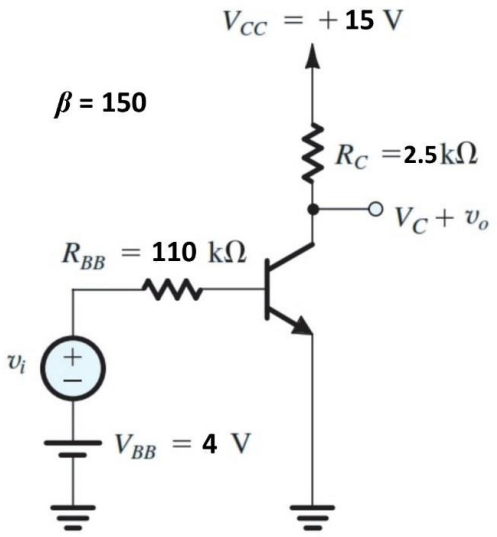
Pekerjaan Rumah #5

EL2040 Elektronika

1. Untuk rangkaian pada **Gambar 1** di bawah ini tentukan voltage gain (v_o/v_i), jika diketahui V_{CC} =15V, ß = 50, R_{BB} = 110 kΩ, R_C = 2,5 kΩ, V_{BB} = 4V.



Gambar 1

a) Karena BJT berada pada kondisi aktif, maka V_{BE} = 0.7 V, $I_E = (\beta+1)I_B$, $I_C = \beta I_B$, $I_C = \alpha I_E$

Perhitungan I_B

$$I_B = \frac{V_{BB} - V_{BE}}{R_{BB}}$$

$$I_B = \frac{4 - 0.7}{110} = 0.03\ mA$$

Perhitungan I_C

$I_C = \beta I_B$

= (150)(0.03) = 4.5 mA

Perhitungan I_E

$I_E = I_C/\alpha$

= 4.5/0.99 = 4.55 mA

Perhitungan V_C

$V_C = V_{CC} – I_C R_C$

= 15 – (4.5)(2.5) = 3.75 V

Analisa Sinyal Kecil

Perhitungan resistansi dan transkonduktansi

$$r_e = \frac{V_T}{I_E} = \frac{25}{4.55} = 5.49\ \Omega$$

$$g_m = \frac{I_c}{V_T} = \frac{4.5}{25} = 180\ \text{mA/V}$$

$$r_\pi = \frac{\beta}{g_m} = \frac{150}{180} = 0.83\ k\Omega$$

Perhitungan v_{be}

$$v_{be} = v_i \frac{r_\pi}{r_\pi + R_{BB}} = v_i \frac{0.83}{0.83 + 110} = 0.0075 v_i$$

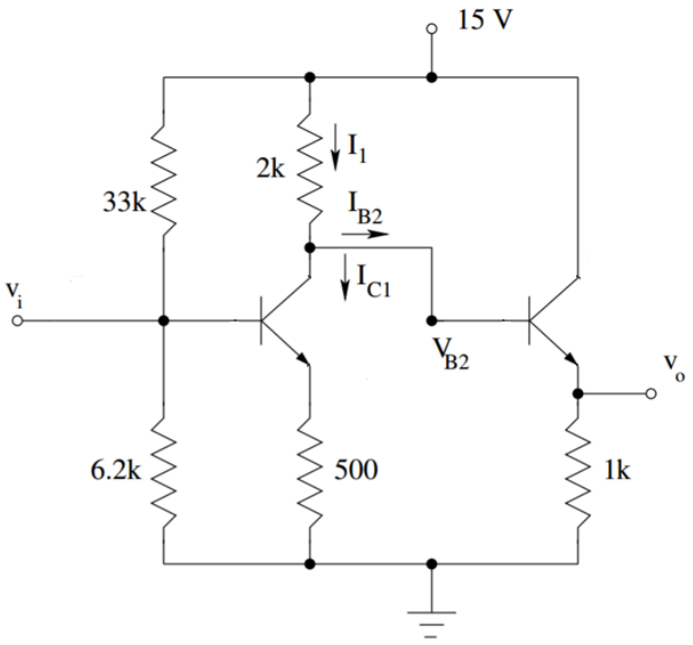
Perhitungan v_o

$$v_o = -g_m v_{be} R_C = -(180)(0.0075 v_i)(2.5) = -3.375 v_i$$

Perhitungan voltage gain (A_V)

$$A_v = \frac{v_0}{v_i} = \frac{-3.375 v_i}{v_i} = -3.375$$

2. Untuk rangkaian pada **Gambar 2,** tentukan voltage gain (v_o/v_i), jika diketahui ß = 200



Gambar 2

Definisi:

$$R_{ek} = \frac{33 * 6.2}{33 + 6.2} = 5.22\ k\Omega$$

Dengan menggunakan analisa sinyal kecil pada Q_1, didapat persamaan:

$$i_{b1} = \frac{v_{i1}}{R_{ek} + r_\pi} \qquad i_{c1} = \beta i_{b1}$$

$$v_{o1} = -R_{C1} i_{c1} \qquad r_\pi = \frac{\beta}{g_m} \qquad I_C = \frac{\beta}{(\beta + 1)} I_E$$

$$= -\beta R_{C1} i_{B1} \qquad = \frac{\beta}{I_C} V_T$$

$$= -\frac{\beta R_{C1}}{R_{ek} + r_\pi} v_{i1}$$

$$A_{v1} = \frac{v_{o1}}{v_{i1}} = -\frac{\beta R_{C1}}{R_{ek} + r_\pi}$$

Perhitungan gain pada Q_1 ($A_{v1} = v_{o1}/v_{i1}$)

$$V_{B1} = \frac{6.2}{6.2 + 33} = 2.37\ V \qquad I_{C1} = \beta I_{B1} = (200)(16) = 3.2\ mA$$

$$I_{B1} = \frac{V_{B1} - V_{BE1}}{R_{ek} + (\beta + 1)R_{E1}}$$

$$= \frac{2.37 - 0.7}{5.22 + (200 + 1)0.5} = 16\ \mu A$$

$$r_{\pi 1} = \frac{\beta}{I_{C1}} V_T$$

$$= \frac{200}{3.2} 25 = 1.56\ k\Omega$$

$$A_{v1} = -\frac{(200)(2)}{5.22 + 1.56} = -59$$

Dengan menggunakan analisa sinyal kecil pada Q_2, didapat persamaan:

$$r_{e2} = \frac{V_T}{I_{E2}}$$

$$A_{v2} = \frac{v_{o2}}{v_{i2}} = \frac{R_{E2}}{R_{E2} + r_{e2}}$$

Perhitungan gain pada Q2 ($A_{v2} = v_{o2}/v_{i2}$)

Karena I_{B2} sangat kecil, maka $I_1 = I_{C1}$

$$V_{B2} = Vcc - I_{C1}R_1 \qquad V_{E2} = V_{C1} - V_{BE2} = 8.6 - 0.7 = 7.9\ V$$

$$= 15 - (3.2)(2) = 8.6\ V$$

$$I_{E2} = \frac{V_{E2}}{R_{E2}} = \frac{7.9}{1} = 7.9\ mA$$

$$r_{e2} = \frac{V_T}{I_{E2}} \qquad A_{v2} = \frac{R_{E2}}{R_{E2} + r_{e2}}$$

$$= \frac{25}{7.9} = 0.003\ k\Omega \qquad = \frac{1}{1 + 0.003} = 1$$

$$A_{total} = A_{v1}A_{v2} = (-59)(1) = -59$$