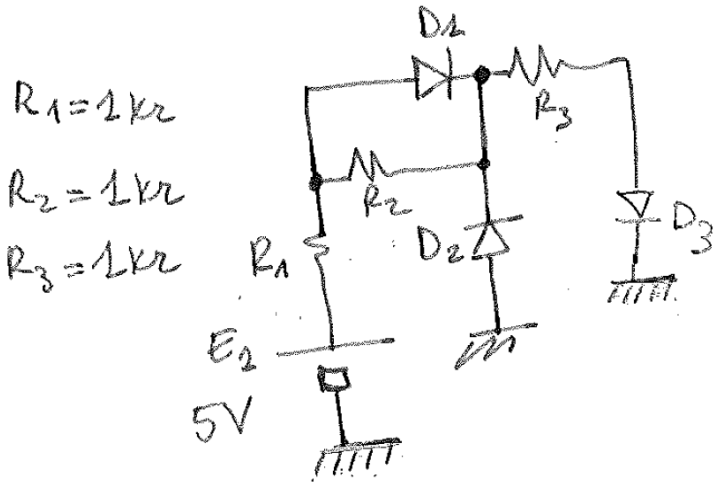
SCHEDA **A14_05**		Data: **11 Giugno 2014**
Cognome	Nome	Matricola

ESERCIZIO N°1

4 punti (4)

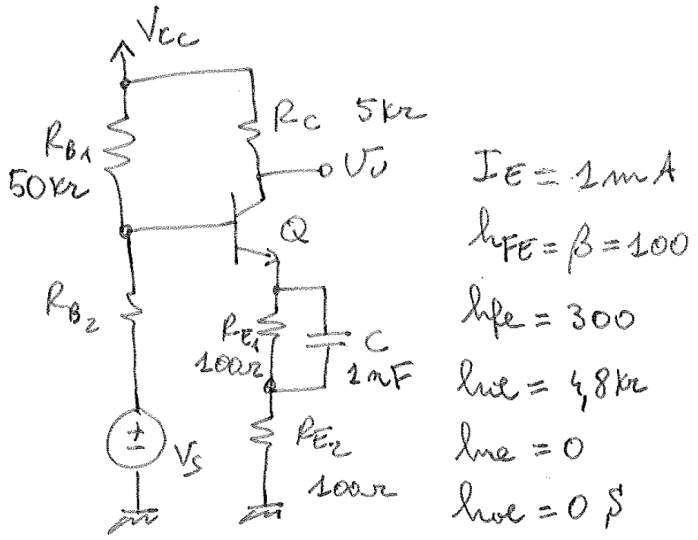
Si calcolino le correnti nei rami e le tensioni ai nodi nel seguente circuito. Si considerino i diodi ideali con $V_\gamma = 0$ V.



ESERCIZIO N°2

8 punti (4)

Con riferimento al circuito in figura, determinare il punto di riposo del transistore BJT e il valore della resistenza R_{B2} per cui $I_E = 1$ mA. **Si utilizzi una precisione numerica fino alla quarta cifra significativa**.



ESERCIZIO N°3

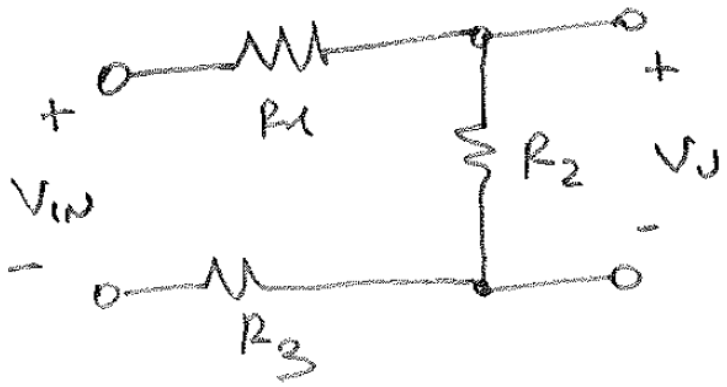
9 punti (4)

Nel circuito mostrato nell'esercizio precedente, si ricavi la funzione di trasferimento $Av(s)=V_U/V_{IN}$ e si disegni il diagramma di Bode del modulo. Si consideri R_{B2}= 50 kΩ.

ESERCIZIO N°4

6 punti (4)

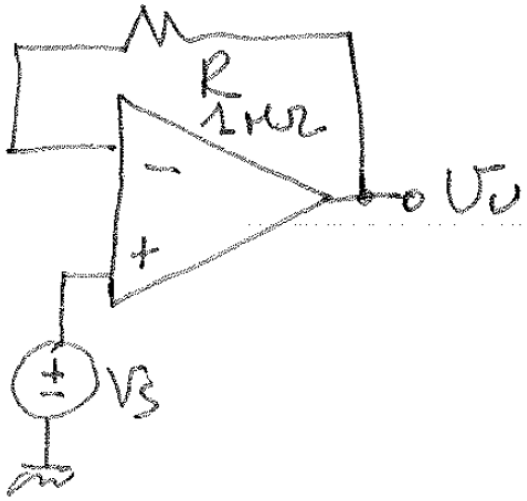
Ricavare i parametri *h* del circuito seguente:



ESERCIZIO N°5

6 punti (4)

Ricavare il massimo sbilanciamento in uscita del circuito mostrato in figura. Si consideri, per tutti gli altri aspetti, l'amplificatore operazionale ideale.

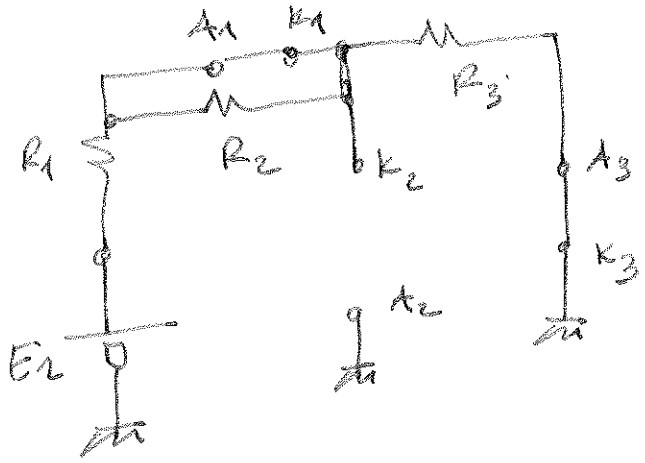


$I_B = 80nA$

$I_{io} = 20nA$

$|V_{io}| = 5mV$

1) Supponiamo D_1 ON, D_2 OFF e D_3 ON



$$I_{R1} = I_{R3} = \frac{E_1}{R_1+R_2} = 2{,}5\,mA$$

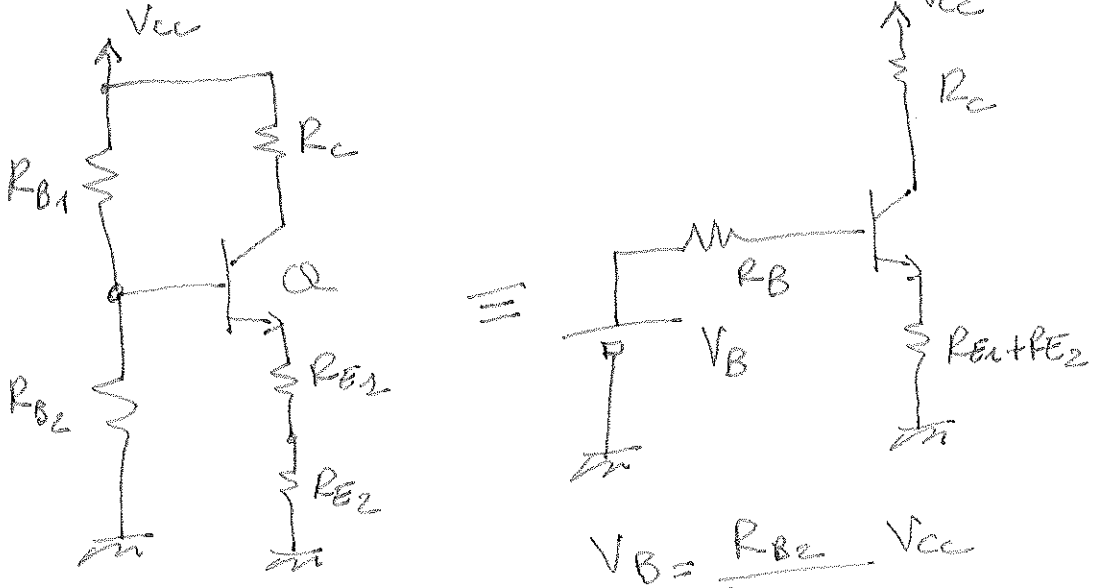
Quindi $I_{D3} > 0 \Rightarrow$ ipotesi D_3 verificata

$$V_{K2} = \frac{R_3}{R_1+R_3} E_2 = 2{,}5\,V$$

$V_{K2} = V_{K1} \Rightarrow V_{A2K2} = -2{,}5\,V \Rightarrow$ Ipotesi D_2 verificata

$I_{R2} = 0\,A \Rightarrow I_{D1} = I_{R3} > 0 \Rightarrow$ Ipotesi su D_1 verificata

2)



$$V_B = \frac{R_{B2}}{R_{B1}+R_{B2}} V_{cc}$$

$$R_B = R_{B1} \| R_{B2}$$

$$V_B = R_B I_B + V_{BEON} + (R_{E1}+R_{E2}) I_E =$$

$$= \frac{R_B I_E}{\beta+1} + V_{BEON} + (R_{E1}+R_{E2}) I_E$$

$$\frac{R_{B2}V_{CC}}{R_{B1}+R_{B2}} = \frac{R_{B1}R_{B2}}{R_{B1}+R_{B2}}\frac{I_E}{\beta+1} + V_{BEON} + (R_{E1}+R_{E2})I_E$$

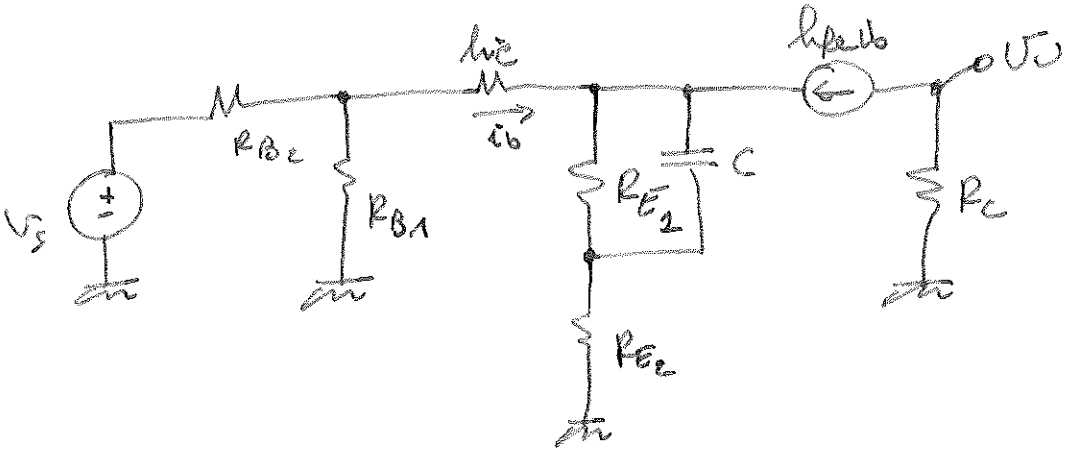
$$R_{B2}V_{CC} = R_{B1}R_{B2}\frac{I_E}{\beta+1} + (R_{B1}+R_{B2})\left[V_{BEON}+(R_{E1}+R_{E2})I_E\right]$$

$$R_{B2}\left[V_{CC} - R_{B1}\frac{I_E}{\beta+1} - V_{BEON} - (R_{E1}+R_{E2})I_E\right] = R_{B1}\left[V_{BEON}+(R_{E1}+R_{E2})I_E\right]$$

$$R_{B2} = \frac{R_{B1}\left[V_{BEON}+(R_{E1}+R_{E2})I_E\right]}{\left[V_{CC} - R_{B1}\frac{I_E}{\beta+1} - V_{BEON} - (R_{E1}+R_{E2})I_E\right]} = 4,243\ k\Omega$$

$$V_{CE} = V_C - V_E = V_{CC} - R_C\frac{I_{EB}}{\beta+1} - (R_{E1}+R_{E2})I_E = 6,8495\ V$$ Forma ultima diretta per verifica

3) $R_{B2} = 50\ k\Omega$



$$A_V(s) = \frac{V_o}{V_s} = \frac{A_{VO}\left(\frac{s}{\omega_0}+1\right)}{\left(\frac{s}{\omega_p}+1\right)}$$

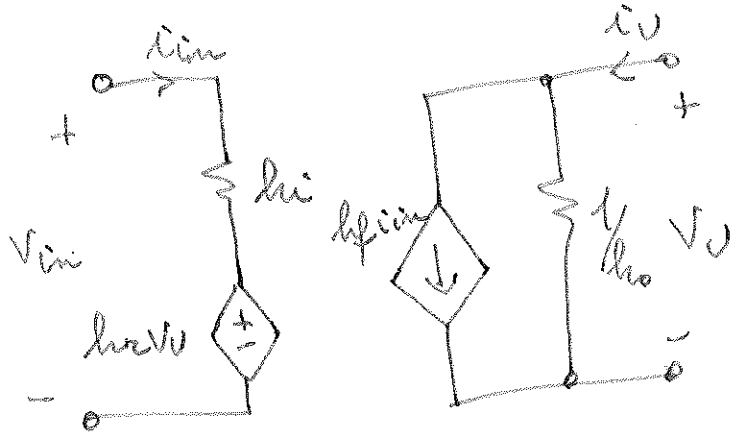
$$\omega_p = \frac{1}{C\cdot\left[R_{E1}\,\|\left[R_{E2}+\frac{h_{ie}+R_{B2}\|R_{B1}}{h_{fe}+1}\right]\right]} = 15,06\ krad/s$$

$R_{E1}\,\|\left[R_{E2}+\frac{h_{ie}+R_{B2}\|R_{B1}}{h_{fe}+1}\right] = 66,56\ \Omega$

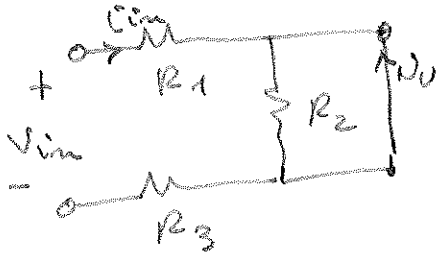
$$\omega_0 = \frac{1}{R_{B1} C} = 20\,\text{Mrad/s}$$

$$A_{V0} = - \frac{R_C h_{fe}}{R_{B1} \| R_{B2} + h_{ie} + (R_{B1} + R_{B2})(h_{fe}+1)} \cdot \frac{R_{B1}}{R_{B1}+R_{B2}} = -8{,}33$$

4)

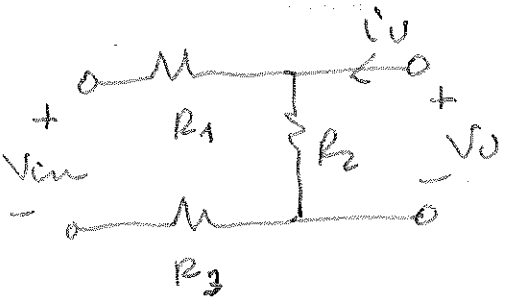


$$h_i = \left.\frac{V_{in}}{i_{in}}\right|_{V_U=0}$$



$$h_i = R_1 + R_3$$

$$h_f = \left.\frac{i_U}{i_{in}}\right|_{V_U=0} = -1$$

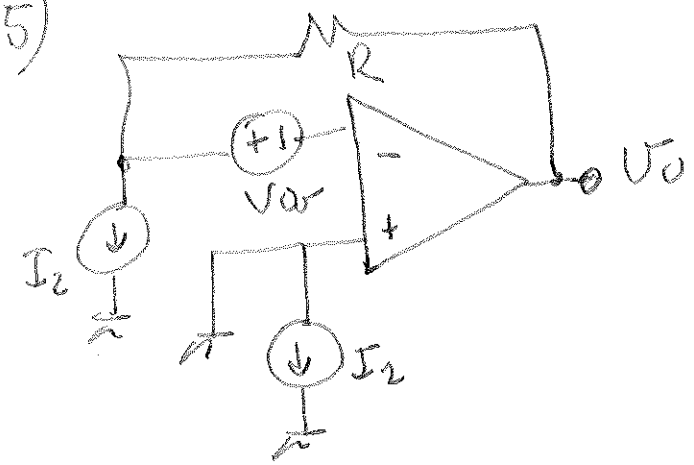


$$h_r = \left.\frac{V_{in}}{V_U}\right|_{i_{in}=0}$$

$$h_{re} = 1$$

$$h_o = \left.\frac{i_U}{V_U}\right|_{i_{in}=0} = \frac{1}{R_2}$$

5)



$$V_O = V_{io} + R I_2$$

V_{Omax} per $V_{io} = 5mV$ e $I_2 = I_B + \frac{I_{io}}{2} = 90mA$

Quindi $V_O = 95mV$