Zadaci – Lončarić 14. 12. 2010.

(1) - spektar parnog signala

$$F(\omega) = \int_{-\infty}^{\infty} f(t)\, e^{-j\omega t} dt = \int_{-\infty}^{\infty} f(t) \cos\omega t\, dt - j \int_{-\infty}^{\infty} f(t) \sin\omega t\, dt = 2\int_{0}^{\infty} f(t) \cos\omega t\, dt, \quad F_{I}(\omega) = 0$$

parna · parna → parna; parna · neparna → neparna

$$F_r(\omega) = 2\int_{0}^{\infty} f(t)\cos\omega t\, dt$$ → realni spektar

→ imaginarni spektar

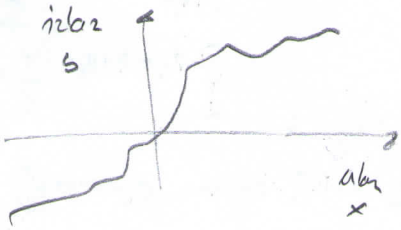
(2) Linearna i nelinearna izobličenja

Linearna – kad a-f kar odstupa od konstante i/ili f-f kar je različita od pravca.

$|H(j\omega)| \neq konst$, i/ili $\varphi(\omega) \neq -t_d\omega$, nema novih harmonika, svaki filter ima linearna izobličenja.

Sustav je bez izobličenja kad $|H(j\omega)| = konst$, $\varphi(\omega) = -t_d\omega$ → pravac

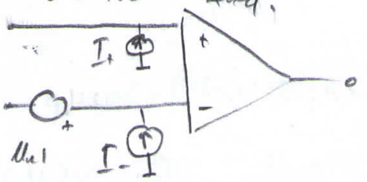
Nelinearna izobličenja – nastaju zbog statičke nelinearne ulazno izlazne karakteristike, ne ovise o frekvenciji.



$$THD = \frac{\sqrt{U_2^2 + U_3^2 + \dots U_n^2}}{U_1}, \quad y = a + bx + cx^2, \quad x = A\sin\omega t$$

(3) Statičke nesavršenosti pojačala.

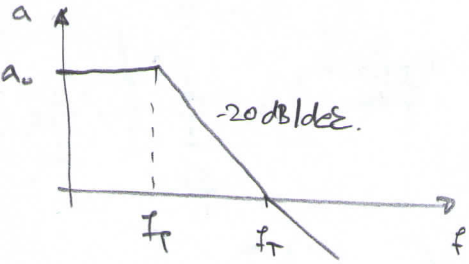
Ne ovise o frekv.

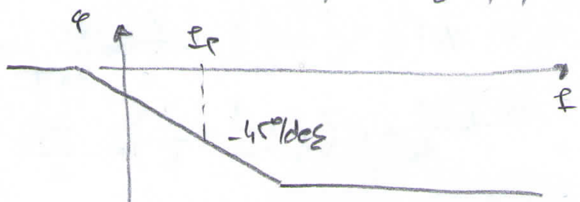


(4) Dinamičke nesavršenosti.

Frekv. ovisnost pojačanja, konačno pojačanje i širina pojasa, vrijeme porasta (za mali signal), brzina porasta izlaznog signala (za veliki signal), šum, Ulazna i izlazna impedancija

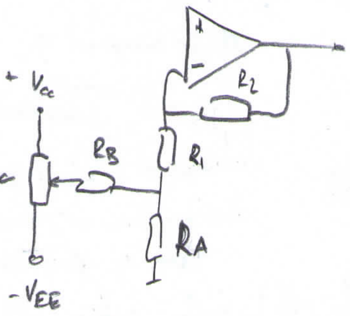
A-f. karakteristika kompenziranog pojačala. F-f. kar. kompenziranog pojačala





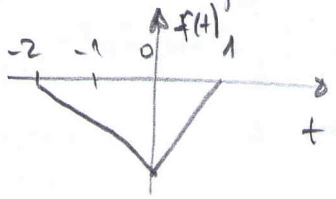
$$a = \frac{a_0}{1 + j\frac{f}{f_p}}$$

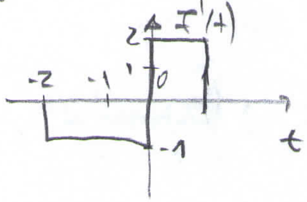
(5) Neinvertirajuće pojačalo s vanjskom kompenzacijom.

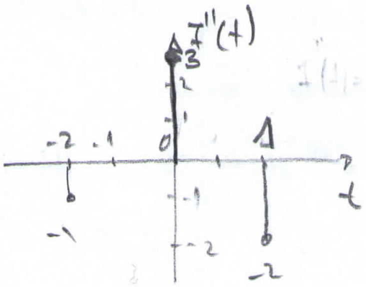


Teorija sustava!

6. Fourierov spektar signala zadanog slikom.



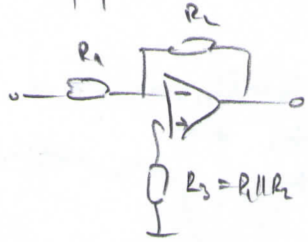




$f''(t) = -\delta(t+2) + 3\delta(t) - 2\delta(t-1)$

$-\omega F(\omega) = -e^{j2\omega} + 3 - 2e^{-j\omega}$ – eulr. transf., razdvojit $Re(\omega)$ i $Im(\omega)$!

7. Inv. poj. $R_{ul} = 10k\Omega$, $|A| = 25$, R – izlazni napon pomaka najmanji.



	TL 081	LM 741
U_{upom}	$= 15mV$	$3mV$
I_{pom}	$= 100pA$	$200nA$
I_{ul}	$= 200pA$	$500nA$

↳ podudarni višak

$|A| = \frac{R_2}{R_1} \Rightarrow R_2 = |A| R_1 = 250k\Omega$

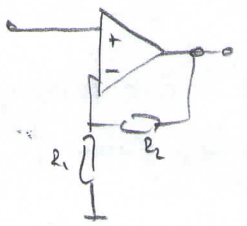
$R_3 = R_1 || R_2 = 9{,}6k\Omega$ = R_3

$U_{izpom} = \left(U_{upom} + I_{pom}\frac{R_3 + (R_1||R_2)}{2}\right)\left(1 + \frac{R_2}{R_1}\right)$ = 26

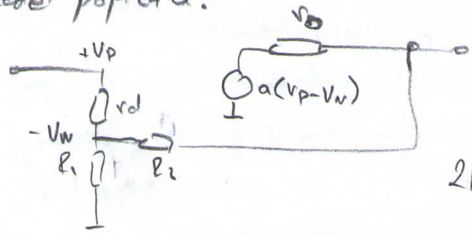
$U_{izpom\,741} = 128mV$ — OVO ODABIREMO! ⇒ manji izl. napon pomaka.

$U_{izpom\,TL081} = 390mV$

8. R_{ul} = ? Neinv. $a = 100\frac{V}{mV}$, $r_d = 2M\Omega$, $r_o = 75\Omega$, $R_1 = 1k\Omega$, $R_2 = 999k\Omega$



– model pojačala:



$R_{ul} = r_d(1 + \beta a) + R_1 || (R_2 + r_o)$

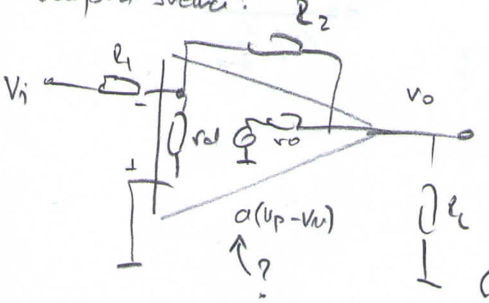
$\beta = \frac{R_1}{R_1 + R_2 + r_o}$

$2M\Omega\left(1 + \frac{1}{1000 + 0.075}10^5\right) + 1 || (999 + 0.075) = 202M\Omega$

(10) (= 1k) (201,985 MΩ)

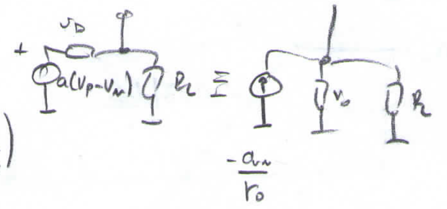
9. Inv. poj. $R_1 = 100k\Omega$, $R_2 = 200k\Omega$, $R_L = 2k\Omega$, $r_d = 1M\Omega$, $r_o = 100\Omega$, a_{min} = ? 0.1% odstupanje $A = \frac{V_o}{V_i}$

– nadomjesna shema:



(1) $V_N\left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{r_d}\right) - V_o\frac{1}{R_2} = \frac{V_i}{R_1}$ / : V_o

(2) $-V_N\cdot\frac{1}{R_2} + V_o\left(\frac{1}{R_2} + \frac{1}{r_o} + \frac{1}{R_L}\right) = -\frac{aV_N}{r_o}$ / $\cdot\left(-\frac{r_o}{V_N}\right)$



(2)' $a = \frac{r_o}{R_2} - \frac{V_o}{V_N}\left(\frac{r_o}{R_2} + \frac{r_o}{R_L} + 1\right)$

(1)' $\frac{V_N}{V_o}\cdot\left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{r_d}\right) - \frac{1}{R_2} = \frac{V_i}{V_o}\frac{1}{R_1} \Rightarrow \frac{V_N}{V_o} = \frac{\frac{1}{AR_1} + \frac{1}{R_2}}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{r_d}}$ ($\frac{V_i}{V_o} = \frac{1}{A}$)

$a = \frac{r_o}{R_2} - \frac{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{r_d}}{\frac{1}{AR_1} + \frac{1}{R_2}}\left(\frac{r_o}{R_2} + \frac{r_o}{R_L} + 1\right)$, $A = 0.999\left(-\frac{R_2}{R_1}\right) = -0.999\cdot 2 = -1.998$

A je manje od a jer ostalo povećavamo!

$a_{min} = 3358{,}24$

10. Inv, $|A| = 10$, $R_{ul} = 10k\Omega$, $R_g = 50\Omega$, $f = 10kHz$, $a_o = 70dB$, $r_d = 1M\Omega$, $f_p = 10Hz$

$a = \frac{a_o}{1 + j\frac{f}{f_p}}$, $|a| = \frac{a_o}{\sqrt{1 + \left(\frac{f}{f_p}\right)^2}}$, $a_{odB} = 20\log a_o \Rightarrow a_o = 10^{\frac{70}{20}} = 10^{3.5} = 3162{,}3$

– nemoguće je da pojačanje ima gubitak u stranu većeg pojačanja!

$a(10^4) = \frac{a_o}{\sqrt{1 + \left(\frac{10\cdot 10^3}{10}\right)^2}} = \frac{a_o}{10^3} = 3{,}16$

$R_{ul} = R_1 \Rightarrow R_1 = 10k$ $a = 3{,}1623$

$R_2 = |A| R_1 = 100k$

$R_3 = (R_1 + R_g) || R_2$

$= 9{,}13k\Omega$

uz zanemarenje $R_g \Rightarrow R_3 = 9.09k\Omega$

Točno:

$V_N = \left(\frac{1}{R_2} + \frac{1}{R_1 + R_g} + \frac{1}{r_d}\right) - V_P\frac{1}{r_d} - V_o\frac{1}{R_2} = \frac{V_g}{R_g + R_1}$

$V_P = V_N\frac{R_3}{R_3 + r_d}$ $r_d \gg R_3$

$R_1 \gg R_g$ $V_o = a(V_P - V_N)$

$a = -2{,}198$

$A = \frac{aR_2}{(1+a)R_1 + R_2\left(1 + \frac{R_1}{R_d}\right)} = -2{,}2$