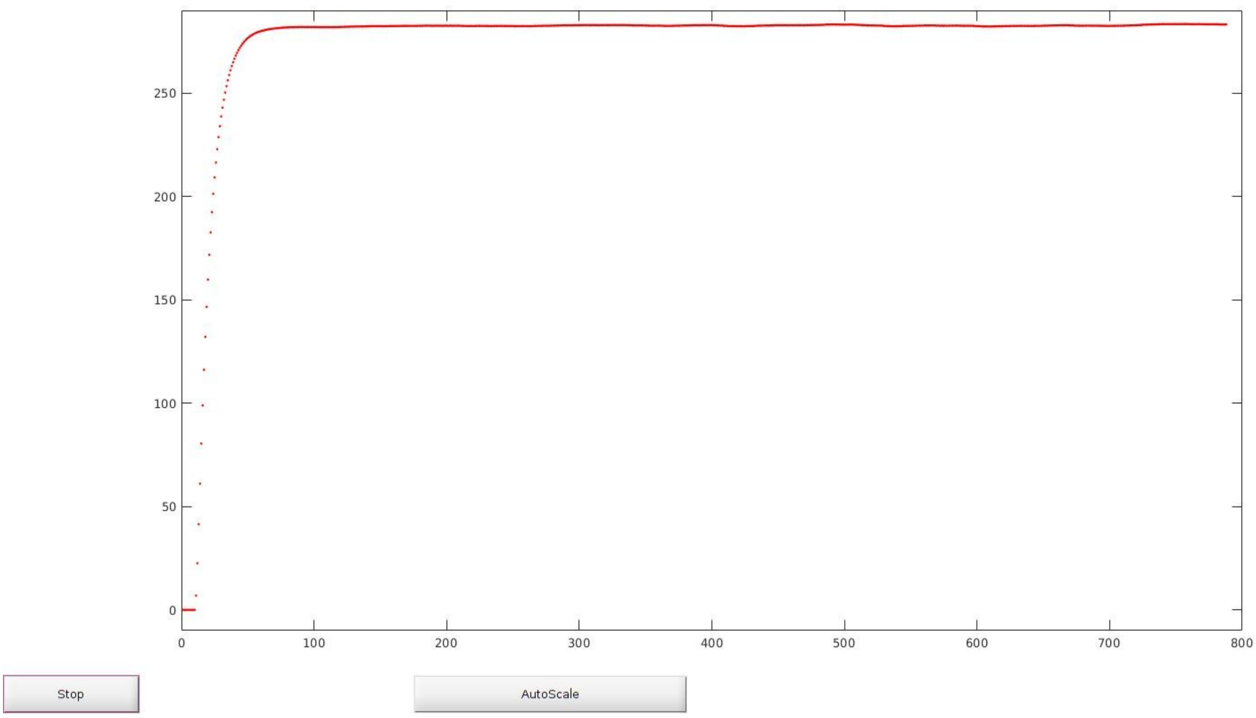
<u>Compensator for DC Motor</u>

Objectives:

1. To identify the Transfer Function of a DC Motor from the transient response.
2. Design a compensator for the same system to meet the given specifications.
3.Testing the designed compansator in real time on DC motor.

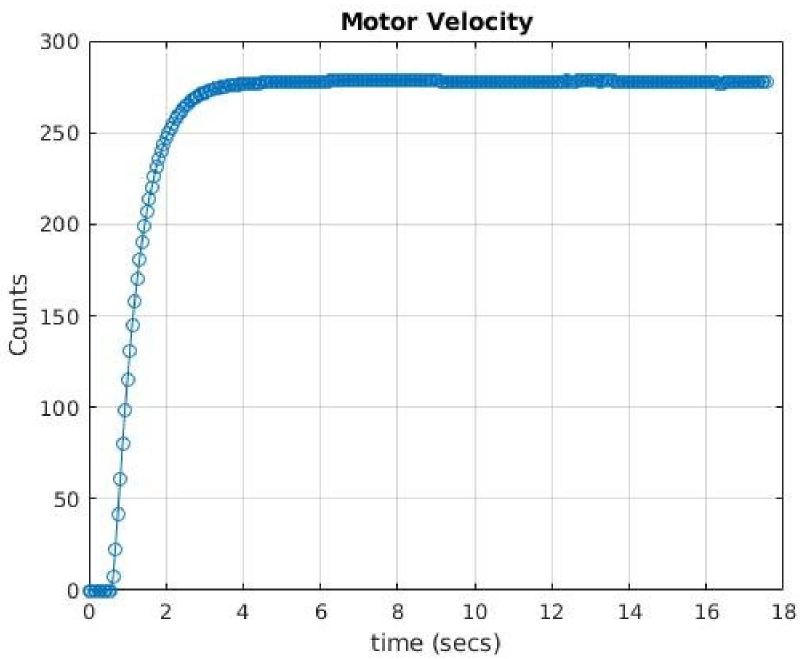
1. Obtain the step response of the given DC motor.

Step Responce (w   v/s Number_of_samples)



Step response (w v/s time)

As we know our sampling time Ts is 0.0625 s , so one sample in above graph corresponds to 0.0625s of time .



2. Deriving the transfer function ($\omega(s)/v(s)$) from the step response.

Assuming motor to be first order system , so , let $\frac{\omega(s)}{v(s)}=\frac{k}{s+a}$.

a = 1 over time_constant and k = steady_state_value

a = 0.769 and k = 213.9

so , $\frac{\omega(s)}{v(s)}=\frac{213.9}{s+0.769}$

3. Obtain the transfer function ($\theta(s)/v(s)$)

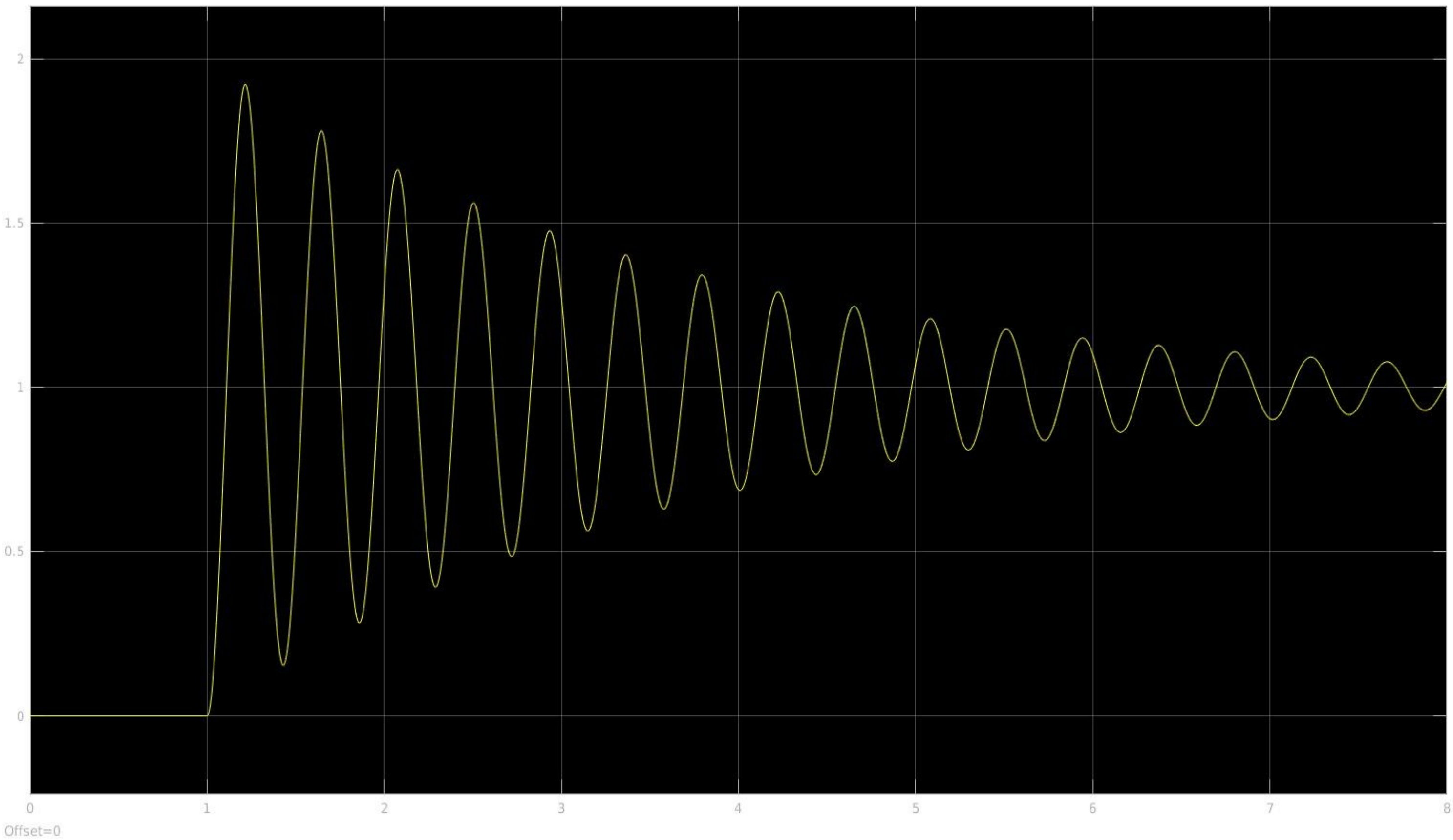
($\theta(s)/v(s)$) can be obtained from transfer function $\omega(s)/v(s)$ using by adding integrator to $\omega(s)/v(s)$.

$$\frac{\theta(s)}{v(s)}=\frac{1}{s}\frac{\omega(s)}{v(s)}$$

$$\Rightarrow \quad \frac{\theta(s)}{v(s)}=\frac{213.9}{s^2+0.769\,s}$$

Modeling feedback look of uncompansated system (defined by $\theta(s)/v(s)$) in simulik

$\theta(s)/v(s)$ for uncompensated system



From the graph the uncompansated system is having percentage overshoot greater than 80% and settling time greater than 8 sec.

As it is given in the question that we require $\zeta=0.7$ and $\omega_n=4$ rad/sec .

So , we have designed one compensater to acheive these system values.

4. Designing a suitable compensator for the DC motor for improved closed loop performance.

Requrements :

$\zeta=0.7$ and ω_n = 4 rad/sec

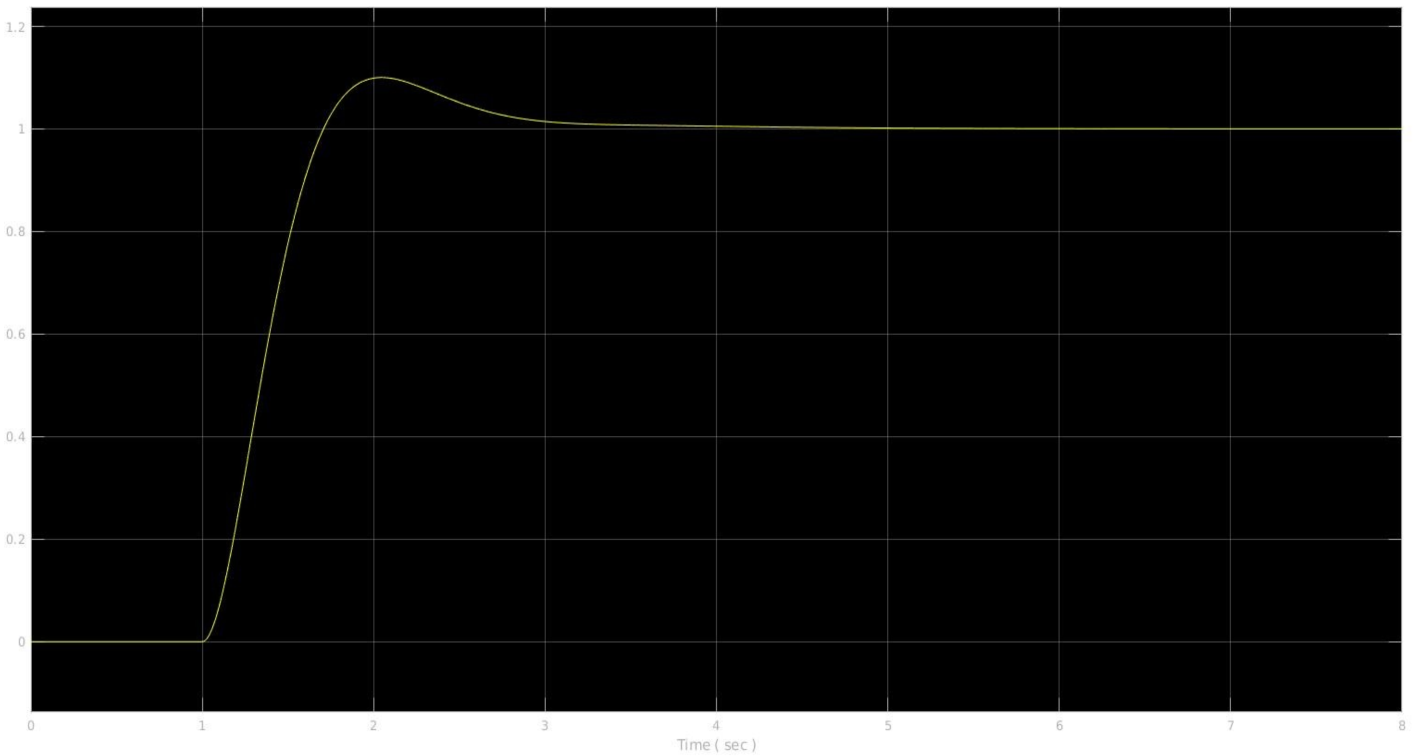
Compensator H(s):

Here we are taking lead compansator , because we have to change the transient response of our system.

Compensator satisfying above criteria and pole zero cancellation is

$$H(s) = \frac{0.08s+0.08}{s+5.7}$$

5. Obtaining the response of the compensated system and verifying the results

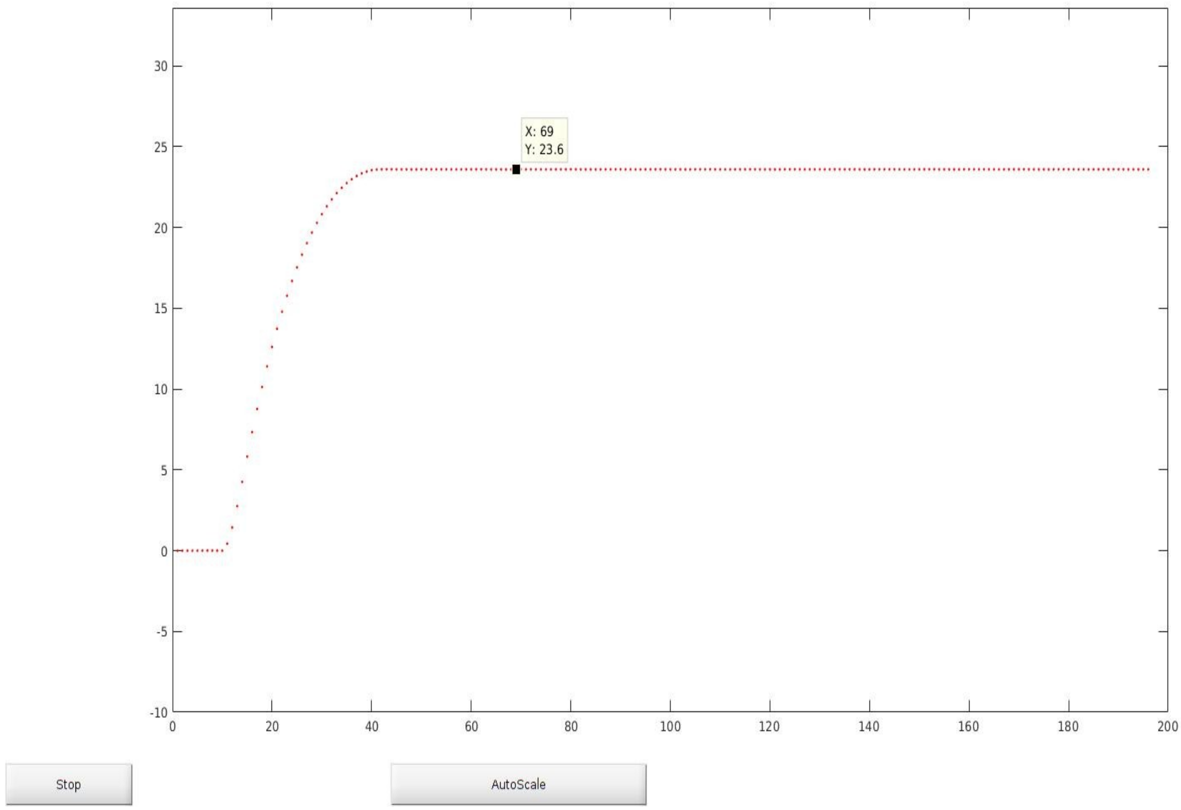


$\theta(s)/v(s)$ for compensated system

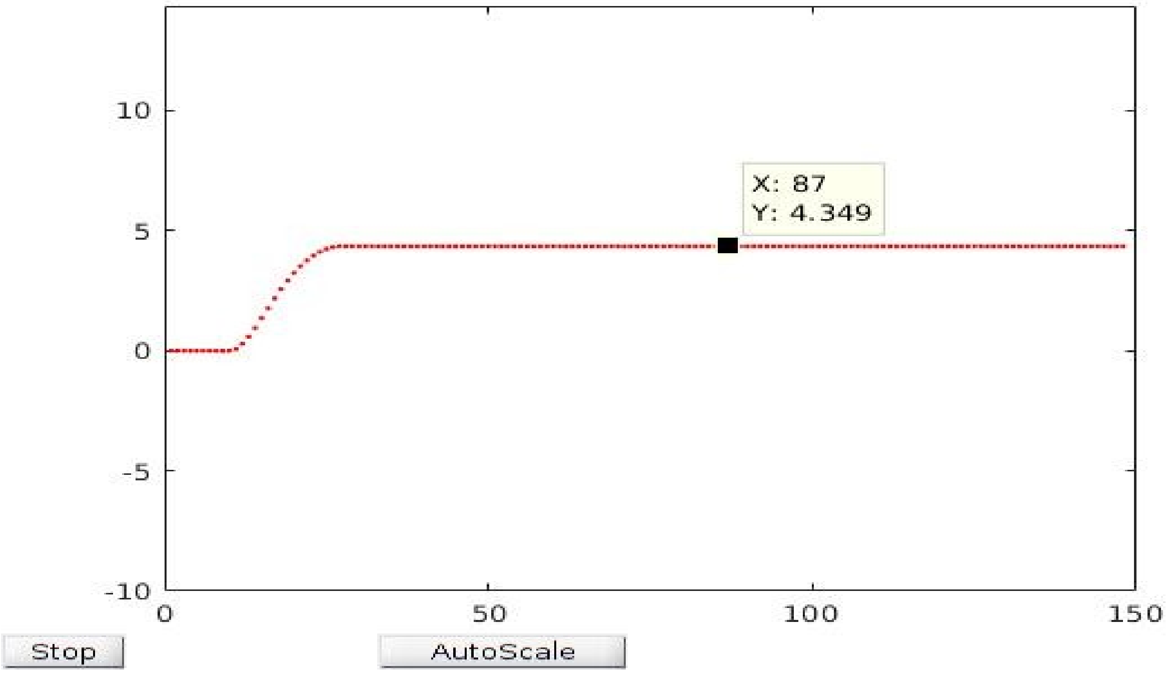
S. No	Settling Time ($\frac{4}{\zeta w_n}$)	% overshoot = $\exp\left(\frac{-\zeta \pi}{\sqrt{1-\zeta^2}}\right)$
Theoretical	1.42 sec	4.5 %
Practical	2.4 sec	8.2 %

Testing the designed compensator in real time on DC motor.

Uncompensated $\theta(s)/v(s)$ for step input of 5 volt



Compensated $\theta(s)/v(s)$ for step input of 5 volt



Initially in uncompensated system for giving step input = 5 volt , we are getting steady state value as 23.6 and for compensated system for giving the same input we are getting steady state value as 4.349.