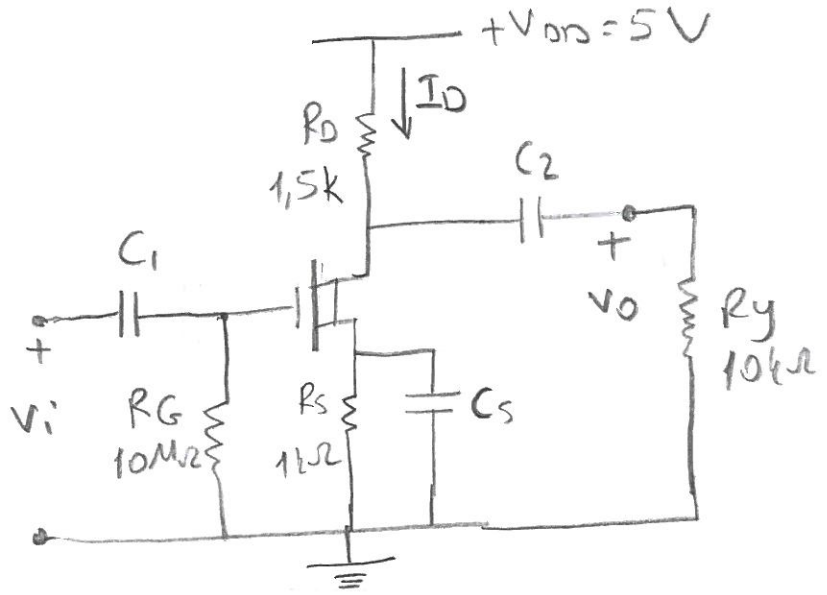
ELEKTRONİK

ÖDEV-2 ÇÖZÜMLER

1)



$\mu_n = 500 cm^2/Vs$

$C_{ox} = 10^{-7} F/cm^2$

$V_T = -2V$

$\lambda = 0$

DC Analiz

a) $I_D = \frac{\mu_n C_{ox}}{2}\left(\frac{W}{L}\right)(V_{GS} - V_T)^2$ $\qquad V_{GS} = -R_S I_D = -1k \cdot 1mA = -1V$

$$\frac{W}{L} = \frac{2I_D}{\mu_n C_{ox}(V_{GS}-V_T)^2} = \frac{2I_D}{\mu_n C_{ox}\left[-R_S I_D - (-2)\right]^2}$$

$$= \frac{2 \cdot 10^{-3} A}{500 cm^2/Vs \cdot 10^{-7} F/cm^2 \left[-1V + 2\right)^2} = \underline{40}$$

b) $K_v = \frac{V_o}{V_i} = -g_m (R_D // R_L)$ → AC analiz

$g_m = \beta (V_{GS} - V_T) = 50 \cdot 10^{-6} \times 1 \times 40 = 2 \frac{mA}{V}$

$R_{AC} = R_D // R_L = \frac{10 \times 1,5}{11,5} k\Omega = 1304\Omega$

$\underline{K_v \cong -2 \times 1,3 = -2,6}$

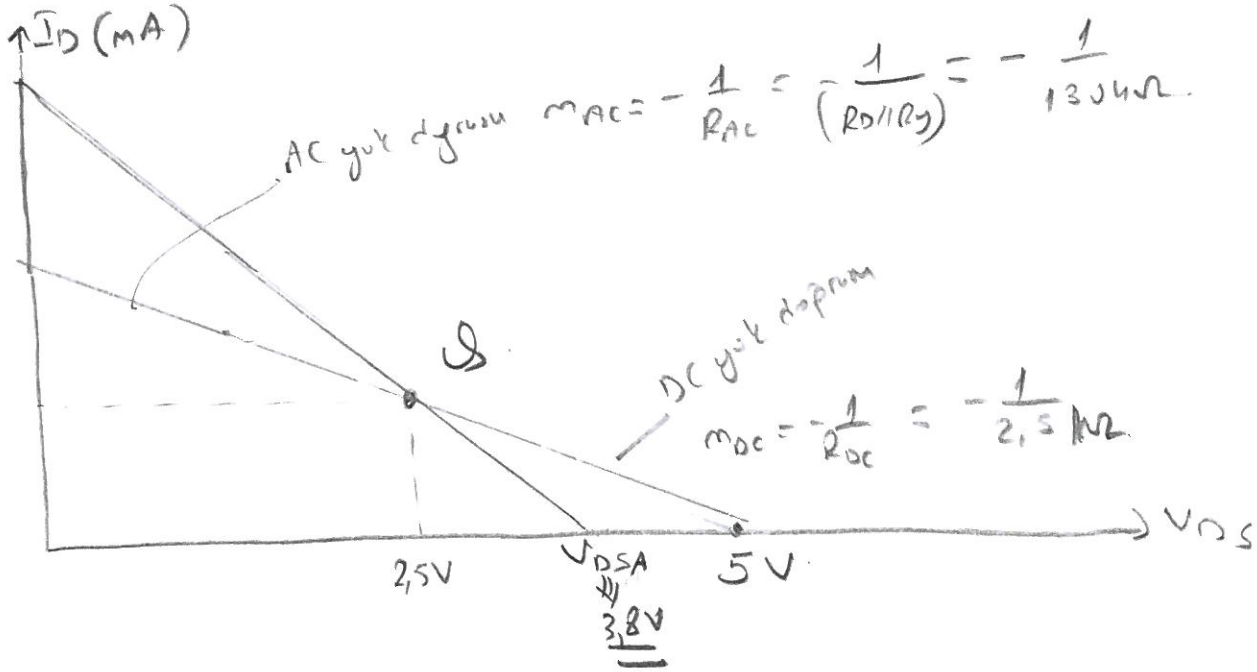
c) Doymada BJT'ye tanım

$V_{DS} = V_{GS} - V_T = -1+2 = 1$

$V_{DS} = V_{DD} - (R_D + R_S) \cdot I_D$

$R_D + R_S = \frac{V_{DD} - V_{DS}}{I_D} = \frac{5-1}{1mA} = 4k\Omega \Rightarrow R_D = 3k\Omega.$

d)



$V_{DD} = V_{DSQ} + (R_D + R_S) I_{DQ}$

$V_{DSQ} = 5V - (1,5k + 1k) \cdot 1mA$

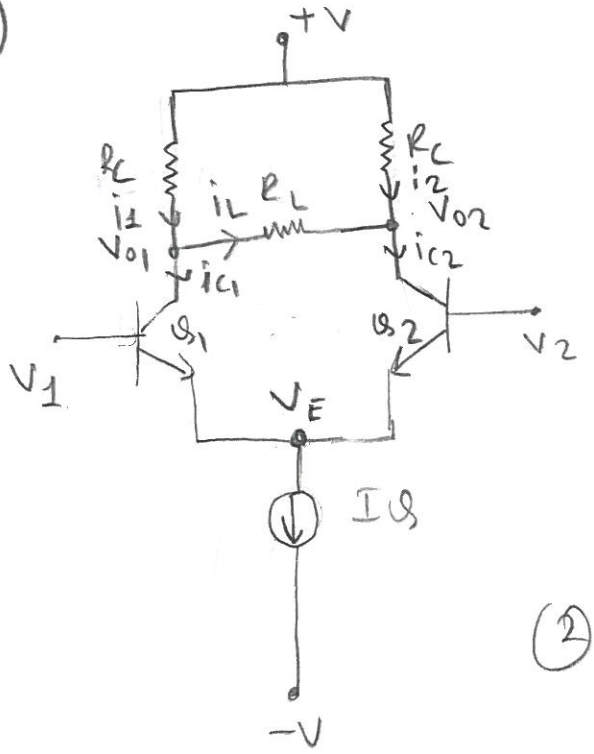
$= 5V - 2,5k \cdot 1mA = \underline{2,5V}$

$\frac{V_{DSA} - 2,5V}{R_{AC}} = 1mA \Rightarrow$

$V_{DSA} = 1,3k \cdot 1mA + 2,5V \cong \underline{3,8V}$

(2)

a)



(3)

$i_1 = i_L + i_{c1}$

$i_2 = i_{c2} - i_L$

(1) $i_1 - i_2 = i_{c1} - i_{c2} + 2i_L$

$V_{o1} = -i_1 \cdot R_C$

$V_{o2} = -i_2 R_C$

(2) $V_{o1} - V_{o2} = -i_1 R_C + i_2 R_C$

$V_{o1} - V_{o2} = -R_C (i_1 - i_2)$

$V_1 = V_{BE1} + V_{EB2} + V_2$

$V_1 - V_2 = V_{BE1} - V_{BE2}$

(3) $i_L = \dfrac{V_{o1} - V_{o2}}{R_L}$

(4) $i_{c1} - i_{c2} = g_m (V_1 - V_2)$

(2), (3), (4) (1)'de yerleştirilirse

$$= \frac{(V_{o1} - V_{o2})}{R_C} = g_m (V_1 - V_2) + 2 \frac{(V_{o1} - V_{o2})}{R_L}$$

$$V_{o1} - V_{o2} \left[\frac{1}{R_C} + \frac{2}{R_L} \right] = -g_m (V_1 - V_2)$$

$$K_{dd} = \frac{V_{o1} - V_{o2}}{V_1 - V_2} = -g_m \frac{1}{\frac{1}{R_C} + \frac{2}{R_L}} = \boxed{-\frac{g_m R_L}{2 + \frac{R_L}{R_C}}}$$ bulunur

b) $I_g = 2mA$, $\beta = 200$, $I_S = 10^{-12} A$, $V_T = 26mV$

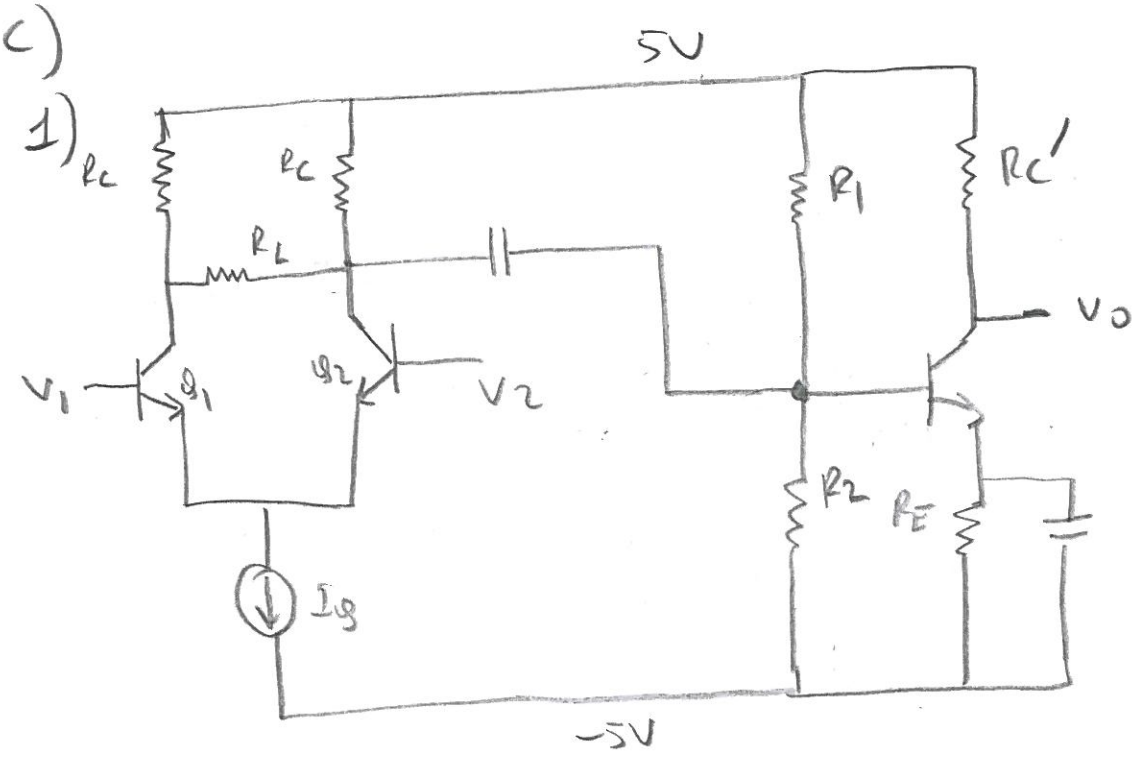
$r_e = \frac{V_T}{I_C} \rightarrow I_g = 2mA \Rightarrow I_{C_1} = I_{C_2} = 1mA$

$r_e = \frac{26mV}{1mA} = 26\Omega \qquad g_m = \frac{1}{r_e} = \frac{1}{26\Omega}$

$$K_{dd} = \frac{-\frac{1}{26} \cdot 3k\Omega}{2 + \frac{3k\Omega}{2k\Omega}} = -32{,}97$$

c)

1)

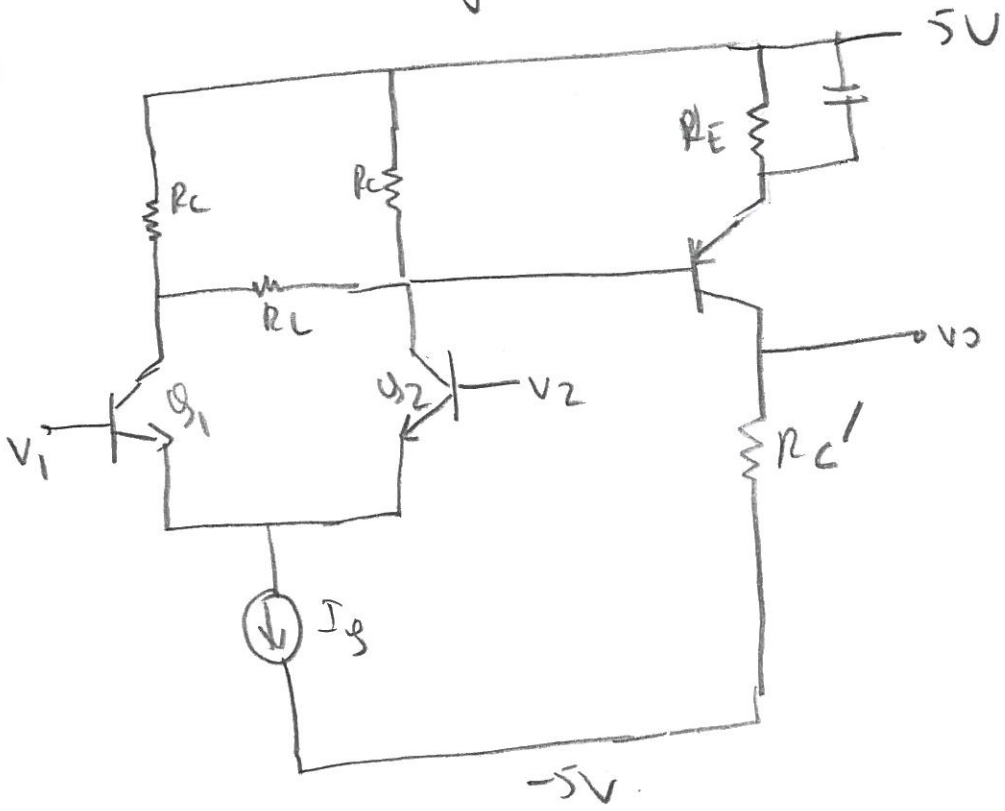


Kondansatör kuplaj ile

veya DC kuplajlı

(5)

2)



(3) V_o dalgalılık : $\mp I_{Dg}(R_D \parallel R_L)$

$I_{Dg}(R_D \parallel R_L) = 3V \Rightarrow$ **$R_D = 4k$**

($I_{Dg} \sim 1mA$, $R_L \sim 12k$)

$g_m = \sqrt{2\beta I_{Dg}} = 2mS$

$$\frac{V_o}{V_i} = -\frac{g_m(R_D \parallel R_L)}{1+g_m \cdot R_{S1}} = -\frac{2mS(4k \parallel 12)}{1+2mS \cdot R_{S1}} = -3,75 \Rightarrow$$

$R_{S1} = 300\Omega$

$P_{TR} = I_{Dg} \cdot V_{DSg} = I_{Dg}\left[V_{DD} - I_{Dg}(R_D + R_{S1} + R_{S2})\right]$

$3,4mW = 1mA\left[10V - 1mA(4k + 0,3k + R_{S2})\right]$

$R_{S2} = 0,3\ k\Omega$

$$I_{DQ} = \frac{\beta}{2}(V_{GS} - V_{th})^2$$

$$1mA = \frac{2mS}{2}(V_{GS} - 1V)^2 \rightarrow V_{GS} = 2,1V$$

$$V_{GG} = V_{GS} + (R_{S1} + R_{S2}) \cdot I_{DQ} \Rightarrow 2,1 + (0,3k + 0,3k) \cdot 1mA = V_{GG}$$

$$\boxed{V_{GG} = 2,7V}$$

b) $V_1 = V_{DD} - I_1 \cdot (R_D + R_{S1} + R_{S2})$

$= 10V - 1mA\,(4k + 0,3k + 0,3k)$

$$\boxed{V_1 = 5,4V}$$

$$\boxed{I_1 = I_{DQ} = 1mA}$$

$$\boxed{V_3 = V_{DD} = 10V}$$

V_2: $R_{AC} = (R_D \,//\, R_L) + R_{S1} = 3,3k$

$$\frac{V_2 - V_1}{3,3k} = 1mA \Rightarrow V_2 = 3,3V + V_1 \Rightarrow \boxed{V_2 = 8,7V}$$