CONTROL SYSTEM LAB REPORTS

LAB 04

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LAB 04

Task 01:

$$\frac{d^2y}{dt^2} + 12\frac{dy}{dt} + 32y(t) = 32u(t)$$

Answer: first of all we have to convert second order differential equation to the closed loop transfer function to obtain the system characteristics parameters.

$$TF = \frac{32}{s^2 + 12s + 32}$$

MATLAB CODE:

Command Window

```
>> %differential equation
% d^2 y + 12 dy +32 y=32 u(t)
% Method 1
s=tf('s');
TF=32/(s^2 +12*s+32);
num=[32];
den=[1 12 32];
wn=(sqrt(32)) % natural frequencey
Z=(12/(2*wn))  %Damping ratio
Tp=(pi/(wn*(sqrt(1-(Z^2))))) %peak time
POS=(exp(-Z*pi/(sqrt(1-Z^2))))*100 % percent overshoot
Ts=4/(Z*wn)   % settling time

% Method 2
step(TF) % graph of step response
stepinfo(TF) % calculate Tr,Ts,Ts,Tos,Tp etc
damp(TF)      %calculate Zeta, wn, pole and time constant

wn =

    5.6569


Z =
```

Command Window

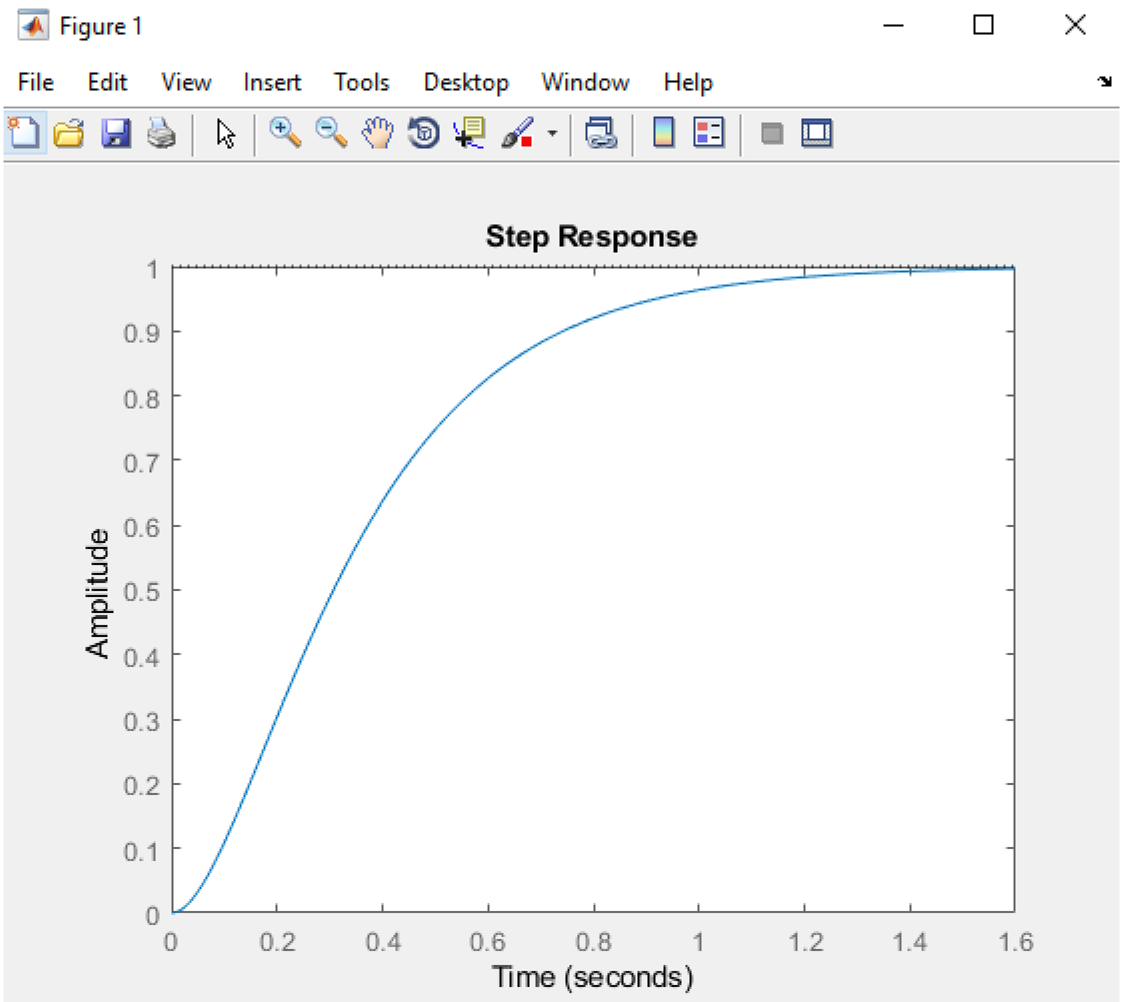
```
Z =

    1.0607


Tp =

   0.0000 - 1.5708i


POS =

  -1.0000e+02 - 6.7380e-13i


Ts =

    0.6667


ans =

  struct with fields:
```

Command Window

```
Ts =

    0.6667


ans =

  struct with fields:

        RiseTime: 0.6475
    SettlingTime: 1.1501
     SettlingMin: 0.9023
     SettlingMax: 0.9992
       Overshoot: 0
      Undershoot: 0
            Peak: 0.9992
        PeakTime: 1.9457


   Pole          Damping        Frequency       Time Constant
                              (rad/seconds)       (seconds)

 -4.00e+00      1.00e+00       4.00e+00         2.50e-01
 -8.00e+00      1.00e+00       8.00e+00         1.25e-01
>>
```

Step response of the transfer function,

$$TF = \frac{32}{s^2 + 12s + 32}$$



Task 02:

$$G(s) = \frac{25}{s^2+8s+25},$$

Answer:

First of all we have to make transfer function of closed loop system, so we will use feedback command with unity as feedback system.

MATLAB CODE:

```
% G(s)= 25/(s^2 + 8*s +25)
Gs=25/(s^2 +8*s +25)
C_Gs=feedback(Gs,[1])
% Method 1
wn=(sqrt(25)) % natural frequencey
Z=(8/(2*wn))  %Damping ratio
Tp=(pi/(wn*(sqrt(1-(Z^2))))) %peak time
POS=(exp(-Z*pi/(sqrt(1-Z^2))))*100 % percent overshoot
Ts=4/(Z*wn)   % settling time

% Method 2
step(C_Gs) % graph of step response
stepinfo(C_Gs) % calculate Tr,Ts,Ts,Tos,Tp etc
damp(C_Gs)     %calculate Zeta, wn, pole and time
constant
```

MATLAB RESULTS:

Command Window

```
wn =

     5


Z =

    0.8000


Tp =

    1.0472


POS =

    1.5165
```

Command Window

```
ans =

  struct with fields:

        RiseTime: 0.2510
    SettlingTime: 0.8301
     SettlingMin: 0.4519
     SettlingMax: 0.5579
       Overshoot: 11.5874
      Undershoot: 0
            Peak: 0.5579
        PeakTime: 0.5411


         Pole              Damping       Frequency      Time Constant
                                       (rad/seconds)      (seconds)

 -4.00e+00 + 5.83e+00i     5.66e-01       7.07e+00         2.50e-01
 -4.00e+00 - 5.83e+00i     5.66e-01       7.07e+00         2.50e-01
>>
```

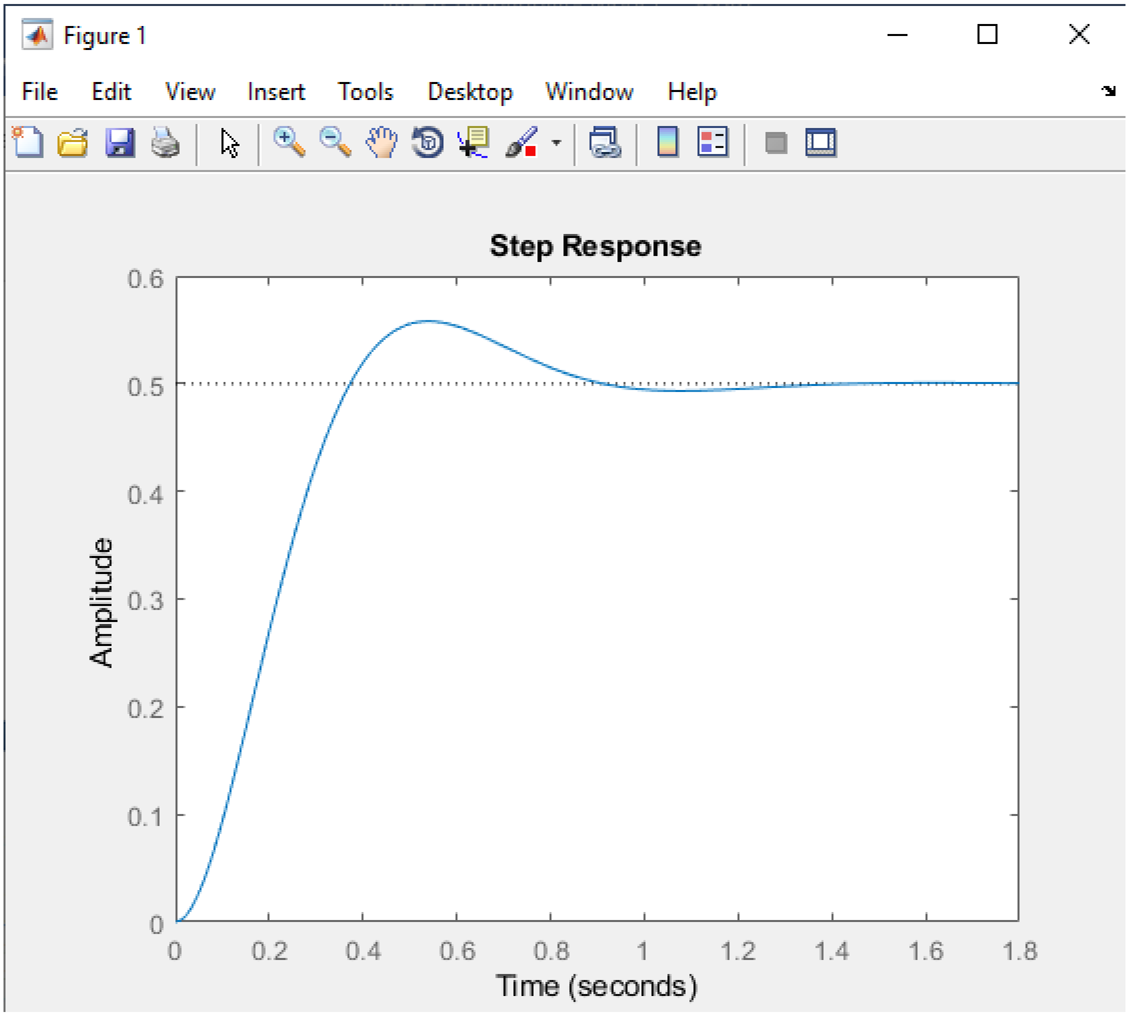


Figure 1
File Edit View Insert Tools Desktop Window Help
Step Response
Amplitude
0
0.1
0.2
0.3
0.4
0.5
0.6
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
Time (seconds)