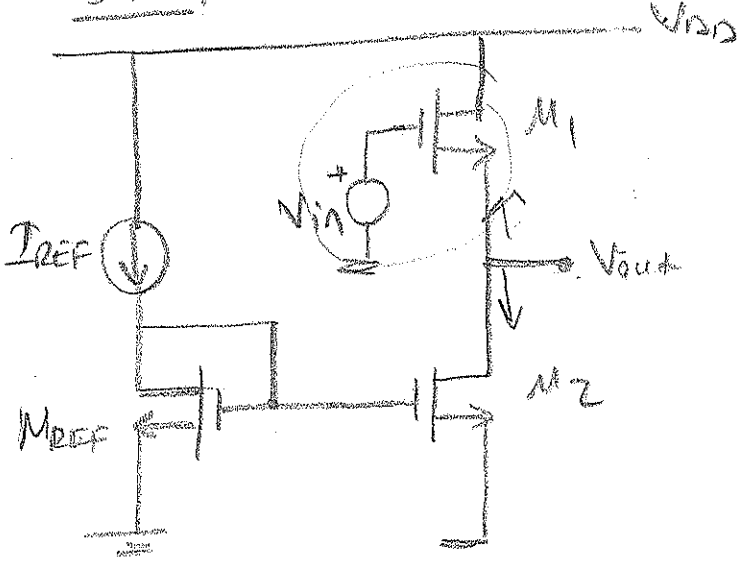
07.03.2017 UYGULAMA-4 (1)

ELEKTRONİK-2

Soru:



Şekildeki devrede devrenin gerilim kazancı 0,85 ve çıkış empedansı 100Ω'dur. $\mu_n C_{ox} = 100\,\mu A/V^2$, $V_t = 0,4V$, $V_{DD} = 1,8V$, $\lambda_n = 0,1V^{-1}$ ise

a) M_1 transistörünün geçiş iletkenliğini (g_{m1}) ve r_{o1} ve r_{o2} çıkış dirençlerinin değerlerini hesaplayınız.

b) Tüm transistörler özdeş ve $V_{OS} = 1V$ ise transistör boyut oranı ($\frac{W}{L}$) nedir?

M_1'in uçlarından bakılan direnç

CEVAP: $R_{out} = r_{o2} \,//\, \frac{1}{g_{m1}} \,//\, r_{o1} = \frac{1}{\frac{1}{r_{o2}} + \frac{1}{r_{o1}} + g_{m1}} = 100\,\Omega$

($r_{o1} // r_{o2}$)

$A_V = \frac{R_L}{R_L + R_{out}} \cdot g_{m1} \cdot R_{out} = \frac{g_{m1}}{\frac{1}{R_{out}} + \frac{1}{r_{o2}} + \frac{1}{r_{o1}} + g_{m1}} = 0,85$

$g_{m1} = \frac{A_V}{R_{out}} = \frac{0,85}{100} = 8,5m\,S$

$r_{o1} = \frac{1}{\lambda_n I_{D1}}$, $r_{o2} = \frac{1}{\lambda_n I_{D2}}$

Yük direnci çıkış direnci farklı bu şey

$I_{D1} = I_{D2} = I_D \Rightarrow r_{o1} = r_{o2} = r_o$

$R_{out} = \frac{1}{g_{m1} + \frac{2}{r_o}} \Rightarrow R_{out} \cdot g_{m1} + 2 \cdot \frac{R_{out}}{r_o} = 1$

$1 - R_{out} g_{m1} = 2 \frac{R_{out}}{r_o}$

$r_o = \frac{2 R_{out}}{1 - R_{out} \cdot g_{m1}} = \frac{2 \cdot 100\Omega}{1 - 100\Omega \cdot 8{,}5mS} \simeq 1333\,\Omega$

b) $r_o = \frac{1}{I_D \lambda_n} \Rightarrow I_D = \frac{1}{r_o \lambda_n} = \frac{1}{1333\Omega \cdot 0{,}1V^{-1}} \simeq 7{,}5mA$

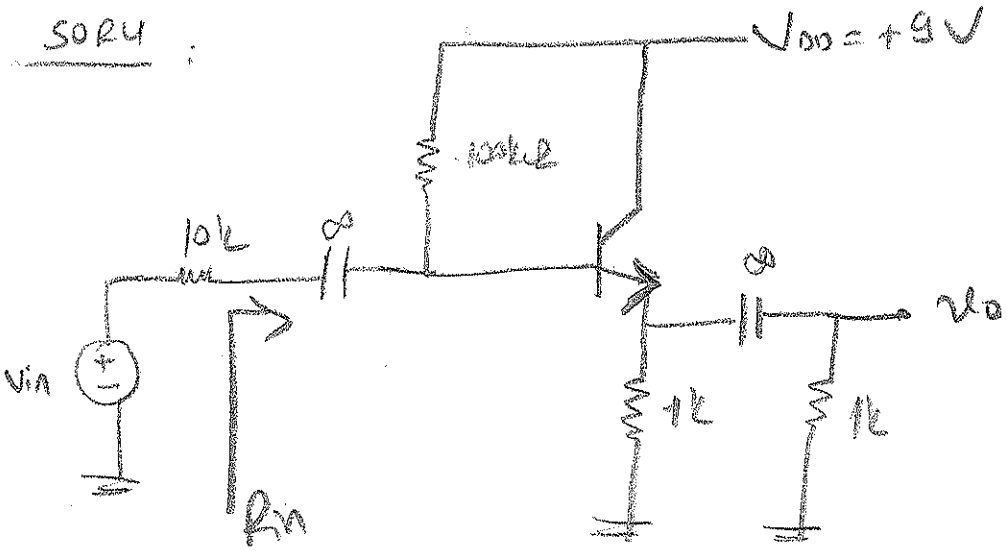
$I_{REF} = I_D = 7{,}5mA$

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

$7{,}5mA = \frac{1}{2} 100 \mu A/V^2 \cdot \left(\frac{W}{L}\right) (1 - 0{,}4)^2$

$\frac{W}{L} = \frac{2 \cdot 7{,}5mA}{100 \mu A/V^2 (1 - 0{,}4)^2} \Rightarrow \boxed{\frac{W}{L} \simeq 416}$

SORU :



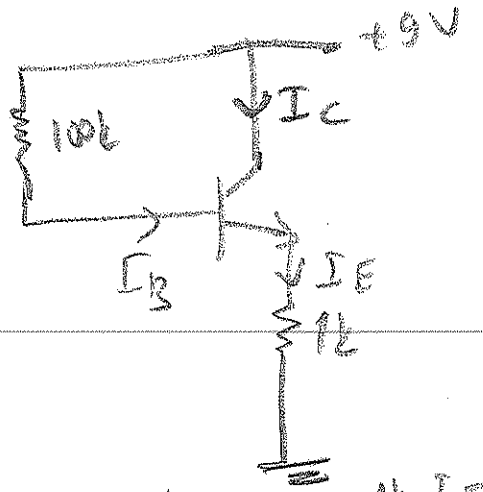
Yandaki devrede
$\beta = 200$ 'dür

a) I_E, V_E ve V_B = ?

b) R_{in} giriş direnci nedir?

b) gerilim kazancı
$\frac{v_o}{v_{in}} = ?$

Çözüm



$I_E = I_B + I_C$ ($I_C = \beta I_B$)

$I_C = \beta I_B$

$V_{BE} = 0,7V$

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

$9V = I_B \cdot 100k + V_{BE} + 1k\, I_E$

$9 - 0,7 = 100k\, I_B + 1k(1+\beta) I_B$

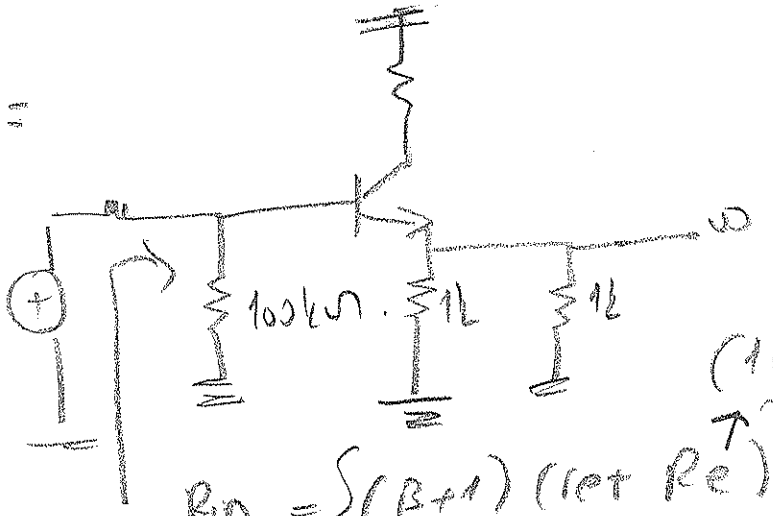
$8,3V = (100k + 201k)\, I_B \Rightarrow I_B = 27,5\mu A$

$I_E = 5,56\,mA$

$V_E = 1k \cdot I_E = 5,56V$ $\Rightarrow V_B - V_E = 0,7$

$V_B = 6,26V$

b) $R_{in} =$



$$R_{in} = \left\{ (\beta+1)(r_e + R_e') \right\} // (R_B)$$

$$r_e = \frac{V_T}{I_C} = \frac{25mV}{5,56mA} \simeq 4,5\Omega$$

$$R_{in} = \left\{ \underbrace{201 \cdot (4,5\Omega + 0,5k)}_{896\Omega} // 100k \right\}$$

$$R_{in} \simeq 888\Omega$$

c) $\frac{v_o}{v_{in}} = \frac{R_e}{r_e + R_e} = \frac{(1k // 1k)}{4,5\Omega + (1k // 1k)} = \frac{0,5k}{4,5 + 0,5k} = 0,99$