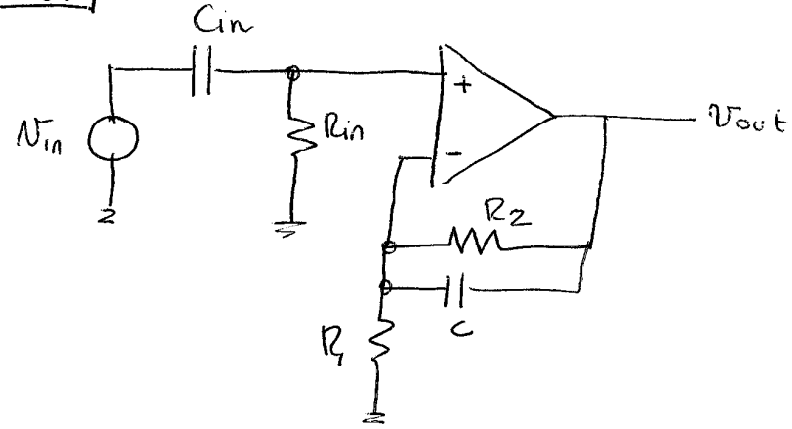
2° PROVA - RECUPERO

ES. A



1.

$$G_{ideale}(s) = \frac{R_{in}}{R_{in} + 1/sC_{in}} \cdot \left(1 + \frac{R_2}{R_1} \cdot \frac{1}{1+sCR_2}\right) =$$

$$= \frac{sC_{in}R_{in}}{1+sC_{in}R_{in}} \cdot \left(\frac{(1+sCR_2)R_1 + R_2}{R_1(1+sCR_2)}\right) =$$

$$= \frac{sCR_{in}}{1+sC_{in}R_{in}} \quad \frac{R_1+R_2}{R_1} \quad \frac{1+sC\frac{R_2R_1}{R_1+R_2}}{1+sCR_2} =$$

$$= \left(1+\frac{R_2}{R_1}\right) \quad \frac{sC_{in}R_{in}}{1+sC_{in}R_{in}} \quad \frac{1+sCR_{//}}{1+sCR_2}$$

$f_{in} = 3.4\,\text{Hz}$

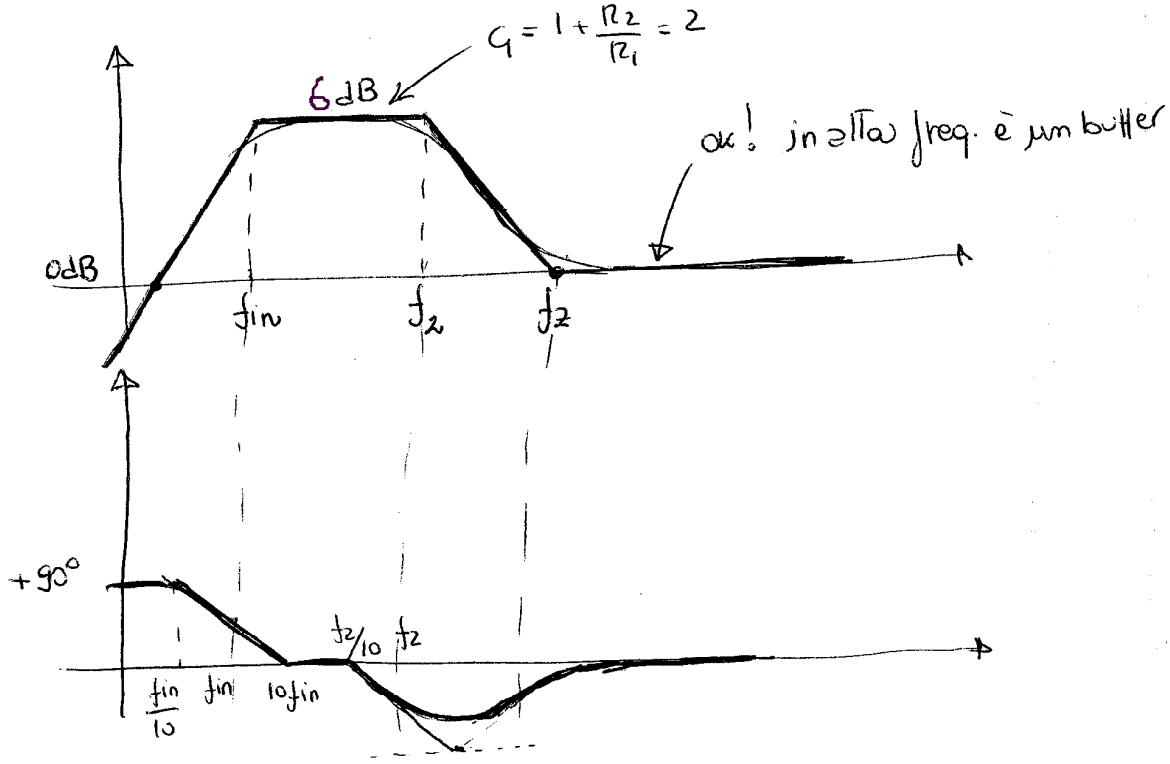
$\tau_{in} = C_{in}R_{in} = 47\,\text{ms}$

$\tau_2 = CR_2 = 47\,\mu\text{s} \hookrightarrow f_2 = 3.4$

$\tau_z = CR_{//} = 23.5\,\mu$

$\hookrightarrow f_z = 6.8$

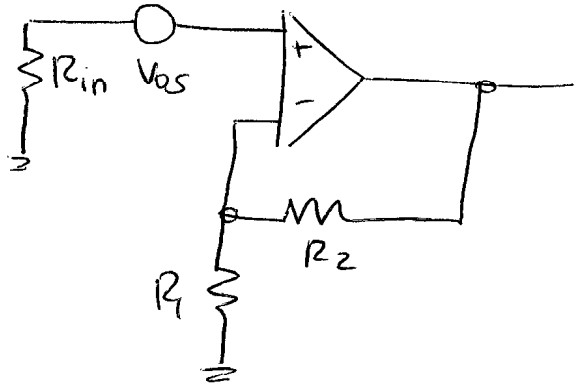
2.



3. $f_{in} = 100\,Hz \Rightarrow$ centro banda

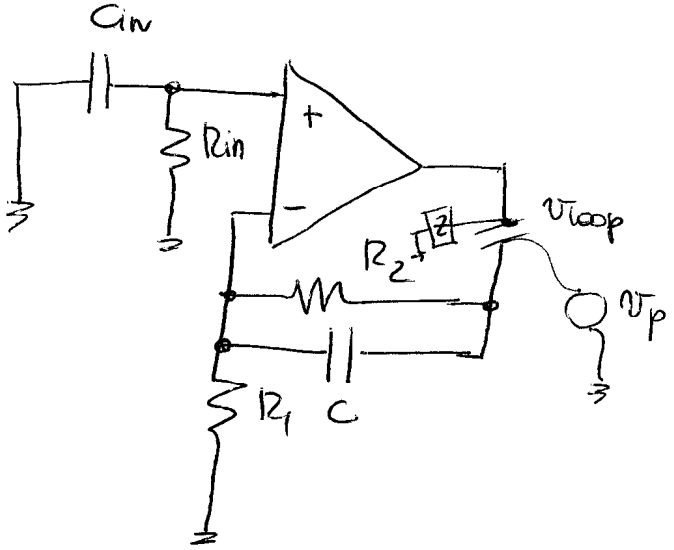
$$V_{out} = \left(1 + \frac{R_2}{R_1}\right) \cdot V_{in} \sin\left(2\pi f_{in} t\right) = +200\,mV \sin\left(2\pi f_{in} t\right)$$

4.



$$V_{out} = V_{os} \cdot \left(1 + \frac{R_2}{R_1}\right) = \pm 4\,mV$$

5.

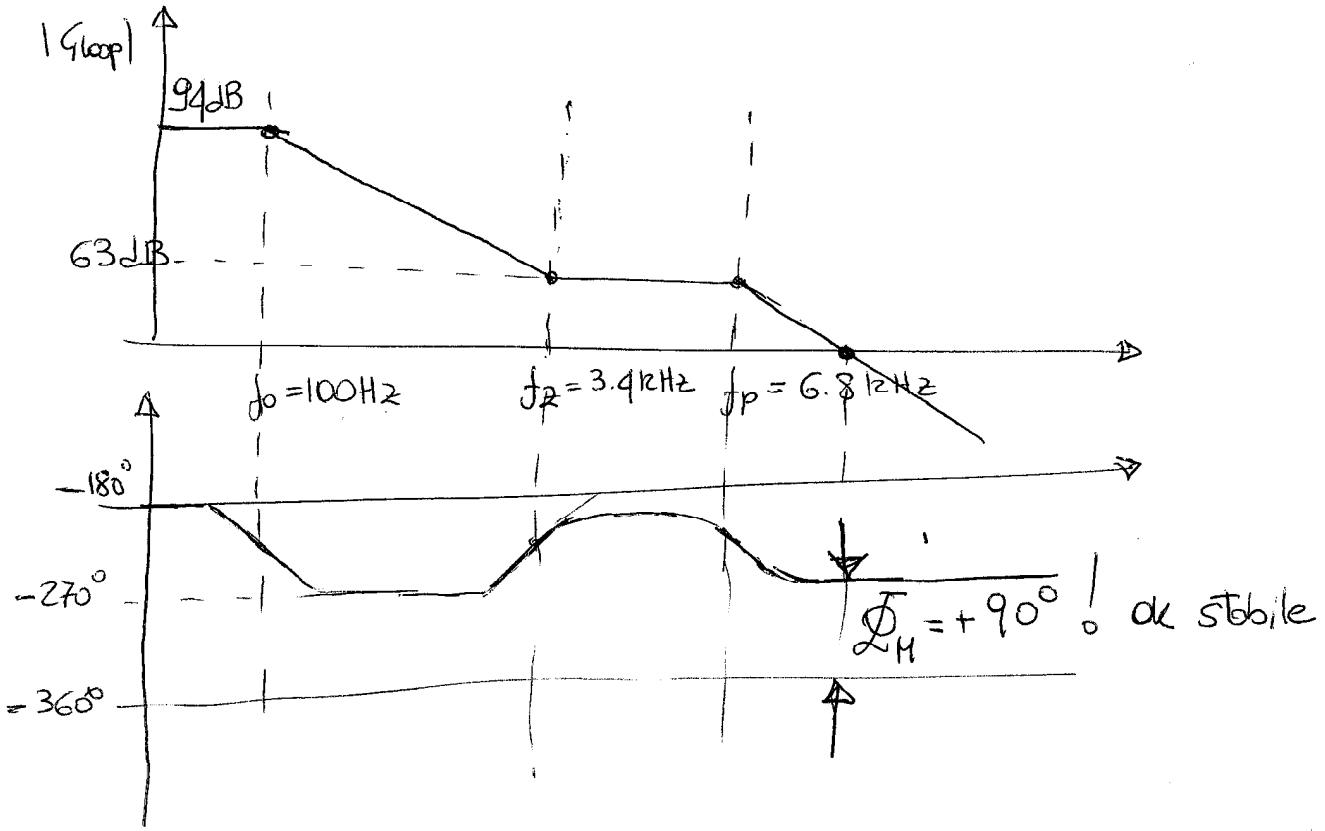


$$G_{loop} = \frac{V_{loop}}{V_p} = \frac{-R_1}{R_1 + \frac{R_2}{1+SCR_2}} \frac{A_0}{1+S\tau_0} =$$

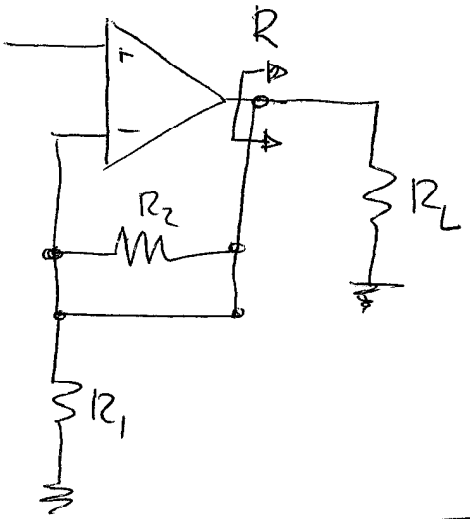
$$A_0 = 100\,dB = 10^5 \Rightarrow f_0 = \frac{GPWP}{A_0} = \frac{10^7\,Hz}{10^5} = 10^2\,Hz = 100\,H$$

$$\hookrightarrow \tau_0 = 1.6\,ms$$

$$= -\frac{R_1}{R_1 + R_2} \frac{1+SCR_2}{1+SCR_{//}} \frac{A_0}{1+S\tau_0} = 5\,10^4 \frac{1+S\tau_z}{1+S\tau_p}$$



6.



$$R = R_L // R_1 = 10k\Omega // 10k\Omega = 5k$$

$$I_{picco} = \frac{V_{picco}}{R} = \frac{5V}{5k} = 1mA$$

ES. B

1. $$v_{in}\Big|_{ADC} = v_{in} \cdot \left(1 + \frac{90k}{10k}\right) = 10\, v_{in} \Rightarrow v_{in}\Big|_{ADC}\Big|_{MAX} = 3V$$

non copre l'intero dinamico dell'ADC

$$\Downarrow$$

$$\frac{5V}{2^m} = 1mV \Rightarrow \frac{5V}{2^m} = 10^{-3}V \Rightarrow 2^m = 5000$$

$$\hookrightarrow m = 12.3 \Rightarrow \boxed{13\ bit}$$

2.

$T_{SAMP} = T_S + T_H = 5\mu s \Rightarrow f_{SAMP} = 2 f_{MAX}$ per Teo campio

$$f_{MAX} = \frac{f_{SAMP}}{2} = \frac{1}{2\,T_{SAMP}} = \frac{1}{10\mu s} = 100\,kHz$$

3. $$\Delta V_{in} = \frac{C_{STray}}{C_{STray}+C} \cdot 5V = \frac{0.4pF}{0.4pF+10nF} \cdot 5V = 0.2\,mV$$

$$1LSB = \frac{5V}{2^{13}} = 610\mu V$$

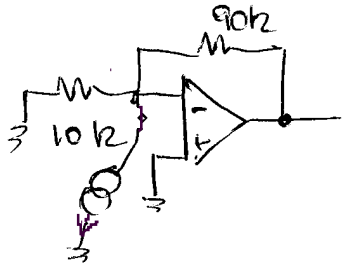
$$\Delta V_{ADC} = 0.2\,mV \times 10 = 2\,mV \Rightarrow \frac{2\,mV}{610\mu V} = 3.3\ LSB$$

4. $$\frac{dv_{in}}{dt} = A_{in}\,\omega_{in}\cos(\omega_{in} t) \Rightarrow \left.\frac{dv_{in}}{dt}\right|_{MAX} = A_{in}\omega_{in}$$

↳ $SR = A_{in}\,\omega_{in} = 300\,10^{-3} \times 10^{6}\,2\pi \simeq 1.88\,10^{6}\,V/s \simeq 2V/\mu s$

5. I_{B+} non conta

I_{B^-} :



$V_{out} = -I_B^- \times 90k\Omega = -50\,mA \times 90k\Omega =$

$= -4.5\,mV$

⇒ errore statico: $\frac{4.5mV}{610\mu V} = 7.$ LSB