RIS LAB Report 3

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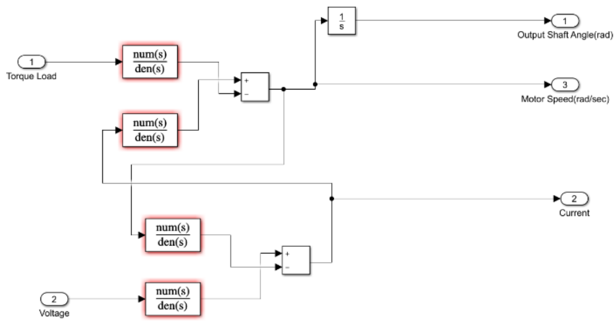
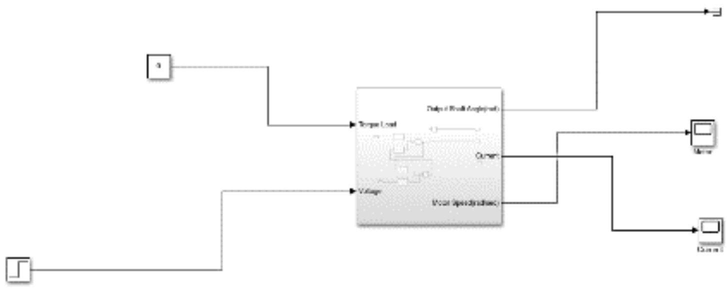
Task 1.10

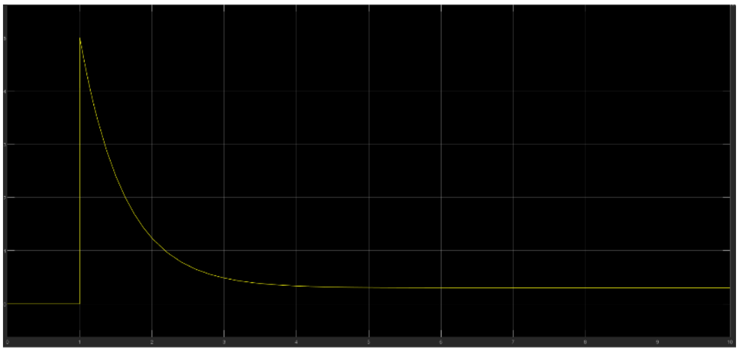
1)



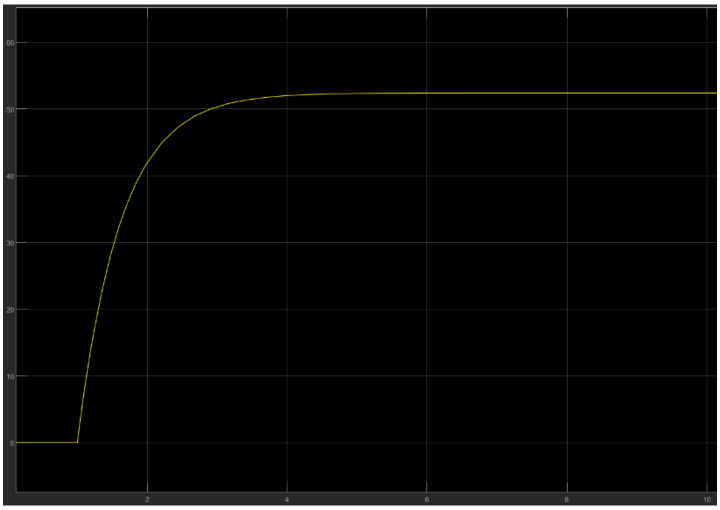


2) No need to be shown

3)



Current Simulation at 12V

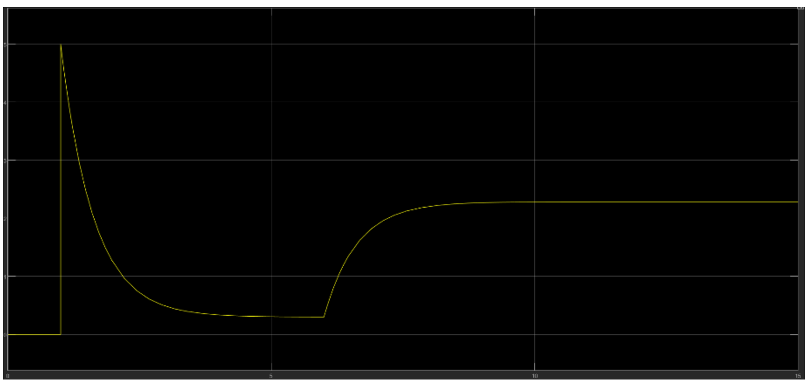


Motor Speed at 12V

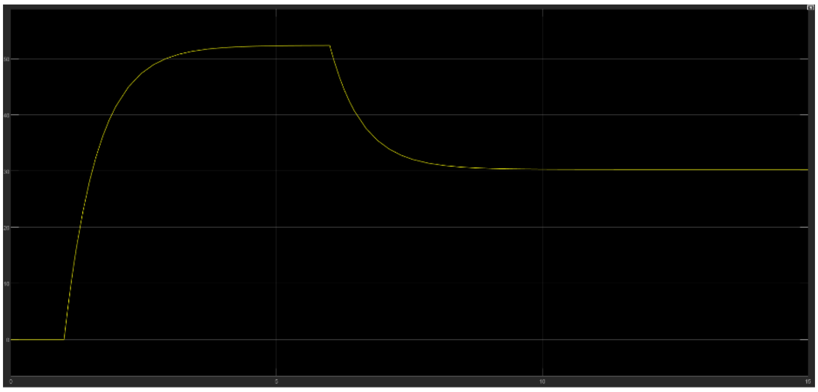
4) No need to be shown

5) The motor is stationary at time t=1 (0 rad/sec). Due to this reason, it also draws the maximum current. So, we a spike at time t=1 which can be seen in the current simulation. And when the motor starts rotating with no load, the system converges to no-load current, i.e., 0.3 A in Current Simulation and the motor speed reached maximum.

6)



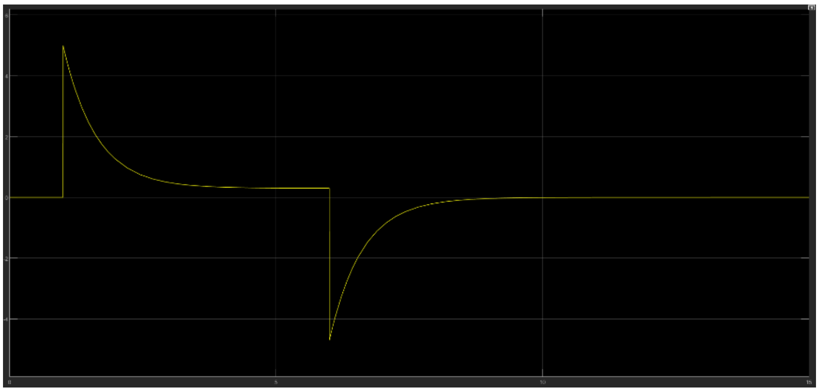
Current Simulation with load at t=6



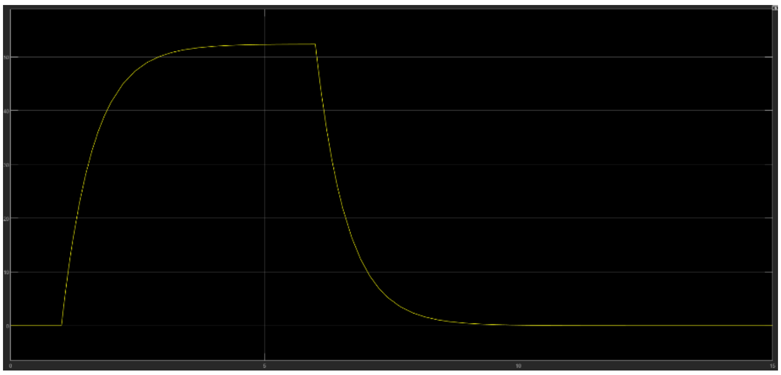
Motor Speed with load at t=6

The system draws out more current with the application of load in time t=6.From the graph we can also see that the speed decreases after the application of load at t=6 well.

7)



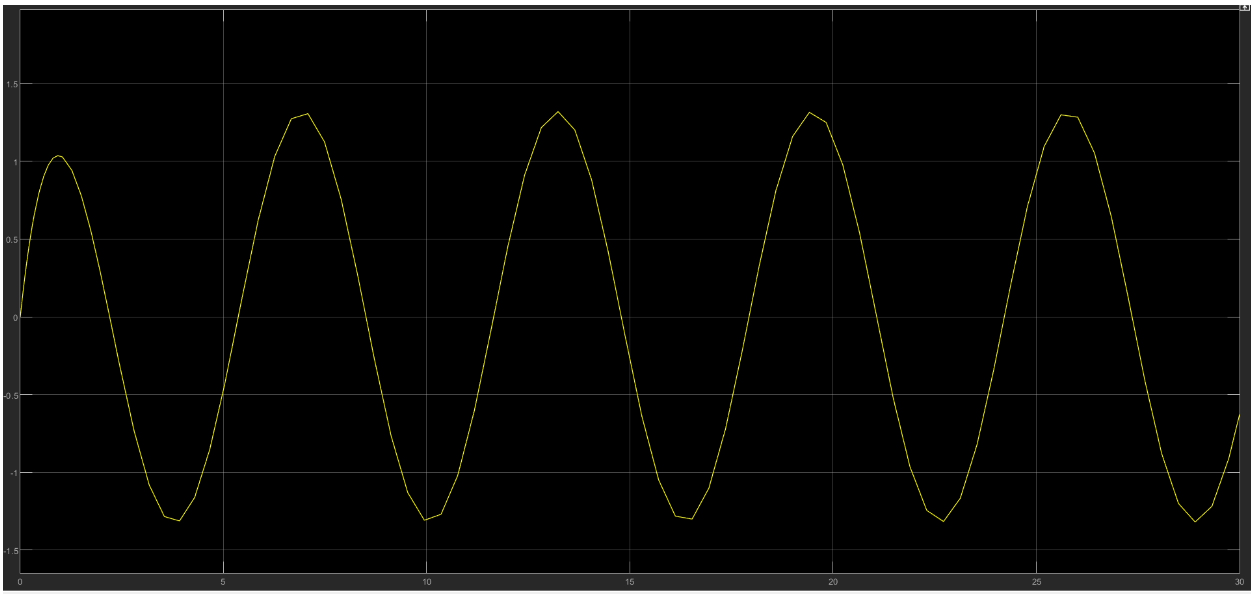
Current Simulation $V = 12V$ at $t = 1sec$ and $V = 0V$ at $t = 6sec$



Motor Speed with $V = 12V$ at $t = 1sec$ and $V = 0V$ at $t = 6sec$

When the voltage drops at t=6 a back EMF is produced due to the law of Electromagnetic induction therefore we observe a negative spike of current in the Current graph above

Task 1.11

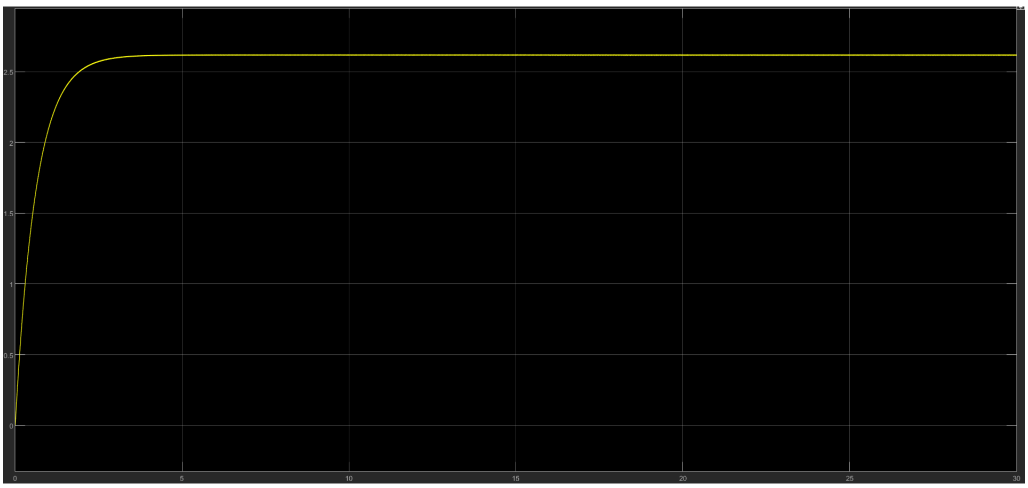


Current Simulation with Sin Generator as Input

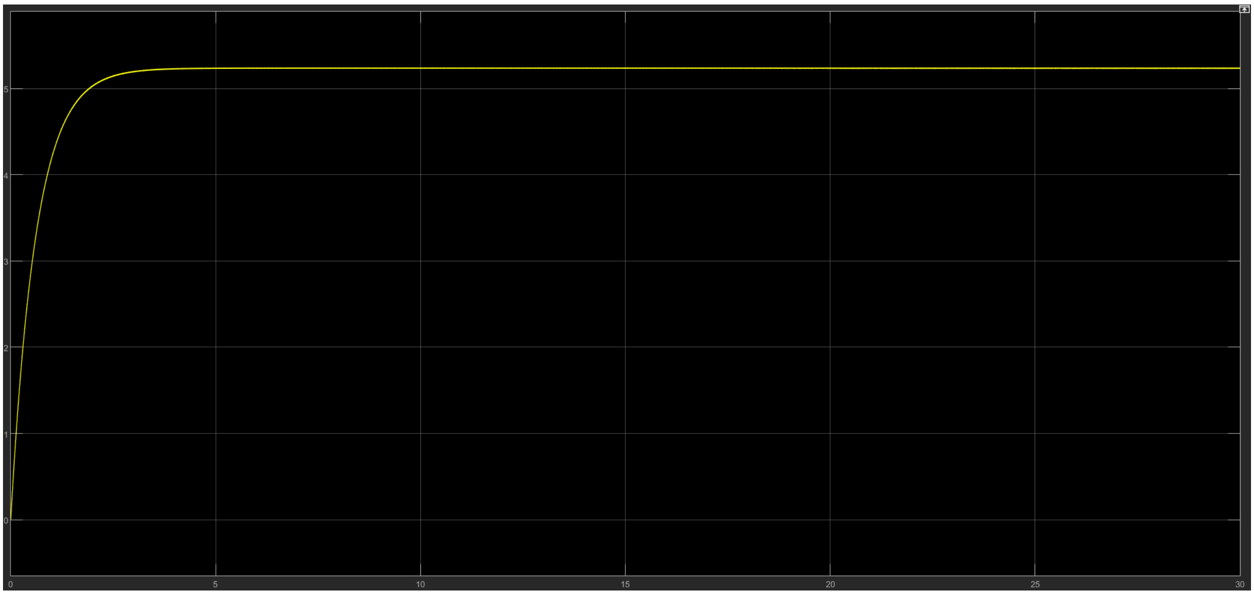
From graph amplitude=1.295

$$h(\omega = 1) = \frac{I}{V_a} = \frac{1.295}{6} = 0.215$$

Task 1.12



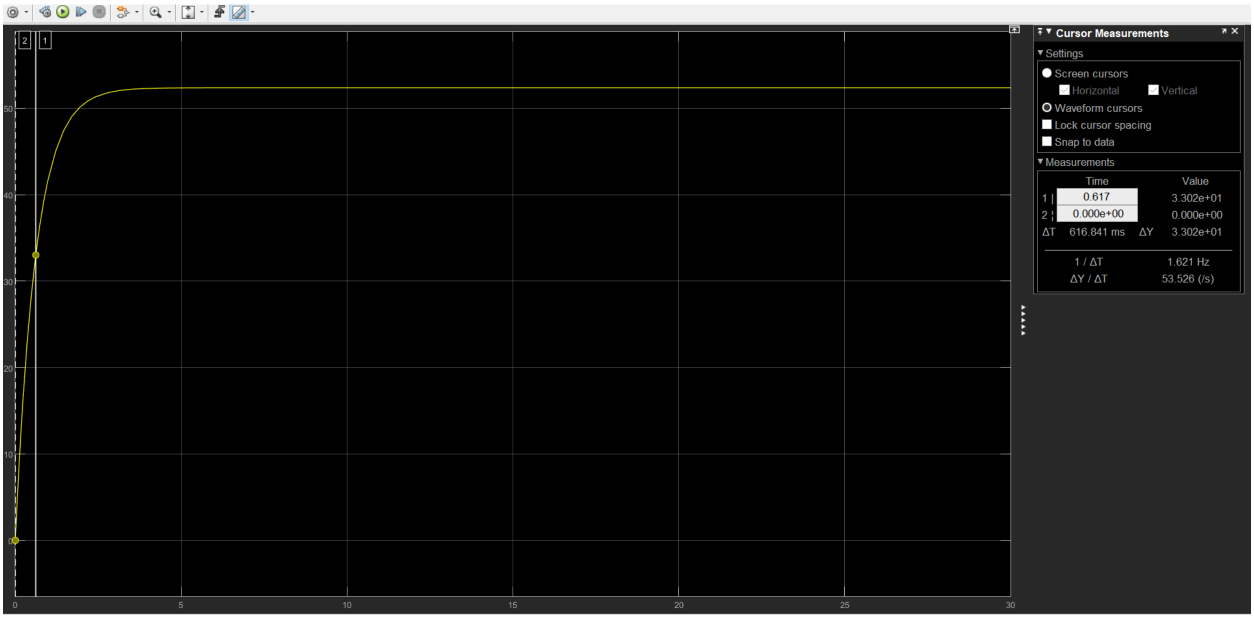
Motor Speed With 5% Pulse Width



Motor Speed With 10% Pulse Width

We can see that when we use 10% pulse width produces a stable motor speed that is double than that produced by the 5% pulse width.

Task 1.13



Motor Speed with V=12 and no load

From the figure Tc=0.617

$$J = \frac{T_c(R_a b + k_t k_e)}{R_a} = 6.98 \cdot 10^{-3}$$

This value is close to what we used, $7 \cdot 10^{-3}$.

Task 1.14

$$I(s) = \frac{1}{L_a s + R_a} V_a(s) - \frac{k_e}{L_a s + R_a} \cdot \frac{k_t}{Js + b} I(s)$$

$$\frac{V_a(s)}{L_a(s) + R_a} = I(s) + \frac{k_e \cdot k_t}{(L_a s + R_a)(Js + b)} \cdot I(s)$$

$$\frac{V_a(s)}{L_a(s) + R_a} = I(s) \left(1 + \frac{k_e \cdot k_t}{(L_a s + R_a)(Js + b)}\right)$$

$$\frac{\overset{I}{\cancel{V_a}}(s)}{V_a\,\cancel{I}(s)} = \left(\frac{\cancel{(L_a s + R_a)}(Js + b)}{(L_a s + R_a)(Js + b) + k_e \cdot k_t}\right) \cdot \frac{1}{\cancel{(L_a (s) + R_a)}}$$

$$\therefore\ H_I(s) = \frac{\cancel{Js+b}\quad Js + b}{(L_a s + R_a)(Js + b) + k_e \cdot k_t} \quad //.$$

Task 1.15

$$H_I(s) = \frac{7 \cdot 10^{-3} j + 6.79 \cdot 10^{-4}}{(10^{-4} j + 2.4)(7 \cdot 10^{-3} j + 6.79 \cdot 10^{-4}) + 0.2154 \cdot 0.1185}$$

$$H_I(s) = 0.1334 + 0.1752i$$

$$|H_i(s)| = 0.2202$$

This value is near to 0.215 which we got in Task 1.11

Task 1.16

$$H_I(s) = \frac{Js + b}{(LaS + Ra)(Js + b) + k_e kt}$$

$$H_I(s)\left[(La\,S + Ra)(Js + b) + k_e kt\right] = Js + B$$

$$H_I(s) \cdot ke\, kt + H_I(s) La\, Js^2 + HLabs + H_{I(s)}RaJs + HRab = Js + B.$$

$$\cancel{H_{I(s)}LaJs^2} + H_I(S)\, LaJs^2 + H_I(S) + Labs = Js + b - H_I(s)ke\,kt - H_I(s)\, Ra\, Js - H_I(s) Rab$$

$$La\,(HJs^2 + H_I(s) \cdot bs) = Js + b - H_I(s)\, ke \cdot kt - H_I(s)\, RaJS - H_I(s) \cdot Rab$$

$$\therefore La = \frac{Js + b - H_I(s) Ra \cdot Js - H_I(S) \cdot ke \cdot kt - H_I(s) \cdot Rab}{H_{I(s)} Js^2 + H_I(s) \cdot bs}$$

//.