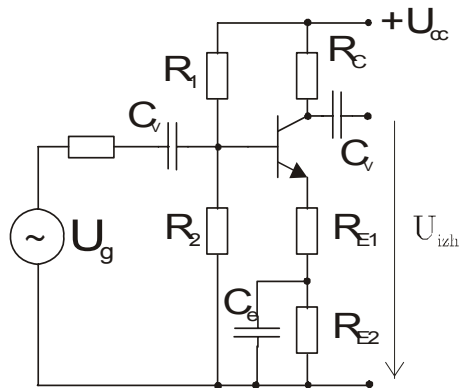


# KOMUNIKACIJSKA VEZJA

## IZPIT 11. februar 2010

### Rešitve nalog

1. Izračunajte ojačenje in spodnjo mejno frekvenco ojačevalnika!



$$\text{Par}(R_1, R_2) := \frac{R_1 \cdot R_2}{R_1 + R_2}$$

$$U_{cc} := 20 \quad U_{be0} := 0.6 \quad R_g := 3000$$

$$R_1 := 40000 \quad R_2 := 4000 \quad R_{E1} := 200$$

$$R_{E2} := 1000$$

$$R_C := 6000 \quad C_v := 4 \cdot 10^{-6} \quad C_E := 10 \cdot 10^{-6}$$

$$\beta := 100$$

$$R_B := \text{Par}(R_1, R_2) \quad R_B = 3.636 \cdot 10^3$$

$$I_{e0} := \frac{U_{cc} \cdot \frac{R_2}{R_1 + R_2} - U_{be0}}{(R_{E1} + R_{E2}) + \frac{R_B}{\beta + 1}} \quad I_{e0} = 9.856 \cdot 10^{-4}$$

potencial kolektorja:  $U_{cc} - R_C \cdot I_{e0} = 14.087$

parametri NF modela bipolarnega transistorja:

$$g_m := 40 \cdot I_{e0} \quad r_{be} := \frac{\beta}{g_m} \quad R_{vh} := \text{Par}(R_B, R_{E1} \cdot (\beta + 1) + r_{be})$$

$$g_m = 0.039 \quad R_{vh} = 3.135 \cdot 10^3$$

$$r_{be} = 2.537 \cdot 10^3$$

ojačenje :

$$A_{sf} := -g_m \cdot R_C \cdot \frac{r_{be}}{r_{be} + R_{E1} \cdot (\beta + 1)} \cdot \frac{R_{vh}}{R_{vh} + R_g} \quad A_{sf} = -13.485$$

$$20 \cdot \log(|A_{sf}|) = 22.597$$

spodnja mejna frekvenca:

$$R_{nv} := R_g + \text{Par}(R_B, (R_{E1} + R_{E2}) \cdot (\beta + 1) + r_{be}) \quad R_{nv} = 6.533 \cdot 10^3$$

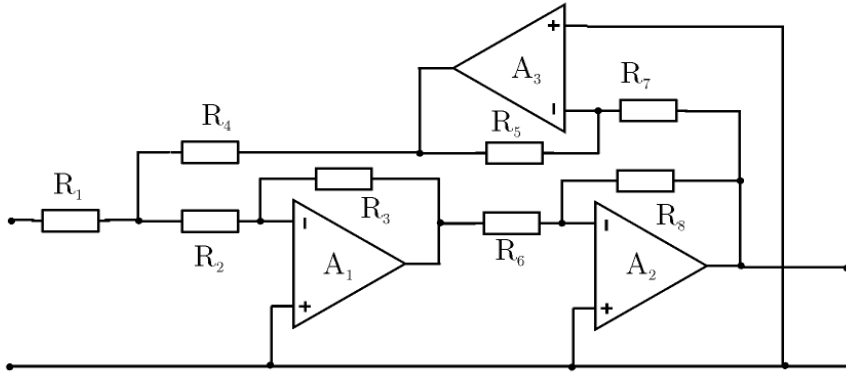
$$f_{pv} := \frac{1}{2 \cdot \pi \cdot C_v \cdot R_{nv}} \quad f_{pv} = 6.091$$

$$R_{NE} := \text{Par}(R_{E2} \cdot (\beta + 1), (r_{be} + R_{E1} \cdot (\beta + 1) + \text{Par}(R_B, R_g))) \quad R_{NE} = 1.964 \cdot 10^4$$

$$f_{pE} := \frac{\beta + 1}{2 \cdot \pi \cdot C_E \cdot R_{NE}} \quad f_{pE} = 81.848 \quad f_{nE} := \frac{1}{2 \cdot \pi \cdot C_E \cdot R_{E2}} \quad f_{nE} = 15.915$$

spodnja mejna frekvenca:  $f_{sp} := f_{pE} \quad f_{sp} = 81.848$

2. Izračunajte natančno napetostno ojačenje vezave na sliki !



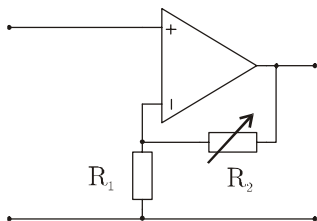
$$\begin{aligned}
 R1 &:= 1000 & R4 &:= 100000 & R7 &:= 2000 & R8 &:= 50000 \\
 R2 &:= 1000 & R5 &:= 10000 & A &:= 100 \\
 R3 &:= 10000 & R6 &:= 5000
 \end{aligned}$$

$$\begin{aligned}
 R_{m1} &:= \frac{R3}{1+A} & R_{m2} &:= \frac{R8}{1+A} & R_{m3} &:= \frac{R5}{1+A} \\
 Ab1 &:= -A \cdot \frac{R_{m1}}{R_{m1} + R2} & Ab1 &= -9.009 & Ab2 &:= -A \cdot \frac{R_{m2}}{R_{m2} + R6} & Ab2 &= -9.009 \\
 A12 &:= Ab1 \cdot Ab2 & A12 &= 81.162
 \end{aligned}$$

$$\begin{aligned}
 R_{v1} &:= R2 + R_{m1} & R_{v1} &= 1.099 \cdot 10^3 & Ab3 &:= -A \cdot \frac{R_{m3}}{R_{m3} + R7} \\
 A_{oz} &:= A12 \cdot \frac{\text{Par}(R_{v1}, R4)}{(R1 + \text{Par}(R_{v1}, R4))} & A_{oz} &= 42.274 & T &:= -Ab3 \cdot \left[ \frac{\text{Par}(R1, R_{v1})}{(R4 + \text{Par}(R1, R_{v1}))} \cdot A12 \right] \\
 & & & & T &= 1.994
 \end{aligned}$$

$$A\beta := \frac{A_{oz}}{1+T} \quad \mathbf{A\beta = 14.119}$$

3. Določite območje R2 tako, da bi faza varnost najman 45 stopinj !



$$A0 := 10^5 \quad 20 \cdot \log(A0) = 100$$

$$fp1 := 100 \quad fp2 := 1 \cdot 10^6 \quad R1 := 1000$$

$$T0max := \frac{fp2}{fp1} \quad T0max = 1 \cdot 10^4$$

$$R2min := R1 \cdot \left( \frac{A0}{T0max} - 1 \right)$$

$$R2min = 9 \cdot 10^3$$

$$R2 := R2min$$

$$T0 := T0max$$

DODATEK : Potek nekomp. in komp. zančnega ojačenja T:

$$T_k(f) := T_0 \cdot \frac{1}{1 + j \cdot \frac{f}{fp1}} \cdot \frac{1}{1 + j \cdot \frac{f}{fp2}} \quad T(f) := T_0 \cdot \frac{1}{1 + j \cdot \frac{f}{fp1}} \cdot \frac{1}{1 + j \cdot \frac{f}{fp2}}$$

$$i := 0 .. 200 \quad fr_i := 10^{\frac{i}{200} \cdot 11} \quad fzg := fp2$$

