

# ELEKTRONIKA 1

Završni ispit - 1.2.2016.

## Rješenja

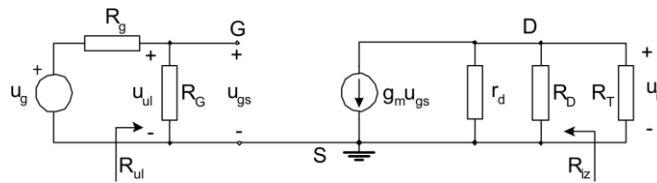
### ZADACI

1. a)

$$U_{GSQ} = U_{GSQ2} = 1,98 \text{ V} \quad I_{DQ} = \frac{K}{2} \cdot (U_{GSQ} - U_{GS0})^2 = 2,25 \text{ mA}$$

$$U_{DSQ} = U_{DD} - I_{DQ} \cdot (R_D + R_S) = 6,66 \text{ V}$$

b)



$$A_V = \frac{-g_m}{1/R_D + 1/R_T} = -4,1$$

c)

$$R_{ul} = R_G = 597,4 \text{ k}\Omega \quad R_{iz} = R_D = 1,8 \text{ k}\Omega$$

$$G_M = \frac{i_{iz}}{u_{ul}} = \frac{i_{iz}}{u_{iz}} \cdot \frac{u_{iz}}{u_{ul}} = \frac{1}{R_T} \cdot A_V = \frac{-4,1}{3,3} = -1,24 \text{ mA/V}$$

2. a)

$$n_{0E} = \frac{n_i^2}{N_{AE}} = \frac{(1,45 \cdot 10^{10})^2}{1 \cdot 10^{18}} = 210,25 \text{ cm}^{-3}$$

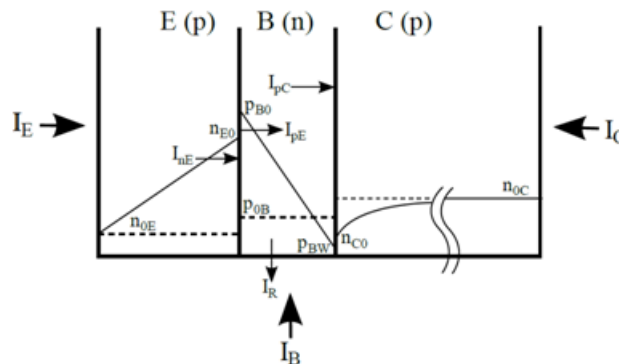
$$p_{0B} = \frac{n_i^2}{N_{BR}} = \frac{(1,45 \cdot 10^{10})^2}{1,5 \cdot 10^{16}} = 14 \ 016,67 \text{ cm}^{-3}$$

$$p_{BO} = p_{0B} \exp\left(\frac{-U_{BE}}{U_T}\right) = 14 \ 016,67 \cdot \exp\left(\frac{0,5}{25,9 \cdot 10^{-3}}\right) = 3,4 \cdot 10^{12} \text{ cm}^{-3}$$

$$n_{EO} = n_{0E} \exp\left(\frac{-U_{BE}}{U_T}\right) = 210,25 \cdot \exp\left(\frac{0,5}{25,9 \cdot 10^{-3}}\right) = 5,1 \cdot 10^{10} \text{ cm}^{-3}$$

$$p_{Bw} \approx 0$$

$$p_{CO} \approx 0$$



b)  $w_B = 1,8382 \cdot 10^{-4} \text{ cm} = 1,84 \text{ } \mu\text{m}$

c)

$$I_{nE} = qSD_{nE} \frac{n_{E0}}{w_E} = 1,6 \cdot 10^{-19} \cdot 2 \cdot 10^{-2} \cdot 25,9 \cdot 10^{-3} \cdot 450 \cdot \frac{5,1 \cdot 10^{10}}{1,5 \cdot 10^{-4}} = 12,68 \text{ } \mu\text{A}$$

$$I_{pE} = qSD_{pE} \frac{p_{B0}}{w_B} = 1,6 \cdot 10^{-19} \cdot 2 \cdot 10^{-2} \cdot 25,9 \cdot 10^{-3} \cdot 260 \cdot \frac{3,4 \cdot 10^{12}}{1,84 \cdot 10^{-4}} = 0,3982 \text{ mA}$$

$$I_E = I_{pE} + I_{nE} = 0,4109 \text{ mA}$$

$$I_B = -I_R - I_{nE} = -17,68 \text{ } \mu\text{A}$$

$$I_{pC} = I_{pE} - I_R = 0,3932 \text{ mA}$$

$$I_C = -I_{pC} = -0,3932 \text{ mA}$$

d)

$$\gamma = \frac{I_{pE}}{I_{pE} + I_{nE}} = 0,9691$$

$$\alpha = \frac{-I_C}{I_E} = 0,9569$$

$$\beta = \frac{\alpha}{1 - \alpha} = 22,23 \approx 22$$

3. a)

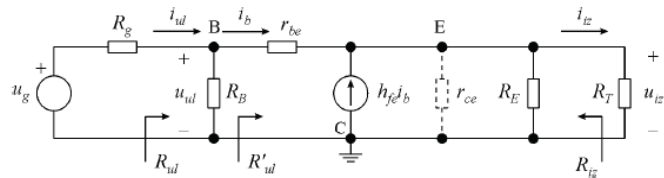
$$R_1 = \frac{12 - 1,5 \cdot [0,7 + (1 + 100)3\text{k} \cdot 19,6\mu]}{19,6\mu} = 104,2 \text{ k}\Omega$$

$$R_2 = 2 \cdot R_1 = 208,4 \text{ k}\Omega$$

NAP:

$$U_{CEQ} = U_{CC} - I_{CQ}R_E = 12 - 1,96\text{m} \cdot 3\text{k} = 6,12 \text{ V}$$

b)



$$A_I = \frac{R_E}{R_E + R_T} \cdot \frac{R_B}{R_B + R'_{ul}} (1 + h_{fe}) = \frac{3\text{k}}{3\text{k} + 2\text{k}} \cdot \frac{69\text{k}}{69\text{k} + 122,47\text{k}} \cdot 101 = 21,8$$

$$R_{ul} = R'_{ul} \parallel R_{BB} = \frac{R'_{ul} R_{BB}}{R'_{ul} + R_{BB}} = \frac{122,5\text{k} \cdot 69\text{k}}{122,5\text{k} + 69\text{k}} = 44,14 \text{ k}\Omega$$

$$R_{iz} = R_E \parallel \frac{R_g + r_{be}}{1 + h_{fe}} = 3\text{k} \parallel 17,5 = 17,4 \text{ } \Omega$$

4.

$$i_O = -1,02 \text{ mA}$$

PITANJA

	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>
<b>1</b>	d	e	a	c
<b>2</b>	b	e	d	c
<b>3</b>	e	d	c	a
<b>4</b>	a	b	d	e
<b>5</b>	c	b	e	d
<b>6</b>	c	b	a	e
<b>7</b>	d	b	e	a