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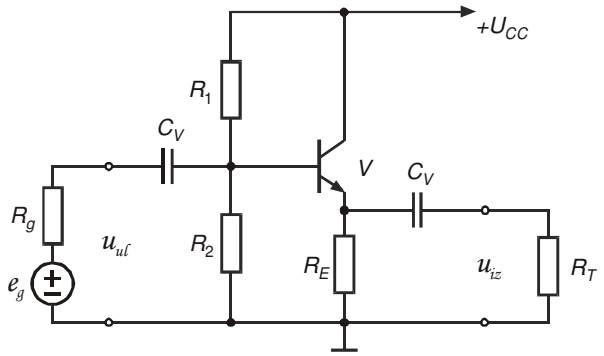
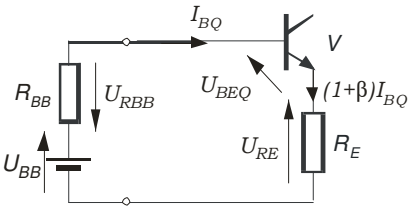
4. domaća zadaća iz Analognih sklopova i Elektroničkih sklopova

1. Za pojačalo sa slike izračunati napon izvora e_g ako je poznato: U_{CC} = 15 V, R_1 = 75 kΩ, R_2 = 130 kΩ, R_E = 680 Ω, h_{fe} = β = 220, R_g = 10 kΩ, R_T = 50 Ω, u_{iz} = 200sinωt, mV.



Rješenje:

Struja baze I_{BQ} može se dobiti postavljanjem Kirchhoffovih zakona za krug baze i rješavanjem dobivenih triju jednadžbi s tri nepoznanice ili s pomoću Theveninovog teorema kao što će se ovdje primjeniti.



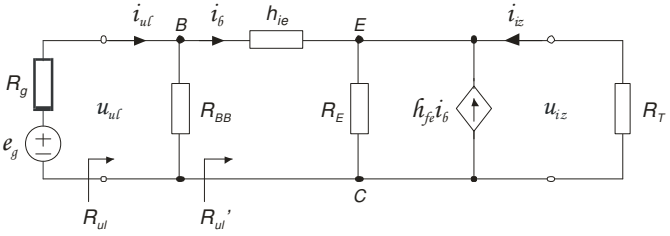
Theveninov napon $U_{BB} = \dfrac{R_2}{R_1 + R_2} \cdot U_{CC} = 9{,}512$ V

Theveninov otpor $R_{BB} = R_1 \| R_2 = 47{,}56$ kΩ

$$U_{BB} = U_{RBB} + U_{BEQ} + U_{RE} = R_{BB} \cdot I_{BQ} + U_{BEQ} + R_E \cdot (1+\beta) \cdot I_{BQ}$$

$$I_{BQ} = \frac{U_{BB} - U_{BEQ}}{R_{BB} + (1+\beta) \cdot R_E} = 44{,}54\,\mu\text{A}$$

$$I_{CQ} = \beta \cdot I_{BQ} = 9{,}799 \text{ mA}, \qquad U_{CEQ} = U_{CC} - R_E \cdot I_{CQ} = 8{,}337 \text{ V}$$



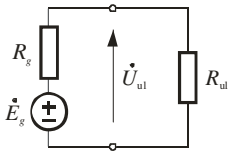
$$h_{ie} = \frac{mU_T}{I_{BQ}} = \frac{0{,}025}{I_{BQ}} = 561{,}3\ \Omega$$

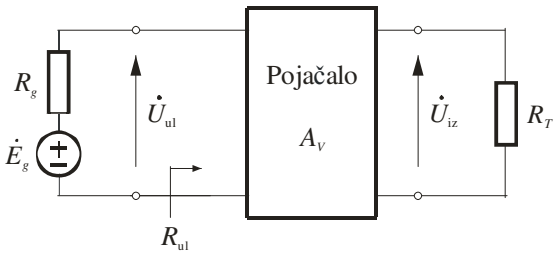
$$R_{\text{ul}} = \frac{\dot{U}_{\text{ul}}}{\dot{I}_{\text{ul}}} = R_B \| R_{\text{ul}}'$$

$$R_{\text{ul}}' = \frac{\dot{U}_{\text{ul}}}{\dot{I}_b} = \ldots = \frac{u_{\text{ul}}}{i_b} = h_{ie} + \left(1 + h_{fe}\right) \cdot R_E \| R_T = 10{,}85\ k\Omega$$

$$R_{\text{ul}} = 8{,}838\ k\Omega$$

S obzirom na izvor signala e_g cijelo se pojačalo može nadomjestiti jednoprilazom čiji je otpor jednak ulaznom otporu pojačala R_{ul} (slika lijevo). S obzirom na zadaću pojačala da ulazni signal pojača i preda ga trošilu na izlazu, pojačalo se može nadomjestiti dvoprilazom s pojačanjem A_V (slika desno).





$$\dot{U}_{\text{ul}} = \frac{R_{\text{ul}}}{R_{\text{ul}} + R_g} \cdot \dot{E}_g$$

$$A_V = \frac{\dot{U}_{iz}}{\dot{U}_{\text{ul}}} = \ldots = \frac{u_{iz}}{u_{\text{ul}}} = \frac{\left(1 + h_{fe}\right) \cdot R_E \| R_T}{h_{ie} + \left(1 + h_{fe}\right) \cdot R_E \| R_T} = 0{,}9483$$

$$\dot{U}_{\text{ul}} = \frac{\dot{U}_{iz}}{A_V}$$

$$u_{\text{ul}} = 210{,}9 \sin \omega t,\ \text{mV}$$

$$\dot{E}_g = \frac{R_{\text{ul}} + R_g}{R_{\text{ul}}} \cdot \dot{U}_{\text{ul}} = 2{,}132 \cdot \dot{U}_{\text{ul}}$$

$$\boxed{e_g = 450{,}0 \sin \omega t,\ \text{mV}}$$