Elementi elektronike – JANUAR 2019 - REŠENJA

3.

$$v_I = \begin{cases} 0, & 0 \le V_{CC} < V_{BE} = 0.6V, & T - OFF, DZ - OFF \\ \dfrac{1}{2}(V_{CC} - V_{BE}), & 0.6V \le V_{CC} < 2V_Z - V_{BE} = 9.4V, & T - DAR, DZ - OFF \\ V_Z - V_{BE}, & 9.4V \le V_{CC} \le 12V, & T - DAR, DZ - Z \end{cases}$$

4.

a)

$$V_G = V_D = V_{DD} - R_D I_D$$

$$V_S = R_S I_D$$

$$V_{GS} = V_T + \sqrt{\frac{2I_D}{B}} = 4V = V_G - V_S = V_{DD} - R_D I_D - R_S I_D$$

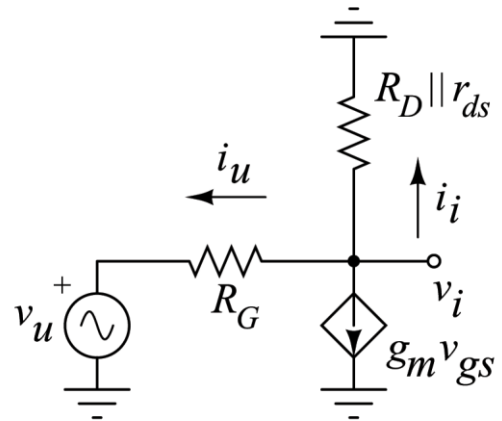$$R_S = \frac{V_{DD} - V_{GS} - R_D I_D}{I_D} = 3k\Omega$$

b) Naponsko pojačanje:

$$v_{gs} = v_u$$

$$i_i = -g_m v_{gs} - i_u = -g_m v_{gs} - \frac{v_i - v_u}{R_G}$$

$$v_i = i_i R_D || r_{ds} = -g_m R_D || r_{ds} v_u - R_D || r_{ds} \frac{v_i - v_u}{R_G}$$

$$v_i = \frac{-g_m R_D || r_{ds} + \dfrac{R_D || r_{ds}}{R_G}}{1 + R_D || r_{ds}} v_u$$

$$A_v = \frac{-g_m R_D || r_{ds} + \dfrac{R_D || r_{ds}}{R_G}}{1 + \dfrac{R_D || r_{ds}}{R_G}} = -5.7$$

Ulazna otpornost:

$$i_t = -i_u = g_m v_{gs} + i_i = g_m v_t + \frac{v_i}{R_D || r_{ds}} = g_m v_t + \frac{A_v v_t}{R_D || r_{ds}}$$

$$R_U = \frac{1}{g_m + \dfrac{A_v}{R_D || r_{ds}}} \approx 1492\Omega$$

Izlazna otpornost:

$$v_{gs} = 0V$$

$$R_I = R_G||R_D||r_{ds} = 3k\Omega$$

7.

Za $V_{EE} \le v_U \le= \frac{V_{EE}+\frac{R_2}{R_1}V_R}{1+\frac{R_2}{R_1}} = -0.4V$:

$$v_I = V_{EE}$$

Za $-0.4V < v_U \le V_R + \frac{R_1}{R_2}V_D = 2.15V$:

$$v_I = v_U\left(1 + \frac{R_2}{R_1}\right) - V_R\frac{R_2}{R_1}$$

Za $2.15V < v_U \le \frac{R_1||R_2||R_3}{R_2||R_3}\left(V_{CC} + V_R\frac{R_2||R_3}{R_1} - V_D\frac{R_2}{R_2+R_3}\right) \approx 6.18V$

$$v_I = v_U\frac{R_2||R_3}{R_1||R_2||R_3} - V_R\frac{R_2||R_3}{R_1} + V_D\frac{R_2}{R_2+R_3}$$

Za $6.18V < v_U \le V_{CC}$:

$$v_I = V_{CC}$$

8.

$$y_2 = a_1a_0b_0 + a_0b_1b_0 + a_1b_1$$

a_1a_0 \ b_1b_0	00	01	11	10
00	0	0	0	0
01	0	0	1	0
11	0	1	1	1
10	0	0	1	1

$$y_1 = \overline{a_1a_0}b_1 + \overline{a_1}b_1\overline{b_0} + a_1\overline{b_1}\,\overline{b_0} + a_1\overline{a_0}\overline{b_1} + \overline{a_1}a_0\overline{b_1}b_0 + a_1a_0b_1b_0$$

b_1b_0 / a_1a_0	00	01	11	10
00	0	0	1	1
01	0	1	0	1
11	1	0	1	0
10	1	1	0	0

$$y_0 = a_0\overline{b_0} + \overline{a_0}b_0$$

b_1b_0 / a_1a_0	00	01	11	10
00	0	1	1	0
01	1	0	0	1
11	1	0	0	1
10	0	1	1	0

9.

Moduo brojanja je 5.