

Soru 1:

$$\Delta I_L = \frac{I}{L} \cdot (V_{IN} - V_{sat}) \cdot t_{ON}$$

$$\Delta I_L = \frac{I}{L} \cdot (|V_O| + V_D) \cdot t_{OFF}$$

$$\frac{t_{ON}}{t_{OFF}} = \frac{|V_O| + V_D}{(V_{IN} - V_{sat})}$$

$$V_O = - \left((V_{IN} - V_{sat}) \cdot \frac{t_{ON}}{t_{OFF}} - V_D \right)$$

$$T = t_{ON} + t_{OFF} = t_{OFF} \cdot \left(\frac{|V_O| + V_D}{(V_{IN} - V_{sat})} + 1 \right)$$

$$\frac{t_{ON}}{t_{OFF}} = \frac{24V + 0.8V}{(12V - 1V)} = 2.254$$

$$t_{OFF} = \frac{T}{\left(\frac{|V_O| + V_D}{(V_{IN} - V_{sat})} + 1 \right)} = \frac{10^{-5} sn}{2.254 + 1} \cdot 0.307 \times 10^{-5} sn = 3.07 \mu sn$$

$$t_{ON} = 2.254 \cdot t_{OFF} = 6.93 \times 10^{-5} sn = 6.95 \mu sn$$

$$\begin{aligned} I_{Omin} &= \frac{1}{2} \cdot \Delta I_L \cdot \frac{t_{OFF}}{T} = \frac{1}{2} \cdot \frac{I}{L} \cdot (|V_O| + V_D) \cdot \frac{t_{OFF}^2}{T} \\ &= \frac{1}{2} \cdot \frac{I}{L} \cdot (|V_O| + V_D) \cdot \frac{T}{\left(\frac{|V_O| + V_D}{(V_{IN} - V_{sat})} + 1 \right)^2} \end{aligned}$$

$$L = \frac{(V_{IN} - V_{sat})^2 \cdot \{|V_O| + V_D\}}{(|V_O| + V_D + V_{IN} - V_{sat})^2} \cdot \frac{T}{2 \cdot I_{Omin}}$$

$$L = \frac{(12V - 1V)^2 \cdot \{24V + 0.8V\}}{(24V + 0.8V + 12V - 1V)^2} \cdot \frac{10^{-5}}{2 \times 0.1A} = 11.6 \times 10^{-5} H = 116 \mu H$$

$$C = \frac{p \cdot T \cdot I_{Omax}}{\Delta V_O} \cdot \frac{0.673 \times 10^{-5} \times 2A}{20 \times 10^{-3}} = 0.693 \times 10^{-3} F = 693 \mu F$$

$$\eta = \frac{P_O}{P_{IN}} = \frac{\overline{I_O} \cdot V_O}{I_{IN} \cdot V_{IN}} = \frac{|V_O|}{|V_O| + V_D} \cdot \frac{V_{IN} - V_{sat}}{V_{IN}} = \frac{24}{24.8} \times \frac{11}{12} = 0.88$$

Soru 2:

$$Q_{G1} = 7\text{nC} \quad V_{G1} = 4\text{V}$$

$$Q_{G2} = 16\text{nC} \quad V_{G2} = 7\text{V}$$

$$Q_{G3} = 92\text{nC} \quad V_{G3} = 12\text{V}$$

$$t_{don} = R_S \cdot \frac{Q_{G1}}{V_{G1}} \cdot \ln \frac{V_{GG}}{V_{GG} - V_{G1}} \quad t_r = R_S \cdot \frac{Q_{G1} - Q_{G2}}{V_{G1} - V_{G2}} \cdot \ln \frac{V_{GG} - V_{G1}}{V_{GG} - V_{G2}}$$

$$t_{ON} = R_S \cdot \left(\frac{Q_{G1}}{V_{G1}} \cdot \ln \frac{V_{GG}}{V_{GG} - V_{G1}} + \frac{Q_{G1} - Q_{G2}}{V_{G1} - V_{G2}} \cdot \ln \frac{V_{GG} - V_{G1}}{V_{GG} - V_{G2}} \right)$$

$$R_S = \frac{t_{ON}}{\left(\frac{Q_{G1}}{V_{G1}} \cdot \ln \frac{V_{GG}}{V_{GG} - V_{G1}} + \frac{Q_{G1} - Q_{G2}}{V_{G1} - V_{G2}} \cdot \ln \frac{V_{GG} - V_{G1}}{V_{GG} - V_{G2}} \right)}$$

$$= \frac{100 \times 10^{-9}}{\left(\frac{7 \times 10^{-9}}{4\text{V}} \cdot \ln \frac{12\text{V}}{12\text{V} - 4\text{V}} + \frac{7 \times 10^{-9} - 16 \times 10^{-9}}{4\text{V} - 7\text{V}} \cdot \ln \frac{12\text{V} - 4\text{V}}{12\text{V} - 7\text{V}} \right)} = 47\text{Ohm} \Rightarrow R_S \leq 47\Omega$$

$$t_{doff} = R_S \cdot \frac{Q_{G3} - Q_{G2}}{V_{G3} - V_{G2}} \cdot \ln \frac{V_{GG}}{V_{G2}} = 47 \cdot \frac{92 \times 10^{-9} - 16 \times 10^{-9}}{12\text{V} - 7\text{V}} \cdot \ln \frac{12}{7} = 385\text{nsn}$$

$$t_f = R_S \cdot \frac{Q_{G2} - Q_{G1}}{V_{G2} - V_{G1}} \cdot \ln \frac{V_{G2}}{V_{G1}} = 47 \cdot \frac{16 \times 10^{-9} - 7 \times 10^{-9}}{7\text{V} - 4\text{V}} \cdot \ln \frac{7\text{V}}{4\text{V}} = 78.9\text{nsn}$$

$$t_{OFF} = 78.9\text{nsn} + 385\text{nsn} = 463.9\text{nsn}$$

c) $I_{Omin} = (1/2) \cdot \Delta I_L$ kabul edilirse $\rightarrow I_{D1} = I_{Omaks} - (1/2) \cdot \Delta I_L = 2\text{A} - 0.05\text{A} = 1.95\text{A}$

$$I_{D2} = I_{Omaks} + (1/2) \cdot \Delta I_L = 2\text{A} + 0.05\text{A} = 2.05\text{A}$$

$$P_S = \frac{V_{DS} \cdot (I_{D1} \cdot t_{s1} + I_{D2} \cdot t_{s2}) \cdot f_s}{2} = \frac{24\text{V} \cdot (1.95\text{A} \times 100\text{nsn} + 2.05\text{A} \times 463.9\text{nsn}) \times 100 \times 10^3}{2} = 1.347\text{W}$$

Soru 3:

a) $V_{REG}=5V, I_L = 5A$

$$R = \frac{V_{REG}}{I_L} = \frac{5V}{5A} = 1\Omega$$

b)

$$0 \leq Z_L \leq \frac{V_{IN} - I_{REG} \cdot R_2 - V_D - V_{REG} - V_{Bmin}}{I_L}$$

$$I_{REG} \cdot R_2 = I_T \cdot R_1 \Rightarrow R_1 = \frac{I_{REG} \cdot R_2}{I_T} = \frac{1A \cdot 1\Omega}{4A} = 0.25\Omega$$

$$Z_L \leq \frac{20V - 1V - 0.8V - 5V - 3V}{5A} = 2\Omega$$

$$Z_{Lmaks} = 2\Omega$$

HAKAN KUNTUZMAN