Elektrotehnika (ASUV)

Vežbe 6

Tevenenova teorema

Visoka škola elektrotehnike i računarstva
strukovnih studija, Beograd 2019

Tevenenova teorema

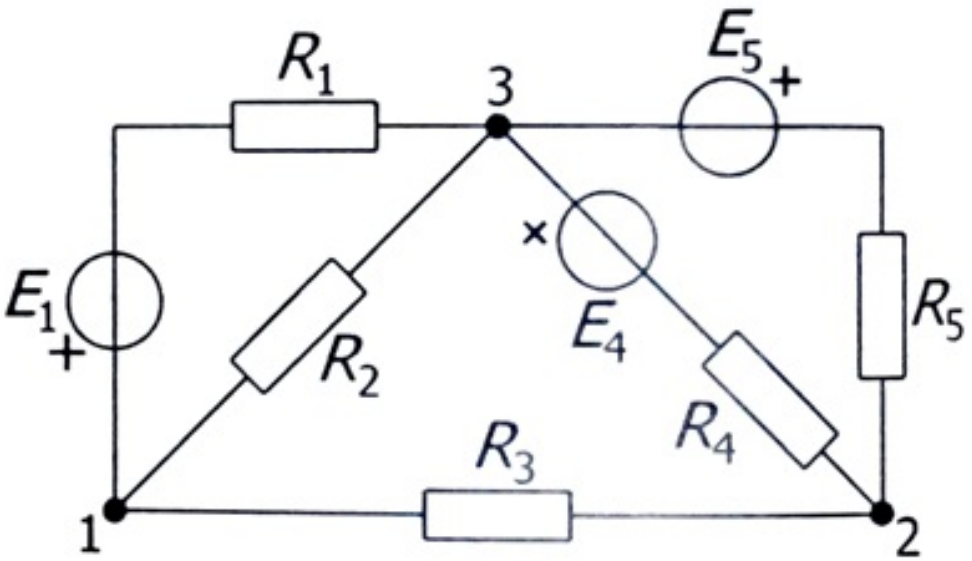
Zadatak II.8.4.2

U kolu prikazanom na slici poznata je struja I_{23} = 50mA kroz otpornik R_4. Primenom Tevenenove teoreme odrediti otpornost R_4, ako je:

E_1 = 6V, E_4 = 40,5V, E_5 = 5V,

R_1 = 2kΩ, R_2 = 6kΩ,

R_3 = 750Ω, R_5 = 750Ω.



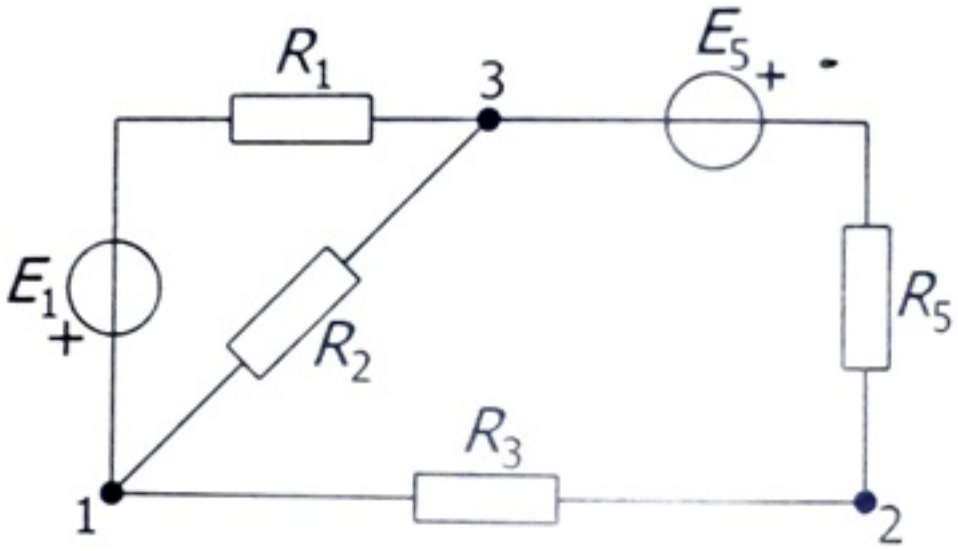
Tevenenova teorema

Zadatak II.8.4.2

Rešenje:

Pošto je poznata struja koja protiče kroz granu sa otpornikom R_4, tu granu ćemo ukloniti, i ostatak kola predstaviti pomoću Tevenenovog generatora.

Prvo je potrebno pronaći napon Tevenenovog generatora, odnosno napon između tačaka 2 i 3 u kolu.



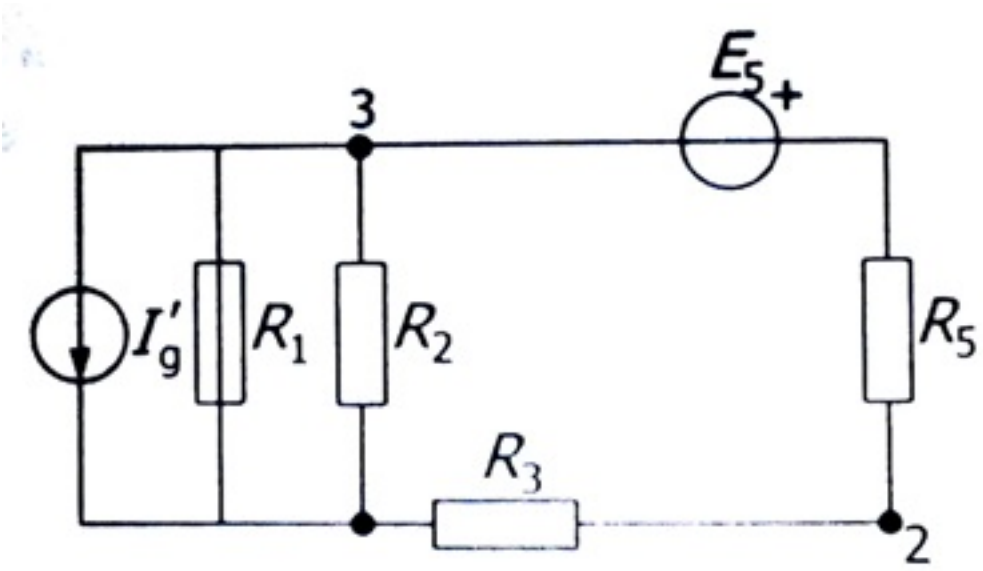
Tevenenova teorema

Zadatak II.8.4.2

Rešenje:

Da bi odredili napon između tačaka 2 i 3, prvo je potrebno da pojednostavnimo kolo transfiguracijom generatora.

$$I_g' = \frac{E_1}{R_1} = \frac{6V}{2k\Omega} = 3mA$$



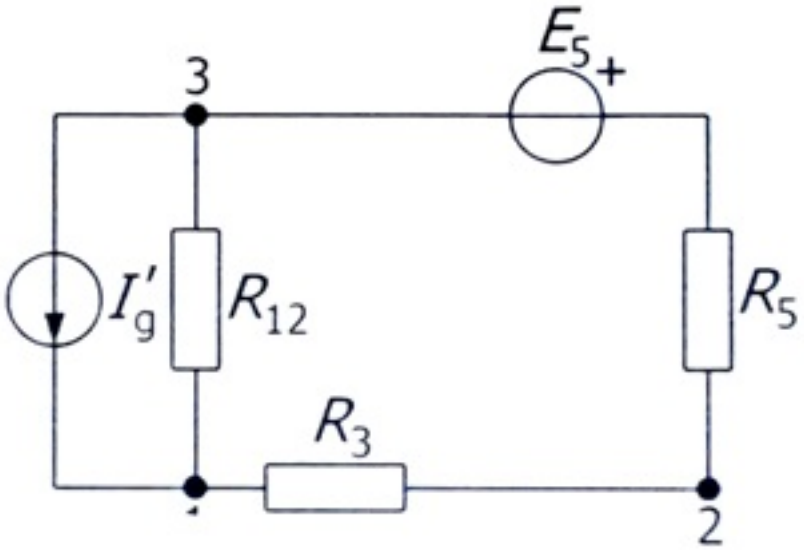
Tevenenova teorema

Zadatak II.8.4.2

Rešenje:

Otpornoci R_1 i R_2 vezani su paralelno:

$$R_{12} = R_1 || R_2 = \frac{R_1 R_2}{R_1 + R_2} = 1.5k\Omega$$



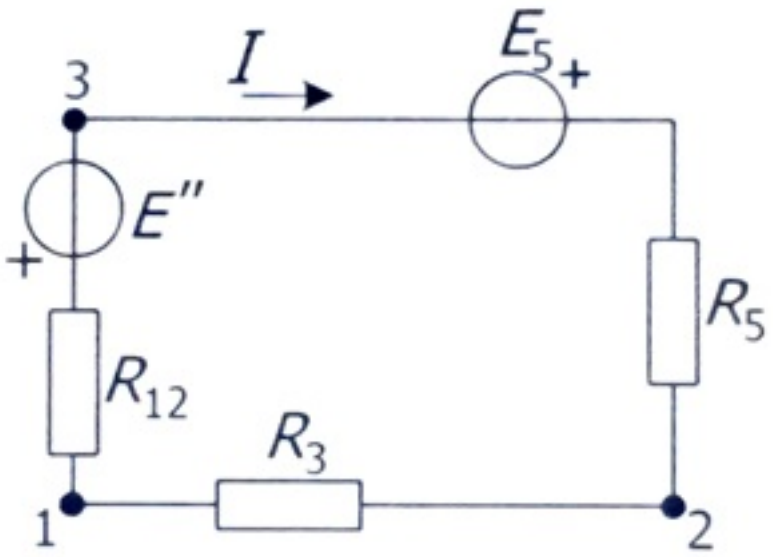
Tevenenova teorema

Zadatak II.8.4.2

Rešenje:

Ponovo primenjujemo transfiguraciju generatora:

$$E'' = R_{12} I_g{}' = 1.5k\Omega \cdot 3mA = 4.5V$$



zatim primenom Omovog zakona na prosto kolo računamo struju I

$$I = \frac{E_5 - E''}{R_{12} + R_3 + R_5} = \frac{36V}{3k\Omega} = 12mA$$

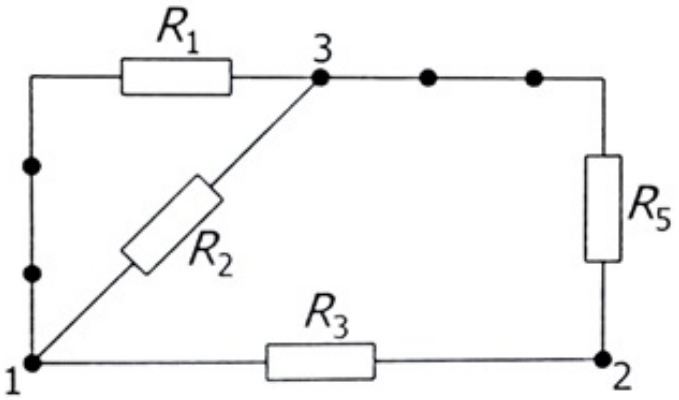
$$E_T = U_{23}{}_{OK}\Big| = E_5 - R_5 I = 31.5V$$

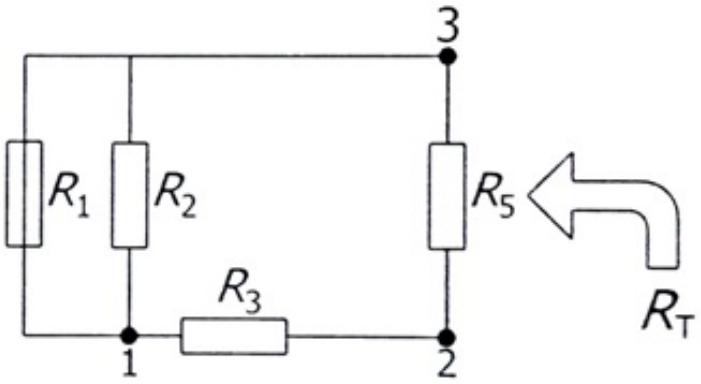
Tevenenova teorema

Zadatak II.8.4.2

Rešenje:

Potrebno je još pronaći otpornost Tevenenovog generatora:





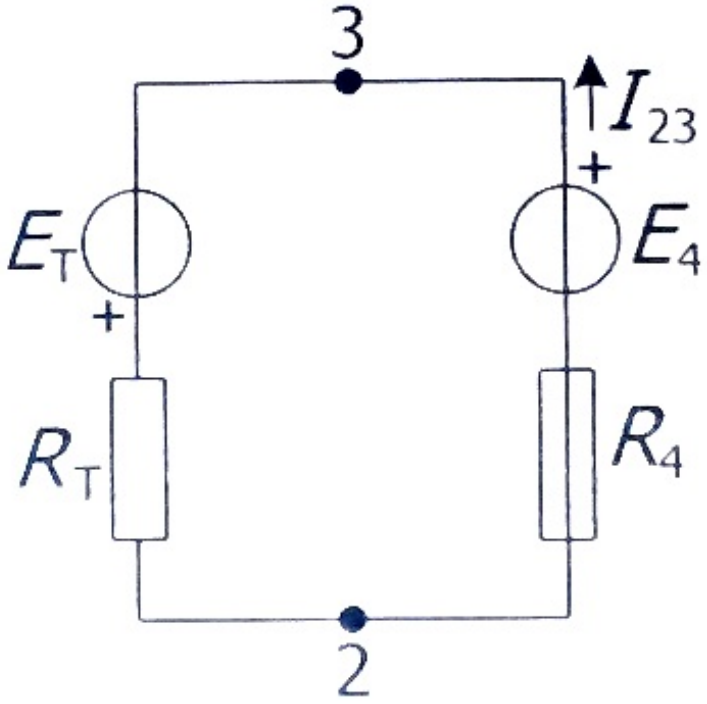
$$R_T = ((R_1||R_2) + R_3)||R_5 = \frac{\left(\frac{R_1 R_2}{R_1 + R_2} + R_3\right) R_5}{\frac{R_1 R_2}{R_1 + R_2} + R_3 + R_5} = 562.5\Omega$$

Tevenenova teorema

Zadatak II.8.4.2

Rešenje:

Sada imamo jednostavno kolo:



Pa je prema Omovom zakonu

$$I_{23} = \frac{E_T + E_4}{R_T + R_4}$$

pa je nepoznata otpornost:

$$R_4 = \frac{E_T + E_4}{I_{23}} - R_T = 730\Omega - 562.5\Omega = 167.5\Omega$$

Prilagođenje prijemnika po snazi

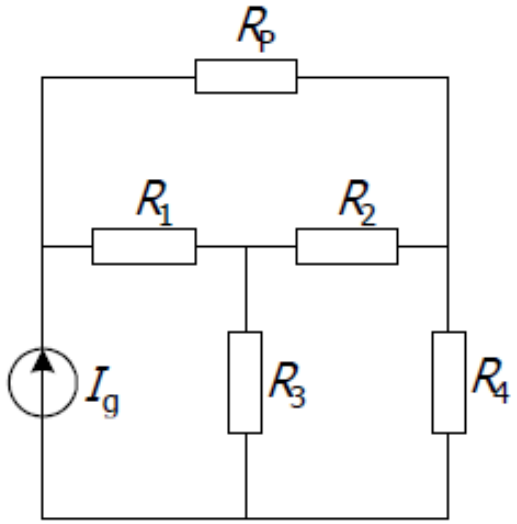
II.8.4.1.1 U kolu sa slike poznato je:

$R_1 = 20\ \Omega$, $R_2 = 10\ \Omega$,

$R_3 = 10\ \Omega$, $R_4 = 5\ \Omega$,

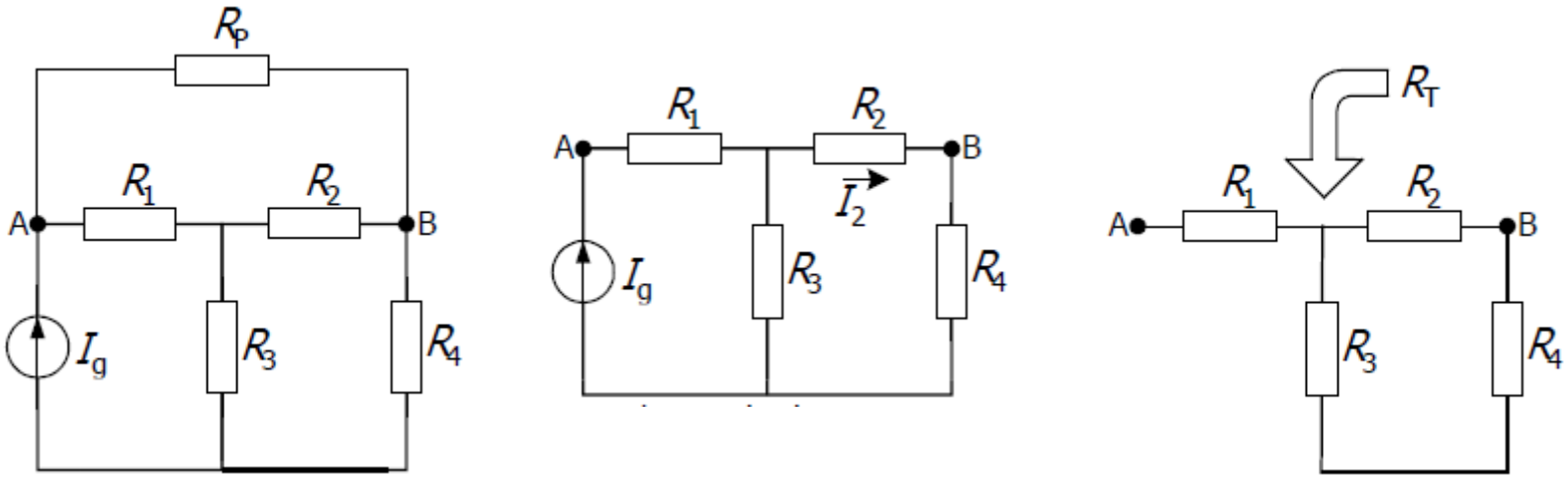
$I_{g1} = 2{,}6$ A

Odrediti otpornost prijemnika R_p tako da se na njemu razvija maksimalna snaga. Kolika je ta snaga?



Prilagođenje prijemnika po snazi

Zadatak II.8.4.1.1 Određivanje R_T

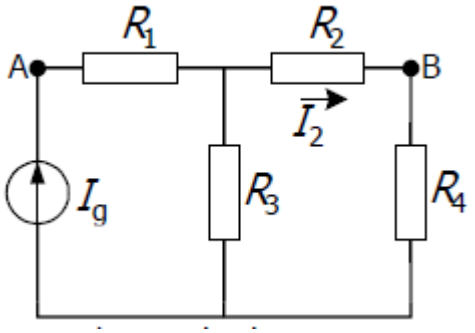


$$R_T = (R_3 + R_4) \,||\, R_2 + R_1 = \frac{(R_3 + R_4)R_2}{R_3 + R_4 + R_2} + R_1 = 26\ \Omega$$

$$R_p = R_T = 26\ \Omega$$

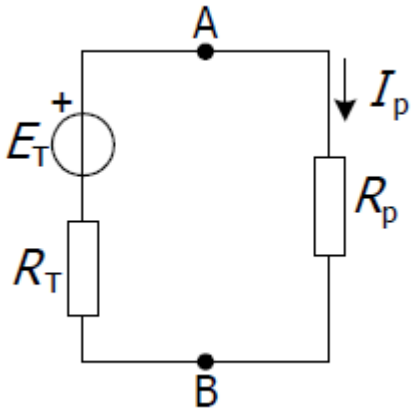
Prilagođenje prijemnika po snazi

Zadatak II.8.4.1.1 Određivanje E_T



$$I_2 = \frac{R_3 + R_4}{R_2 + R_3 + R_4} I_g = \frac{15\ \Omega}{25\ \Omega} \cdot 2{,}6\ \text{A} = 1{,}56\ \text{A}$$

$$E_T = U_{AB}\Big|_{OK} = R_2 I_2 + R_1 I_g = 67{,}6\ \text{V}$$



$$I_p = \frac{E_T}{R_T + R_p} = \frac{67{,}6\ \text{V}}{52\ \Omega} = 1{,}3\ \text{A}$$

$$P_{R_p} = I_p^{\,2} R_p = 43{,}94\ \text{W}$$

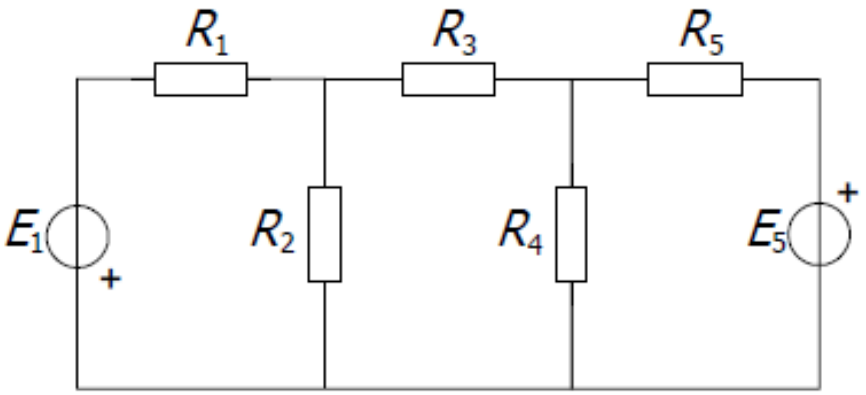
Prilagođenje prijemnika po snazi

II.8.4.1.2 U kolu prikazanom na slici odrediti otpornost otpornika R_3 tako da se na njemu razvije maksimalna snaga. Odrediti tu snagu.

$E_1 = 10$ V, $E_5 = 100$ V,

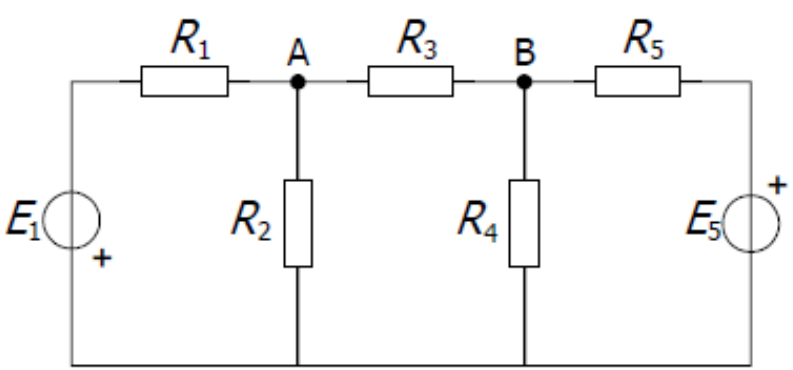
$R_1 = 2\ \Omega$, $R_2 = 40\ \Omega$,

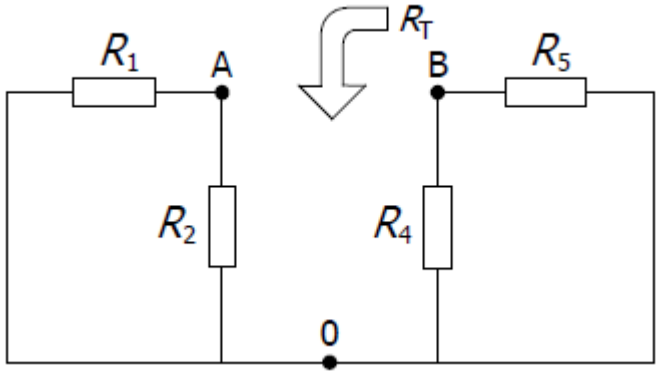
$R_4 = 20\ \Omega$, $R_5 = 20\ \Omega$



Prilagođenje prijemnika po snazi

Zadatak II.8.4.1.2



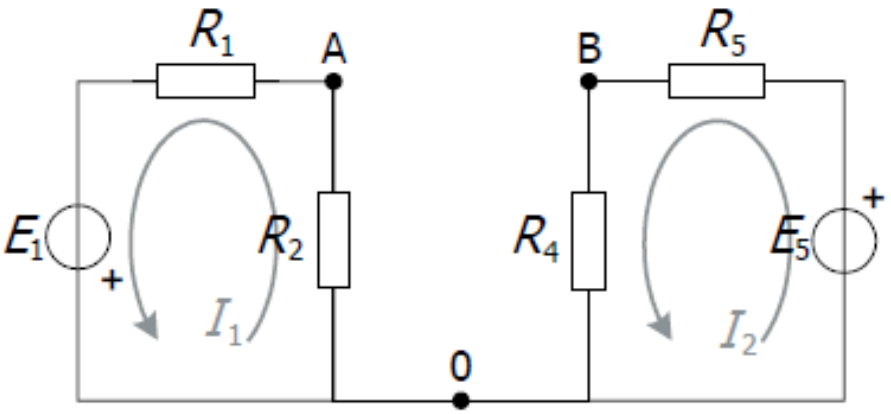


$$R_T = (R_1 \,||\, R_2) + (R_4 \,||\, R_5) = \frac{R_1 R_2}{R_1 + R_2} + \frac{R_4 R_5}{R_4 + R_5} = 1{,}9\ \Omega + 10\ \Omega = 11{,}9\ \Omega$$

$$R_p = R_T = 11{,}9\ \Omega$$

Prilagođenje prijemnika po snazi

Zadatak II.8.4.1.2



$$I_1 = \frac{E_1}{R_1 + R_2} = \frac{10\ \text{V}}{42\ \Omega} = 0{,}24\ \text{A}$$

$$I_2 = \frac{E_5}{R_4 + R_5} = \frac{100\ \text{V}}{40\ \Omega} = 2{,}5\ \text{A}$$

$$E_T = U_{AB}\Big|_{OK} = U_{OB} + U_{AO} = -R_4 I_2 - R_2 I_1 = -59{,}6\ \text{V}$$

Prilagođenje prijemnika po snazi

Zadatak II.8.4.1.2

$$I_p = \frac{E_T}{R_T + R_p} = \frac{-59{,}6\ \text{V}}{23{,}8\ \Omega} = -2{,}5\ \text{A}$$

$$P_{R_p} = I_p^2 R_p = 74{,}375\ \text{W}$$