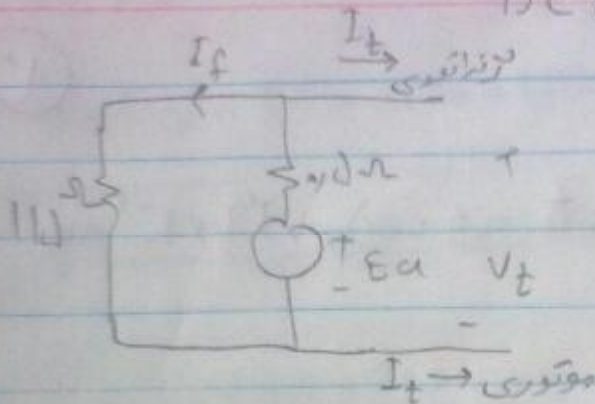


تسریع ماشین DC



تمرین (۱)

رابطه توان: $E_a = R_a I_a + V_t$

$$I_f = \frac{V_t}{110} = \frac{230}{110} = 2 \text{ A}$$

$$I_a = I_f + I_t = 2 + 2 = 4 \text{ A}$$

$$E_a = 230 + 0.4 \times 4 = 231.6 \text{ V}$$

موتوری: $I_a = I_f = 2 = 4 \text{ A}$

$$E_a = 230 - 0.4 \times 4 = 229.6 \text{ (V)}$$

و $E = k_a \phi \omega$ و $\phi = k' I_f$

$$\Rightarrow \frac{E_a \text{ مولی}}{E_a \text{ مولی}} = \frac{I_f \text{ مولی}}{I_f \text{ مولی}} \times \frac{\omega \text{ مولی}}{\omega \text{ مولی}} \Rightarrow \frac{229.6}{230} = \frac{2}{2} \times \frac{\omega \text{ مولی}}{\omega \text{ مولی}}$$

$$\Rightarrow \frac{\omega \text{ مولی}}{\omega \text{ مولی}} = 1.0$$

$$\theta = \frac{l\Delta}{r} = \frac{l\Delta}{R} \text{ rad}$$

(٢)

$$\theta = \omega t \Rightarrow \frac{l\Delta}{R} = 1000 \times \frac{r_0}{40} \times t \Rightarrow t = \Delta / \sqrt{9} \times 10^{-3} \text{ sec}$$

(٣)

$$i_f = \frac{r_0}{r_0 + R} = 1, 3 \Delta r$$

طبق بقية قانون : $E_a = k_a \phi \omega = k_a k' i_f \omega = K_T i_f \omega$

$$\Rightarrow I_a = K_T \times 1 \times I_a \times \frac{r_0}{40} \Rightarrow K_T = \frac{I_a \times 40}{I_a \times r_0} = \frac{r}{\pi}$$

$$E_a = r_0 - 1 \Delta \times 40 = 221 \text{ v}$$

$$\Rightarrow 221 = \frac{r}{\pi} \times 1, 3 \Delta r \times \omega \Rightarrow \omega = 1 \sqrt{1, 0} \Delta \text{ rad/sec}$$

ب) : $P = T \omega \Rightarrow 1 \Delta \times \sqrt{9} = T \times 1 \sqrt{1, 0} \Delta \Rightarrow T = 4 \Delta / \sqrt{2} \text{ N.m}$

ج) :

$$P_{\text{loss cu}} = 1 \sqrt{0} \times 1, 3 \Delta r^2 + 1 \Delta \times 40^2 = 1 \Delta 1, 20 r^2 \quad \omega$$

$$P_{in} = V_{in} I_{in} = 230 \times (40 + 1,353) = 14111,19 \text{ W}$$

$$P_{rot} = P_{in} - P_{out} - P_{cu} = 14111,19 - 14 \times 747 - 121,203$$

$$\Rightarrow P_{rot} = 2049,91 \text{ W}$$

$$\Rightarrow \eta = \frac{P_{out}}{P_{in}} \times 100 = \frac{14 \times 747}{14111,19} \times 100 = 79,37\%$$

$$\text{b) if } i_a \approx 0 \Rightarrow E_a \approx V_t = 221 \text{ V}$$

$$i_f = \frac{221}{170} = 1,3 \Rightarrow \omega = \frac{221}{\frac{\pi}{6} \times 1,3} = 178,023 \text{ rad/sec}$$

و در این حالت سرعت موتور ناگهان افزایش می یابد زیرا $i_a \approx 0$ می شود و اگر موتور

خاموش نشود خواهد سوخت.

اگر فرض کنیم ولتاژ داخلی ماشین تغییر نکند آنگاه $E_a \approx V_t = 221 \text{ V}$

$$\text{if } R_{adj} = 0 \Rightarrow i_f = \frac{221}{10} = 2,21 \text{ A}$$

$$\Rightarrow \omega = \frac{221}{\frac{\pi}{6} \times 2,21} = 13,77 \text{ rad/sec}$$

$$\text{if } R_{adj} = 200 \Rightarrow i_f = \frac{221}{210} = 1,05 \Rightarrow \omega = 293,21 \text{ rad/sec}$$

$$i_a = \frac{220}{110} = 2 \text{ (A)}$$

(F)

$$E_a = 220 - 2 \times 2 = 219,4$$

$$P_{conv} = E_a I_a = 219,4 \times 2 = 438,8 = P_{rot}$$

شرایطی: $i_a = 52 - 2 = 50 \text{ (A)}$

$$E_a = 220 - 50 \times 2 = 210 \text{ V}$$

$$P_{conv} = 210 \times 50 = 10500 \text{ W}$$

$$\Rightarrow P_{محر} = 10500 - 438,8 = 9161,2$$

و داریم $E_a = k_T i_f \omega \Rightarrow 219,4 = k_T \times 2 \times 1500 \times \frac{2\pi}{60}$

$$\Rightarrow k_T = \frac{219,4}{\pi}$$

شرایطی $\Rightarrow 210 = \frac{219,4}{\pi} \times 2 \times \omega \Rightarrow \omega = 150,34 \text{ rad/sec}$

$$\Rightarrow N = 1435,73 \text{ rpm}$$

$$T_{محر} = \frac{P_{محر}}{\omega} = \frac{9161,2}{150,34} = 61,0 \text{ N.m}$$

طبق معادلة: $T_L = \Delta \sqrt{n}$

$$P = VI \Rightarrow I_n = \frac{P_{0000}}{V_{\Delta 0}} = 140 \text{ (A)} \quad (5)$$

$$E_a = V_{\Delta 0} - I_n \times r = 211 \text{ V}$$

$$P_{conv} = E_a I_a = 211 \times 140 = 29540 \text{ kW}$$

$$\Rightarrow P = T\omega \Rightarrow 29540 = T\omega \quad (1) ; T = \Delta \sqrt{n} \quad (2)$$

$$(1), (2) \Rightarrow 29540 = (\Delta \sqrt{n}) n \times \frac{2\pi}{40} \Rightarrow n = 1417, 7 \text{ rpm}$$

الف): $i_f = \frac{V_{00}}{100} = 2 \text{ (A)} \Rightarrow i_a = 20 \text{ (A)} \quad (4)$

$$E_a = V_{00} - i_a \times r = 191 \text{ V}$$

$$E_a = k_t i_f \omega \Rightarrow k_t = \frac{191}{2 \times 1000 \times \frac{2\pi}{40}} = \frac{2,9 \text{ V}}{\pi}$$

$$\text{if } n = 1000 \text{ rpm} \Rightarrow E = \frac{2,9 \text{ V}}{\pi} \times 2 \times 1000 \times \frac{2\pi}{40} = 1011,5 \text{ V}$$

$$R_a + R_{adj} = \frac{V_{00} - 1011,5}{20} \Rightarrow R_{adj} = 1,91 \text{ } \Omega$$

ب): $E_a I_a = T\omega = k' \omega^2$

$$\text{سلسلة : } 191 \times V_0 = K' \times (1000 \times \frac{V_0}{4})^2 \Rightarrow K' = 0,134$$

$$\omega = 100 \text{ rpm} \Rightarrow 101,1^\circ \text{ ia} = 0,134 \times (1000 \times \frac{V_0}{4})^2 \Rightarrow \text{ia} = 10,9 \text{ A}$$

$$\Rightarrow R_{adj} = \frac{V_0 - 101,1^\circ}{10,9 \text{ A}} \Rightarrow R_{adj} = 2,201 \Omega$$

$$\text{ج. : } T \propto \omega^2 \Rightarrow T = K'' \omega^2 ; E_a T_a = T \omega = K'' \omega^3$$

$$\text{سلسلة } \Rightarrow 191 \times V_0 = K'' (1000 \times \frac{V_0}{4})^3 \Rightarrow K'' = 1,11 \times 10^{-6}$$

$$\text{if } \omega = 100 \text{ rpm} \Rightarrow \text{ia} = \frac{1,11 \times 10^{-6} \times (1000 \times \frac{V_0}{4})^3}{101,1^\circ} = 12,55 \text{ (A)}$$

$$R_{adj} = \frac{V_0 - 101,1^\circ}{12,55} = 0,1 = 1,105 \Omega$$

$$\text{د) } T \propto \omega^3 \Rightarrow T = K''' \omega^3$$

$$\text{د) } T \propto \omega^3 \Rightarrow T = K''' \omega^3$$

$$\text{سلسلة } \Rightarrow 191 \times V_0 = K''' (1000 \times \frac{V_0}{4})^4 \Rightarrow K''' = 1,11 \times 10^{-9}$$

$$\text{if } \omega = 100 \text{ rpm} \Rightarrow \text{ia} = \frac{1,11 \times 10^{-9} \times (1000 \times \frac{V_0}{4})^4}{101,1^\circ} = 10,15 \text{ (A)}$$

$$\Rightarrow R_{adj} = \frac{V_0 - 101,1^\circ}{10,15} = 0,1 = 1,942 \Omega$$