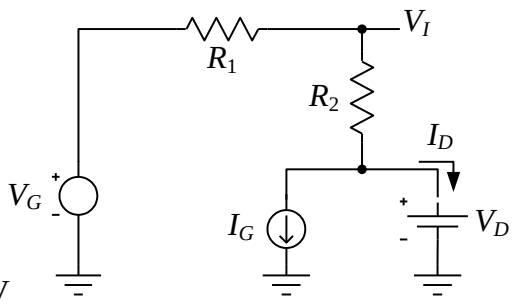
Elementi elektronike – FEBRUAR 2017 - REŠENJA

2. Ekvivalentna šema kola za veliki signal prikazana je na sledećoj slici



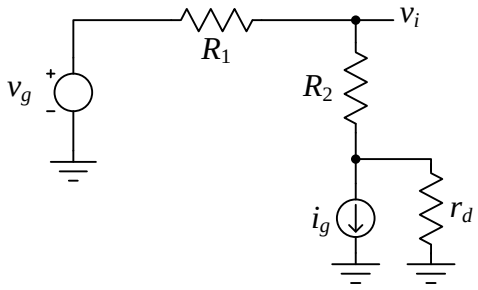
$$I_D = \frac{V_G - V_D}{R_1 + R_2} - I_G = 10\ \text{mA}$$

$$V_I = V_D + R_2\left(I_D + I_G\right) = 2.3\ \text{V}$$

Za proračun u režimu malih promenljivih signala potreban je parametar diode za mali signal:

$$r_d = \frac{V_T}{I_D} = 2.5\ \Omega\,.$$

Ekvivalentna šema kola za mali signal prikazana je na sledećoj slici



$$v_i = \frac{R_2 + r_d}{R_1 + R_2 + r_d} v_g - \frac{r_d}{R_1 + R_2 + r_d} R_1 i_g = 0.376\ \text{V}\sin\omega\text{t}\,,$$

Ukupni napon na izlazu kola je

$$v_I = V_I + v_i = 2.3\ \text{V} + 0.376\ \text{V}\sin\omega\text{t}$$

3.

a) Ako se levi deo kola zameni tevenenovim generatorom $V_T = \frac{R_{B2}}{R_{B1} + R_{B2}} V_{CC} = 2\ \text{V}$ i $R_T = R_{B1} \parallel R_{B2} = 1.6\ \text{k}\Omega$. Računa se

$$I_B = \frac{V_T - V_{BE}}{R_T + (1+\beta)R_E} = 48\mu\text{A}$$

$$I_C = \beta I_B = 2.4\ \text{mA}$$

$$I_E = (1+\beta) I_B = 2.45\ \text{mA}$$

$$V_{CEQ} = V_{CC} - V_E - R_C I_C = 3.9\ \text{V}$$

$$V_P = V_{CC} - R_C I_C = 5.2\ \text{V}$$

b) $A_v = \frac{v_p}{v_g} = \frac{g_m + \frac{1}{R_P}}{\frac{1}{R_P} + \frac{1}{R_C}}$,

$R_u = r_\pi \parallel R_E \parallel R_x$,

$R_x = \frac{1}{g_m + \frac{1 - A_v}{R_P}}$.

c) $g_m = \frac{I_C}{V_T} = 96\ \text{mS}$,

$r_\pi = \frac{\beta}{g_m} = 521.15\ \Omega$,

$A_v = 160.1$,

$R_u = 11.9\ \Omega$.

6.

$$v_I = \begin{cases} V_{CC} & v_U < -\frac{R_1}{R_2} V_{CC} = -V_{CC} \\ -\frac{R_2}{R_1} v_U & -V_{CC} \le v_U < -V_R + 2V_D \\ -(2v_U + V_R - 2V_D) & -V_R + 2V_D \le v_U < \frac{V_{CC} - V_R + 2V_D}{2} \\ -V_{CC} & v_U \ge \frac{V_{CC} - V_R + 2V_D}{2} \end{cases}$$

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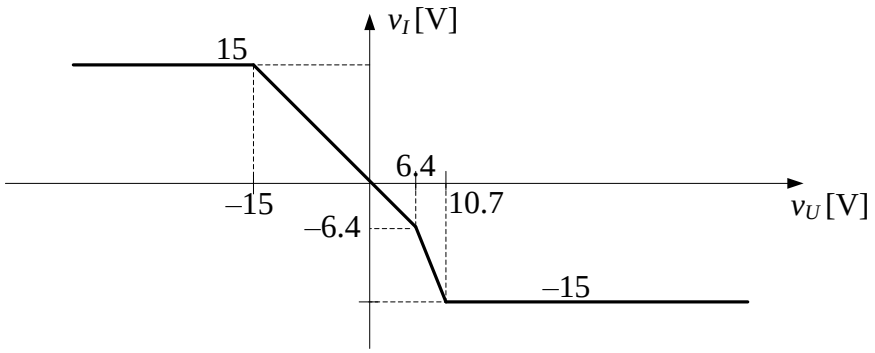
$$v_I = \begin{cases} 15\text{V} & v_U < -15\text{V} \\ -v_U & -15\text{V} \le v_U < 6.4\text{V} \\ -(2v_U - 6.4\text{V}) & 6.4\text{V} \le v_U < 10.7\text{V} \\ -15\text{V} & v_U \ge 10.7\text{V} \end{cases}$$



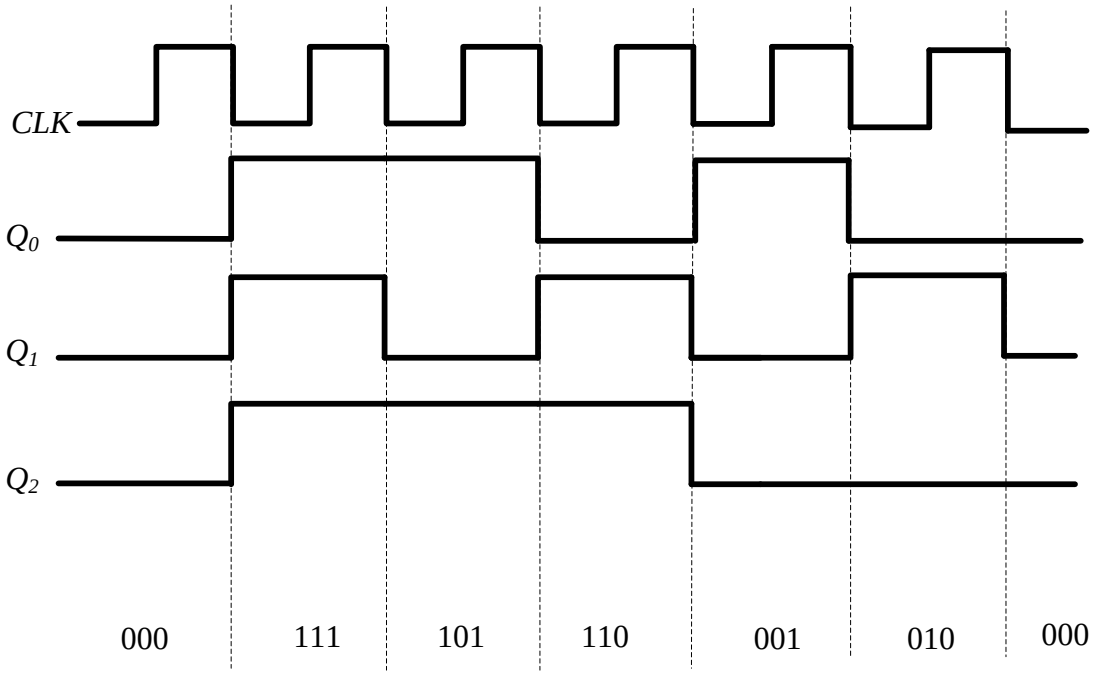
7.

a) Dva desna MOS tranzistora predstavljaju invertor.

$Y = AB + C$

b) $s_1 = A, s_0 = B, d_0 = d_1 = d_2 = C, d_3 = 1$

8.



Moduo brojanja je 6.