Elektronik I. - 3. ödev

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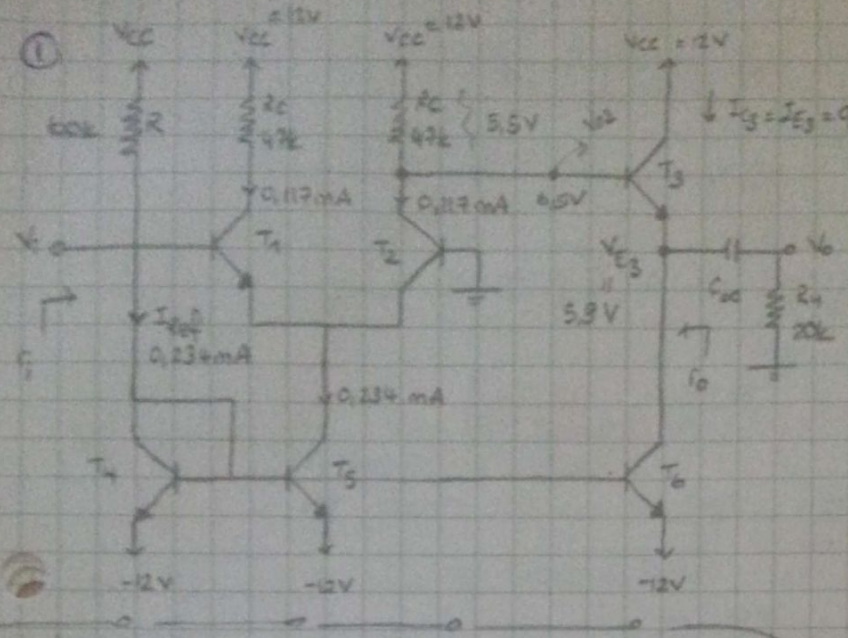
① 

$\beta_f = 300$, $V_{BE} = 0,6V$, $V_T = 25mV$, $\frac{1}{r_{ce}} = 0$

a) $I_{Ref} = \frac{V_{CC} - V_{BE} - (-V_{EE})}{R}$

$I_{2ef} = \frac{12 - 0,6 - (-12)}{100k} = \underline{0,234\,mA}$

$I_{C_1} = I_{C_2} = \underline{0,117\,mA}$

$V_{RC} = 0,117\,mA \cdot 47k \cong \underline{5,5V}$

$V_{C2} = V_{B3} = 12 - 5,5 = 6,5V.$

$V_{E3} = 6,5 - 0,6 = \underline{5,9\,V}$

b) $I_{C_3} = I_{E_3} = 0,234\,mA$ olmalıdır.

$r_{e3} = \frac{25m}{0,234m} \cong 107\,\Omega = r_{e6} = r_{e5} = r_{e4}$

T_3'ün bulunduğu kat. (Emetör Çıkışlı) $K_{V3} = + \frac{R_4'}{r_{e3} + R_4'}$

$R_4' = R_4 \,//\, r_{ce6} \cong 47k \,//\, 20k \cong \underline{14k}$ $\quad K_{V3} = \frac{14k}{14k + 107} \cong \boxed{0,992 = K_{V3}}$

Fark Kuvvetlendiricisinden

Gelen Kazanç $K_{vd} = \frac{V_{o2}}{V_i} = \frac{+1}{2} \cdot \frac{R_C \,//\, r_{i3}}{r_{e2}}$, $r_{i3} = \beta_{f3} \cdot (r_{e3} + R_4') \cong \underline{4,23M}$

$r_{e2} = \frac{25m}{0,117m} = 213,7\,\Omega = r_{e1}$ $\quad K_{vd} = \frac{1}{2} \cdot \frac{47k \,//\, 4,23M}{213,7} = \frac{46,48k}{0,214k} \cdot \frac{1}{2}$

$\boxed{K_{vd} = 108,6}$

$\Sigma K_V = K_{vd} \cdot K_{V3} = 108,6 \cdot 0,992 = \boxed{107,72 \frac{V}{V} = K_V}$

c) $r_d = 2\beta \cdot r_{e1} = 2 \cdot 300 \cdot 213,7 \cong \underline{128,2k}$

$r_o = r_o' \,//\, r_{ce6}$

$r_o' = r_{e3} + \frac{R_B}{\beta} = 107\,\Omega + \frac{R_C \,//\, r_{i3}}{300} \cong 261\,\Omega$

$r_o = 261 \,//\, 47k = \boxed{260\,\Omega = r_o}$

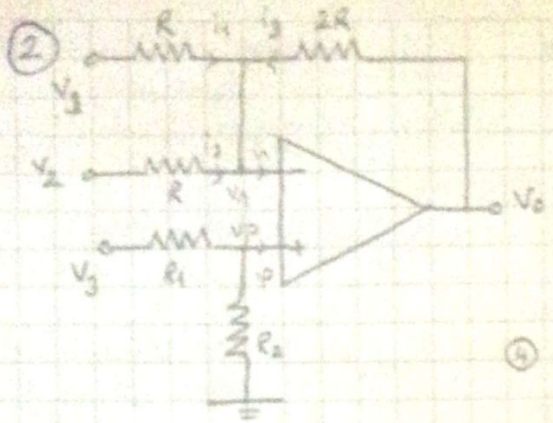
d) $CMRR = 20 \log \left| \frac{K_{vd}}{K_{vc}} \right|$, $K_{vd} = 107,72$

$K_{vc} = \frac{R_C \,//\, r_{i3}}{2 r_{ce5} + r_{e5}} \cong \frac{1}{2}$

$CMRR = 20 \log (2 \cdot 107,72)$

$\boxed{CMRR = 46,76\,dB}$

②



a) $n = p = 0$. $V_n = V_p$

① $i_1 = \frac{V_1 - V_n}{R}$ ② $i_2 = \frac{V_2 - V_n}{R}$

③ $V_p = V_n = V_3 \cdot \frac{R_2}{R_1+R_2}$

④ $i_3 = -(i_1 + i_2)$ ⑤ $\frac{V_o - V_n}{2R} = i_3$

①, ②, ④, ⑤ $\rightarrow$ $\frac{V_o - V_n}{2R} = -\left(\frac{V_1 - V_n}{R} + \frac{V_2 - V_n}{R}\right)$

$$\frac{V_o}{2R} - \frac{V_n}{2R} = \frac{-V_1}{R} + \frac{V_n}{R} - \frac{V_2}{R} + \frac{V_n}{R}$$

$$\frac{V_o}{2R} = \frac{-V_1}{R} - \frac{V_2}{R} + \frac{V_n}{2R} + \frac{2V_n}{R}$$

$$\frac{V_o}{2R} = \frac{-V_1}{R} - \frac{V_2}{R} + \frac{5V_n}{2R} \leftarrow ③ \quad \frac{V_o}{2R} = \frac{-(V_1+V_2)}{R} + 5 \cdot V_3 \cdot \frac{R_2}{R_1+R_2} \cdot \frac{1}{2R}$$

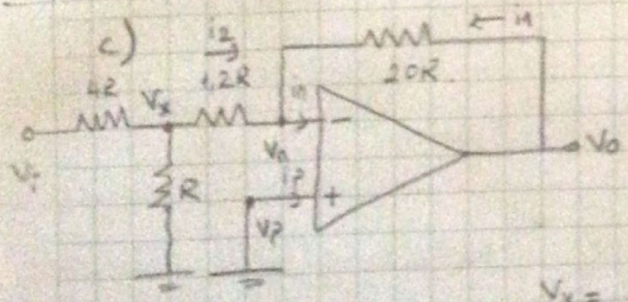
$$\boxed{V_o = -2\cdot(V_1+V_2) + 5 \cdot V_3 \cdot \frac{R_2}{R_1+R_2}}$$

b) $V_1 = V_2 = V_3 = V$ olsun. $V_o = 0 \Rightarrow 0 = -2V + 5 \cdot V \cdot \frac{R_2}{R_1+R_2}$

$$1 = \frac{5R_2}{R_1+R_2} \Rightarrow 2R_1 + 2R_2 = 5R_2 \Rightarrow 2R_1 = 3R_2$$

$$\boxed{\frac{R_2}{R_1} = \frac{2}{3}}$$

c)



$V_n = V_p = 0$ (Sanal Toprak)

$i_p = i_n = 0$ (Tanım Bağıntısı, Giriş Akımları 0.)

$$V_x = \frac{2 \,//\, (1,2R)}{4R + (R \,//\, (1,2R))} \cdot V_i \Rightarrow \boxed{V_x \cong 0,12 \cdot V_i}$$

$i_2 = -i_1$,

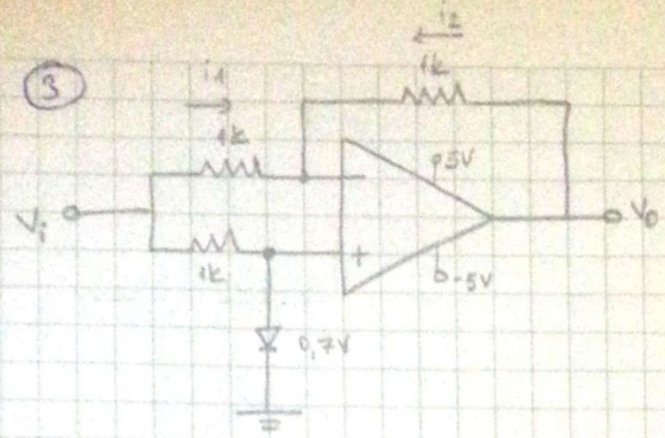
$i_2 = \frac{V_x}{1,2R}$

$i_1 = \frac{V_o}{20R}$

$$\frac{-0,12 \cdot V_i}{1,2R} = \frac{V_o}{20R}$$

$$\boxed{\frac{V_o}{V_i} = -2}$$

(3)



a) $V_p = V_n = 0,7\ V$ $\quad i_1 = -i_2$

$$\frac{V_i - 0,7}{1k} = \frac{-(V_o - 0,7)}{1k}$$

$$V_i - 0,7 = -V_o + 0,7$$

$$\boxed{V_o = 1,4 - V_i}$$

b) İşlemsel Kaynak 7,5V ile kutuplandığı için V_o 5V'un üstüne çıkamaz.

$V_p < 0,7V$ iken ; $V_o = -V_i$ olur (Diyot Tıkamada)

$0,7V < V_p \Rightarrow V_o = 1,4 - V_i$ (iletimde)