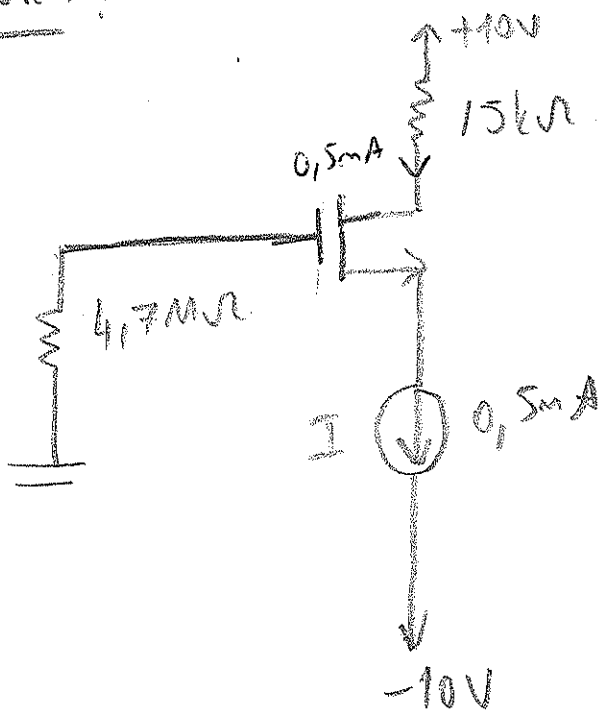
(1)

ELEKTRONİK 2

UYGULAMA-1

14.02.2017

SORU:



Şekilde gösterilen devrede NMOS transistör için

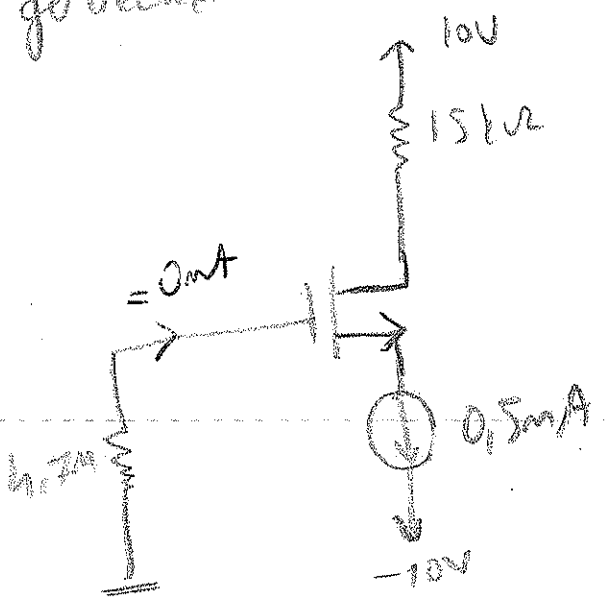
$V_t = 1{,}5V$ ve

$\mu_n C_{ox}\left(\frac{W}{L}\right) = 1mA/V^2$

V_{GS}, V_D değerlerini transistörün g_m değerini ve r_o çıkış direncini

hesaplayınız. ($V_A = 75V$)

I ile gösterilen akım kaynağını, basit akım aynasıyla gerçekleştiriniz.



$I_D = 0{,}5mA$

$g_m = \sqrt{2\mu_n C_{ox}\frac{W}{L} I_D}$

$r_o = V_A / I_D = 1/\lambda I_D$

$g_m = \sqrt{2 \cdot 1mA/V^2 \cdot 0{,}5mA}$

$\underline{g_m = 1mA/V}$

$10V - V_D = 15k \cdot 0{,}5mA$

$V_D = 10V - 7{,}5V = \underline{2{,}5V}$

(2) $r_o = V_A / I_D = \frac{75V}{0,5mA} = 150k\Omega$.

$$I_D = \frac{1}{2} \mu_n C_{ox} \frac{W}{L} \cdot (V_{GS} - V_t)^2$$

$$0,5mA = \frac{1}{2} \cdot 1mA/V^2 \cdot (V_{GS} - 1,5V)^2$$

$$\Rightarrow (V_{GS} - 1,5V)^2 = 1 \cdot V^2$$

$$V_{GS} - 1,5V = \mp 1V$$

$$\underline{V_{GS} = 2,5V}$$

$V_{GS} = -1 + 1,5$

$= 0,5V \Rightarrow$ alemão.

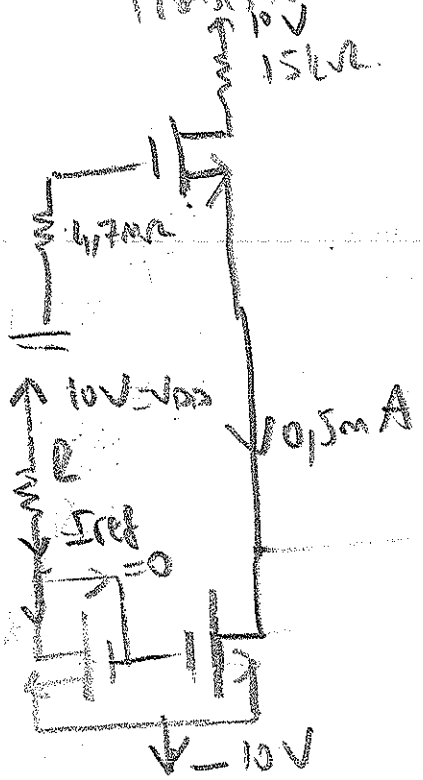
$V_G = 0 \Rightarrow V_S = -2,5V$

$V_{DS} = 2,5 - (-2,5) = 5V \gtrsim V_{GS} - V_t$

$5V > 2,5V - 1,5V$

$\underline{1V}$

Transistor dogmeden çalışıyor.



$10V = I_{ref} \cdot R + V_{GS} - 10V$

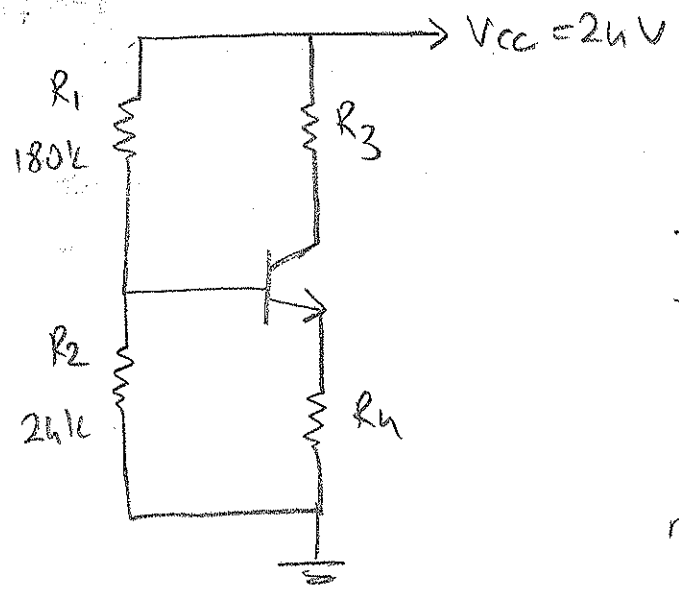
$2,5V$

$R \cdot I_{ref} = 20V - V_{DS}$

$R = \frac{20V - 2,5V}{0,5mA}$

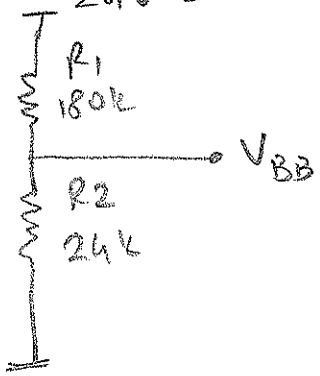
$\boxed{R = 35k\Omega}$.

SORU



Şekildeki devrede kullanılan transistör için $h_{FE} = 200$, $V_{BE} = 0,6V$ tur. Çalışma noktasında $V_{CE} = 10V$ ve $I_C = 1mA$ olması isteniyor. R_3 ve R_4 dirençlerinin değerlerini hesaplayınız.

ÇÖZÜM.

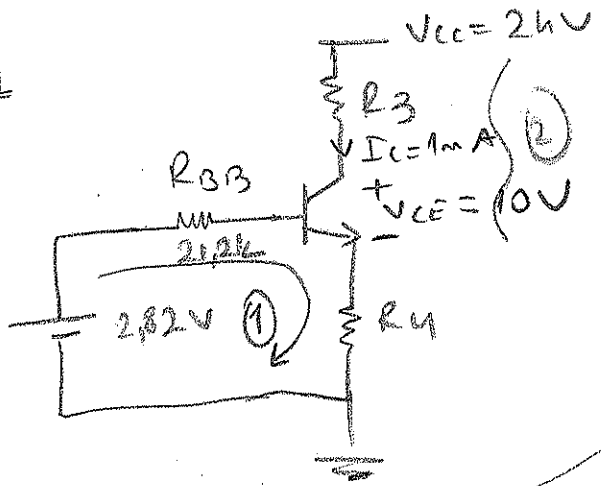


$$V_{BB} = R_2 \cdot \frac{V_{CC}}{R_1 + R_2} = 2,82V$$

$$R_{BB} = R_1 \,//\, R_2 \cong 21,2\,k\Omega.$$

$$I_C = h_{FE} I_B$$

$$I_B + I_C = I_E$$



(1) $2,82V = 21,2k\,I_B + V_{BE} + R_4 \cdot I_E$

$$2,82V = 21,2k \cdot \frac{I_C}{h_{FE}} + V_{BE} + R_4 \left(\frac{1+h_{FE}}{h_{FE}}\right) I_C$$

$$I_C = h_{FE} \cdot \frac{V_{BB} - V_{BE}}{R_{BB} + (h_{FE}+1) \cdot R_4}$$

$$1mA = 200 \cdot \frac{2,82 - 0,6}{21,2k + 201 \cdot R_4} \Rightarrow \boxed{R_4 = 2,1\,k\Omega.}$$

(2) $V_{CC} = R_3 \cdot I_C + V_{CE} + R_4 \cdot \frac{I_E}{\left(\frac{1+h_{FE}}{h_{FE}}\right) I_C}$ $\Rightarrow R_3 = \frac{V_{CC} - V_{CE} - R_4 \cdot I_E}{I_C}$

$$R_3 = \frac{2\text{k} - 10\text{V} - 2{,}1\text{k}\Omega \cdot \left(\frac{1+h_{FE}}{h_{FE}}\right) \cdot 1\text{mA}}{1\text{mA}}$$

(4)

$$R_3 \approx 11{,}9\,\text{k}\Omega$$