

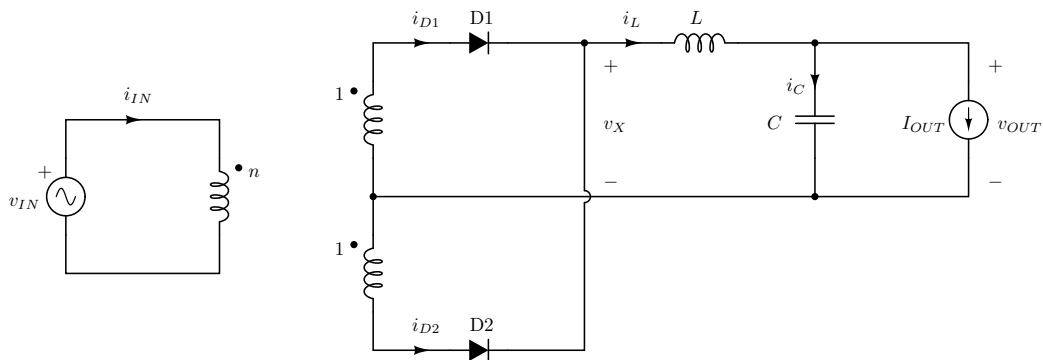
2. Ispravljač sa slike 2 ima $v_{IN} = 230\sqrt{2} \text{ V} \sin(2\pi(50 \text{ Hz})t)$, $V_D = 1 \text{ V}$, $n = 13.80$, $L = 159.15 \text{ mH}$, $C = 3.18 \text{ mF}$, $I_{OUT} = 200 \text{ mA}$. Smatrati $|\sin x| \approx \frac{2}{\pi} - \frac{4}{3\pi} \cos(2x)$.

a) [1] Odrediti srednju vrednost izlaznog napona $V_{OUT} = \overline{v_{OUT}}$.

b) [6] Odrediti vremenske dijagrame i_L , i_C , i_{D1} , i_{D2} , i_{IN} , v_X i $v_{out} = \hat{v}_{OUT} = v_{OUT} - V_{OUT}$. Dijagrame nacrtati jedan ispod drugog.

c) [2] Odrediti srednje snage disipacije na diodama D1 i D2, P_{D1} i P_{D2} .

d) [1] Odrediti koeficijent korisnog dejstva ispravljača.



Slika 2.

REŠENJE:

a) [1]

$$V_m \triangleq 230\sqrt{2} \text{ V}; \quad \omega_0 \triangleq 2\pi \times 50 \text{ Hz} = 100\pi \frac{\text{rad}}{\text{s}}$$

$$V_{OUT} = \frac{2}{\pi} \frac{V_m}{n} = 14 \text{ V}$$

b) [6] (slike na kraju)

$$i_L = I_L + i_l$$

$$I_L = I_{OUT} = 200 \text{ mA}$$

$$v_L = L \frac{di_L}{dt} = L \frac{di_l}{dt}$$

$$v_L \approx -\frac{4}{3\pi} \frac{V_m}{n} \cos(2\omega_0 t)$$

$$i_l = -\frac{4}{3\pi} \frac{V_m}{n} \frac{1}{2\omega_0 L} \sin(2\omega_0 t) = -\frac{2V_m}{3\pi \omega_0 L n} \sin(2\omega_0 t) = -100 \text{ mA} \sin(2\omega_0 t)$$

$$i_L = 200 \text{ mA} - 100 \text{ mA} \sin(2\omega_0 t)$$

$$i_C = i_l = -100 \text{ mA} \sin(2\omega_0 t)$$

$$i_{D1} = \begin{cases} i_L, & v_{IN} > 0 \\ 0, & v_{IN} < 0 \end{cases} = \begin{cases} 200 \text{ mA} - 100 \text{ mA} \sin(2\omega_0 t), & \sin(\omega_0 t) > 0 \\ 0, & \sin(\omega_0 t) < 0 \end{cases}$$

$$i_{D2} = \begin{cases} 0, & v_{IN} > 0 \\ i_L, & v_{IN} < 0 \end{cases} = \begin{cases} 0, & \sin(\omega_0 t) > 0 \\ 200 \text{ mA} - 100 \text{ mA} \sin(2\omega_0 t), & \sin(\omega_0 t) < 0 \end{cases}$$

$$i_{IN} = \frac{1}{n} (i_{D1} - i_{D2}) = \frac{1}{n} i_L \operatorname{sgn}(v_{IN}) = (14.49 \text{ mA} - 7.25 \text{ mA} \sin(2\omega_0 t)) \operatorname{sgn}(\sin(\omega_0 t))$$

$$v_X = \left| \frac{v_{IN}}{n} \right| - V_D = 23.57 \text{ V} |\sin(\omega_0 t)| - 1 \text{ V}$$

$$i_l = i_C = C \frac{dv_{OUT}}{dt} = C \frac{dv_{out}}{dt}$$

$$v_{out} = \frac{1}{2\omega_0 C} \frac{2V_m}{3\pi \omega_0 L n} \cos(2\omega_0 t)$$

$$v_{out} = \frac{V_m}{3\pi n \omega_0^2 LC} \cos(2\omega_0 t) = 50 \text{ mV} \cos(2\omega_0 t)$$

c) [2]

$$P_{D1} = P_{D2} = \frac{1}{2} I_L V_D = 100 \text{ mW}$$

d) [1]

$$P_{OUT} = V_{OUT} I_{OUT} = 2.8 \text{ W}$$

$$\eta = \frac{P_{OUT}}{P_{OUT} + P_{D1} + P_{D2}} = 93.33\%$$

