

Elementi elektronike – SEPTEMBAR 2016 - REŠENJA

Rešenje:

3. Na početku tranzistor vodi u zasićenju i tada je

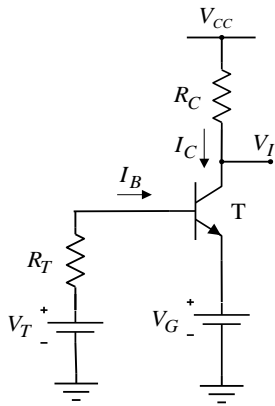
$$V_I = V_G + V_{CES}$$

i

$$I_C = \frac{V_{CC} - V_{CES} - V_G}{R_C}$$

Predstavimo deo kola desno od baze tranzistora Tevenenovim generatorom sa parametrima $V_T = \frac{R_2}{R_1 + R_2} V_{CC} = 2 \text{ V}$ i

$R_T = R_1 \parallel R_2 = 16.67 \text{ k}\Omega$. Tranzistor prelazi u aktivan režim kada je $I_C = \beta I_B$.



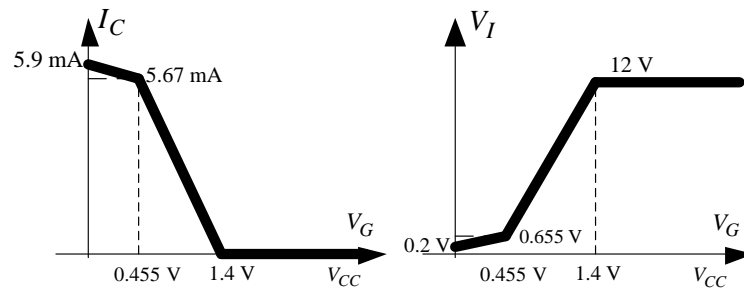
$$I_B = \frac{V_T - V_{BE} - V_G}{R_T}$$

Na granici između zasićenja i aktivnog režima je

$$V_{CES} = V_{CC} - R_C \beta I_B - V_G = V_{CC} - \frac{\beta R_C}{R_T} (V_T - V_{BE}) + V_G \left(\frac{\beta R_C}{R_T} - 1 \right)$$

i tada je $V_G = \frac{\frac{\beta R_C}{R_T} (V_T - V_{BE}) - V_{CC} + V_{CES}}{\frac{\beta R_C}{R_T} - 1} = 0.455 \text{ V}$. Za $V_G > 0.455 \text{ V}$ je tranzistor u aktivnom

režimu. Nadalje je $I_C = 8.4 \text{ mA} - \frac{V_G}{166.7 \Omega}$ i $V_I = -4.8 \text{ V} + 12V_G$, dok se tranzistor ne zakoči što se dešava kada je napon $V_G = 1.4 \text{ V}$.



4.

a) $I_{D1,2} = \frac{V_{DD} - V_I}{R_D} = 1 \text{ mA}$

$I_{D3,4} = 2 \text{ mA}$

$$R_R = \frac{V_{DD} - V_{GS3} - (-V_{DD})}{I_{D3}} = \frac{2V_{DD} - \left(V_i + \sqrt{\frac{2I_D}{k_n}} \right)}{I_{D3}} = 8 \text{ k}\Omega$$

b) $A_d = \frac{g_{m2} R_D}{2}$

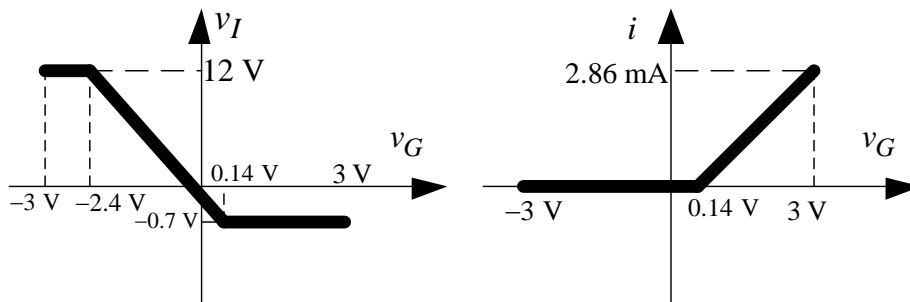
c) $A_s = \frac{-g_{m2} R_D}{1 + 2g_{m2} r_{ds4}}$

d) $g_{m1,2} = \sqrt{2k_n I_{D1,2}} = 2.82 \text{ mS}$, $A_d = \frac{g_{m2} R_D}{2} = 7.07$, $A_s = \frac{-g_{m2} R_D}{1 + 2g_{m2} r_{ds4}} = -0.025$

6.

$$v_I = \begin{cases} 12 \text{ V} & -3 \text{ V} \leq v_G < -2.4 \text{ V} & \text{OP negativno zasićenje} \\ -\frac{R_2}{R_1} v_G = -5 v_G & -2.4 \text{ V} \leq v_G < 0.14 \text{ V} & \text{T off} \\ -V_{EB} = -0.7 \text{ V} & 0.14 \text{ V} \leq v_G < 3 \text{ V} & \text{T on} \end{cases}$$

$$i = \begin{cases} \frac{v_G}{R_1} - 0.14 \text{ mA} & 0.14 \text{ V} \leq v_G < 3 \text{ V} & \text{T on} \\ 0 & -3 \text{ V} \leq v_G < 0.14 \text{ V} & \text{T off} \end{cases}$$



7.

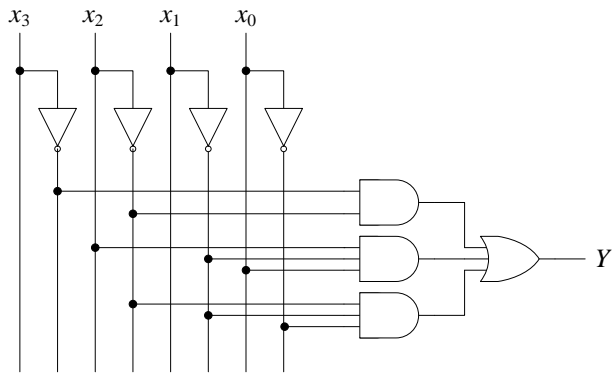
a)

x_3	x_2	x_1	x_0	Y
0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	0	1	1	1
0	1	0	0	0
0	1	0	1	1
0	1	1	0	0
0	1	1	1	0
1	0	0	0	1
1	0	0	1	0
1	0	1	0	0
1	0	1	1	0
1	1	0	0	0
1	1	0	1	1
1	1	1	0	0
1	1	1	1	0

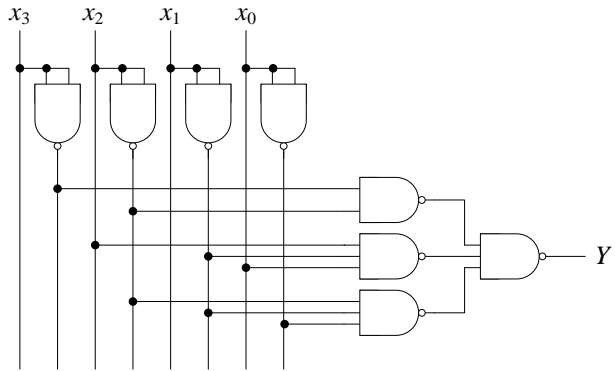
b)

		Y			
		$x_1 x_0$			
$x_3 x_2$		00	01	11	10
00		1	1	1	1
01			1		
11			1		
10		1			

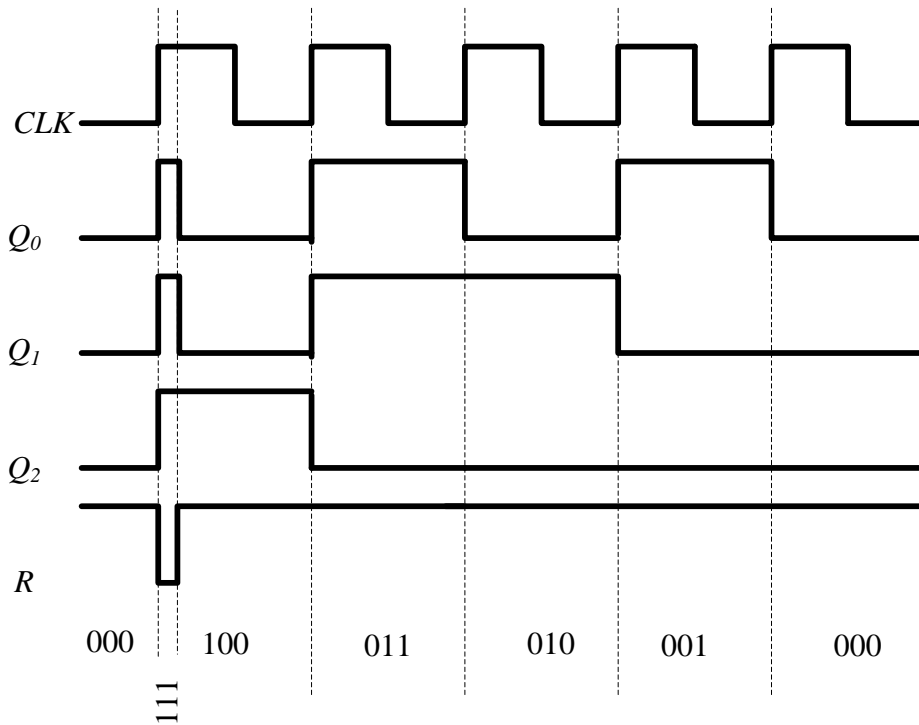
$$Y = \overline{x_3} \overline{x_2} + x_2 x_1 x_0 + x_2 x_1 \overline{x_0}$$



c)



8.



Moduo brojanja brojača je pet.