

ESERCIZIO 1 (Settimana 8)

Dato l'amplificatore di figura, avente i seguenti parametri (a 25°C):

$$V_{CC} = 24 \text{ V}, R_1 = 390 \text{ k}\Omega, R_2 = 68 \text{ k}\Omega, R_3 = 56 \text{ k}\Omega, R_C = 10 \text{ k}\Omega, R_E = 1.8 \text{ k}\Omega, R_g = 10 \text{ k}\Omega;$$

Q_1 : BJT npn,

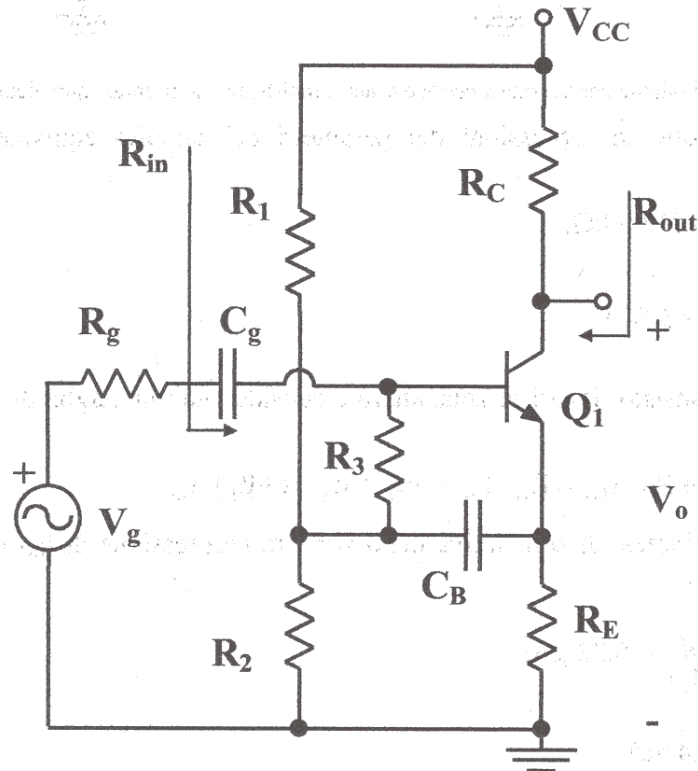
$$V_{BE} = 0.6 \text{ V}, \beta_F = \beta_0 = 200, r_o = \infty;$$

si richiede di:

1) determinare il punto di riposo del transistor (I_{CQ}, V_{CEQ}).

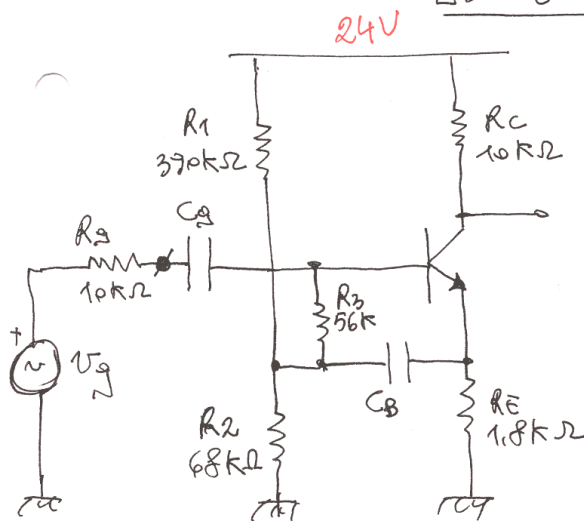
Supponendo le capacità equivalenti a corto circuiti, si richiede ancora di:

- 2) calcolare il guadagno di tensione $A_v = V_o/V_g$ a centro banda;
- 3) le resistenze di ingresso e uscita indicate.



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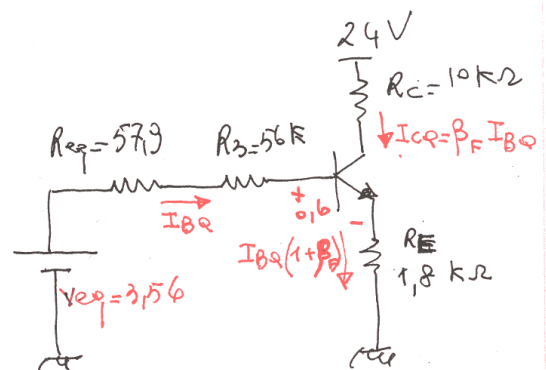
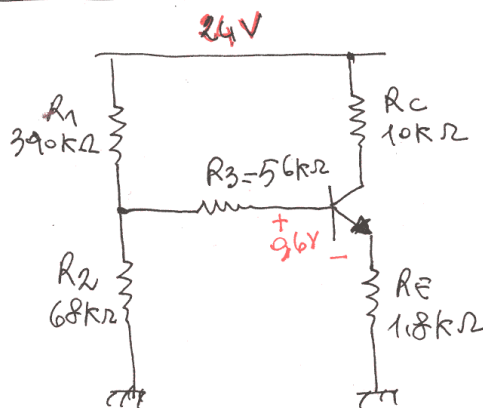


$$\beta_F = \beta_0 = 200 \quad r_{be} = \infty$$

$$V_{BE} = 0.6V$$

Polarizzazione

(1)



$$V_{eq} = 24 \cdot \frac{68}{390 + 68} = 3.56V$$

$$R_{eq} = \frac{68 \cdot 390}{68 + 390} = 57.9k\Omega$$

$$I_{BQ} = \frac{V_{eq} - V_{BE}}{R_{eq} + R_3 + R_E(1 + \beta_F)} = \frac{3.56 - 0.6}{57.9 + 56 + 1.8(1 + 200)} \approx 6.22\mu A$$

$$I_{CQ} = \beta_F I_{BQ} = 200 \cdot 6.22 = 1.244mA$$

$$V_{CEQ} = V_{CC} - R_C I_C - R_E I_C \left(1 + \frac{1}{\beta_F}\right) = 24 - 10 \cdot 1.244 - 1.8 \left(1 + \frac{1}{200}\right) \cdot 1.244$$

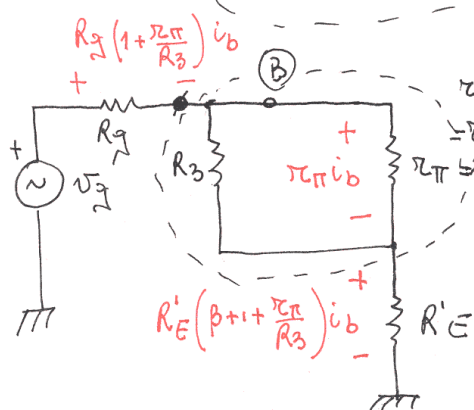
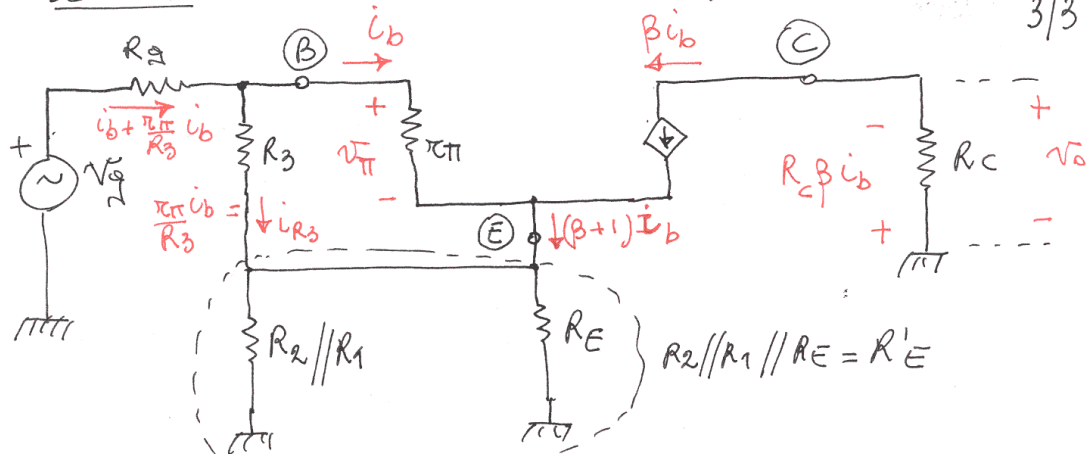
$$= 9.32V$$

SEGNALI

(ESERCIZIO 1 (SEMILAVANDRO))

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$$R'E = \frac{1}{\frac{1}{390} + \frac{1}{68} + \frac{1}{1.8}} = 1,746 \text{ k}\Omega$$

$$g_m = \frac{I_{CQ}}{V_T} = \frac{1,244}{25} \approx 49,76 \frac{\text{mA}}{\text{V}}$$

$$r_{\pi} = \frac{\beta_0}{g_m} = \frac{200}{49,76 \frac{\text{mA}}{\text{V}}} \approx 4 \text{ k}\Omega$$

$$V_g = \left[R_g \left(1 + \frac{r_{\pi}}{R_3} \right) + r_{\pi} + R'E \left(\beta + 1 + \frac{r_{\pi}}{R_3} \right) \right] i_b$$

$$V_o = -R_c \beta i_b = -R_c \beta \frac{V_g}{R_g \left(1 + \frac{r_{\pi}}{R_3} \right) + r_{\pi} + R'E \left(\beta + 1 + \frac{r_{\pi}}{R_3} \right)}$$

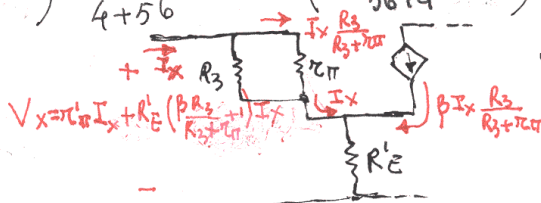
$$A_v = \frac{V_o}{V_g} = -\beta \frac{R_c}{R_g \left(1 + \frac{r_{\pi}}{R_3} \right) + r_{\pi} + R'E \left(\beta + 1 + \frac{r_{\pi}}{R_3} \right)}$$

$$= -200 \frac{10}{10 \left(1 + \frac{4}{56} \right) + 4 + 1,746 \left(200 + 1 + \frac{4}{56} \right)} \approx -5,47$$

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$$R_i = \frac{V_x}{I_x} = r_{\pi} \parallel R_3 + R'E \left(\beta \frac{R_3}{R_3 + r_{\pi}} + 1 \right) = \frac{4 \cdot 56}{4 + 56} + 1,746 \left(200 \frac{56}{56 + 4} + 1 \right) \approx 331 \text{ k}\Omega$$

$$R_o = R_c = 10 \text{ k}\Omega$$



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"BOOSTRAP"