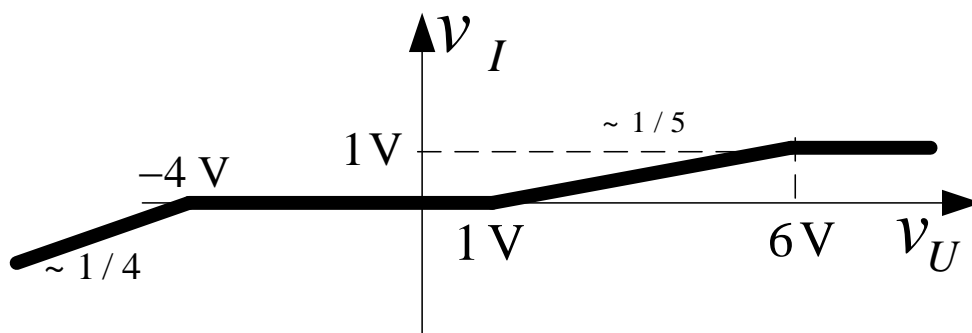


Elementi elektronike januar 2016 – REŠENJA

2.

$$v_I = \begin{cases} \frac{v_U + V_D + V_Z}{4} & v_U < -(V_D + V_Z) & \text{D1,2 off; DZ1 zener, DZ2 dioda} \\ 0 \text{ V} & -(V_D + V_Z) \leq v_U < V_D & \text{D1,2 off; DZ1,2 off} \\ \frac{v_U - V_D}{5} & V_D \leq v_U < 6V_D & \text{D1 on; D2, DZ1, DZ2 off} \\ V_D & v_U \geq 6V_D & \text{D1 on, D2 off; DZ1,2 off} \end{cases} = \begin{cases} \frac{v_U}{4} + 1 \text{ V} & v_U < -4 \text{ V} \\ 0 \text{ V} & -4 \text{ V} \leq v_U < 1 \text{ V} \\ \frac{v_U}{5} - 0.2 \text{ V} & 1 \text{ V} \leq v_U < 6 \text{ V} \\ 1 \text{ V} & v_U \geq 6 \text{ V} \end{cases}$$



3. a) $I_D = 2 \text{ mA}$.

b) Naponsko pojačanje je $A_v = \frac{v_i}{v_g} = \frac{R_D}{R_D + R_F} \frac{1 + g_m(R_{S2} - R_F)}{1 + g_m R_{S2}} = -4$, odakle se dobija nepoznata otpornost $R_F = 5.83 \text{ k}\Omega$.

6.

Napon v_1 je jednak

$$v_1 = -\frac{2R}{R} v_U = -2v_U.$$

Sve dok je $v_1 < V_D$, odnosno $v_U > -\frac{V_D}{2}$ dioda D ne vodi, pa je napon na izlazu jednak

$$v_I = -\frac{5R}{R} v_U = -5v_U.$$

Operacioni pojačavač ulazi u negativno naponsko zasićenje za $v_U = 3 \text{ V}$.

Za $v_U \leq -\frac{V_D}{2}$, dioda D vodi, pa se dobija kolo sa sledeće slike. Za čvor v_1 važi Kirhofov zakon za struje $-i_1 + i_D + i_2 = 0$ i važi

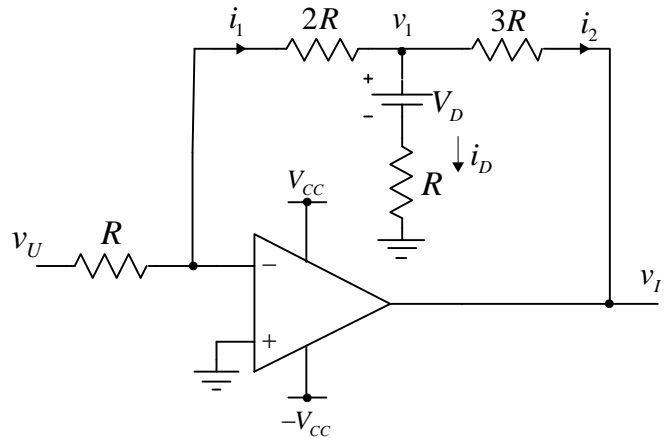
$$i_1 = \frac{v_U}{R},$$

$$i_D = \frac{v_1 - V_D}{R} = -\frac{2v_U + V_D}{R}.$$

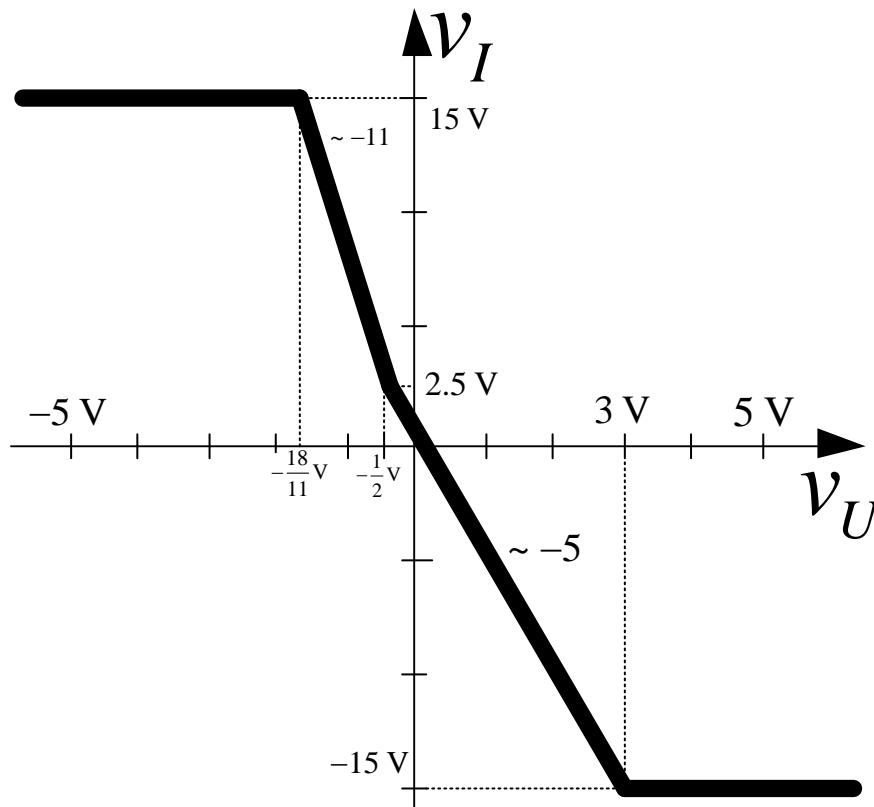
Dobija se da je

$$i_2 = i_1 - i_D = \frac{3v_U + V_D}{R}.$$

$$v_I = -3Ri_2 + v_1 = -11v_U - 3V_D$$



Operacioni pojačavač ulazi u pozitivno naponsko zasićenje za $v_U = -\frac{18}{11} \text{ V}$.



b)

		s_0			
	a_1a_0	00	01	11	10
a_3a_2	00	1			
	01				
	11	x	x	x	x
	10				

$$s_0 = \overline{a_3} \cdot \overline{a_2} \cdot \overline{a_1} \cdot \overline{a_0}$$

		s_1			
	a_1a_0	00	01	11	10
a_3a_2	00	1	1	1	1
	01	1	1	1	1
	11	x	x	x	x
	10	1	1	1	1

$$s_1 = 1$$

		s_2			
	a_1a_0	00	01	11	10
a_3a_2	00	1		1	1
	01	1	1	1	1
	11	x	x	x	x
	10	1	1	1	1

$$s_2 = a_3 + a_2 + a_1 + \overline{a_0}$$

		s_3			
	a_1a_0	00	01	11	10
a_3a_2	00	1		1	
	01	1	1	1	1
	11	x	x	x	x
	10	1	1	1	1

$$s_3 = a_3 + a_2 + a_1a_0 + \overline{a_1a_0}$$

		s_4			
	a_1a_0	00	01	11	10
a_3a_2	00	1			
	01	1	1	1	1
	11	x	x	x	x
	10	1	1	1	1

$$s_4 = a_3 + a_2 + \overline{a_1a_0}$$

s_5

	a_1a_0	00	01	11	10
a_3a_2	00	1			
	01		1	1	1
	11	x	x	x	x
	10	1	1	1	1

$$s_5 = a_3 + a_2a_0 + a_2a_1 + \overline{a_2a_1a_0}$$

s_6

	a_1a_0	00	01	11	10
a_3a_2	00	1			
	01			1	1
	11	x	x	x	x
	10	1	1	1	1

$$s_6 = a_3 + a_2a_1 + \overline{a_2a_1a_0}$$

s_7

	a_1a_0	00	01	11	10
a_3a_2	00	1			
	01			1	
	11	x	x	x	x
	10	1	1	1	1

$$s_7 = a_3 + a_2a_1a_0 + \overline{a_2a_1a_0}$$

s_8

	a_1a_0	00	01	11	10
a_3a_2	00	1			
	01				
	11	x	x	x	x
	10	1	1	1	1

$$s_8 = a_3 + \overline{a_2a_1a_0}$$

s_9

	a_1a_0	00	01	11	10
a_3a_2	00	1			
	01				
	11	x	x	x	x
	10		1	1	1

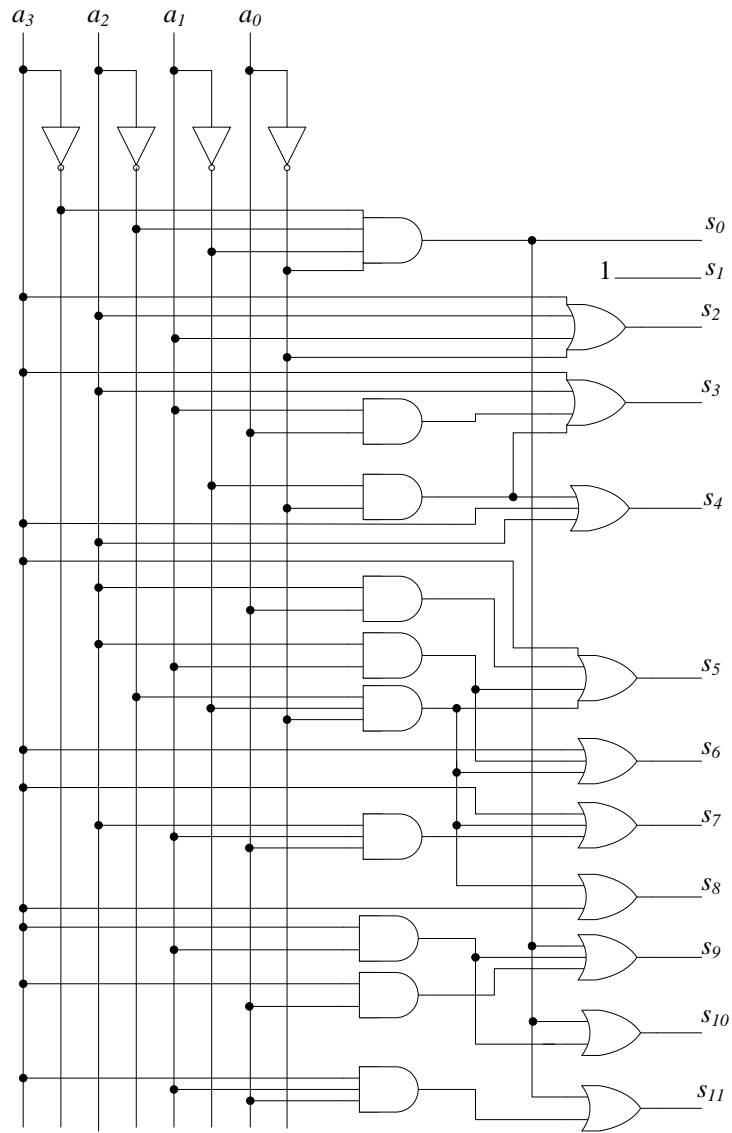
$$s_9 = a_3a_1 + a_3a_0 + \overline{a_3} \cdot \overline{a_2} \cdot \overline{a_1} \cdot \overline{a_0}$$

		s_{10}			
		a_1a_0	00	01	11
a_3a_2	00	1			
	01				
	11	x	x	x	x
	10			1	1

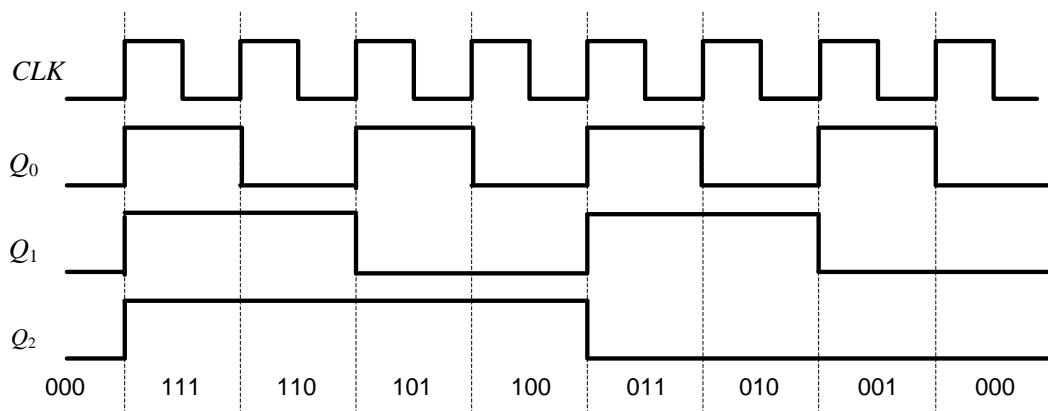
$$s_{10} = a_3 a_1 + \overline{a_3} \cdot \overline{a_2} \cdot \overline{a_1} \cdot \overline{a_0}$$

		s_{11}			
		a_1a_0	00	01	11
a_3a_2	00	1			
	01				
	11	x	x	x	x
	10			1	

$$s_{11} = a_3 a_1 a_0 + \overline{a_3} \cdot \overline{a_2} \cdot \overline{a_1} \cdot \overline{a_0}$$



8.



Moduo brojanja brojača je 8.