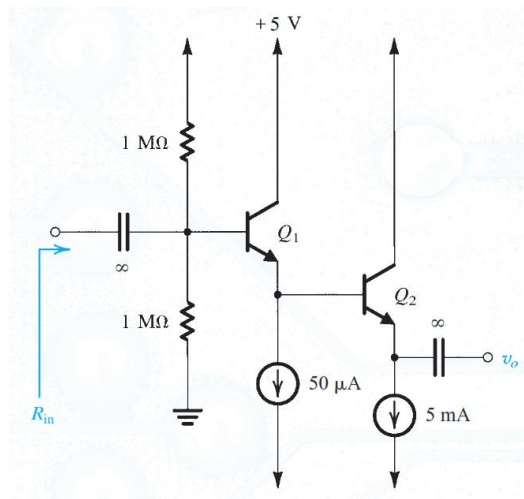


Pekerjaan Rumah #6

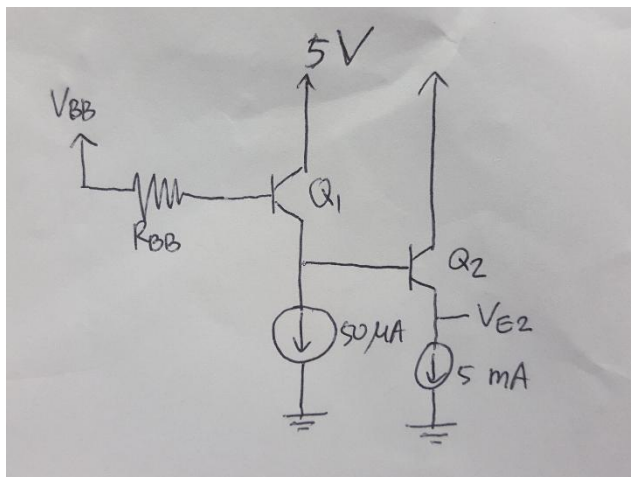
EL2005 Elektronika

Pada rangkaian yang ditunjukkan pada **Gambar 1**,
 Q_1 memiliki $\beta = 50$ dan Q_2 memiliki $\beta = 100$, $V_{BE} = 0.7 \text{ V}$, dan r_o diabaikan



Gambar 1

a) Rangkaian pengganti sinyal besarnya



b) Carilah I_{E1} , I_{E2} , V_{B1} , dan V_{B2} pada Q_1 dan Q_2

$$I_{E1} = 50 \mu\text{A}$$

$$I_{C1} = I_{E1} - I_{B1} = 50 - 0.98 = 49.02 \mu\text{A}$$

$$I_{B1} = \frac{I_{E1}}{(\beta + 1)} = \frac{50 \mu\text{A}}{(51)} = 0.98 \mu\text{A}$$

$$\begin{aligned}
 V_{B1} &= V_{BB} - I_{B1}R_{BB} \\
 &= 2.5 - (0.98)(500)/1000 \\
 &= 2.01 \text{ V}
 \end{aligned}$$

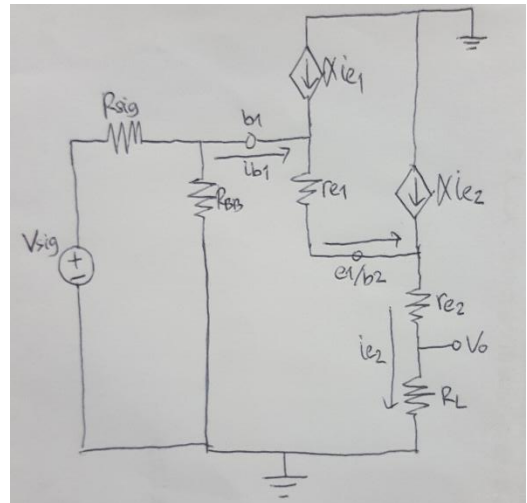
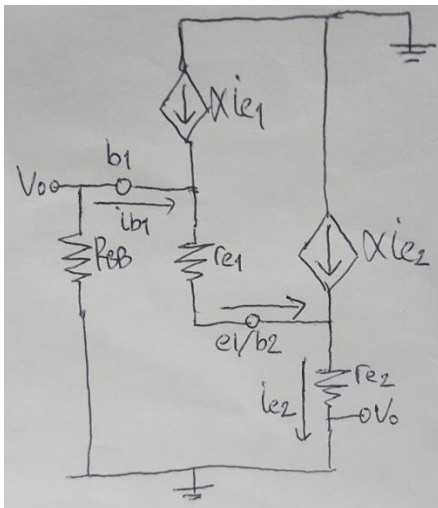
$$\begin{aligned}
 V_{E1} &= V_{B1} - V_{BE} \\
 &= 2.01 - 0.7 = 1.31 \text{ V}
 \end{aligned}$$

$$V_{B2} = V_{E1} = 1.31 \text{ V}$$

$$I_{E2} = 5 \text{ mA}$$

$$I_{C2} = \frac{\beta}{(\beta + 1)} I_{E2} = \frac{50}{(51)} 5 \text{ mA} = 4.9 \text{ mA}$$

c) Gambarkan rangkaian pengganti sinyal kecilnya (r_o diabaikan)



$$r_{e1} = \frac{V_T}{I_{E1}} = \frac{25 \text{ V}}{50 \text{ mA}} = 0.5 \text{ k}\Omega$$

$$r_{e2} = \frac{V_T}{I_{E2}} = \frac{(25)(10^{-3}) \text{ V}}{5 \text{ mA}} = 0.005 \text{ k}\Omega$$

d) Jika $R_L = 1 \text{ k}\Omega$ terhubung pada terminal output, carilah penguatan tegangan dari base ke emitter pada Q_2 , v_o/v_{b2} , dan resistansi masukan base pada Q_2 (R_{ib2})

Catatan: anggap Q_2 sebagai emitter follower dengan tegangan masukan v_{b2}

$$v_o = i_{e2}R_L$$

$$i_{e2} = \frac{v_{ib2}}{r_{e2} + R_L}$$

$$\frac{v_o}{v_{ib2}} = \frac{R_L}{r_{e2} + R_L} = \frac{1}{0.005 + 1} \cong 1$$

$$R_{ib2} = \frac{v_{ib2}}{i_{b2}} = \frac{v_{ib2}}{i_{b2}} (\beta_2 + 1) = (\beta_2 + 1)(r_{e2} + R_L) = (101)(0.005 + 1) \cong 101 \text{ k}\Omega$$

e) Jika rangkaian dicatu dengan sumber yang mempunyai resistansi $R_{sig} = 100 \text{ k}\Omega$, carilah v_{b1}/v_{sig}

$$v_{b1} \frac{r_{e1}}{r_{e1} + r_{r2} + R_L} = v_{sig} \frac{R_{BB}}{R_{sig}}$$

$$\frac{v_{b1}}{v_{sig}} = \frac{R_{BB} (r_{e1} + r_{e2} + R_L)}{R_{sig} r_{e1}} = \frac{(500)(0.5 + 0.005 + 1)}{(100)(0.5)} = 15$$

f) Carilah penguatan menyeluruh v_o/v_{sig}

$$\frac{v_o}{v_{sig}} = \frac{v_o}{v_{ib2}} \frac{v_{ib2}}{v_{ib1}} \frac{v_{ib1}}{v_{sig}}$$

$$v_{ib1} = \frac{i_{e2}}{(\beta_1 + 1)} r_{e1} \qquad i_{e2} = \frac{v_{ib2}}{(r_{e2} + R_L)}$$

$$\frac{v_{ib2}}{v_{ib1}} = \frac{(\beta_1 + 1)(r_{e2} + R_L)}{r_{e1}} = \frac{(51)(0.005 + 1)}{0.5} = 102$$

$$\frac{v_o}{v_{sig}} = (1)(102)(15) = 1530$$