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CH5120 ASSIGNMENT 6

Question-1

System Equation: $G(s) = \frac{5}{\tau s+1} e^{-0.15s}$

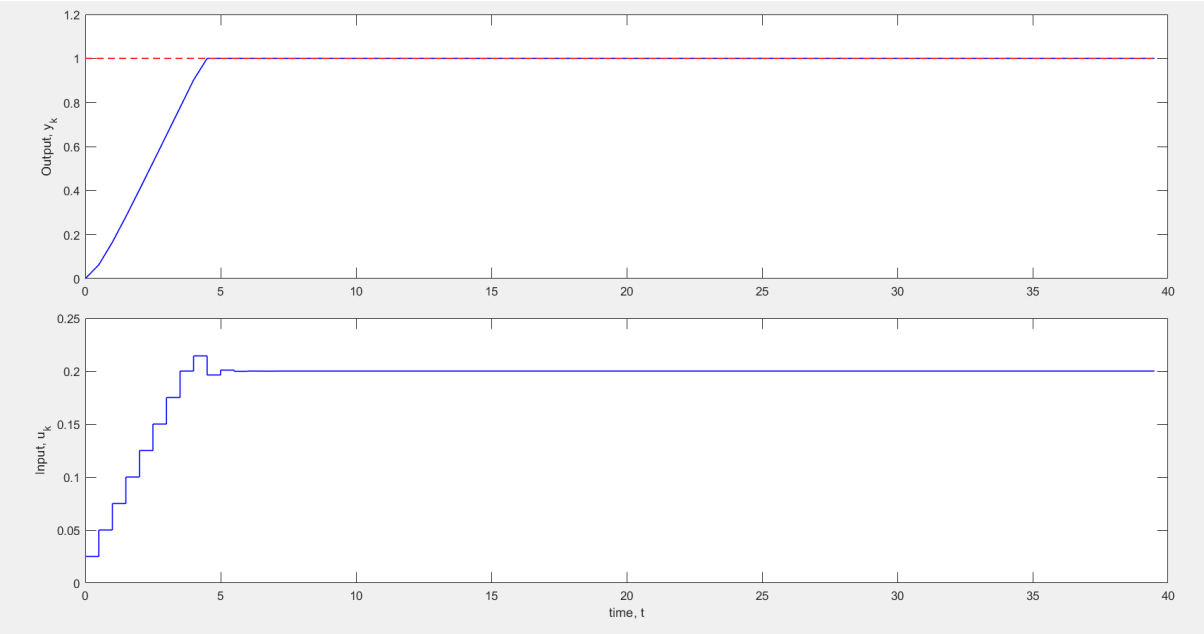
τ = 0.5

```
%% Controller Parameters
ySP=1;        % Setpoint
m=4;          % Control horizon
p=10;         % Prediction horizon
Q=1;          % Output weight
R=0.1;        % Input weight
```

Constraints: $-0.4 \leq u(k) \leq 0.4$ and $|\Delta u(k)| < 0.025$

As expected the controller is able to smoothly increase the output the set-point.

Plots of inputs and output responses



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Question-2

Disturbance Response:

$$y(s) = \frac{2.5}{20s+1}e^{-7s}u(s) + \frac{0.4}{10s+1}e^{-4s}d(s)$$

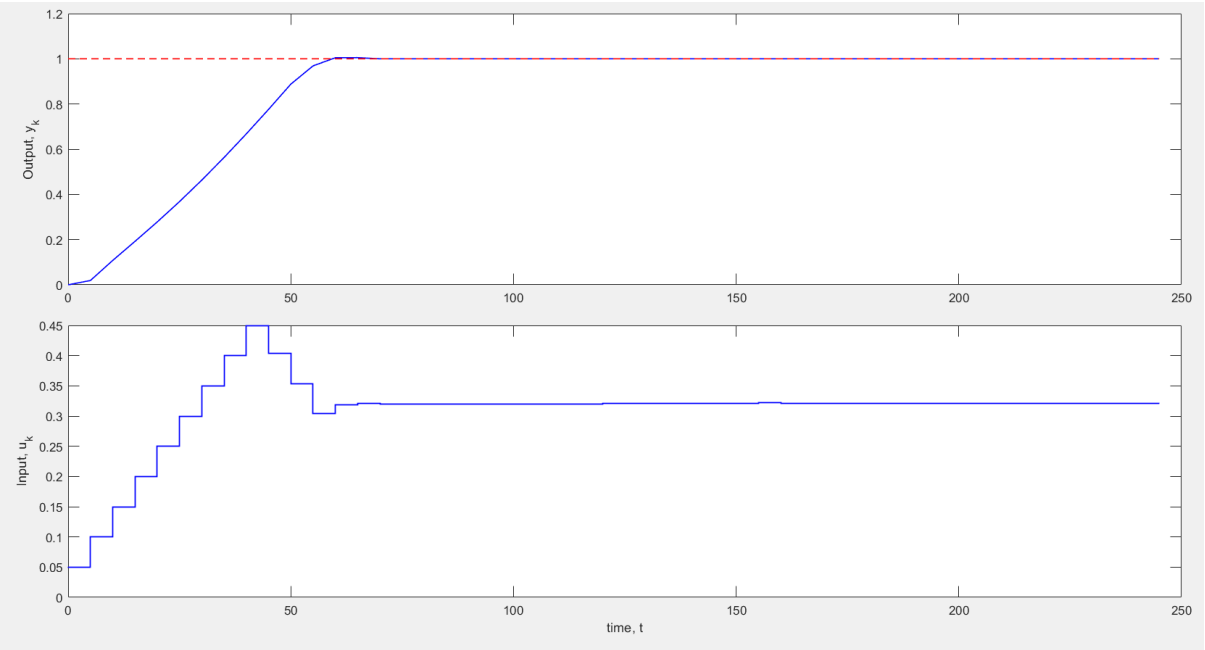
```
n=24;
% Please replace with your chosen n
h=5;              % Sampling interval: Don't change
maxTime=50;       % Run this case for 50 time-steps

%% Controller Parameters
ySP=1;        % Setpoint
m=4;          % Control horizon
p=10;         % Prediction horizon
Q=1;          % Output weight
R=0.04;       % Input weight
```

Constraints: $-0.5 \leq u(k) \leq 0.5$ and $|\Delta u(k)| < 0.05$

Single disturbance

Disturbance is simply a step change given at t=0.

Plots of inputs and output responses



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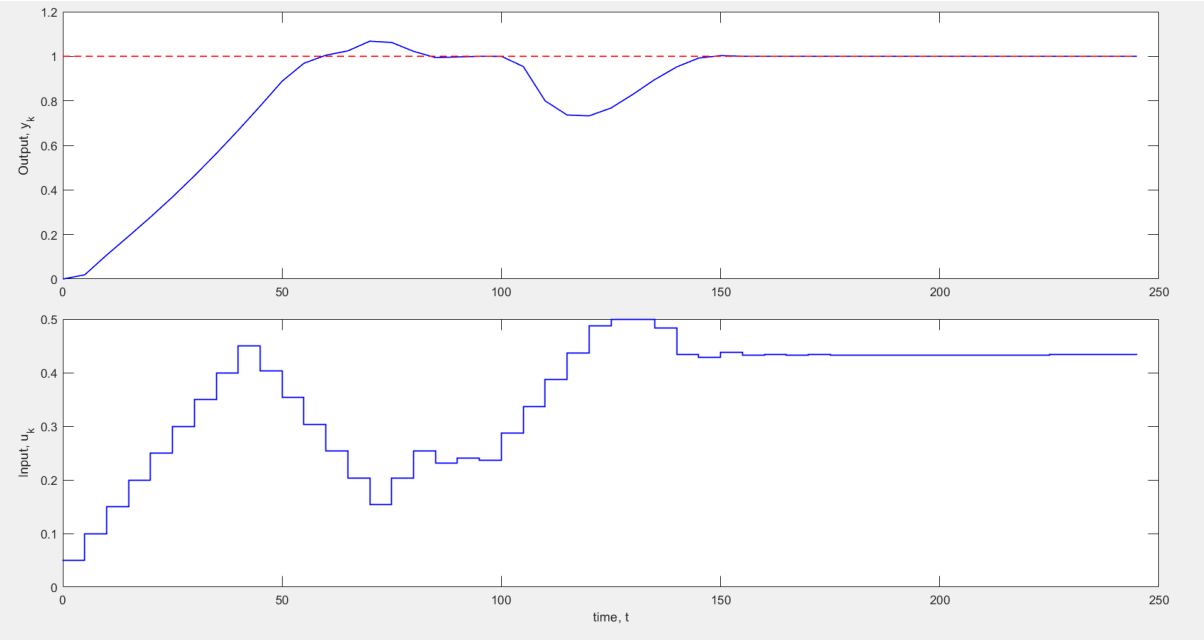
Multiple Disturbance case

A series of step changes, with *d* = 0.5, 1.0 and –0.2 made at *k* = 0, 12, 20.

As expected we can see deviations in the y values at 13*h = 13*5 = 65, and at 21*5 = 105. Basically the effect of the sudden change in disturbance is seen the time instant after it and slowly it dies down.

Plots of inputs and output responses



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Question-3

Here the tuning parameters remain the same and we remove the disturbance effects. Instead this question deals with model-plant mismatch.

Model: $y(s) = \frac{2.5}{20s+1} e^{-7s} u(s)$

Plant: $y(s) = \frac{2.75}{18.5s+1} e^{-6.2s} u(s)$

I verified that the time taken to get reasonably close to the set-point value (~0 error) is more for the case with mismatch. This extra time is needed to incorporate the effects of the mismatch (bias) in the process of optimization.

Plots of inputs and output responses