University of Nottingham

EEEE2045:

Control Coursework

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1 Aim of the Lab

2 Approach

git source Control using github full repo available report written in latex installation of matlab's control sandbox integration of matlab's scripts withing latex to produce graphs running of matlab's scripts from terminal to produce output tex files. whens matlabs script is run latex document updated with latest plots

3 Results and Discussion

3.1 Exercise 1

$$G_p(s) = \frac{a}{s+20} \tag{1}$$

$$\lim_{s \to 0} \left(G_p(s)\right) \tag{2}$$

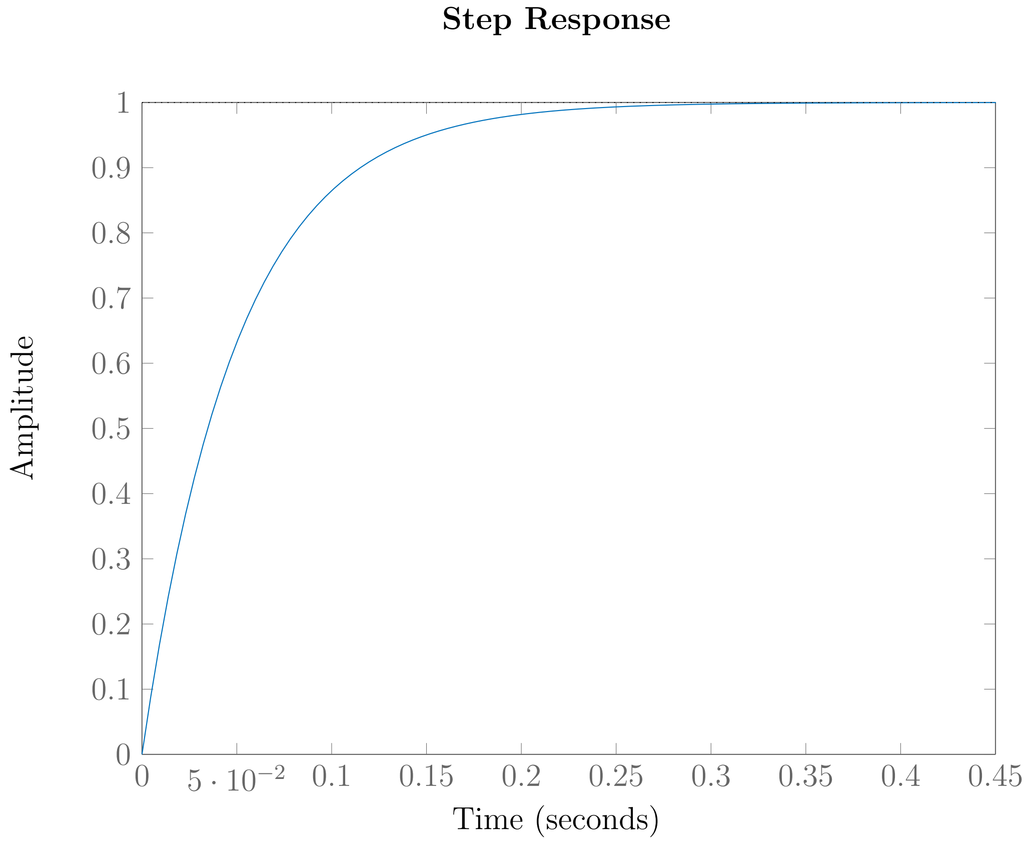

Figure 1: Graph showing step response of plant

The plant transfer function for a simple first order system is given by (1) where a is the gain of the system and s is the Laplace variable. Steady state is achieved when s approaches 0 as described by (2). Therefore the steady state gain of the system is $a/20$.

When $a = 10$ the steady state gain is $\frac{10}{20}$ which is 0.5.

Unity gain is achieved when the gain is equal to 1 at steady state. Hence the gain of the system is equal to 1 when $a = 20$. The step response of such system is shown in Figure 1.

The time constant is the time taken for the system to reach $1 - e^{-1}$ or approximately 63.2% of its final value. The time constant is equal to the reciprocal of the denominator at steady state. Hence the time constant is equal to 0.05 at all values of a.

3.2 Exercise 2

$$G_p(s) = \frac{a}{s + a} \tag{3}$$

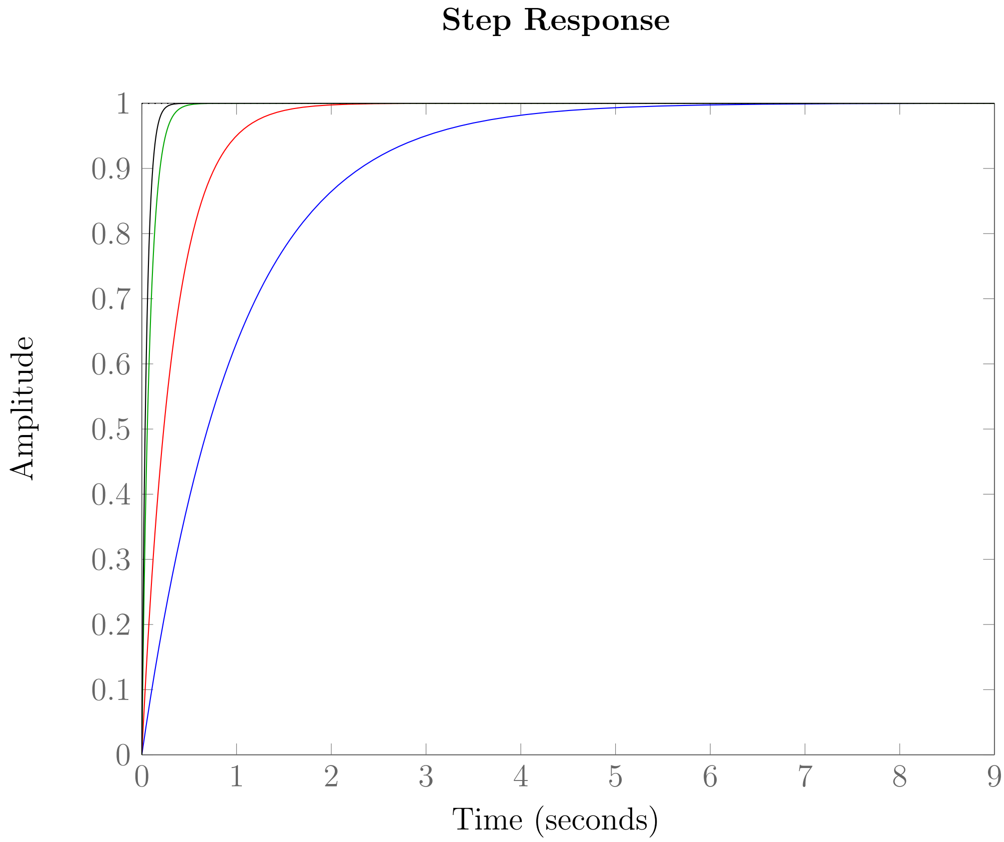

Figure 2: Graph showing step response of the transfer function shown in (3) where a = 1 (blue), 3 (red), 12 (green) and 20 (black)

a[arb]	Time Constant[s]
1	1
3	0.333
12	0.0883
20	0.05

Table 1: Table to show the time constant of the system for different values of a

Figure 2. shows the step response of the system for different values of a. The steady state gain of the system is a/a which is equal to 1 for all values of a. The time constant of the system is shown in Table 1. The time constant is equal to the reciprocal of the denominator at steady state. Hence the time constant is equal to $1/a$ at all values of a.

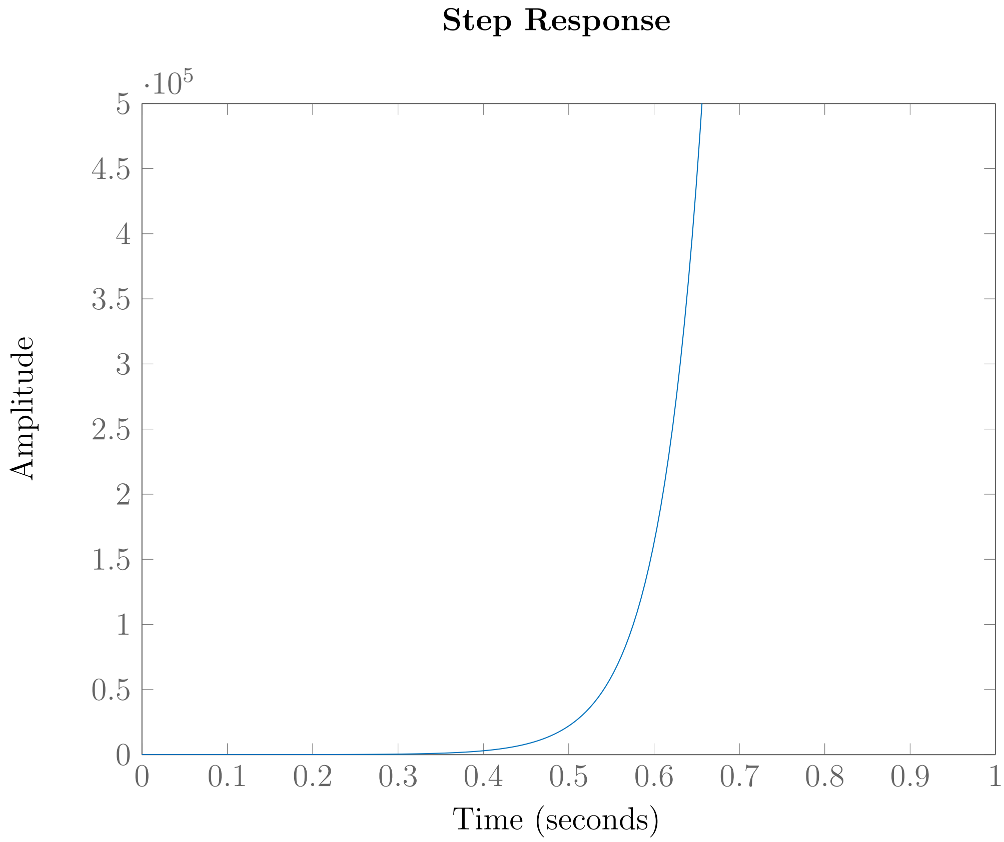

Figure 3: graph showing the step response of the transfer function shown in (4)

$$G_p(s) = \frac{a}{s - a} \tag{4}$$

Figure 3. shows the step response of the transfer function shown in (4). where the plant has a positive pole the system is unstable and will not converge to a steady state. the rate of change of the system is increasing and will continue to increase until the system is destroyed.

3.3 Exercise 3

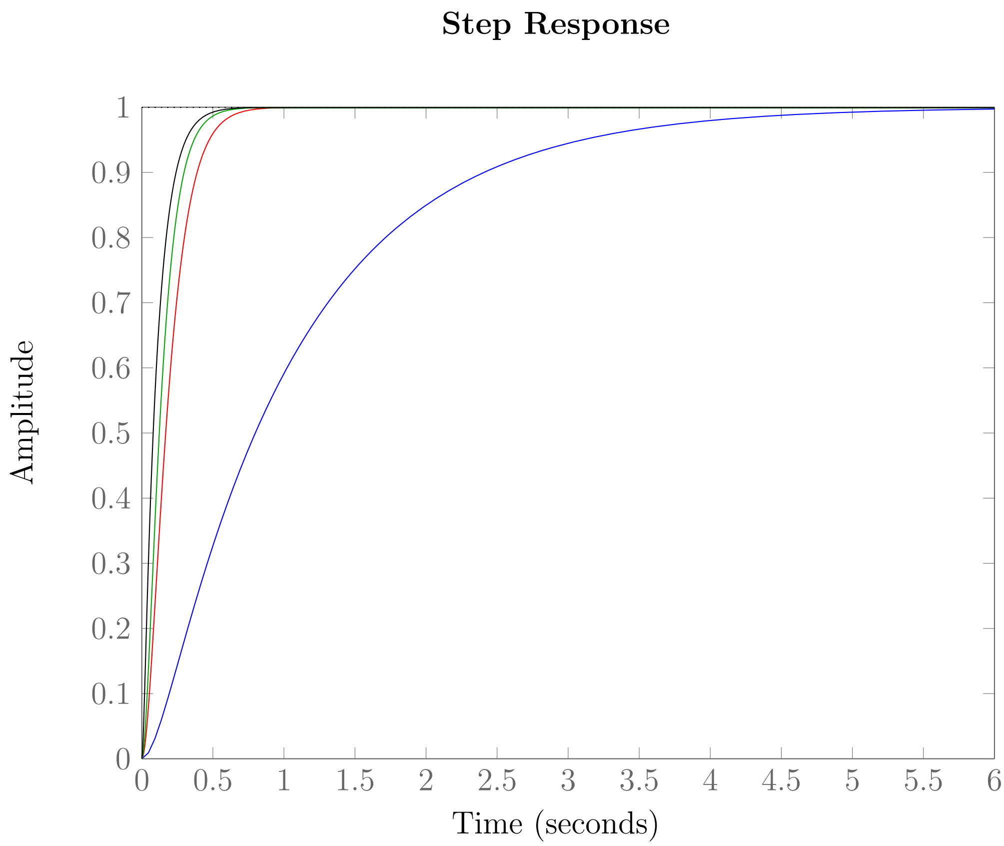

Figure 4: Graph showing step response of the transfer function shown in (3) where a = 1 (blue), 3 (red), 12 (green) and 20 (black)

3.4 Exercise 4a

3.5 Exercise 4b

3.6 Exercise 5

4 Design Questions and Solutions

5 Summary and Conclusions

References

Appendix

Code for Ex1: 3.1

```
Gp=tf([20],[1 20])
step(Gp)
cleanfigure
matlab2tikz('Output/ex1.tex');
```

Code for Ex2: 3.2

```
figure;
hold on;

Gp=tf([1],[1 1])
step(Gp,'b')

Gp=tf([3],[1 3])
step(Gp,'r')

Gp=tf([12],[1 12])
step(Gp,'g')

Gp=tf([20],[1 20])
step(Gp,'k')

cleanfigure;
matlab2tikz('Output/ex2.tex');

figure;
Gp=tf([20],[1 -20])
step(Gp)
axis([0 1 0 500000]);
cleanfigure
matlab2tikz('Output/ex2_2.tex');
```

Code for Ex3: 3.3

```
figure;
hold on;
```

```
a = 1;
Gp=tf([10],[1 10]) % this is the original plant
Temp=tf([a], [1 a]) % this is a/(s+a) for a=1
G=Gp*Temp % Multiply them both together
step(G,'b') % Plot the unity step response

a = 10;
Gp=tf([10],[1 10]) % this is the original plant
Temp=tf([a], [1 a]) % this is a/(s+a) for a=1
G=Gp*Temp % Multiply them both together
step(G,'r') % Plot the unity step response

a = 20;
Gp=tf([10],[1 10]) % this is the original plant
Temp=tf([a], [1 a]) % this is a/(s+a) for a=1
G=Gp*Temp % Multiply them both together
step(G, 'g') % Plot the unity step response

a = 100;
Gp=tf([10],[1 10]) % this is the original plant
Temp=tf([a], [1 a]) % this is a/(s+a) for a=1
G=Gp*Temp % Multiply them both together
step(G,'k') % Plot the unity step response

cleanfigure
matlab2tikz('Output/ex3.tex');
```