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HW #4

(forward converter)

Q1) i. When S is ON, $v_L = V_d \cdot \frac{N_2}{N_1} - V_o$

When S is OFF, $v_L = -V_o$

$\Rightarrow \left(V_d \cdot \frac{N_2}{N_1} - V_o\right) D - V_o (1-D) = 0 \Rightarrow V_o = \frac{N_2}{N_1} D V_d$ for $i_L > 0$

so, $R_L = \frac{705}{25} = \frac{N_2}{N_1} \cdot D$ $\quad \frac{N_1}{N_2} \cdot \frac{1}{D} = 25 \Rightarrow$ choose $\boxed{\begin{array}{l} D = 0.2 \\ N_1 = 5 \\ N_2 = 1 \end{array}}$

ii. $I_o = \frac{V_o}{R_L} \geq I_{OB} \Rightarrow R_L = R_{Lmax}$

$i_{Lavg} = I_o = \frac{i_{peak}}{2} \cdot \frac{\left(\frac{N_2}{N_1} D V_d - V_o\right)}{L} \cdot DT_s = i_{peak} = 3.84A$

$i_{Lavg} = 1.92A \Rightarrow R_{Lmax} = \frac{12}{1.92} = \boxed{6.25\Omega}$

iii. $(D + \Delta_M) T_s = 36\mu s$ wanted. D is chosen as 0.2, so $\Delta_M T_s = 28\mu s$.

$\boxed{\Delta_M = 0.7} \Rightarrow D = \frac{N_1}{N_2} \cdot \Delta_M \Rightarrow N_2 = \frac{N_1}{D} \cdot \Delta_M = \frac{35}{2} = \boxed{17.5 \text{ turns}}$

iv $i_{Lavg} = \frac{V_o}{R_L}$ choose $R_L = 10\Omega$

$$V_o = \frac{N_2}{N_1} \cdot V_d \cdot \frac{2}{\sqrt{1 + \frac{8 \cdot L}{R_L \cdot T_s}}} = \boxed{16.8\ V}$$

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(push-pull converter)

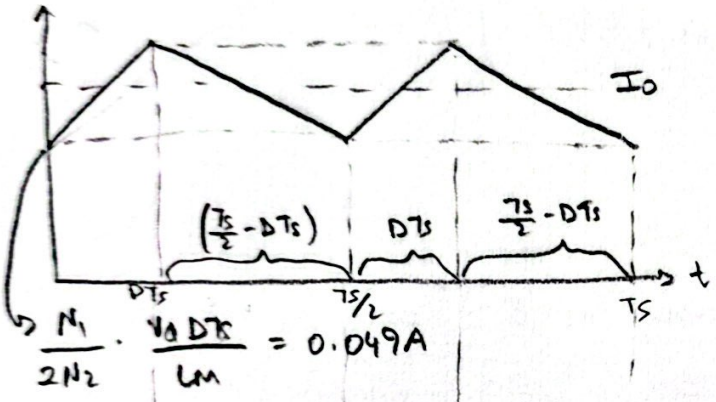
Q2) $\left(\frac{N_2}{N_1} V_d - V_o\right) DT_s - V_o\left(\frac{T_s}{2} - DT_s\right) = 0$

↳ $\frac{V_o}{V_d} = 2D \cdot \frac{N_2}{N_1} \Rightarrow \frac{18}{200} = 2\frac{N_2}{N_1} \cdot D$

$N_2 = 9$
$N_1 = 20$
$D = 0.1$

ii. $I_{OB} = \frac{V_o(1-D)T_s}{2L}$ => $\frac{1}{2}$ multiplier due to 4 states ($\frac{T_s}{2}$).

$\frac{V_o}{I_{OB}} = R_{LMax} \Rightarrow I_{OB} = 3.24A \Rightarrow$ $R_{LMax} = 5.55\Omega$



$\frac{N_1}{2N_2} \cdot \frac{V_d DT_s}{L_M} = 0.049A$

iii.