Z. K. Ü. E. E. M.

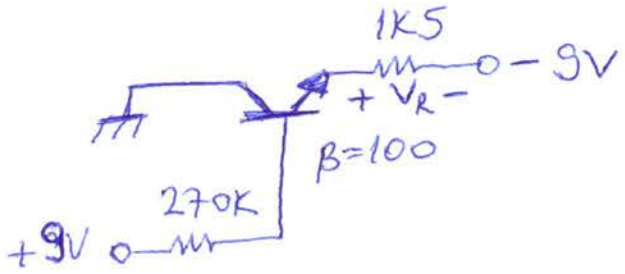
EEM301 ELEKTRONİK-1

BÜTÜNLEME SINAVI

01.02.2012

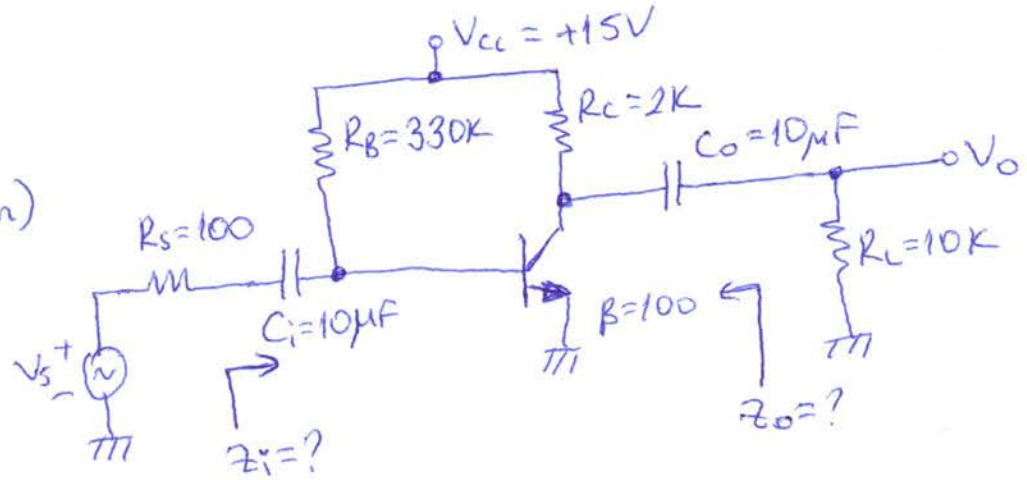
Süre: 90 dakikadır.

1°) (28 puan)



V_R = ?

2°) (36 puan)

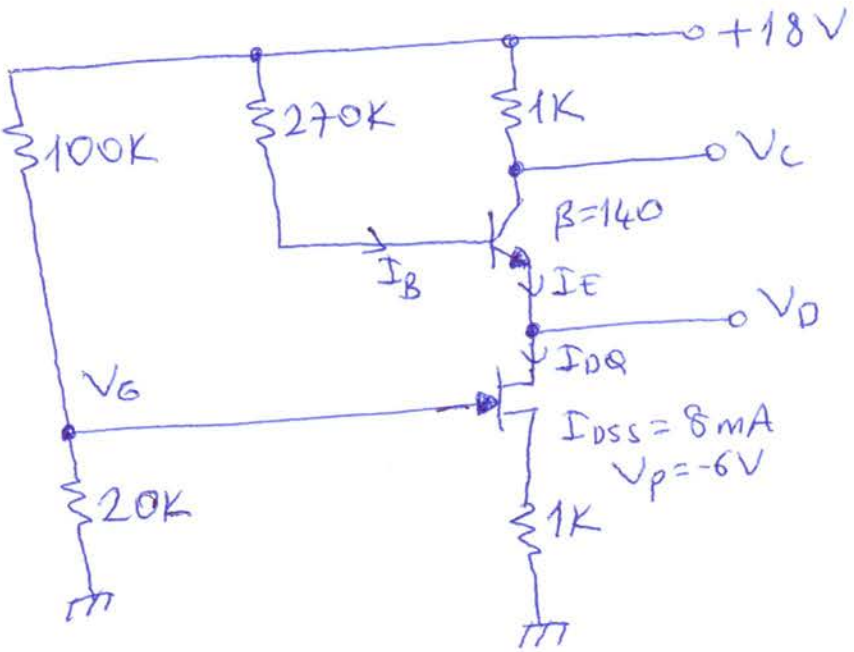


a.) Z_i = ?

b.) Z_o = ?

c.) $A_V = \frac{V_o}{V_s}$ = ?

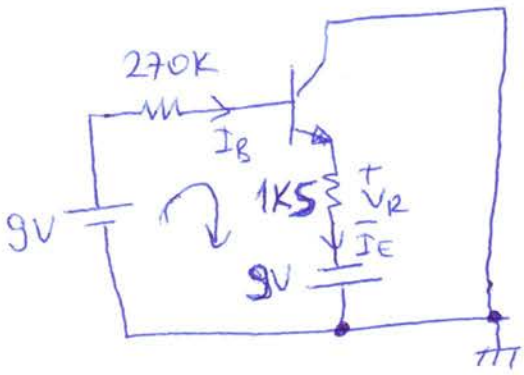
3°) (36 puan)



a.) I_{DQ} = ? b.) V_{GSQ} = ? c) V_G = ? d.) V_p = ? e.) V_C = ?

f.) I_E = ?

1°)



$V_R = I_E \cdot 1K5 = (\beta+1)\cdot I_B \cdot 1500$

$-9 + 270K \cdot I_B + V_{BE} + V_R - 9 = 0$

$270000 \cdot I_B + 1500 \cdot 101 \cdot I_B = 18 - V_{BE} = 17,3$

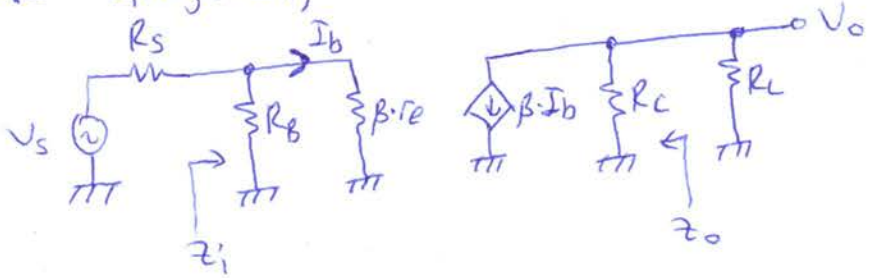
$I_B = 41\,\mu A \Rightarrow V_R = 101 \cdot 1500 \cdot I_B \cong \underline{6,22\,V}$

2°) DC analizden,

$I_B = \frac{V_{CC} - V_{BE}}{R_B} = 43\,\mu A \Rightarrow I_C = 4,33\,mA$ ve $I_E = 4,37\,mA$

$r_e = \frac{26mV}{I_E} = 5,95\,\Omega$

AC eşdeğerden,



a) $Z_i = R_B // \beta \cdot r_e = 330K // 595 = \underline{593,9\,\Omega}$

b) $Z_o = R_C = \underline{2K\,\Omega}$

c) $V_o = -(R_C // R_L)\cdot \beta \cdot I_b$

$I_i = \frac{V_S}{R_S + Z_i} \Rightarrow I_b = \frac{R_B}{R_B + \beta \cdot r_e} \cdot I_i$

$\Big\} V_o = -(R_C // R_L)\cdot \beta \cdot \frac{R_B}{R_B + \beta \cdot r_e} \cdot \frac{V_S}{R_S + Z_i}$

$A_V = \frac{V_o}{V_S} = -\frac{R_C \cdot R_L}{R_C + R_L} \cdot \frac{\beta \cdot R_B}{R_B + \beta \cdot r_e} \cdot \frac{1}{R_S + Z_i} \cong \underline{-240}$

3°) $V_G = \frac{18}{100K+20K} \cdot 20K = 3\,V \Rightarrow V_{GS} = 3 - 1K \cdot I_{DQ}$

$$I_{DQ} = I_{DSS} \cdot \left(1 - \frac{V_{GS}}{V_p}\right)^2 = I_{DSS} \cdot \left(1 - \frac{3 - 1000 \cdot I_{DQ}}{V_p}\right)^2$$

$$\frac{I_{DQ}}{8 \cdot 10^{-3}} = 1 - 2 \cdot \frac{3 - 1000 \cdot I_{DQ}}{-6} + \left(\frac{3 - 1000 \cdot I_{DQ}}{-6}\right)^2$$

$$125 \cdot I_{DQ} = 1 + 1 - \frac{1000}{3} \cdot I_{DQ} + \frac{9 - 6000 \cdot I_{DQ} + 1000000 \cdot I_{DQ}^2}{36}$$

$$4500 \cdot I_{DQ} = 72 - 12000 \cdot I_{DQ} + 9 - 6000 \cdot I_{DQ} + 1000000 \cdot I_{DQ}^2$$

$$1000000 \cdot I_{DQ}^2 - 22500 \cdot I_{DQ} + 81 = 0$$

$I_{D1} = 18\,mA$ $\quad I_{D2} = 4{,}5\,mA$

$V_{GS1} = 3 - 1000 \cdot I_{D1} = -15\,V$

$V_{GS2} = 3 - 1000 \cdot I_{D2} = -1{,}5\,V$ (mantıklı)

a.) $I_{DQ} = I_{D2} = 4{,}5\,mA$

b.) $V_{GSQ} = V_{GS2} = -1{,}5\,V$

c) $V_G = 3\,V$

f.) $I_E = I_{DQ} = 4{,}5\,mA$

e.) $I_C = \frac{\beta}{\beta+1} \cdot I_E = 4{,}47\,mA \Rightarrow V_C = 18 - 1000 \cdot I_C = 13{,}53\,V$

d) $V_D = 18 - 270000 \cdot I_B - V_{BE} = 18 - 270000 \cdot \frac{I_E}{\beta+1} - V_{BE}$

$V_D = 8{,}68\,V$