REŠENJA:

1. a) $V_G = R_G I_G = 5\text{k}\Omega \times 0,5\text{mA} = 2,5\text{V}$ Ako se zanemari amplituda napona v_g, minimalni napon drejna je $V_G - V_t = 1,5\text{V}$.
$V_{CC} - 1,5\text{V} - R_{Dopt} I_G = 2IR_{Dopt} \Rightarrow R_{Dopt} = 8,5\text{V}/2,5\text{mA} = 3,4\text{k}\Omega$.

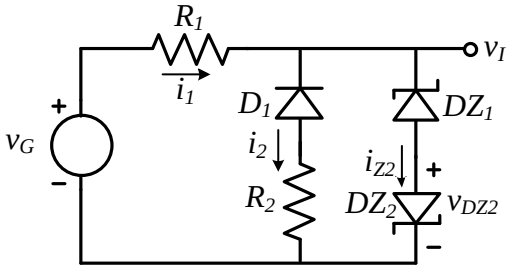
b) $a_v = -v_d / v_g = -g_m R_D = -\sqrt{2IB} \times R_D = -2\text{mS} \times 7\text{k}\Omega = -14$.

2. Beleške za predavanja, „7_Strujni_izvori_i_aktivno_opterecenje.pdf“, slajd 4.

$$I_{IZL} R_E = V_T \ln\left(\frac{I_{REF}}{I_{IZL}}\right) \quad \Rightarrow \quad I_{REF} = I_{IZL} e^{I_{IZL} R_E / V_T} = 10\mu\text{A} e^{10\mu\text{A}\cdot 5\text{k}\Omega/25\text{mV}} = 10\mu\text{A} e^2 = 73,89\mu\text{A}$$

3. Beleške za predavanja, 13_Regulator_(stabilizator)_napona.pdf, slajdovi 4, 5, 6.

4. a) i b)



I $-15\text{V} \le v_G < V_1$, DZ1 i D1 direktno polarisane, DZ2 inverzno polarisana

$v_I = -V_Z - V_D = -5.4\text{V}$

$$\left.\begin{array}{ll} i_1 = \dfrac{v_G + V_Z + V_D}{R_1} & i_{Z2} = i_1 - i_2 = \dfrac{v_G + 2V_Z + V_D}{R} \\ i_2 = \dfrac{-V_Z - V_D + V_D}{R_2} = -\dfrac{V_Z}{R} & v_{DZ2} = -V_Z \end{array}\right\} \Rightarrow P_{Z2} = v_{DZ2} \cdot i_{Z2} = -\frac{V_Z}{R}(v_G + 2V_Z + V_D)$$

Zener diode su polarisane na ovaj način dok god je $i_{Z2} < 0$. Pri ulaznom naponu V_1 struja i_{Z2} pada na 0 i dolazi do gašenja zener dioda.

$$i_{Z2}(V_1) = 0 \Rightarrow \frac{V_1 + 2V_Z + V_D}{R} = 0 \Rightarrow V_1 = -(2V_Z + V_D) = -10.1\text{V}$$

II $V_1 \le v_G < -V_D$, D1 direktno polarisana, DZ1 i DZ2 isključene

$i_{Z2} = 0 \Rightarrow P_{Z2} = 0$

$$v_I = R_2 \frac{v_G + V_D}{R_1 + R_2} - V_D = \frac{v_G - V_D}{2}$$

III $-V_D \le v_G < V_Z + V_D$, D1, DZ1 i DZ2 isključene

$i_{Z2} = 0 \Rightarrow P_{Z2} = 0$

$v_I = v_G$

IV $V_Z + V_D \le v_G \le 15\text{V}$, D1 isključena, DZ1 inverzno polarisana, DZ2 direktno polarisana

$$\left.\begin{array}{l} i_{Z2} = \dfrac{v_G - V_Z - V_D}{R_1} \\ v_{DZ2} = V_D \end{array}\right\} \Rightarrow P_{Z2} = \frac{V_D}{R}(v_G - V_Z - V_D)$$

$v_I = V_Z + V_D = 5.4\text{V}$

5.
a)

$$v_X = v_A - R\frac{v_B - v_A}{R} = 2v_A - v_B$$

$$v_I = v_X - (\frac{v_B - v_A}{R} - \frac{v_X}{R_X})R = (3 + \frac{2R}{R_X})v_A - (2 + \frac{R}{R_X})v_B$$

b) $v_B = V_m \sin(2\pi ft + \pi) = -V_m \sin(2\pi ft) = -v_A$

$$v_I = (5 + \frac{3R}{R_X})v_A = (5 + \frac{3R}{R_X})V_m \sin(2\pi ft) \le V_{CC} \Rightarrow R_X \ge \frac{3R}{\frac{V_{CC}}{V_m} - 5} = 15\text{k}\Omega$$