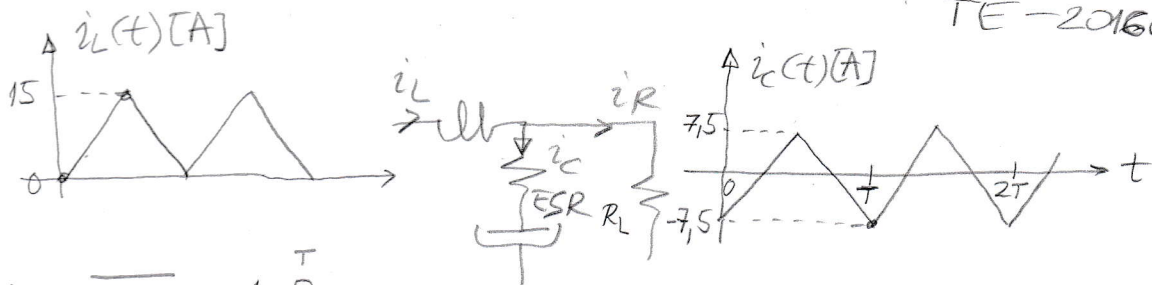


①.



$$P_c = \overline{P_c(t)} = \frac{1}{T} \int_0^T ESR i_c^2(t) dt$$

$$P_c = \frac{4}{T} \int_0^{T/4} ESR \left(\frac{(I_M/2)t}{T/4} \right)^2 dt = \frac{4}{T} \cdot ESR \cdot \left(\frac{2I_M}{T} \right)^2 \int_0^{T/4} t^2 dt$$

$$P_c = ESR \cdot \frac{16I_M^2}{T^3} \cdot \frac{t^3}{3} \Big|_0^{T/4} = \frac{16I_M^2}{T^3} \cdot \frac{T^3}{4^3} \cdot \frac{1}{3} \cdot ESR = \frac{I_M^2}{12} \cdot ESR = \frac{15^2}{12} \cdot 0,1 = 1,875 W$$

$$\textcircled{2.} \int_0^T v_L(t) dt = 0; (24 - I_L \cdot r_{DSon} - 14)D = (V_D + U_B)(1-D)$$

$$I_L = I_B$$

$$(24 - I_B \cdot r_{DSon} - 14)D = (V_D + U_B)(1-D)$$

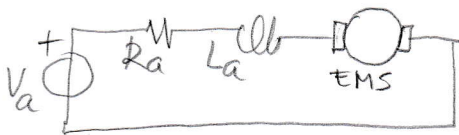
$$(24 - 10 \cdot 0,05 - 14)D = (1 + 14)(1-D)$$

$$9,5D = 15(1-D) \Rightarrow 9,5D + 15D = 15 \Rightarrow D = \frac{15}{24,5} = 0,612 = 61,2\%$$

$$r_{DSon} = 0 \Rightarrow (24 - 14)D_0 = 14(1-D_0)$$

$$10D_0 + 14D_0 = 14 \Rightarrow 24D_0 = 14 \Rightarrow D_0 = \frac{14}{24} = 0,583 = 58,3\%$$

③.



$$V_{a1} = 50 \cdot 0,7 - 50 \cdot 0,3 = 20 V$$

$$V_a = R_a I_a + EMS = R_a I_a + k n$$

$$V_{a1} = R_a I_{a1} + k n_1 = 20 V$$

$$0,6 \cdot 10 + k \cdot 2000 = 20$$

$$k \cdot 2000 = 14 \Rightarrow k = \frac{14}{2000} = 7 \cdot 10^{-3} V/(rev/min)$$

$$V_{a2} = R_a I_{a2} + k n_2 = 0,6 \cdot 10 + 7 \cdot 10^{-3} \cdot 2500 = 23,5 V$$

$$V_{a2} = 50 \cdot D_2 - 50(1-D_2)$$

$$V_{a2} = 100D_2 - 50 = 23,5 \Rightarrow 100D_2 = 50 + 23,5$$

$$D_2 = \frac{73,5}{100} = 73,5\%$$