```
clc;
clear all;
close all;
```

```
run("Q310_Basic.mlx")
```

```
sys_dis_open =

   0.1604 z^2 - 0.1958 z + 0.07861
  ----------------------------------
  z^3 - 1.937 z^2 + 1.122 z - 0.1421

Sample time: 0.24388 seconds
Discrete-time transfer function.
c = 1×4
        0    0.1604   -0.1958    0.0786
d = 1×4
    1.0000   -1.9367    1.1220   -0.1421
sys_cont_close =

    7.8 s^3 + 205.7 s^2 + 601.4 s + 1276
  --------------------------------------------
  s^4 + 15.8 s^3 + 212.7 s^2 + 608.4 s + 1276

Continuous-time transfer function.


sys_dis_close =

  0.1328 z^3 - 0.3505 z^2 + 0.3048 z - 0.08705
  --------------------------------------------
  z^4 - 3.73 z^3 + 5.24 z^2 - 3.288 z + 0.778

Sample time: 0.015887 seconds
Discrete-time transfer function.
c1 = 1×5
        0    0.1328   -0.3505    0.3048   -0.0871
d1 = 1×5
    1.0000   -3.7296    5.2395   -3.2878    0.7780
```

generate data
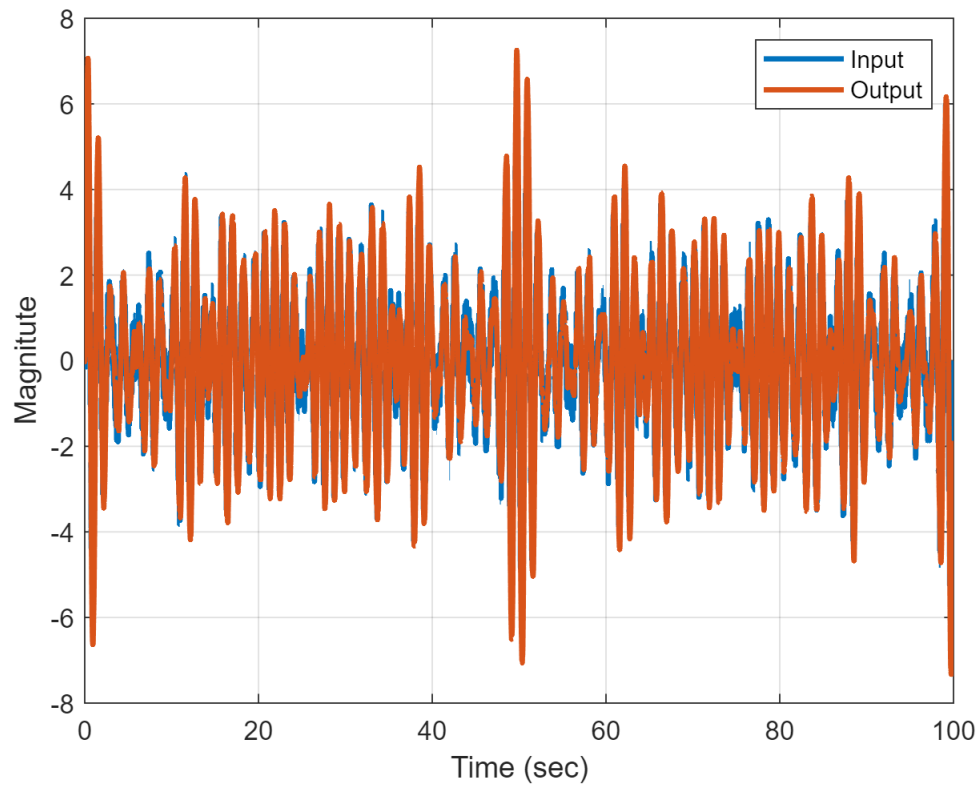
```
tfinal=100;
t = 0:T_s_close:tfinal;

Priemss=primes(100);
u=zeros(numel(t),1);
for i=20:numel(Priemss)
    input_dummy=gensig('sine' , tfinal/Priemss(1,i) , tfinal ,T_s_close);
    u=u+input_dummy;
end

var_e=0.7;
e=sqrt(var_e);
Noise=(-e+(e+e)*rand(numel(t),1));
u=u+Noise;
y = lsim(sys_dis_close ,u ,t);
plot(t,u ,t , y ,'LineWidth',2) ;
```

```matlab
xlabel('Time (sec)') ;
ylabel('Magnitude') ;
grid on
legend('Input','Output') ;
```


Kalman Filter

```matlab
N = numel(y) ;
% %--------------------------%
%choose number of parameters
Parameters_in_den=3
```

Parameters_in_den = 3

```matlab
Parameters_in_num=3
```

Parameters_in_num = 3

```matlab
% %--------------------------%
Nv=Parameters_in_num+Parameters_in_den;
```

```matlab
p_KF(1:Nv,1:Nv,1:N)=zeros(Nv,Nv,N);
%intitial Conditions
theta_hat_KF(1:Nv,1:N)=ones(Nv,N);
K_KF(1:Nv,1:N)=zeros(Nv,N);
var_e=0.05;

p_KF(1:Nv,1:Nv,1)=1e5*eye(Nv);p_KF(1:Nv,1:Nv,2)=p_KF(1:Nv,1:Nv,1);p_KF(1:Nv,1:Nv,3)=p_KF(1:Nv,1:
```

2

```
for i=(max(Parameters_in_num,Parameters_in_den)+1):N
    phi_KF(:,i)          =[(y(i-1:-1:i-Parameters_in_den))',(u(i-1:-1:i-Parameters_in_num))']';
    K_KF(:,i)            =p_KF(:,:,i-1)*phi_KF(:,i)*(1+phi_KF(:,i)'*p_KF(:,:,i-1)*phi_KF(:,i))^(
    p_KF(:,:,i)          =p_KF(:,:,i-1)-p_KF(:,:,i-1)*phi_KF(:,i)*(1+phi_KF(:,i)'*p_KF(:,:,i-1)*
    theta_hat_KF(:,i)    =theta_hat_KF(:,i-1)+K_KF(:,i)*(y(i)-phi_KF(:,i)'*theta_hat_KF(:,i-1));
end
```

Bode

```
ident_dis = tf(theta_hat_KF((Parameters_in_num+1):end,end)' ,[1 -theta_hat_KF(1:Parameters_in_n
```

```
ident_dis =

   0.1328 z^2 - 0.2056 z + 0.07826
  ----------------------------------
  z^3 - 2.639 z^2 + 2.344 z - 0.6998

Sample time: 0.015887 seconds
Discrete-time transfer function.
```

```
ident_analog = d2c(ident_dis)
```
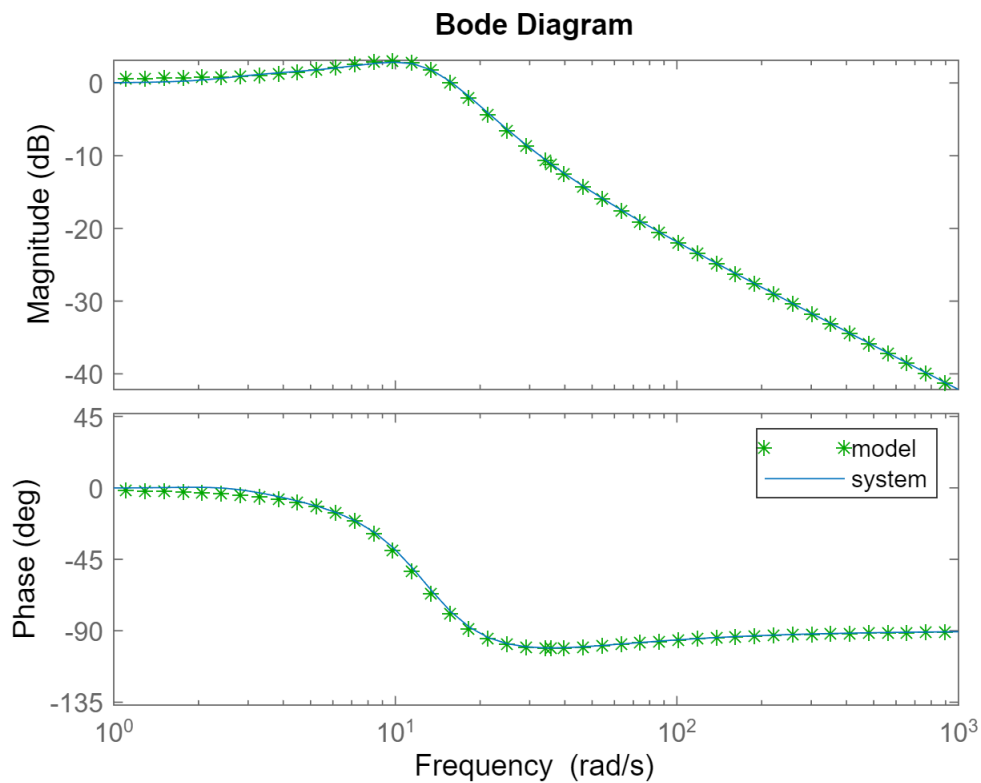
```
ident_analog =

      7.799 s^2 + 258 s + 1636
  --------------------------------
  s^3 + 22.47 s^2 + 276.1 s + 1531

Continuous-time transfer function.
```
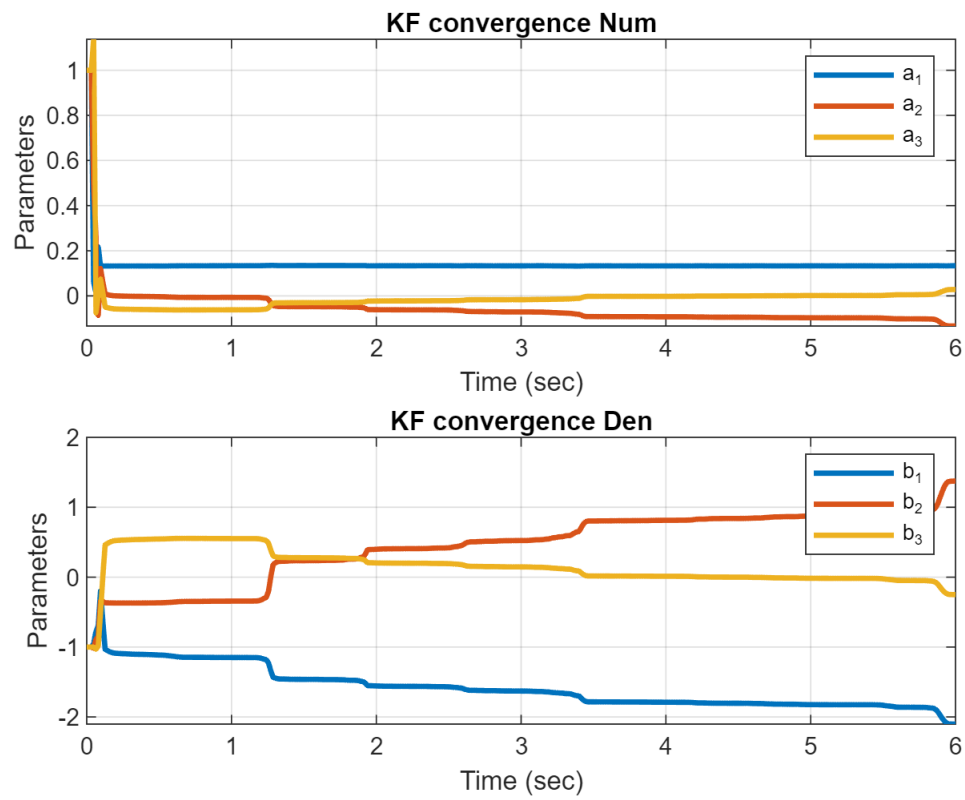
```
bode(ident_analog ,'g*',sys_cont_close )
legend('model ','system')
```

Bode Diagram

KF Convergence

```
subplot(2,1,1)
plot(t , theta_hat_KF((Parameters_in_num+1):end,:) , 'LineWidth' , 2) ;
xlabel('Time (sec)') ;
ylabel('Parameters') ;
title('KF convergence Num') ;
grid on
legend('a_1','a_2','a_3')
xlim([0 6])
% ylim([-1 1])
%--------------------------------------------------------------
subplot(2,1,2)
plot(t , -theta_hat_KF(1:Parameters_in_num ,:) , 'LineWidth' , 2) ;
xlabel('Time (sec)') ;
ylabel('Parameters') ;
title('KF convergence Den') ;
grid on
legend('b_1','b_2','b_3')
xlim([0 6])
```

KF convergence Num

KF convergence Den

```
% ylim([-7  7])
```