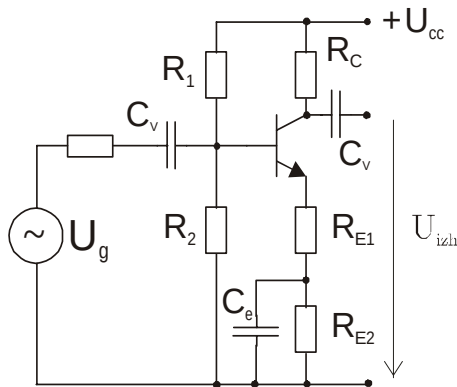


# KOMUNIKACIJSKA VEZJA

## IZPIT 2.februar 2005

### Rešitve nalog

1. Izračunajte ojačenje in spodnjo mejno frekvenco ojačevalnika!



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

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

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

$$R_{E2} := 1000$$

$$R_C := 10000 \quad C_v := 4 \cdot 10^{-6} \quad C_E := 10 \cdot 10^{-6}$$

$$\beta := 100$$

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

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

potencial kolektorja:  $U_{cc} - R_C \cdot I_{e0} = 10.144$

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 :

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

$$A_{sf} = -22.475$$

$$20 \cdot \log(|A_{sf}|) = 27.034$$

spodnja mejna frekvenca:

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

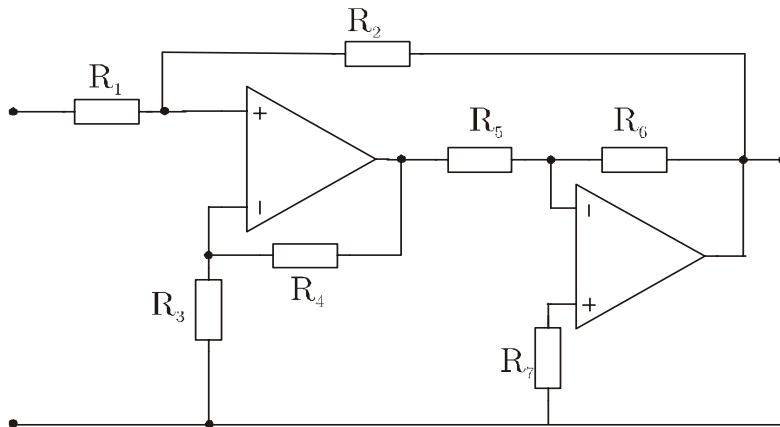
$$f_{pv} := \frac{1}{2 \cdot \pi \cdot C_v \cdot R_{nv}} \quad f_{pv} = 6.091$$

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

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

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

2. Izračunajte natančno napetostno ojačenje vezave na sliki !



$R1 := 1000$   
 $R2 := 10000$   
 $R3 := 1000$   
 $R4 := 10000$   
 $R5 := 1000$   
 $R6 := 10000$   
 $R7 := 1000$   
 $A0 := 100$

ojačenj vezave A, R3,R4:

$$A_{oz1} := A0 \quad T1 := A0 \cdot \frac{R3}{R3 + R4} \quad A\beta1 := \frac{A_{oz1}}{1 + T1} \quad A\beta1 = 9.91$$

ojačenje vezave A, R5,R6,R7:

$$A_{oz2} := \frac{-R6}{R6 + R5} \cdot A0 \quad T2 := A0 \cdot \frac{R5}{R5 + R6} \quad T1 = 9.091 \quad T2 = 9.091$$

$$A\beta2 := \frac{A_{oz2}}{1 + T2} \quad A\beta2 = -9.009$$

ojačenje vezja R1,R2,  $A\beta1 \cdot A\beta2$ :

$$A_{oz2} = -90.909$$

$$(-A\beta1 \cdot A\beta2) = 89.278$$

$$A_{oz} := -\frac{R2}{R1 + R2} \cdot (-A\beta1 \cdot A\beta2) \quad A_{oz} = -81.162$$

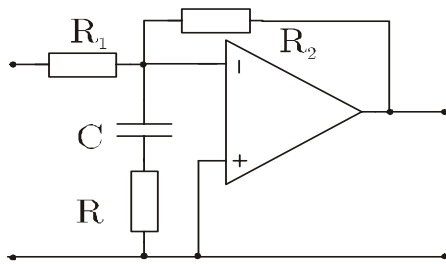
$$T := \frac{R1}{R1 + R2} \cdot (-A\beta1 \cdot A\beta2) \quad T = 8.116$$

$$A\beta := \frac{A_{oz}}{1 + T} \quad A\beta = -8.903$$

$$RM6 := \frac{R6}{A0 + 1}$$

$$\frac{RM6}{RM6 + R5} \cdot A0 = 9.009$$

3. Določite elemente kompenzacijskega vezja tako, da bo faza varnost 60 stopinj !



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

$$fp1 := 2 \cdot 10^6 \quad fp2 := 10 \cdot 10^6 \quad R1 := 10000 \quad R2 := 1000$$

$$T0 := A0 \cdot \frac{R1}{R1 + R2} \quad T0 = 9.091 \cdot 10^3$$

Kompensacija PN: kompenzacijski pol pri nižji frekvenci, ničla pokriva prvi pol

$$f_{nk} := fp1 \quad f_{nk} = 2 \cdot 10^6$$

mejna frekvenca je v 2. segmentu,  $f_{pk} < f_{zg} < fp2$ :  $T0 \cdot fp1 = 1.818 \cdot 10^{10}$

$$f_{zg} := \frac{fp2}{\sqrt{3}} \quad f_{zg} = 5.774 \cdot 10^6 \quad B := f_{zg} \quad B = 5.774 \cdot 10^6$$

$$f_{pk} := \frac{f_{zg}}{T0} \quad f_{pk} = 635.085$$

$$R := \frac{\text{Par}(R1, R2)}{\frac{f_{nk}}{f_{pk}} - 1}$$

$$R = 2.888$$

$$C := \frac{1}{R \cdot 2 \cdot \pi \cdot f_{nk}}$$

$$C = 2.756 \cdot 10^{-8}$$

$$\frac{1}{2 \cdot \pi \cdot C \cdot R} = 2 \cdot 10^6$$

$$\frac{1}{2 \cdot \pi \cdot C \cdot (R + \text{Par}(R1, R2))} = 635.085$$

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

$$T_k(f) := T_0 \cdot \frac{1}{1 + j \cdot \frac{f}{f_{pk}}} \cdot \frac{1}{1 + j \cdot \frac{f}{f_{p2}}} \quad T(f) := T_0 \cdot \frac{1}{1 + j \cdot \frac{f}{f_{p1}}} \cdot \frac{1}{1 + j \cdot \frac{f}{f_{p2}}}$$

$$i := 0..200 \quad f_{r_i} := 10^{\frac{i}{200} \cdot 9}$$

