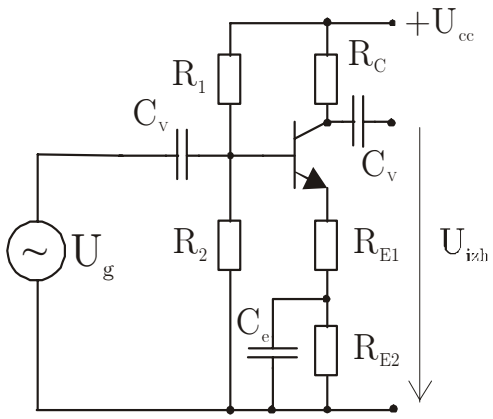
Komunikacijska vezja - IZPIT 16.4.2004

1. Izračunajte amplitudo druge harmonske komponente na izhodu ojačevalnika !

Podatki :



$R1 := 40000 \quad R2 := 4000$

$Re1 := 200 \quad Re2 := 1000$

$Rc := 10000 \quad Cv := 4 \cdot 10^{-6}$

$Ce := 10 \cdot 10^{-6} \quad Ucc := 20$

$\beta := 100 \quad Ube0 := 0.6$

$U1 := 20 \cdot 10^{-3} \quad f1 := 2000$

$$Par(R1, R2) := \frac{R1 \cdot R2}{(R1 + R2)}$$

$RB := Par(R1, R2) \quad RB = 3.636 \cdot 10^{3}$

Delovna točka transistorja in parametri NF modela:

$$Ie := \frac{Ucc \cdot \frac{R2}{R1 + R2} - Ube0}{(Re1 + Re2) + \frac{RB}{\beta + 1}} \qquad gm := 40 \cdot Ie \qquad rbe := \frac{\beta}{gm}$$

$Ie = 9.856 \cdot 10^{-4} \qquad gm = 0.039 \qquad rbe = 2.537 \cdot 10^{3}$

Ojačenje pri srednjih frekvencah:

$$Asf := -gm \cdot Rc \cdot \frac{rbe}{rbe + \beta \cdot Re1} \qquad Asf = -44.372$$

faktor nelinearnega popačenja zaradi druge harmonske komponente:

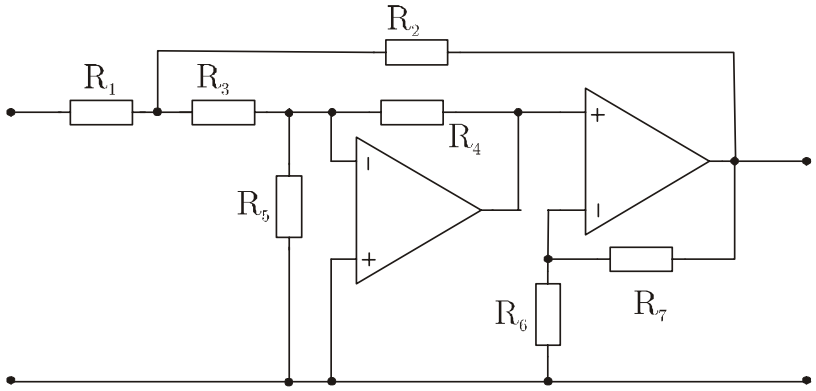
$$ube := U1 \cdot \frac{rbe}{rbe + Re1 \cdot \beta} \qquad k2 := \frac{ube}{100 \cdot 10^{-3}} \qquad k2 = 0.023 \qquad ube = 2.251 \cdot 10^{-3}$$

amplituda druge harmonske komponente signala na izhodu ojačevalnika:

$U\omega := U1 \cdot |Asf| \qquad U2\omega := U\omega \cdot k2 \qquad U2\omega = 0.019977$

2. Izračunajte natančno napetostno ojačenje in natančno vhodno upornost ojačevalnika !

$R1 := 1000$ $R3 := 1000$ $R5 := 1000$ $R6 := 1000$
$R2 := 10000$ $R4 := 10000$ $R7 := 10000$ $A1 := 100$ $A2 := 1000$



$$Rm4 := \frac{R4}{1 + A1} \qquad Rm4 = 99.01$$

$$Ab1 := -A1 \cdot \frac{Par(Rm4, R5)}{R3 + Par(Rm4, R5)} \qquad Rvh1 := R3 + Par(Rm4, R5)$$

$Ab1 = -8.264$ $\qquad Rvh1 = 1.09 \cdot 10^3$

$$Ab2n := \frac{R7}{R6} + 1 \qquad T2 := \frac{R6}{R6 + R7} \cdot A2$$

$$Ab2 := \frac{Ab2n}{1 + \frac{1}{T2}} \qquad Ab2 = 10.88 \qquad Ab2n = 11 \qquad T2 = 90.909$$

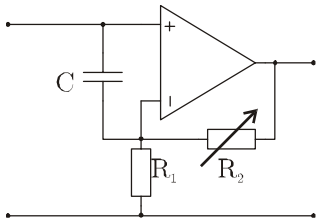
$A12 := Ab1 \cdot Ab2$ $\qquad A12 = -89.92$

$$Rm2 := \frac{R2}{1 - A12} \qquad Rm2 = 109.987$$

$$Ab := A12 \cdot \frac{Par(Rvh1, Rm2)}{R1 + Par(Rvh1, Rm2)} \qquad Rvh := R1 + Par(Rvh1, Rm2)$$

$Ab = -8.168$ $\qquad Rvh = 1.1 \cdot 10^3$

3. Določite minimalno fazno varnost ojačevalnika !



$AodB := 80 \qquad A0 := 10^4$

$fp1 := 2 \cdot 10^6 \qquad fp2 := 10 \cdot 10^6$

$C := 40 \cdot 10^{-9} \qquad R1 := 10000$

$R2min := 10000 \qquad R2max := 100000$

$$T0max := A0 \cdot \frac{R1}{R1 + R2min} \qquad T0max = 5 \cdot 10^3$$

$$fpx := \frac{1}{2 \cdot \pi \cdot C \cdot Par(R1, R2min)} \qquad fpx = 795.775$$

$$\frac{fp1}{fpx} = 2.513 \cdot 10^3$$

$$fzg := \sqrt{T0max \cdot fpx \cdot fp1} \qquad fzg = 2.821 \cdot 10^6$$

točna vrednost: $$\Phi := \left[180 - \left(\frac{180}{\pi} \right) \cdot atan\left(\frac{fzg}{fpx} \right) - \left(\frac{180}{\pi} \cdot atan\left(\frac{fzg}{fp1} \right) \right) \right] - \frac{180}{\pi} \cdot atan\left(\frac{fzg}{fp2} \right)$$

$\Phi = 19.599$

Minimalna fazna varnost ojačevalnika je 19.6 stopinj.