Q2(a)

Initialize transfer function

```
s = tf('s');
G = [10*(s+2)/(s^2+0.2*s+100),1/(s+5);(s+2)/(s^2+0.1*s+10),5*(s+1)/((s+2)*(s+3))]
```

```
G =

  From input 1 to output...
          10 s + 20
   1:  -----------------
       s^2 + 0.2 s + 100

            s + 2
   2:  ----------------
       s^2 + 0.1 s + 10

  From input 2 to output...
         1
   1:  -----
       s + 5

          5 s + 5
   2:  -------------
       s^2 + 5 s + 6

  Continuous-time transfer function.
```

Set the high frequency value to achieve the approximate desired loop shape

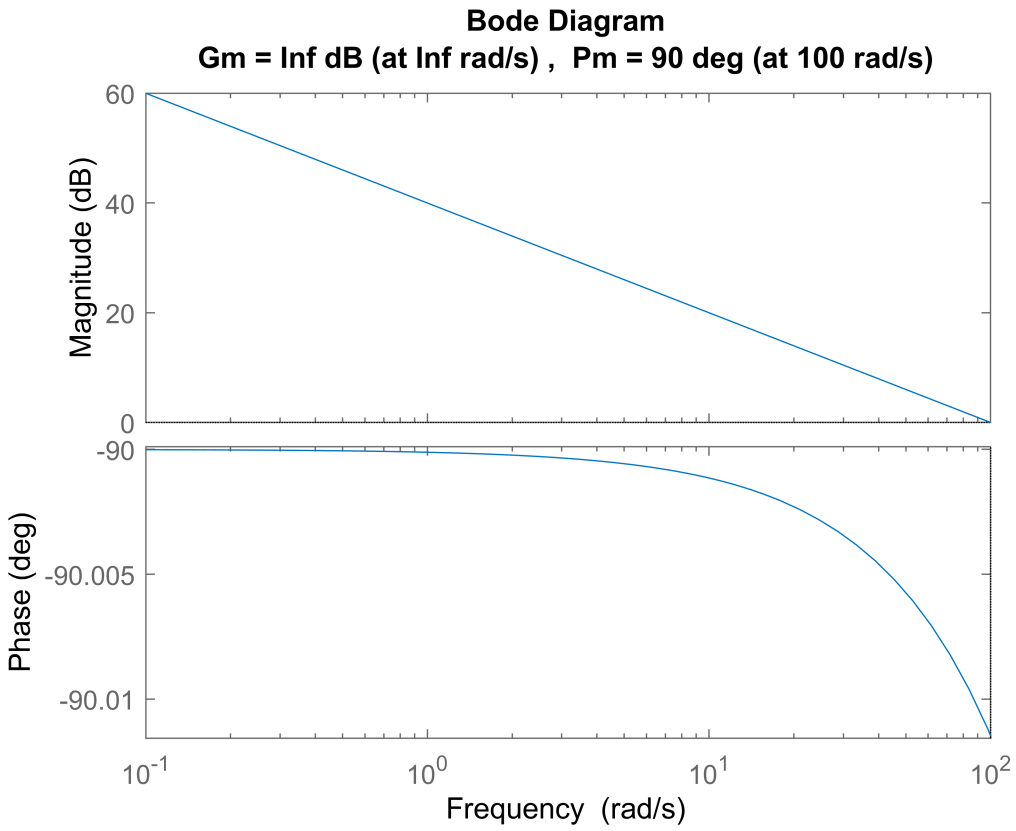
```
tau = 500000;
```

Calculating L

```
G_hat = inv(G,'min')/(1+s/tau);
L = [100/s 0;0 100/s];
K = L*G_hat;

l = G*K;
```

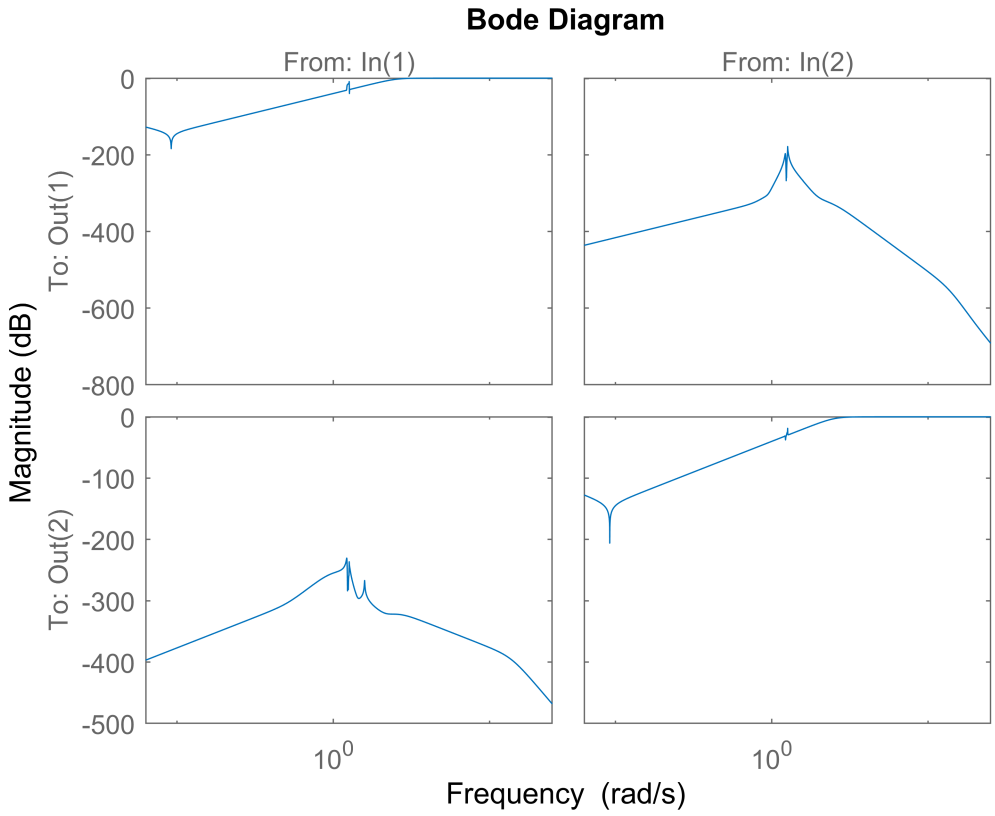
Performance plot of l(1,1)

```
L11 = l(1,1);
margin(L11)
```



Sensitivity function magnitude bode plot

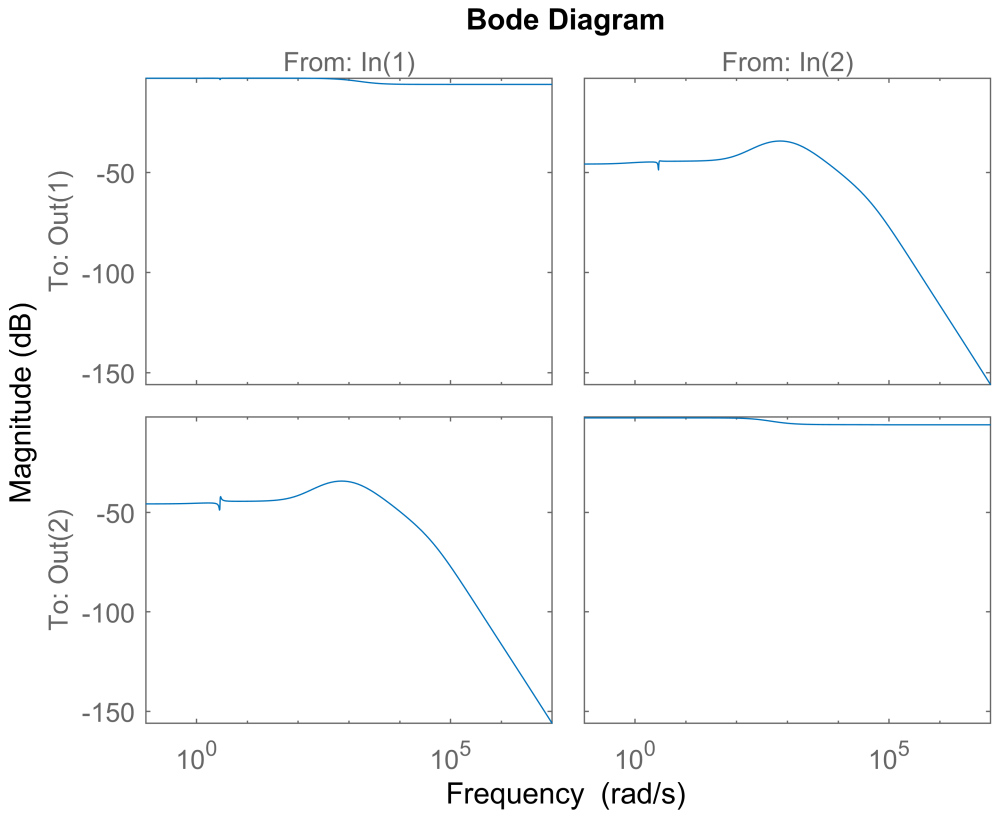
```
T = feedback(G*K,eye(2));
S = eye(2) - T;
bodemag(S)
```



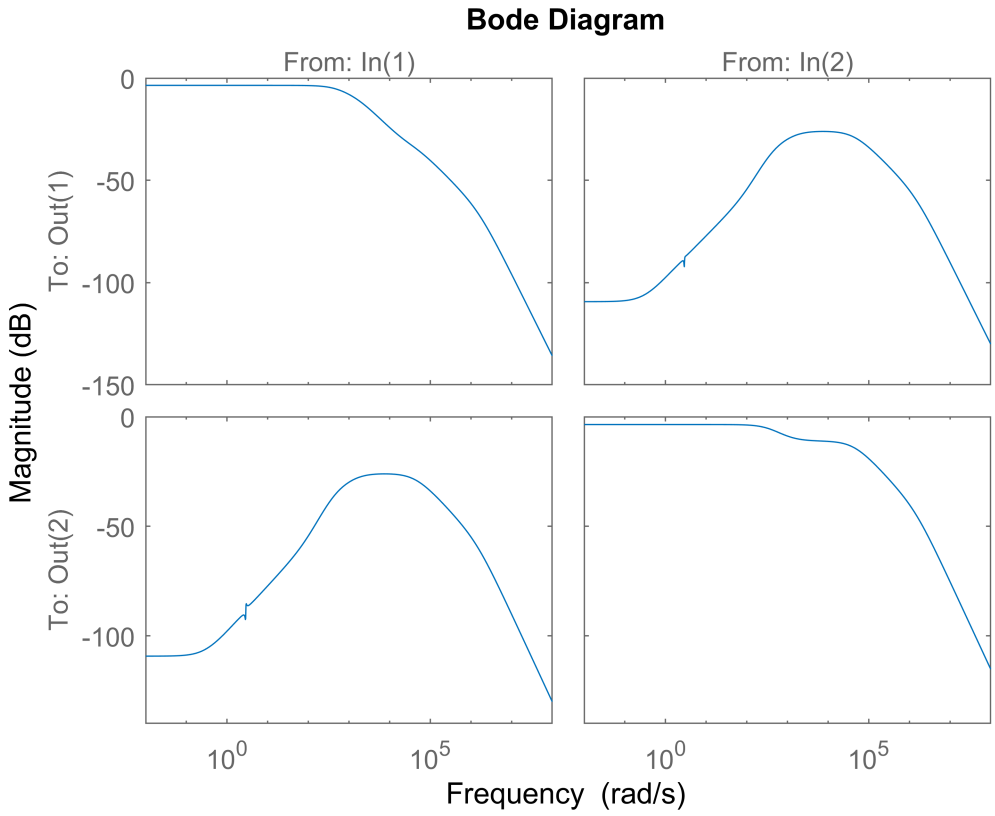
Q2(b)

Initialize parameters

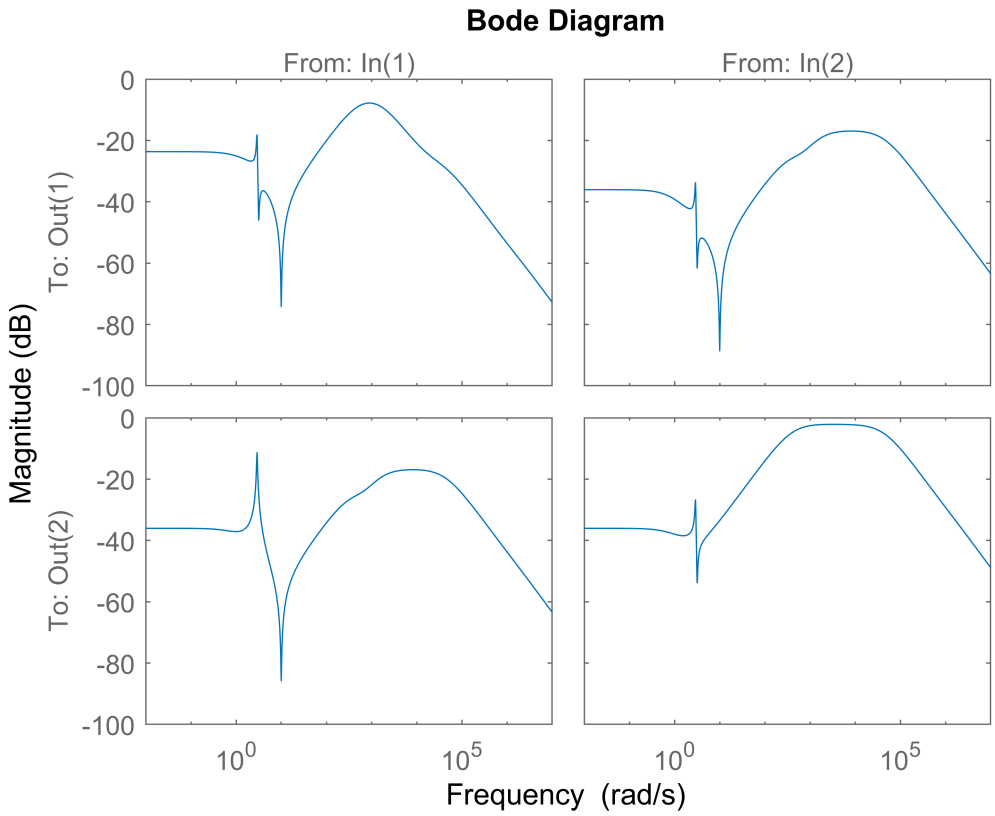
```
BW = 100;
Wu = [1/100 0;0 1/100];

% A while loop to maximize the bandwidth
while 1
    Wp = makeweight(1000,BW,1/2)*eye(2);
    Wt = makeweight(1/1.5,3*BW,1000)*eye(2);
    [K,CL,GAM,info] = mixsyn(G,Wp,Wu,Wt);
    if GAM>1
        break
    end
    BW = BW + 5;
end

% Computing the Sensitivity, Complementary Sensitivity, and the controller weight compensator
L = G*K;
T = feedback(L,eye(2));
S = eye(2) - T;

bodemag(Wp*S)
```


Bode Diagram
From: In(1)
From: In(2)
To: Out(1)
To: Out(2)
Magnitude (dB)
-50
-100
-150
10^0
10^5
Frequency (rad/s)

```
bodemag(Wt*T)
```


Bode Diagram
From: In(1)
From: In(2)
To: Out(1)
To: Out(2)
Magnitude (dB)
0
-50
-100
-150
10^0
10^5
Frequency (rad/s)

```
bodemag(Wu*K*S)
```



Q3. (b)

Defining summing junctions

```
Sum1 = sumblk('V = w-y',2);
Sum2 = sumblk('yh = w-y',2);
s = tf('s');
```

Defining the transfer function blocks' inout and output signals

```
Wu = Wu*tf(1,1);
G.u = 'u';
G.y = 'y';

Wu.u = 'u';
Wu.y = 'z2';
Wp.u = 'yh';
Wp.y = 'z1';
Wt.u = 'y';
Wt.y = 'z3';
```

Connecting the blocks

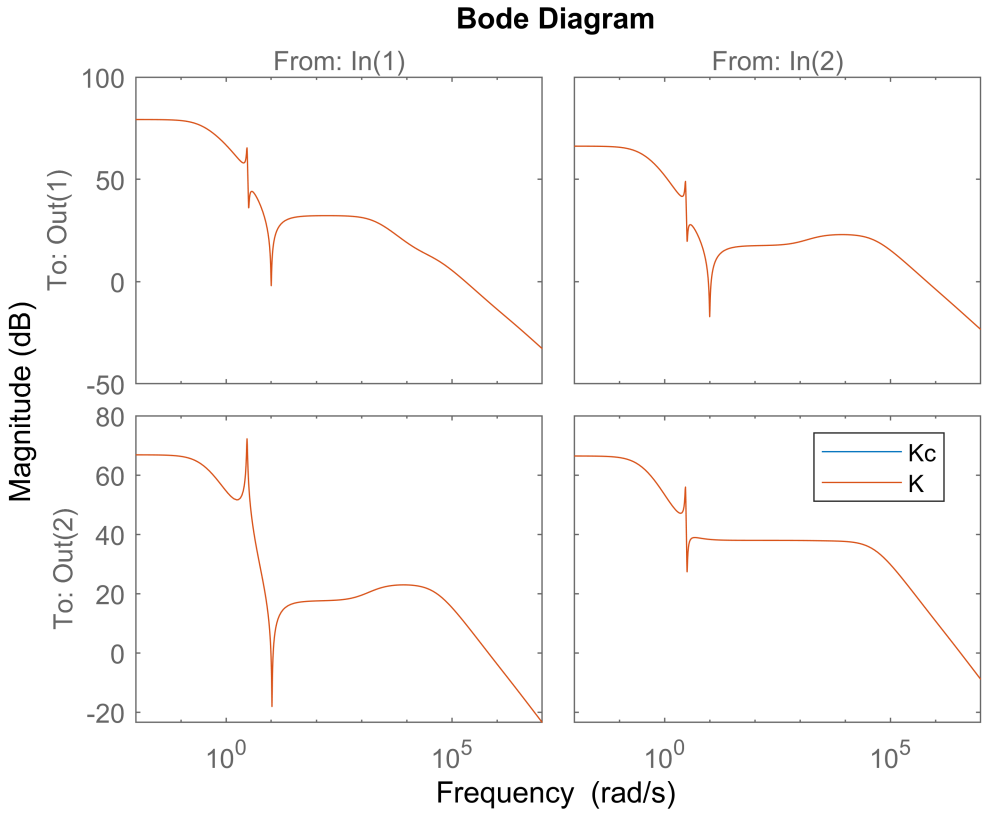
```
P = connect(G,Wp,Wu,Wt,Sum1,Sum2,{'w','u'},{'z1','z2','z3','V'});
```

Perform hinfsyn for finding K

```
Kc = hinfsyn(P,2,2);
```

Plotting magnitude bode graph

```
bodemag(Kc,K)
legend('Kc','K','Location',"best")
```



It can be observed that the controllers designed by both the methods are exactly equal and overlap each other on the magnitude bode plot.