By :

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Matlab Assignment

1. Code (M File) :

MATLAB R2015a

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Editor - C:\MATLAB\bin\Ishaan_Kharbanda_A3.m

A3.m | Ishaan_Kharbanda_A3.m | +

```
clear all
clc

n = input('Enter array of coefficients of numerator polynomial : ');
d = input('Enter array of coefficients of denomirator polynomial : ');

g_s = tf(n,d)
[y1,t1] = step(g_s);

s_i = stepinfo(g_s);
os_s = s_i.Overshoot;

disp(['Current overshoot : ',num2str(os_s)])

os_des = input('Enter desired overshoot percentage : ');

X = ['  Desired overshoot : ',num2str(os_des)];
disp(X)

for kp = 0.1:0.5:75
    kp;

    g_cl = (kp*g_s) / ( 1 + (kp*g_s) );
    s_cl = stepinfo(g_cl);
    os_cl = s_cl.Overshoot;

    diff = abs(os_cl - os_des);
    '-----------------------------------';
    X = ['For Kp = ',num2str(kp),' difference in OverShoot will be ',num2str(diff),'%'];
    disp(X)

    if diff <= 0.5
        gain = kp;

        Y = ['Required gain to achieve the deired ocershoot : ',num2str(kp)];

        g_cl

        [y2,t2] = step(g_cl);

        plot(t1,y1,'b')
        hold on
        plot(t2,y2,'m')
        legend('Initial','Desired')
        hold off
        disp(Y)
        break
    end

end
```

2. Command window :

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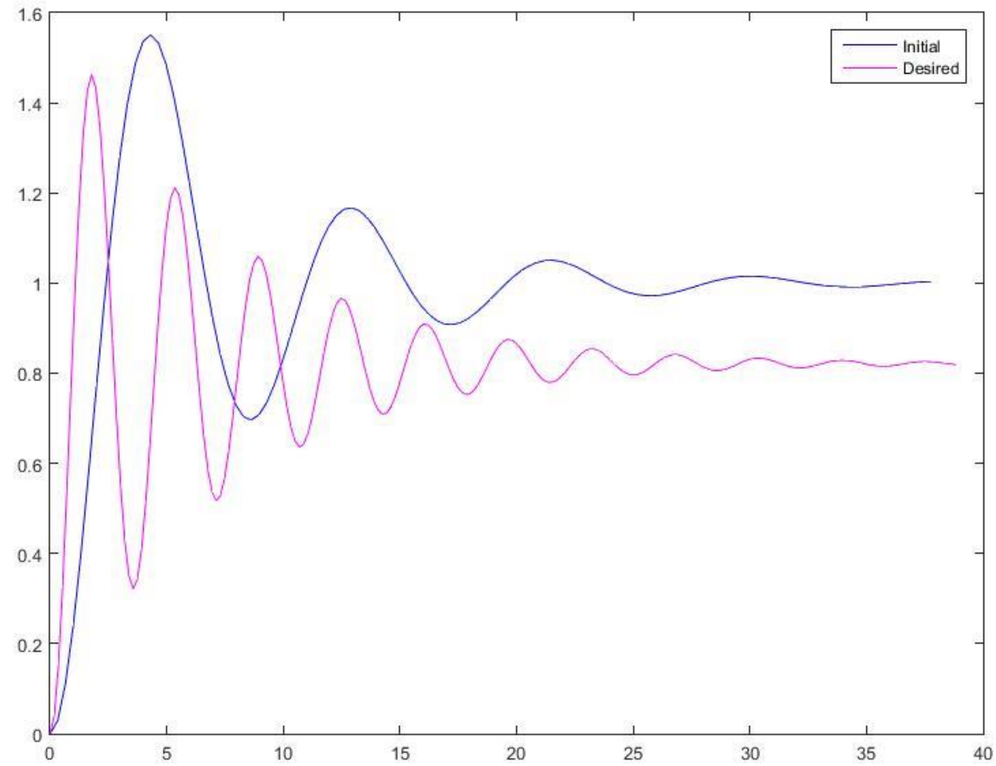
Command Window

```
Enter array of coefficients of numerator polynomial : [1]
Enter array of coefficients of denomirator polynomial : [1.8 0.5 1]

g_s =

           1
  -------------------
  1.8 s^2 + 0.5 s + 1

Continuous-time transfer function.

Current overshoot : 55.1037
Enter desired overshoot percentage : 78
  Desired overshoot : 78
For Kp = 0.1 difference in OverShoot will be 21.4801%
For Kp = 0.6 difference in OverShoot will be 15.4479%
For Kp = 1.1 difference in OverShoot will be 11.4817%
For Kp = 1.6 difference in OverShoot will be 8.6306%
For Kp = 2.1 difference in OverShoot will be 6.4319%
For Kp = 2.6 difference in OverShoot will be 4.6662%
For Kp = 3.1 difference in OverShoot will be 3.2059%
For Kp = 3.6 difference in OverShoot will be 1.9707%
For Kp = 4.1 difference in OverShoot will be 0.90755%
For Kp = 4.6 difference in OverShoot will be 0.020734%

g_cl =

             8.28 s^2 + 2.3 s + 4.6
  --------------------------------------------
  3.24 s^4 + 1.8 s^3 + 12.13 s^2 + 3.3 s + 5.6

Continuous-time transfer function.

Required gain to achieve the deired ocershoot : 4.6
>>
```

3. Graph :



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Automatic Controls Assignment 3

Installing Control module

In [1]:

```
pip install control
```

```
Collecting control
  Downloading control-0.8.3.tar.gz (249 kB)
     |████████████████████████████████| 249 kB 3.4 MB/s eta 0:00:01
Requirement already satisfied: numpy in /srv/conda/envs/notebook/lib/pytho
n3.6/site-packages (from control) (1.19.2)
Requirement already satisfied: scipy in /srv/conda/envs/notebook/lib/pytho
n3.6/site-packages (from control) (1.5.2)
Requirement already satisfied: matplotlib in /srv/conda/envs/notebook/lib/
python3.6/site-packages (from control) (3.3.2)
Requirement already satisfied: kiwisolver>=1.0.1 in /srv/conda/envs/notebo
ok/lib/python3.6/site-packages (from matplotlib->control) (1.2.0)
Requirement already satisfied: cycler>=0.10 in /srv/conda/envs/notebook/li
b/python3.6/site-packages/cycler-0.10.0-py3.6.egg (from matplotlib->contro
l) (0.10.0)
Requirement already satisfied: pillow>=6.2.0 in /srv/conda/envs/notebook/l
ib/python3.6/site-packages (from matplotlib->control) (8.0.1)
Requirement already satisfied: certifi>=2020.06.20 in /srv/conda/envs/note
book/lib/python3.6/site-packages (from matplotlib->control) (2020.6.20)
Requirement already satisfied: pyparsing!=2.0.4,!=2.1.2,!=2.1.6,>=2.0.3 in
/srv/conda/envs/notebook/lib/python3.6/site-packages (from matplotlib->con
trol) (2.4.7)
Requirement already satisfied: python-dateutil>=2.1 in /srv/conda/envs/not
ebook/lib/python3.6/site-packages (from matplotlib->control) (2.8.1)
Requirement already satisfied: six in /srv/conda/envs/notebook/lib/python
3.6/site-packages (from cycler>=0.10->matplotlib->control) (1.15.0)
Building wheels for collected packages: control
  Building wheel for control (setup.py) ... done
  Created wheel for control: filename=control-0.8.3-py2.py3-none-any.whl s
ize=260982 sha256=fa5880ba90dc902e295a6a6ce9c1c13880a93621177cae9b0daa3d6a
91489397
  Stored in directory: /home/jovyan/.cache/pip/wheels/38/cd/b8/9f67ad46525
980cf57dc48bb98876aeab3b5771c342a213d4a
Successfully built control
Installing collected packages: control
Successfully installed control-0.8.3
Note: you may need to restart the kernel to use updated packages.
```

In [2]:

```
import control as co
import matplotlib.pyplot as plt
```

Defining a function to get numerator array

In [3]:

```
def get_numerator():
    numerator = []

    while True:
        n = input("Enter the coefficients of the polynomial of the numerator : ")

        try:
            n = float(n)
            numerator.append(n)

        except:
            if n == 'done':
                break
            else:
                print("Enter a valid number ")
    return numerator
```

Defining a function to get numerator array

In [4]:

```
def get_denominator():
    denominator = []

    while True:
        d = input("Enter the coefficients of the polynomial of the denominator : ")

        try:
            d = float(d)
            denominator.append(d)

        except:
            if d == 'done':
                break
            else:
                print("Enter a valid number ")
    return denominator
```

In [12]:

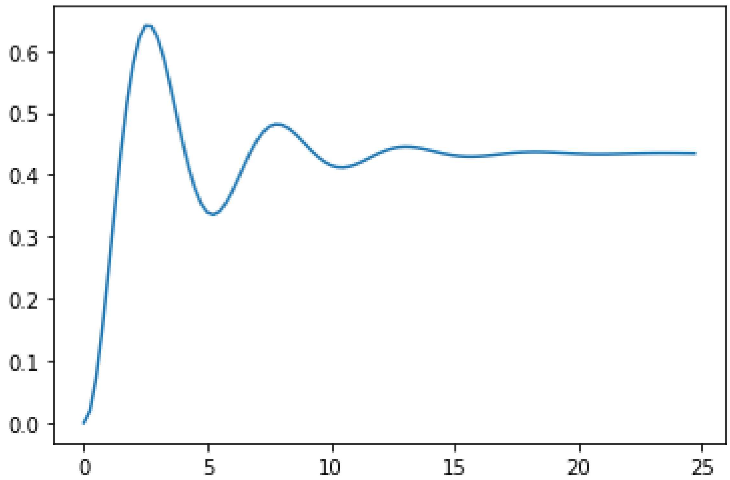
```
N = get_numerator()
D = get_denominator()
print("----------------------\nNumerator coefficients : ",N)
print("\nDenominator coefficients : ",D)
```

```
Enter the coefficients of the polynomial of the numerator : 1
Enter the coefficients of the polynomial of the numerator : done
Enter the coefficients of the polynomial of the denominator : 1.5
Enter the coefficients of the polynomial of the denominator : 0.85
Enter the coefficients of the polynomial of the denominator : 2.3
Enter the coefficients of the polynomial of the denominator : done
----------------------
Numerator coefficients :  [1.0]

Denominator coefficients :  [1.5, 0.85, 2.3]
```

In [13]:

```
G_s = co.tf(N,D)
print('----------------------\n The system is : ',G_s)

(t,y) = co.step_response(G_s)
plt.plot(t,y)

OS = round(((y.max()/y[-1]-1)*100) , 4)

print("Over shoot is : ",OS,'%')
```

```
----------------------
 The system is :
          1
----------------------
1.5 s^2 + 0.85 s + 2.3

Over shoot is :  47.289 %
```

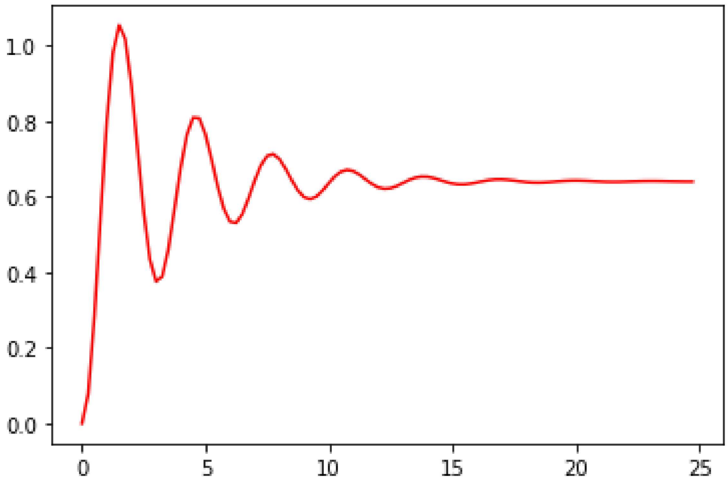


Asking the user for deired Overshoot percentage and finding the appropriate value of Kp.

In [14]:

```
import numpy as np
import math

print("When we increase Kp overshoot increases .")
print("Initial overshoot : ",OS,'%')
OS_des = float(input("Enter desierd overshoot percentage : "))


for Kp in np.arange(0.1,75.0,0.5):

    G_p = co.tf([Kp],[1])
    #print(G_p)

    G_cl = ( G_p * G_s) / ( 1 + (G_p * G_s))


    (t,y) = co.step_response(G_cl)
    OS_cl =  round(((y.max()/y[-1]-1)*100) , 4)

    #print("Overshoot for Kp = ",Kp,"is : ",OS_cl,"%")

    diff = (OS_cl - OS_des)
    print(Kp," : ")
    print("Controller : ",OS_cl,'%')
    print("Desired : ",OS_des,'%')
    print('----------------')

    if abs(diff) <= 1:
        print("Appropriate value of KP is : ",Kp)

        print("-----------\nThe system is : ",G_cl)

        (t2,y2) = co.step_response(G_cl)
        plt.plot(t2,y2,'r')

        (t,y) = co.step_response(G_s)
        #plt.plot(t,y)


        break
```

```
When we increase Kp overshoot increases .
Initial overshoot :  47.289 %
Enter desierd overshoot percentage : 65
0.1  :
Controller :  48.5183 %
Desired :  65.0 %
----------------
0.6  :
Controller :  51.7474 %
Desired :  65.0 %
----------------
1.1  :
Controller :  53.9118 %
Desired :  65.0 %
----------------
1.6  :
Controller :  57.0889 %
Desired :  65.0 %
----------------
2.1  :
Controller :  57.8024 %
Desired :  65.0 %
----------------
2.6  :
Controller :  60.8663 %
Desired :  65.0 %
----------------
3.1  :
Controller :  61.5554 %
Desired :  65.0 %
----------------
3.6  :
Controller :  62.141 %
Desired :  65.0 %
----------------
4.1  :
Controller :  64.6721 %
Desired :  65.0 %
----------------
Appropriate value of KP is :  4.1
-----------
The system is :
            6.15 s^2 + 3.485 s + 9.43
-------------------------------------------------
2.25 s^4 + 2.55 s^3 + 13.77 s^2 + 7.395 s + 14.72
```


1.0
0.8
0.6
0.4
0.2
0.0
0
5
10
15
20
25