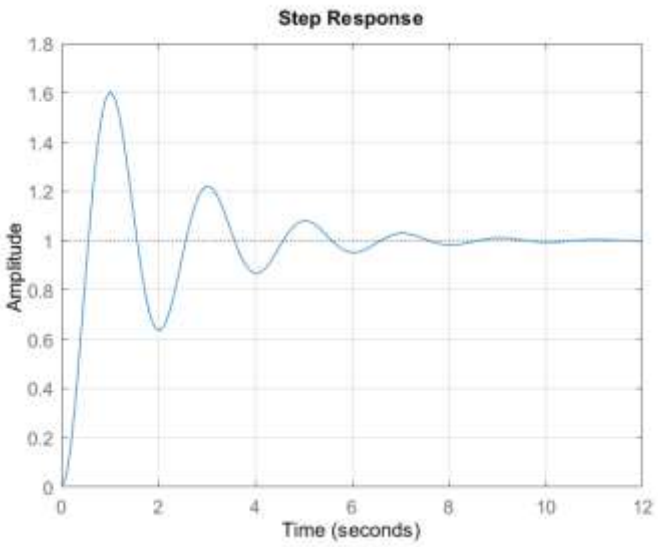
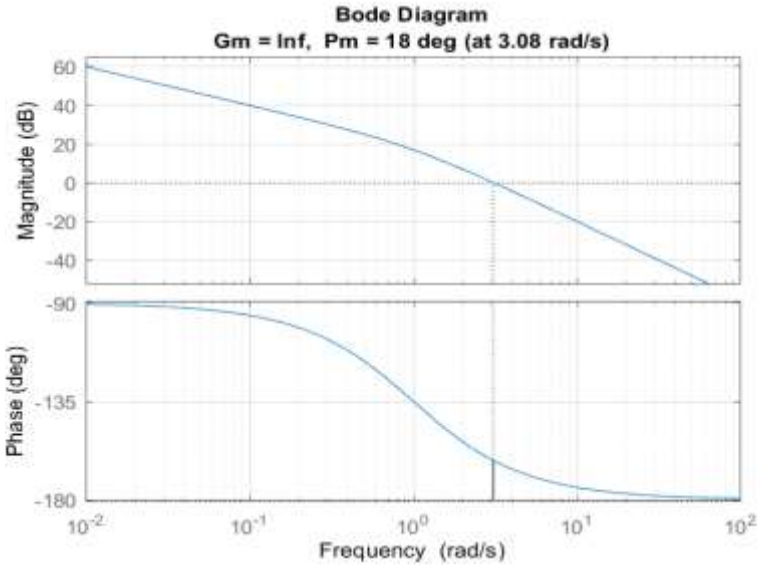
MATLAB CODE :

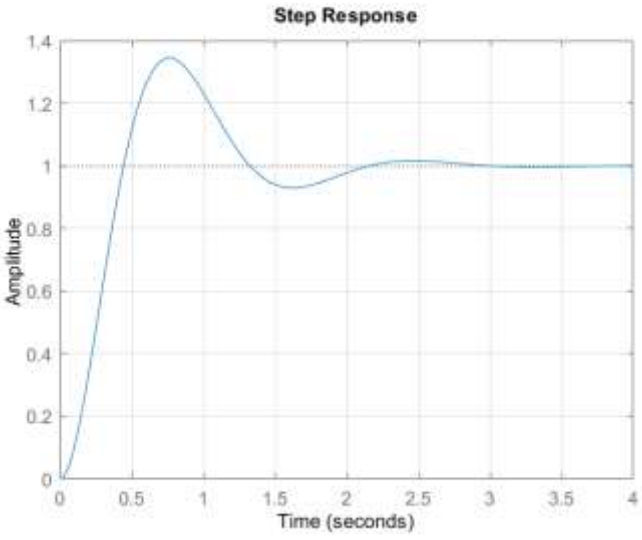
```
% Design of lead compensator
clc;
clear all;
num = [10];
den = [1 1 0];
sys = tf(num,den)
figure;
step(feedback(sys,1));
stepinfo(feedback(sys,1))
figure;
margin(sys)
title('Lead Compensator');
[mr,wr] = getPeakGain(sys,1)
num1 = [0.385 1];
den1 = [0.162 1];
comp = tf(num1,den1)
g = sys*comp
figure;
step(feedback(g,1));
figure;
margin(g)
[mr_cont,gr_cont] = getPeakGain(feedback(g,1))
```

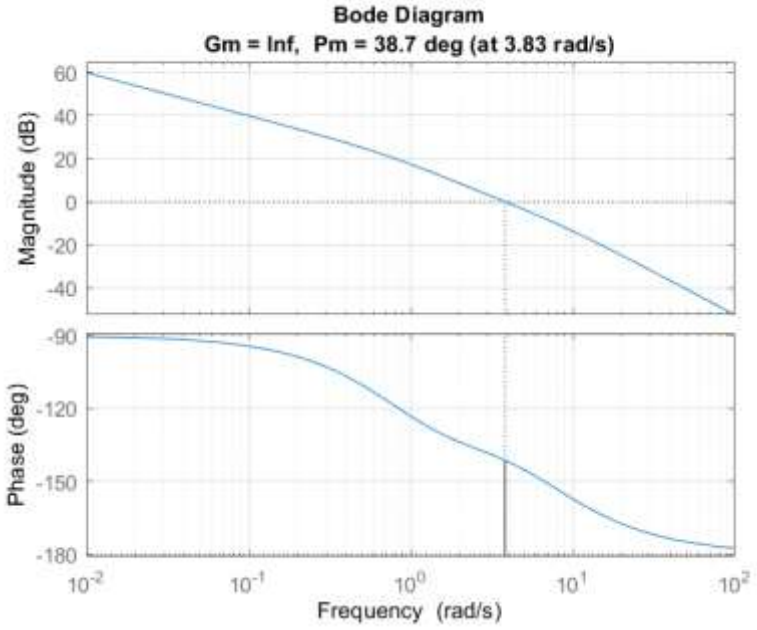
OUTPUT :

```
          10
 sys   =  -------
         s^2 + s
 Continuous-time transfer function.
Ans   =        RiseTime  :  0.3738
         TransientTime  :  7.3148
           SettlingTime  :  7.3148
            SettlingMin  :  0.6347
           SettlingMax  :  1.6045
             Overshoot  :  60.4530
           Undershoot  :  0
                 Peak  :  1.6045
             PeakTime  :  1.0131
mr   =   Inf
wr   =   0
          0.385 s + 1
comp  =   -----------
          0.162 s + 1

          3.85 s + 10
g  =   ------------------------
     0.162 s^3 + 1.162 s^2 + s
mr_cont   =   1.5418
gr_cont   =   3.460
```


Step Response
Amplitude
Time (seconds)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
0
2
4
6
8
10
12


Bode Diagram
Gm = Inf, Pm = 18 deg (at 3.08 rad/s)
Magnitude (dB)
Phase (deg)
Frequency (rad/s)
60
40
20
0
-20
-40
-90
-135
-180
10^-2
10^-1
10^0
10^1
10^2


Step Response
Amplitude
Time (seconds)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
0
0.5
1
1.5
2
2.5
3
3.5
4

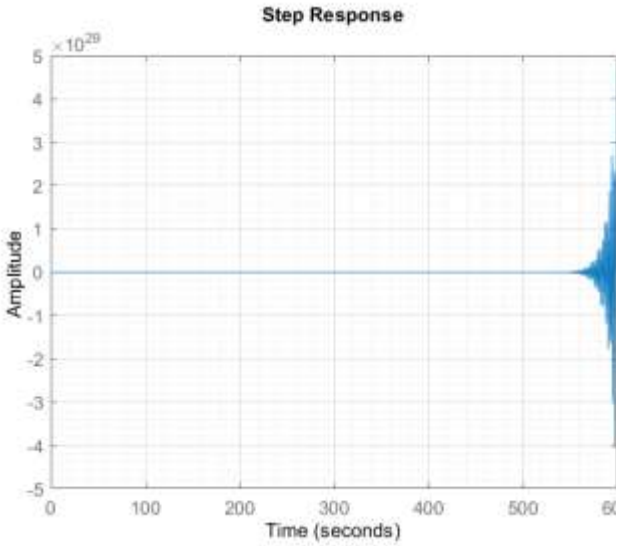

Bode Diagram
Gm = Inf, Pm = 38.7 deg (at 3.83 rad/s)
Magnitude (dB)
Phase (deg)
Frequency (rad/s)
60
40
20
0
-20
-40
-90
-120
-150
-180
10^-2
10^-1
10^0
10^1
10^2

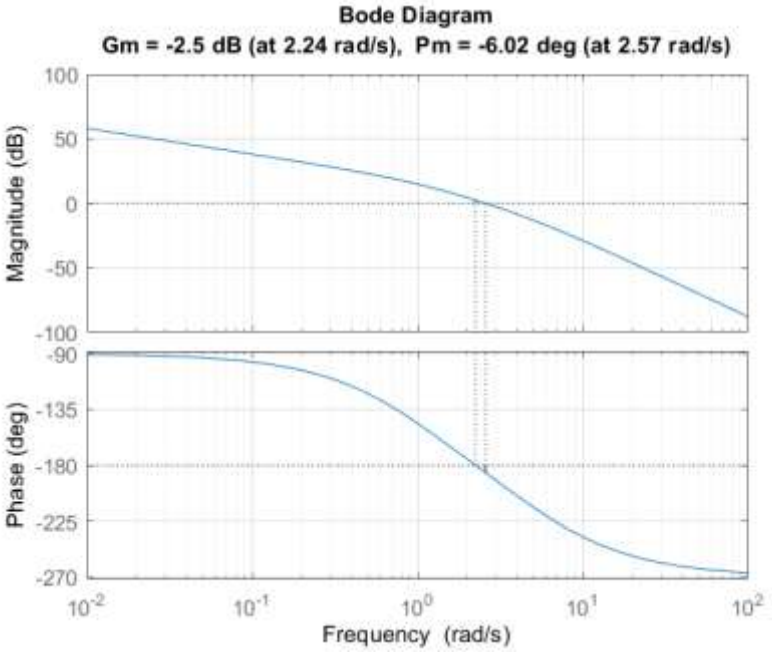
MATLAB CODE :

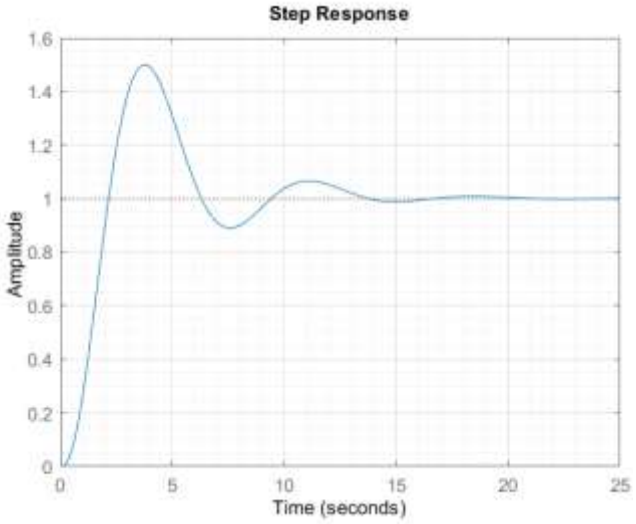
```
% Design of lag compensator
clc;
clear all;
s = tf('s');
gf = 8/((s)*(s+1)*(1+0.2*s))
figure;
step(feedback(gf,1));
stepinfo(feedback(gf,1))
figure;
margin(gf);
[mr,wr] = getPeakGain(gf,1)
gc = (1+5*s)/(1+40*s)
g = gf*gc
figure;
step(feedback(g,1));
figure;
margin(g);
[mr_cont,wr_cont] = getPeakGain(feedback(g,1))
```

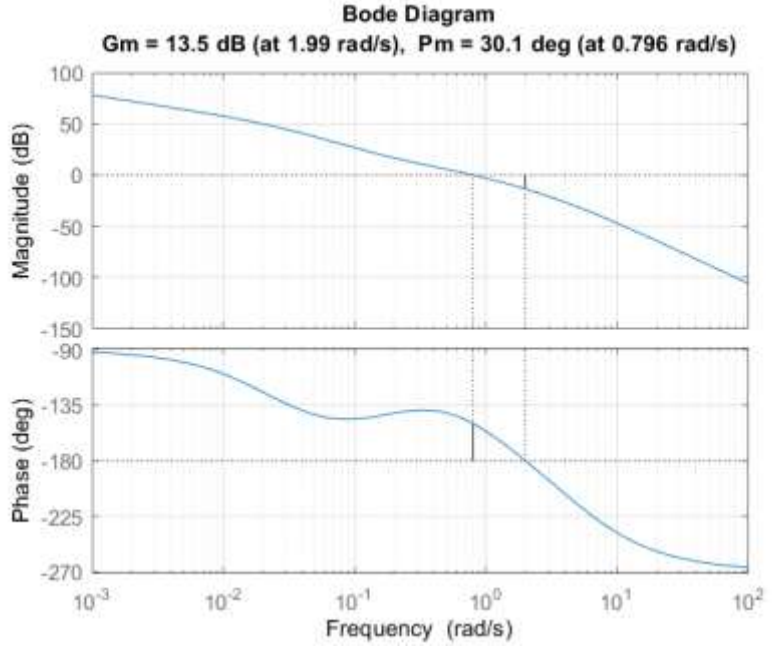
OUTPUT :

```
             8
gf  =  ---------------------
       0.2 s^3 + 1.2 s^2 + s

ans  =      RiseTime  :  NaN
       TransientTime  :  NaN
         SettlingTime  :  NaN
          SettlingMin  :  NaN
          SettlingMax  :  NaN
            Overshoot  :  NaN
           Undershoot  :  NaN
                 Peak  :  Inf
            PeakTime   :  Inf
mr  =  Inf
wr  =  0
        5 s + 1
gc  =  --------
       40 s + 1

                40 s + 8
 g  =    -------------------------------
       8 s^4 + 48.2 s^3 + 41.2 s^2 + s

mr_cont   =   1.9250
wr_cont   =   0.8062
```


Step Response
×10^29
Amplitude
Time (seconds)


Bode Diagram
Gm = -2.5 dB (at 2.24 rad/s), Pm = -6.02 deg (at 2.57 rad/s)
Magnitude (dB)
Phase (deg)
Frequency (rad/s)


Step Response
Amplitude
Time (seconds)

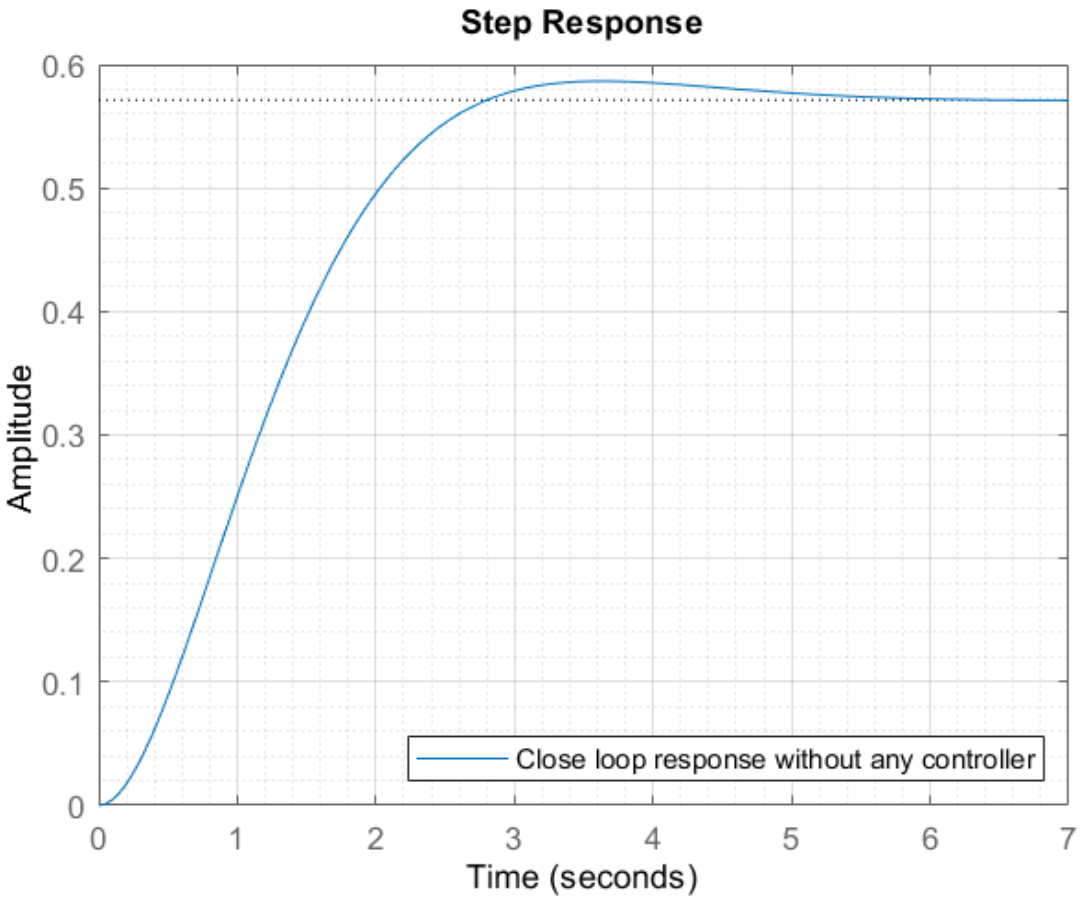

Bode Diagram
Gm = 13.5 dB (at 1.99 rad/s), Pm = 30.1 deg (at 0.796 rad/s)
Magnitude (dB)
Phase (deg)
Frequency (rad/s)

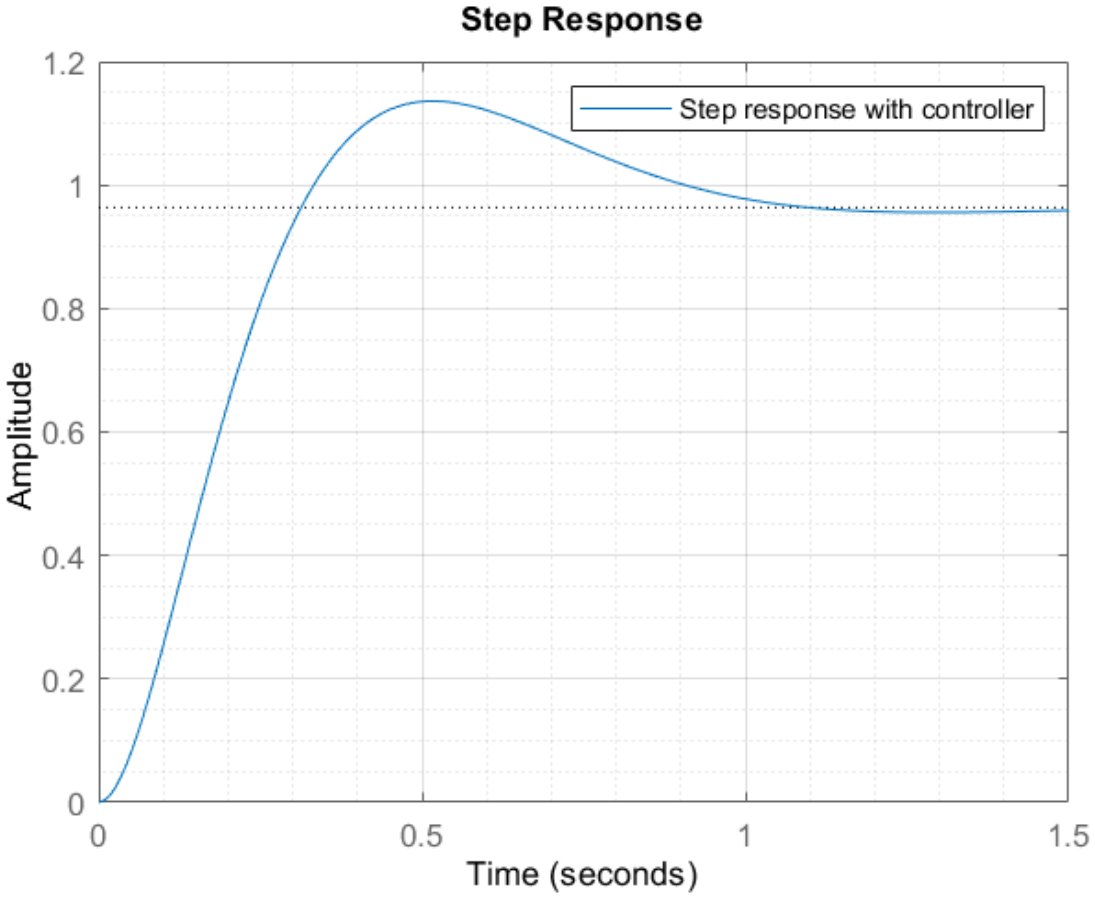
MATLAB CODE :

```
% Design of Lag-Lead compensator
clc;
clear all;
% Transfer Function
s = tf('s');
G = 1/((s+0.5)*(s+1.5));
% Close loop response without any controller
figure;
step(G/(1+G)); % step(feedback(G,1))
grid on;
legend('Close loop response without any controller');
pole(G/(1+G));
stepinfo(G/(1+G))
% Controller Design
zita = 0.7;
wn = 5.71;
poles = roots([1 2*zita*wn wn^2]);
syms s1
G1 = 1/((s1+0.5)*(s1+1.5));
phi = double(angle(subs(G1,s1,-4+4.08i)))*180/pi;
sphi = 180-phi;
z = -4;
p = -4-4.01/tand(90-sphi);
% shartandazeh
Gc1 = (s1-z)/(s1-p);
kc = 1/(double(abs(subs(Gc1*G1,-4+4.01i))))
% Simulation
Gc = (s-z)/(s-p);
Gcloseloop = kc*Gc*G/(1+kc*Gc*G);
figure;
step(Gcloseloop);
grid on;
legend('Step response with controller');
stepinfo(Gcloseloop)
```

OUTPUT :

```
ans  =      RiseTime  :  1.7452
       TransientTime  :  4.2965
        SettlingTime  :  4.2965
         SettlingMin  :  0.5188
         SettlingMax  :  0.5866
          Overshoot  :  2.6577
         Undershoot  :  0
                Peak  :  0.5866
            PeakTime  :  3.6381
kc  =  81.9305
ans  =     RiseTime  :  0.2158
      TransientTime  :  0.9729
       SettlingTime  :  0.9729
        SettlingMin  :  0.8682
        SettlingMax  :  1.1361
         Overshoot  :  17.8868
        Undershoot  :  0
               Peak  :  1.1361
           PeakTime  :  0.5165
```


Step Response
Amplitude
Time (seconds)
Close loop response without any controller
0
0.1
0.2
0.3
0.4
0.5
0.6
0
1
2
3
4
5
6
7


Step Response
Amplitude
Time (seconds)
Step response with controller
0
0.2
0.4
0.6
0.8
1
1.2
0
0.5
1
1.5