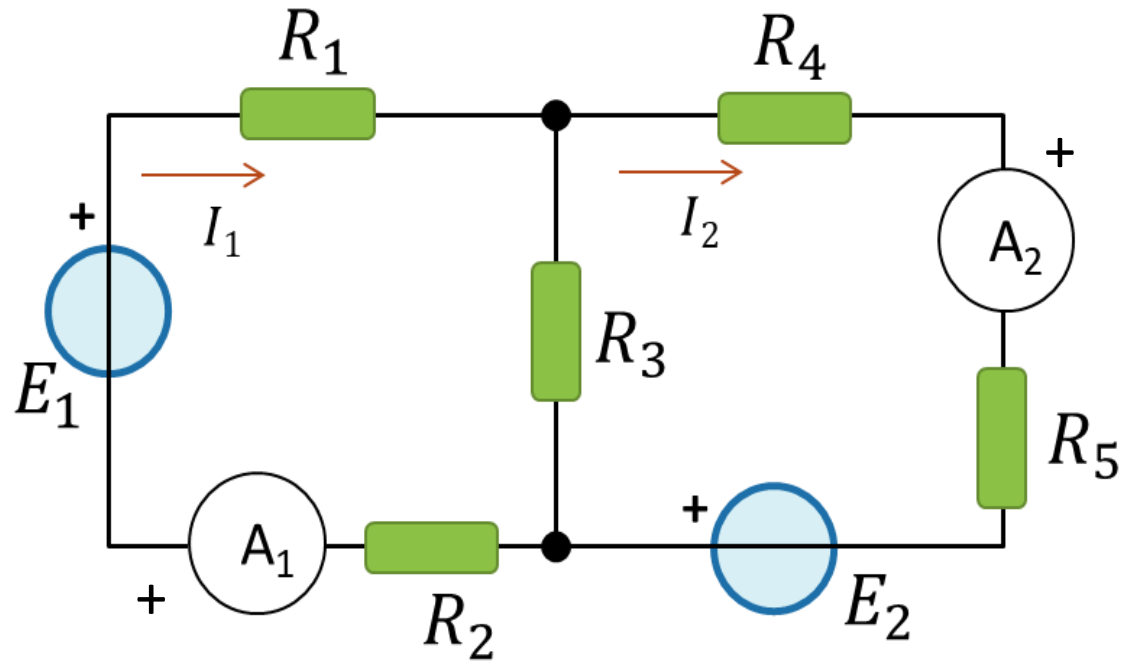


c)



d)

Merni instrumenti



$$I_{A1} = -I_1$$

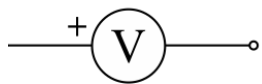
$$I_{A2} = I_2$$

Merni instrumenti

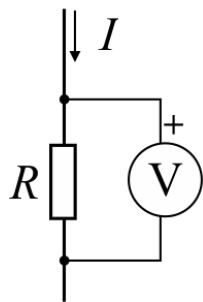
Voltmetar – instrument za merenje napona

Meri napon između priključnih tačaka.

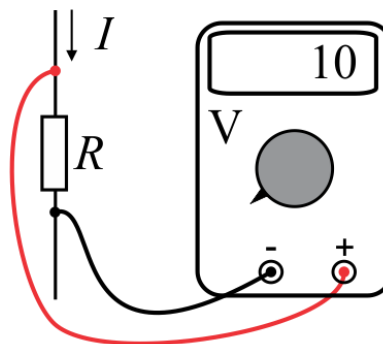
- Kolo se ne prekida
- Generatori se ne isključuju



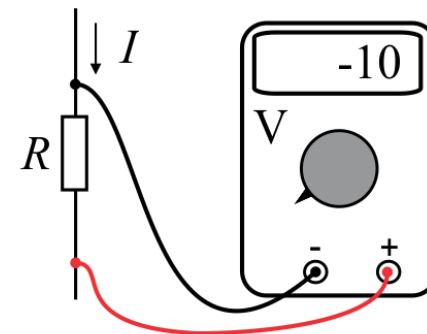
a)



b)

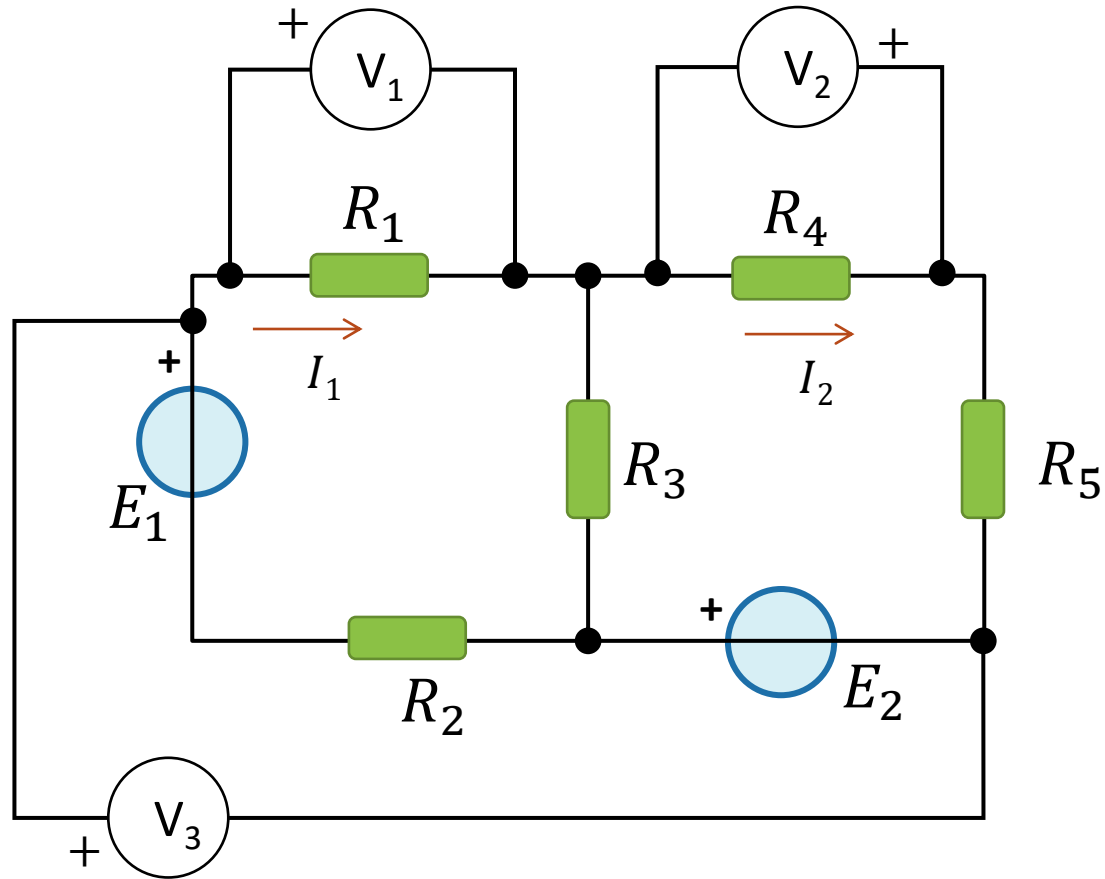


c)

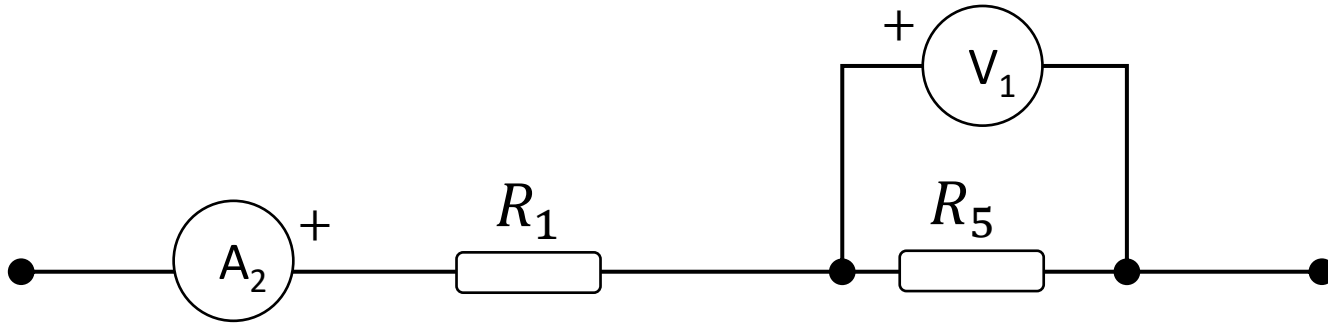


d)

Merni instrumenti



Merni instrumenti



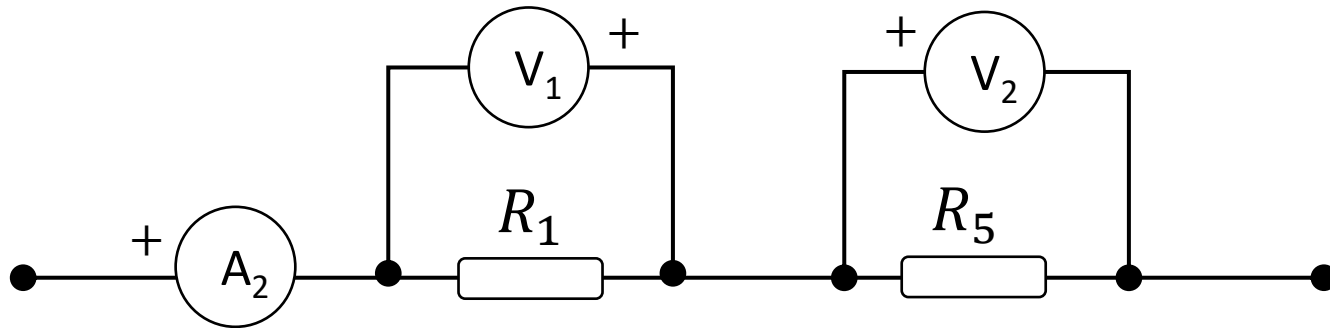
$$R_1 = 10\Omega$$

$$R_5 = 50\Omega$$

$$A_2 = 1\text{ A}$$

$$V_2 = ?$$

Merni instrumenti



$$R_1 = 10\Omega$$

$$R_5 = 50\Omega$$

$$V_2 = 100V$$

$$A_2 = ?$$

$$V_1 = ?$$

Merni instrumenti

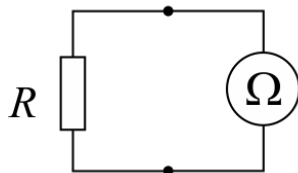
Ommetar – instrument za merenje otpornosti

Meri otpornost između priključnih tačaka

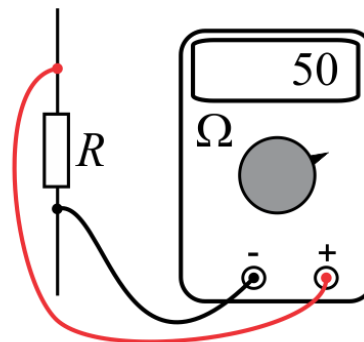
- Generatori se **OBAVEZNO** isključuju



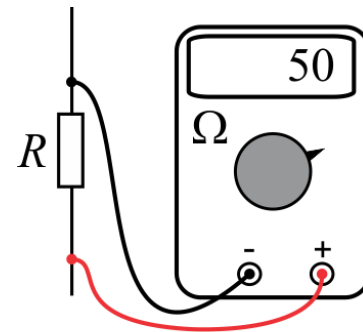
a)



b)



c)

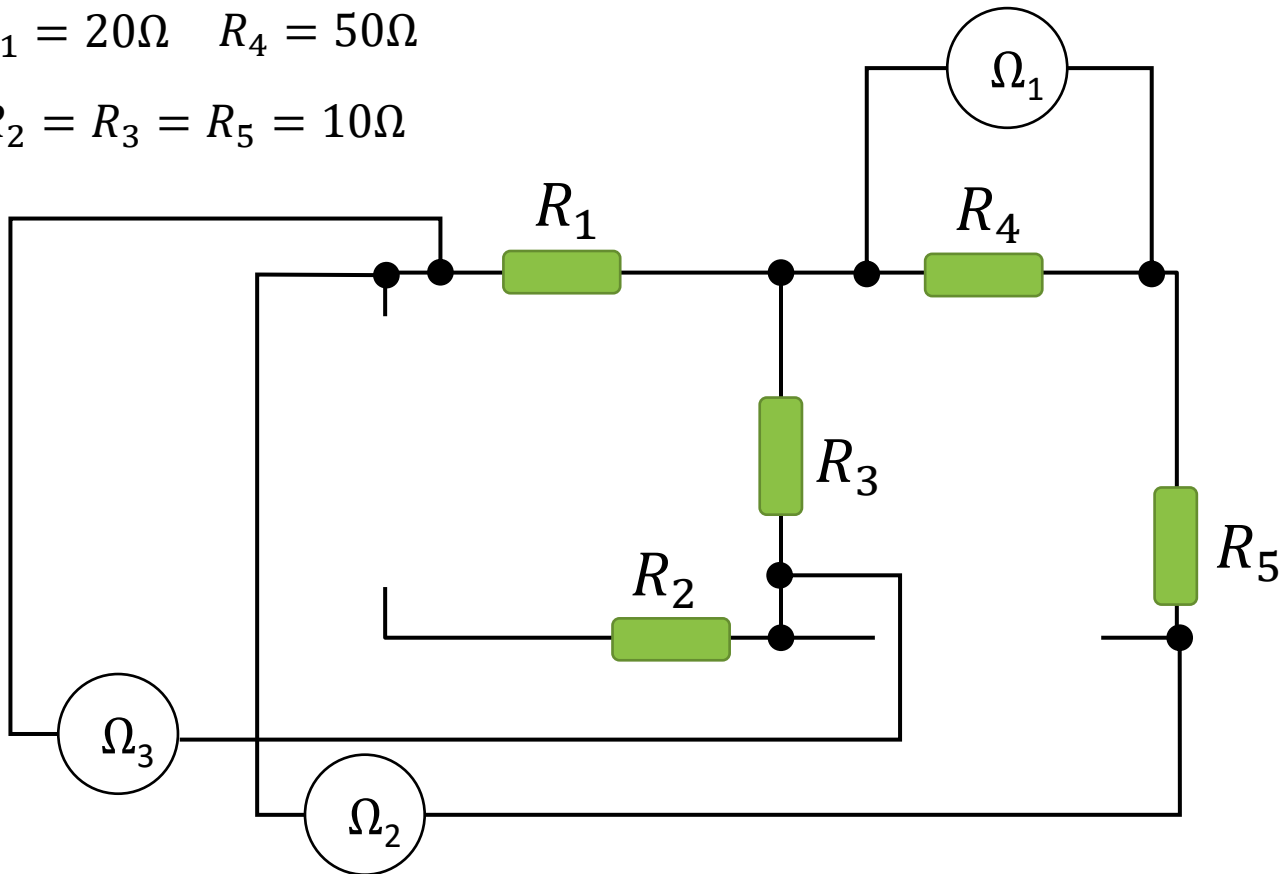


d)

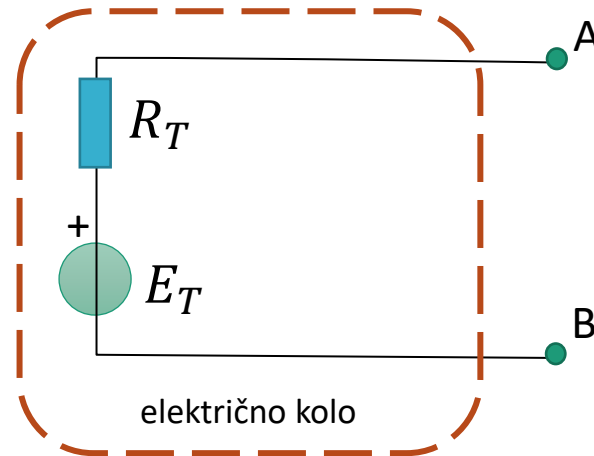
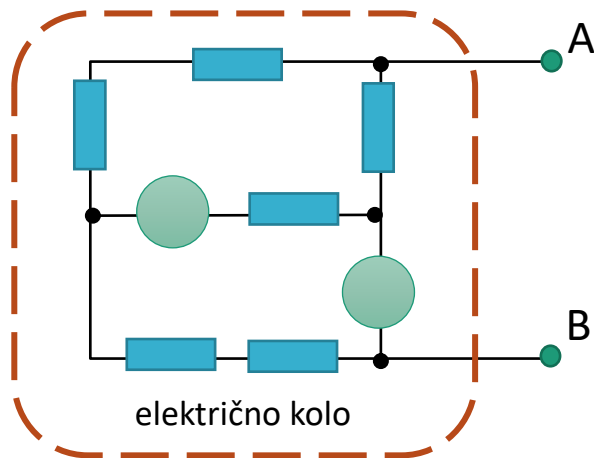
Merni instrumenti

$$R_1 = 20\Omega \quad R_4 = 50\Omega$$

$$R_2 = R_3 = R_5 = 10\Omega$$



Tevenenova teorema

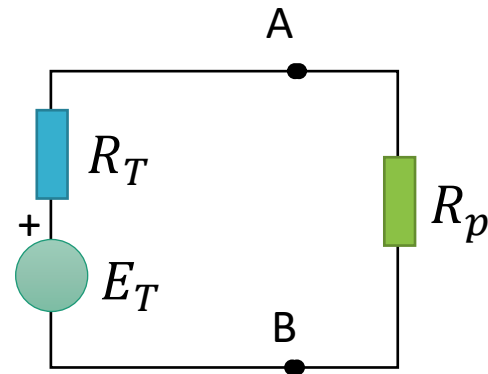
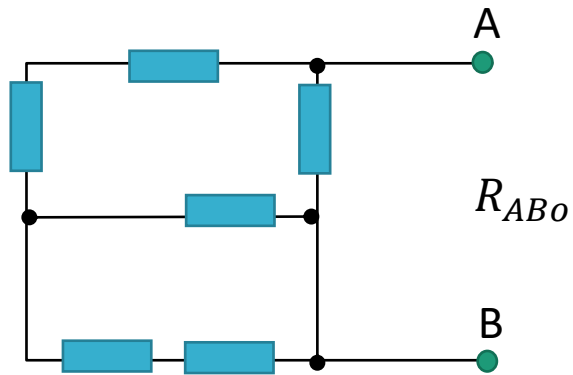
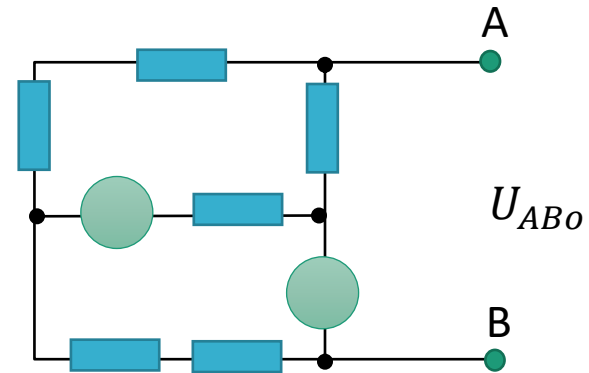
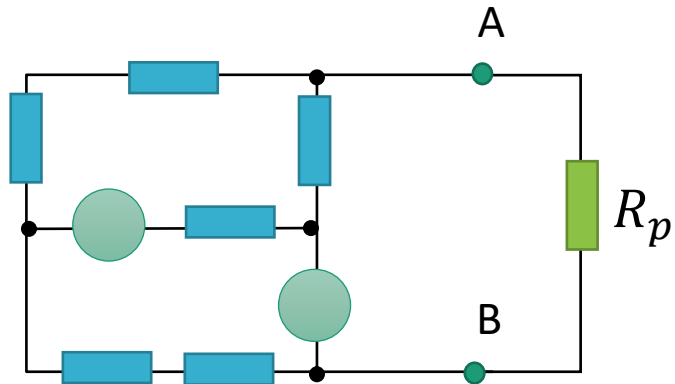


- Deo kola u odnosu na svoje dve tačke može da se posmatra kao realni naponski generator, tzv. Tevenenov generator, opisan sa E_T i R_T .
- Omogućava pojednostavljenje dela električnog kola.

$$E_T = U_{AB0}$$

$$R_T = R_{AB0}$$

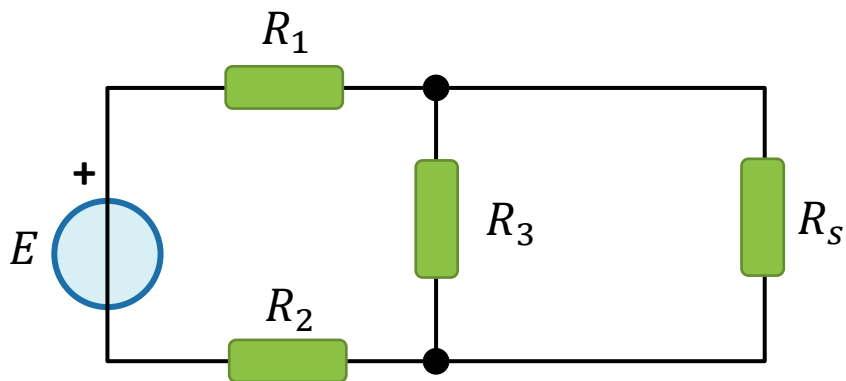
Tevenenova teorema



$$E_T = U_{AB0} \quad R_T = R_{AB0}$$

Primer

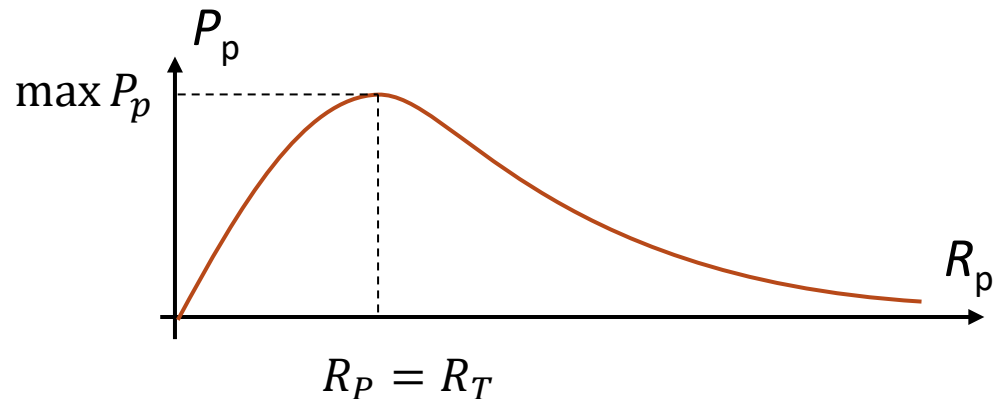
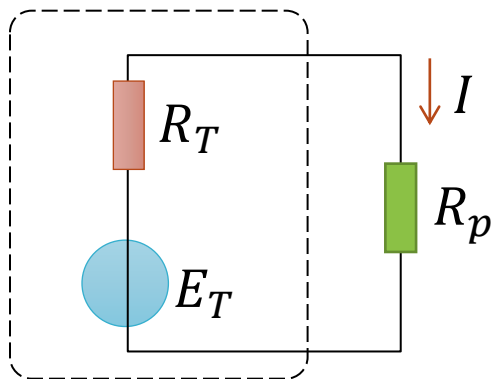
Odrediti elemente Tevenenovog generatora u odnosu na sijalicu otpornosti $R_s = 10\Omega$.



$$E = 30V \quad R_1 = R_2 = R_3 = 30\Omega$$

Prenos maksimalne snage

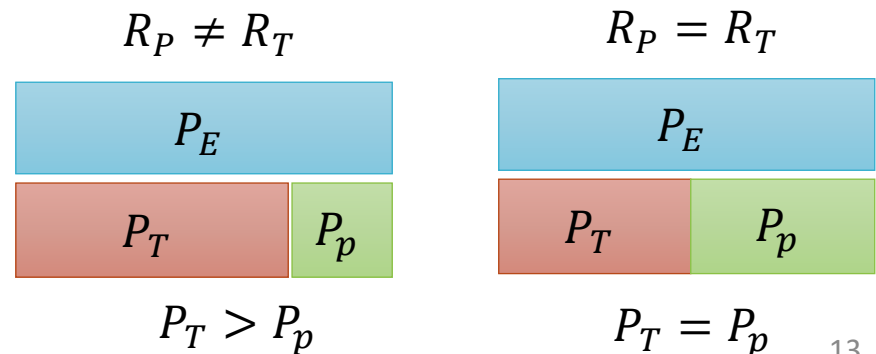
- Maksimalna snaga na prijemniku otpornosti R_p



$$I = \frac{E_T}{R_T + R_p}$$

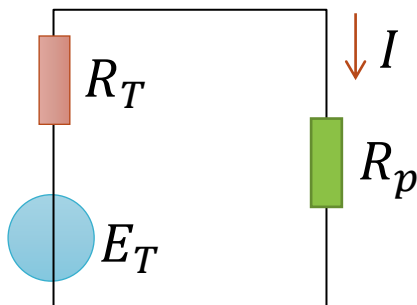
$$P_E = EI \quad P_T = R_T I^2$$

$$P_p = R_p I^2 = R_p \left(\frac{E_T}{R_T + R_p} \right)^2$$



Primer

Odrediti snagu prijemnika?



$$E_T = 60V$$

$$R_T = 10\Omega$$

- a) $R_p = 50\Omega$
- b) $R_p = 20\Omega$
- c) $R_p = 10\Omega$
- d) $R_p = 2\Omega$

Teorema superpozicije

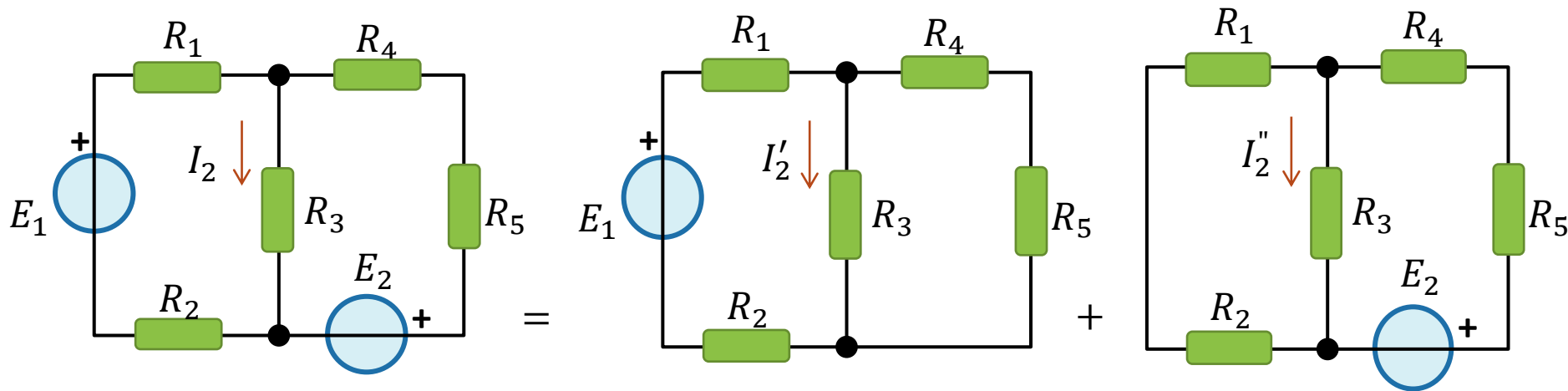
U linearnim kolima sa više generatora važi princip superpozicije.

Struja proizvoljnoj grani kola je jednaka zbiru struja koje u toj grani stvara svaki od generatora posebno.

$$I_2 = f(E_1, E_2, R) = f_1(E_1, R) + f_2(E_2, R) = I'_2 + I''_2$$

$$I'_2 = f_1(E_1, R)$$

$$I''_2 = f_2(E_2, R)$$

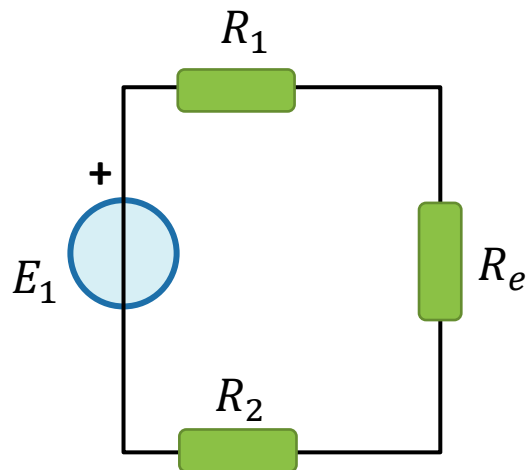
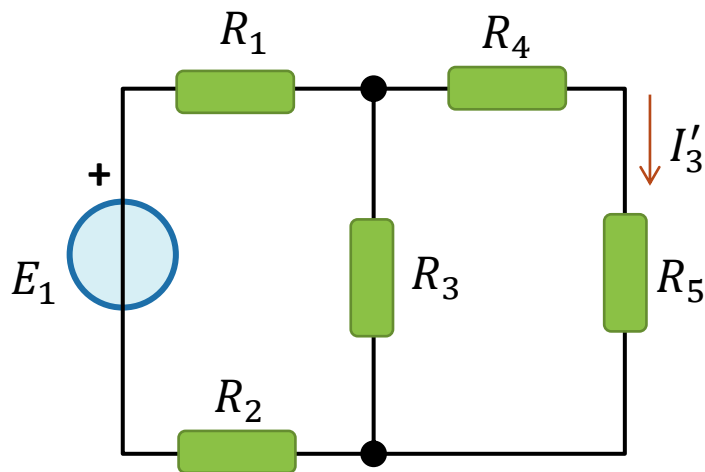
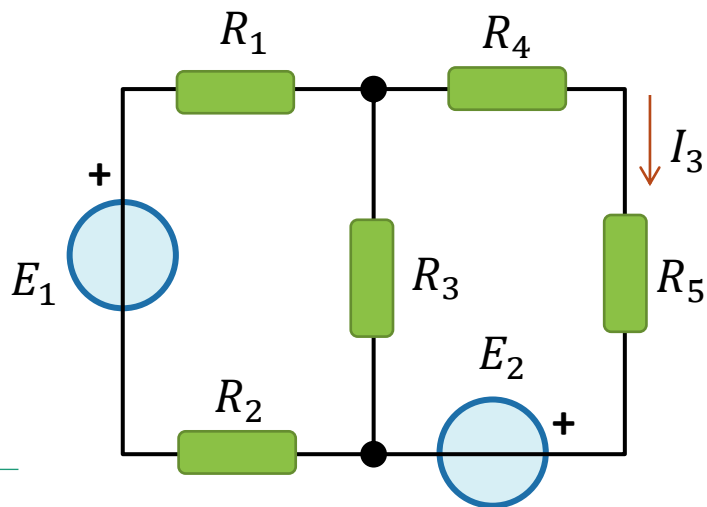


Primer

Odrediti struju I_3 primenom teoreme superpozicije.

$$E_1 = 40V \quad E_2 = 6V \quad R_3 = 20\Omega$$

$$R_1 = R_2 = R_5 = 10\Omega \quad R_4 = 8\Omega$$



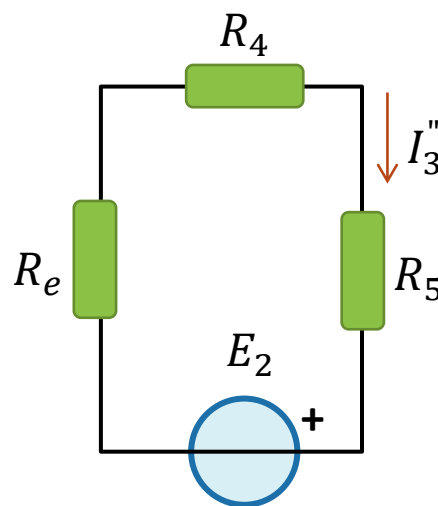
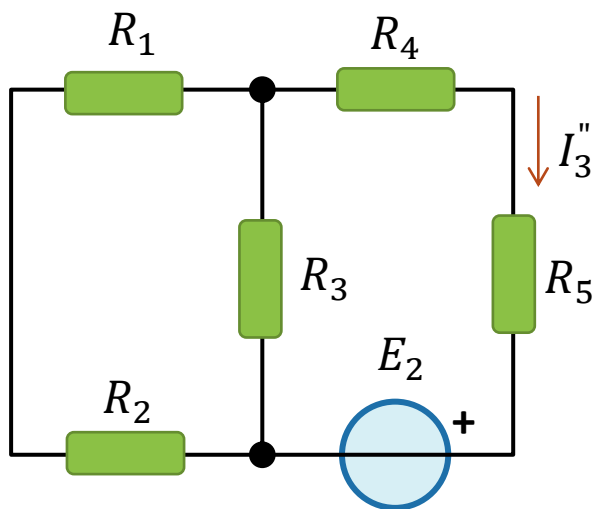
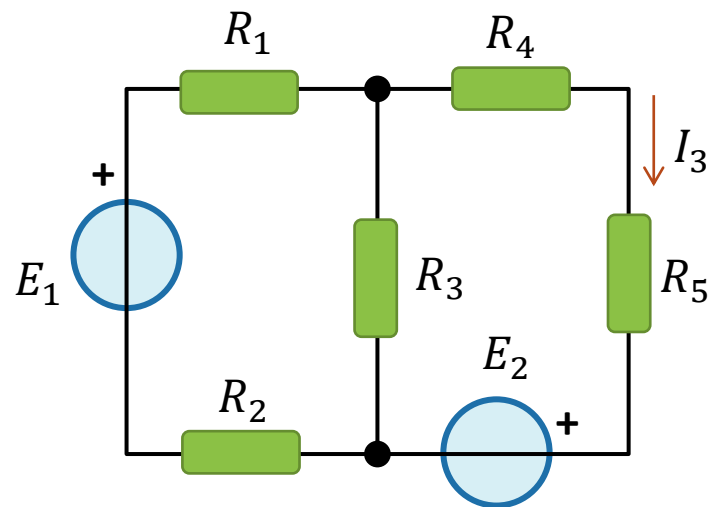
$$I'_3 = 0.7143A$$

Primer

Odrediti struju I_3 primenom teoreme superpozicije.

$$E_1 = 40V \quad E_2 = 6V \quad R_3 = 20\Omega$$

$$R_1 = R_2 = R_5 = 10\Omega \quad R_4 = 8\Omega$$



$$I_3' = 0.7143A$$

$$I_3'' = -0.2143A$$

$$I_3 = 0.5A$$

Pitanja

1. Šta meri ampermetar i kako se priključuje u kolo?
2. Šta meri voltmetar i kako se priključuje u kolo?
3. Šta meri ommetar i kako se priključuje u kolo?
4. Kako glasi Tevenenova teorema? Kako se određuju elementi tevenenovog generatora?
5. Ako je otpornost prijemnika veća od otpornosti generatora da li je snaga na prijemniku veća od snage Džulovih gubitaka u generatoru?
6. Kada je snaga na prijemniku najveća moguća? Ako je u tom slučaju snaga generatora 100W kolika je snaga prijemnika?