```
%%%%%%%%%%%%%%%%main program%%%%%%%%%%%%%%%%

clear all;
global h h1 j L t0 u dstate a1 a2 b1 b2 v yr e10;
b1=0.3072;
b2=1.8560;
b3=3.92;
b4=3.4;
L=6;



x0=[0.2 0.4 0.8 1 0 0 0 0];
u=0;
dstate=0;
h=0.01;
h1=0.001;
tfinal=5;
traspan=0:h:tfinal;
N=length(traspan)-1;
e10=x0(1);
j=1;
t0=0;

for i=1:1:N
   timeset=t0:h1:i*h;
   options=odeset('RelTol',1e-6,'AbsTol',[1e-7 1e-7 1e-7 1e-7 1e-7 1e-7 1e-7 1e-7]);
   [t,xx]=ode45('state',timeset,x0,options);

   x(1+(i-1)*10:10+(i-1)*10+1,:)=xx;
   %x(1)=x(10+(i-1)*10+1,1);
%    dstate(1+(i-1)*10:10+(i-1)*10+1)=x((i-1)*10+1,1);
   % dstate=x(1);
   x0=xx(11,:);

   t0=i*h;
   v(1+(i-1)*10:10+(i-1)*10+1)=-L^4*b1*x((i-1)*10+1,5)-L^3*b2*x((i-1)*10+1,6)-L^2*b3*x((i-1)*10+1,7)-L*b4*x((i-1)*10+1,8);
   %L^4*b1*sin((i-1)*0.01+0.001
   u=v(10+(i-1)*10+1);
   dstate=x((i-1)*10+1,1);
   e10=xx(11,1);
   j=j+1;
end

% tt=0:0.001:tfinal;
% plot(tt,x(:,1),'-',tt,sin(tt));
% legend('Response of x_1(t)','reference signal')
%
% figure
% tt=0:0.001:tfinal;
% plot(tt,v);
% legend('Sampled-data Controller')
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% tt=0:0.001:tfinal;
% plot(tt,x(:,5),tt,x(:,6),tt,x(:,7),tt,x(:,8));
% legend({'$\hat{x}_1$','$\hat{x}_2$','$\hat{x}_3$','$\hat{x}_4$'},'Interpreter','latex');
tt=0:0.001:tfinal;
plot(tt,x(:,1),tt,x(:,2),tt,x(:,3),tt,x(:,4));
legend({'${x}_1$','${x}_2$','${x}_3$','${x}_4$'},'Interpreter','latex');




%%%%%function%%%%%%%%%%%%%%%%%%%%%%
function y=state(t,x)
global  x1 x2 x3 x4 x1hat x2hat x3hat x4hat u L a1 a2 a3 a4 e10 dstate
x1=x(1);
x2=x(2);
x3=x(3);
x4=x(4);
x1hat=x(5);
x2hat=x(6);
x3hat=x(7);
x4hat=x(8);
e1=e10-x1hat;
a1=3.4;
a2=3.92;
a3=1.8560;
a4=0.3072;
y(1)=x(2);
y(2)=x(3)-0.1*sin(t)*x(2)-0.1*dstate;
y(3)=x(4);
y(4)=u-0.1*dstate-0.1*x(3)-0.1*cos(t)*x(4);
y(5)=x2hat+L*a1*e1+cos(t);
y(6)=x3hat+L^2*a2*e1;
y(7)=x4hat+L^3*a3*e1;
y(8)=u+L^4*a4*e1;


y=[y(1);y(2);y(3);y(4);y(5);y(6);y(7);y(8)];
```