Elektronskifakultet u Nišu
Katedra za Elektroniku
Predmet: OE(E,M,T/U/P)3O0(1,1,1/2/3)

Datum: 19. oktobar 2020.

ISPIT IZ OSNOVA ELEKTRONIKE
modul: ELK, EKM, EEN, US i T

Zadaci

1. Zadatak: Izmereno je da napon na izlazu pojačavača opadne za 20% kada mu se priključi potrošač od 1kΩ. Kolika je izlazna otpornost pojačavača?

$$V_i = \frac{R_p}{R_i + R_p} V_{i0} = 0.8 \cdot V_{i0} \Rightarrow \frac{R_p}{R_i + R_p} = 0.8$$

$$R_p = 0.8 \cdot (R_i + R_p) \Rightarrow R_i = \frac{0.2}{0.8} R_p = 0.25 R_p = 250\Omega$$ 100%

2. Zadatak: Za kolo sa Sl. 2 odrediti:

a) jednosmernu struju drejna svih tranzistora,

b) parametre modela za male signale (g_m, r_o) svih tranzistora i

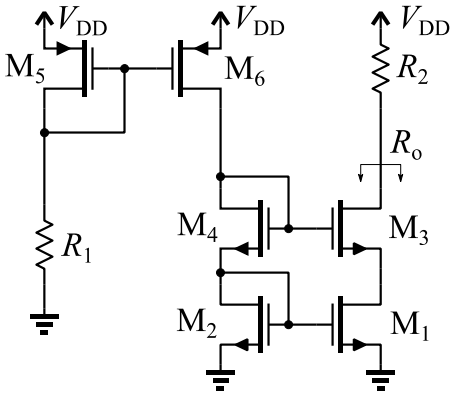
c) otpornost, R_o.

Poznato je: R_1=65kΩ, R_2=35kΩ,V_{DD}=3.3V, $V_A \approx 1/\lambda$.

Parametri tranzistora su:

A_k=100μA/V^2, V_{THk}=500mV, V_{Ak}=80V, k=1,2,3,4,

A_n=70μA/V^2, V_{THn}=450mV, V_{An}=60V, n=5,6.



Sl. 2

a)

$$V_{DD} = V_{SG5} + I_{D5}R_1$$
$$V_{DD} - V_{TH5} = V_{SG5} - V_{TH5} + A_5 R_1 (V_{SG5} - V_{TH5})^2$$
$$A_5 R_1 V_{ov5}^2 + V_{ov5} - (V_{DD} - V_{TH5}) = 0$$ 25%

$$V_{ov5} = \frac{-1+\sqrt{1+4A_5R_1(V_{DD}-V_{TH5})}}{2A_5R_1} = 0.689V$$ 10%

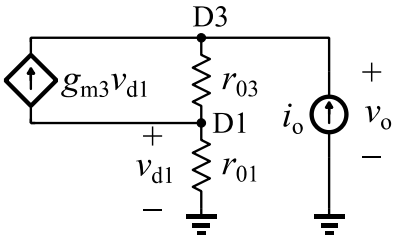
$$I_{D5} = A_5 V_{ov5}^2 = 33.23\mu A, I_{D1} = I_{D2} = I_{D3} = I_{D4} = I_{D6} = I_{D5}$$ 10%

b)

$$g_{m5} = \frac{2I_{D5}}{V_{ov5}} = 96.46\mu S, g_{m5} = g_{m6}, g_{m1} = \frac{2I_{D1}}{V_{ov1}} = 115.292\mu S, g_{m1} = g_{m2} = g_{m3} = g_{m4}$$ 10%

$$r_{o5} = \frac{V_{A5}}{I_{D5}} = 1.805M\Omega, r_{o5} = r_{o6}, r_{o1} = \frac{V_{A1}}{I_{D1}} = 2.407M\Omega, r_{o1} = r_{o2} = r_{o3} = r_{o4}$$ 10%

c)



$$\begin{bmatrix} \left(\frac{1}{r_{o1}} + \frac{1}{r_{o3}} + g_{m3}\right) & -\frac{1}{r_{o3}} \\ -\frac{1}{r_{o3}} - g_{m3} & \frac{1}{r_{o3}} \end{bmatrix} \begin{bmatrix} v_{d1} \\ v_0 \end{bmatrix} = \begin{bmatrix} 0 \\ i_0 \end{bmatrix}$$ 25%

$$R_o = \frac{v_o}{i_o} = r_{o3} + (1 + g_{m3}r_{o3})r_{o1} = 673.013M\Omega$$ 10%

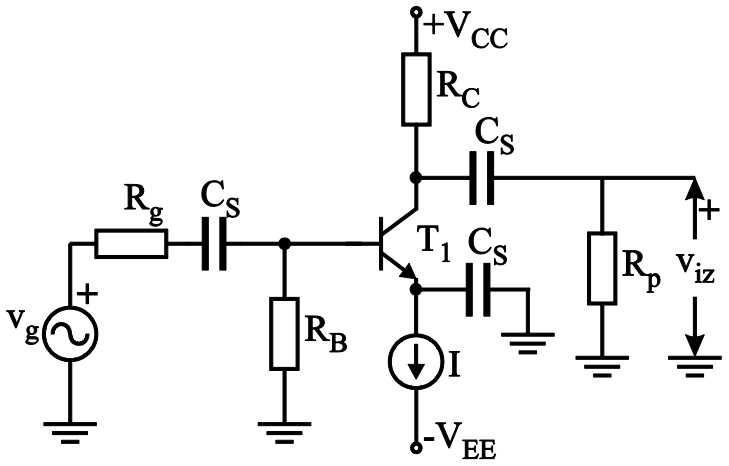
3. Zadatak

Za kolo pojačavača sa Sl. 3 odrediti:

a) Jednosmerni napon na bazi tranzistora, V_B;

b) Naponsko pojačanje $A_n = \frac{v_{iz}}{v_g}$.

Deo kola koji predstavlja izvor konstantne struje prikazan je kao idealni jednosmerni strujni generator *I*. Parametri tranzistora su: $h_{11E} = r_\pi = 2{,}5\ \text{k}\Omega$; $h_{21E} = \beta = 100$; $g_m = \beta / r_\pi = 40\ mS$; $V_{BE} = 0{,}7\ V$. Poznato je $R_B = 100\ \text{k}\Omega$; $R_C = 8\ \text{k}\Omega$; $R_g = R_p = 5\ \text{k}\Omega$; $I = 1\ \text{mA}$; $V_{CC} = V_{EE} = 12\ \text{V}$; $C_S \to \infty$.



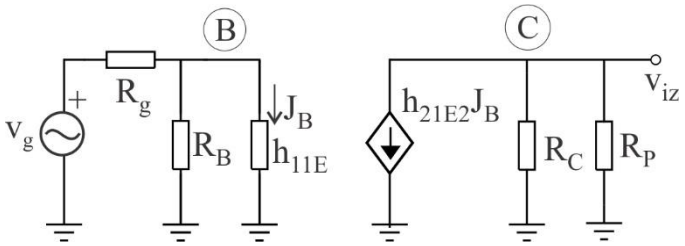
Sl. 3

a)

$$I_E = I = (1+\beta) I_B$$

$$V_B = -R_B I_B = -R_B \frac{I}{1+\beta} = -0{,}99\ V$$

b)



$$J_B = \frac{v_B}{h_{11E}}$$

$$\frac{1}{h_{11E}} \cdot v_B + \frac{1}{R_B} \cdot v_B + \frac{1}{R_g} \cdot (v_B - v_g) = 0$$

$$h_{21E} \cdot J_B + \frac{1}{R_C} \cdot v_{iz} + \frac{1}{R_P} \cdot v_{iz} = 0$$

$$A_n = \frac{v_{iz}}{v_g} = \frac{-h_{21E} \cdot R_C || R_P \cdot R_B}{R_B \cdot h_{11E} + R_g \cdot R_B + R_g \cdot h_{11E}} = -40{,}3$$

4. Zadatak

U kolu sa Sl. 4 upotrebljen je idealizovani pojačavač sa A=100dB. Odrediti:

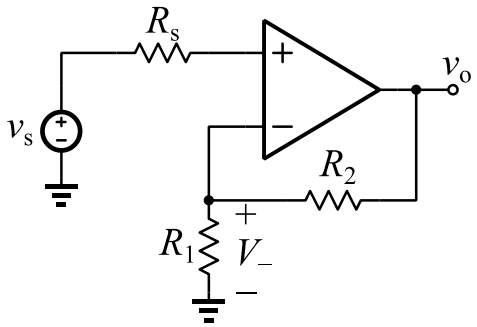
a) R_2/R_1 tako da se dobije A_r=50,

b) β u dB,

c) napon na izlazu V_o i V_- ukoliko je V_s=0.1V,

d) za koliko će se smanjiti A_r ukoliko pojačanje A opadne za 20%?

Idealizovani pojačavač ima beskonačnu ulaznu i nultu izlaznu otpornost.



Sl. 4

a) Odrediti R_2/R_1 tako da se dobije A_r=100!

$$A_r = \frac{A}{1-AB} = 50 \text{ zaAB} >> 1 \Rightarrow -\frac{1}{B} = 50$$

$$B = \frac{V_-}{V_o} = -\frac{R_1}{R_1+R_2}$$

$$-\frac{1}{B} = \frac{R_1+R_2}{R_1} = 1+\frac{R_2}{R_1} = 50 \Rightarrow \frac{R_2}{R_1} = 49$$

b) Odrediti B u dB?

$$B = 20\log(\frac{1}{50}) = 20\log(0.02) = -33{,}8dB$$

c) Odrediti napon na izlazu V_o, i V_- ukoliko je V_s=0.1V.

$$V_o = \frac{A}{1-AB}V_s = 50\cdot 0.1V = 5V$$

$$V_- = \frac{R_1}{R_1+R_2}V_o = 5V/50 = 0.1V$$

d)

Odrediti za koliko će se smanjiti A_r ukoliko pojačanje A opadne za 20%?

$$A_r = \frac{A}{1-AB} = 50; \quad A_r' = \frac{0.8A}{1-0.8AB}$$

$$\frac{A_r - A_r'}{A_r}\cdot 100 = \left(1-\frac{\frac{0.8A}{1-0.8AB}}{\frac{A}{1-AB}}\right)\cdot 100$$

$$\frac{A_r - A_r'}{A_r}\cdot 100 = 0{,}0122\%$$

Predmetni nastavnici