THE UNIVERSITY OF TEXAS AT ARLINGTON, TEXAS
DEPARTMENT OF ELECTRICAL ENGINEERING

EE 5329

Distributed Decision and Control

HW # 3
ASSIGNMENT

by

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Presented to

Dr. Frank Lewis

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EE 5329 Distributed Decision and Control

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Homework Pledge of Honor

On all homeworks in this class - YOU MUST WORK ALONE.

Any cheating or collusion will be severely punished.

It is very easy to compare your software code and determine if you worked together

It does not matter if you change the variable names.

Please sign this form and include it as the first page of all of your submitted homeworks.

.....
.....

Typed Name: Soutrik Maiti

Pledge of honor:

"On my honor I have neither given nor received aid on this homework."

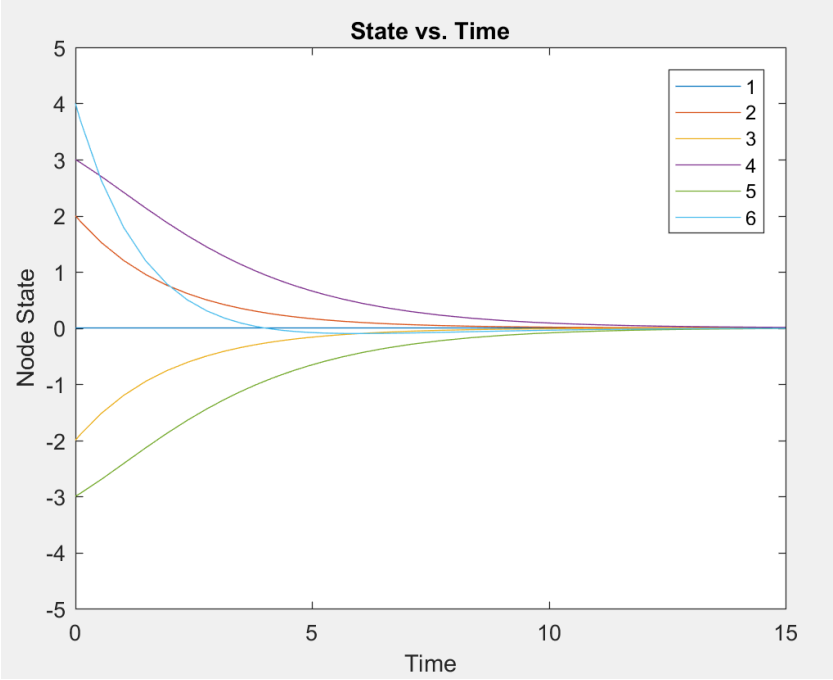
e-Signature: Soutrik Maiti

1. MATLAB CODE:

a)

```
%Solving for first problem
a1= [0 0 0 0 0 0;
    0.5 0 0 0 0 0;
    0.5 0 0 0 0 0;
    0 0.5 0 0 0 0;
    0 0 0.5 0 0 0;
    0 0 0.5 0 0 0];
d1=diag(sum(a1,2));
l1=d1-a1;
conpro1=@(t1,x1)([-l1*x1]);      %Consensus Protocol
[T1,X1]=ode23(conpro1,[0 15],[0 2 -2 3 -3 4]');

%Plotting states Vs. Time

figure(1)
plot(T1,X1)
axis([0 15 -5 5]);
legend('1','2','3','4','5','6')
title('State vs. Time')
xlabel('Time');
ylabel('Node State');
hold on
```

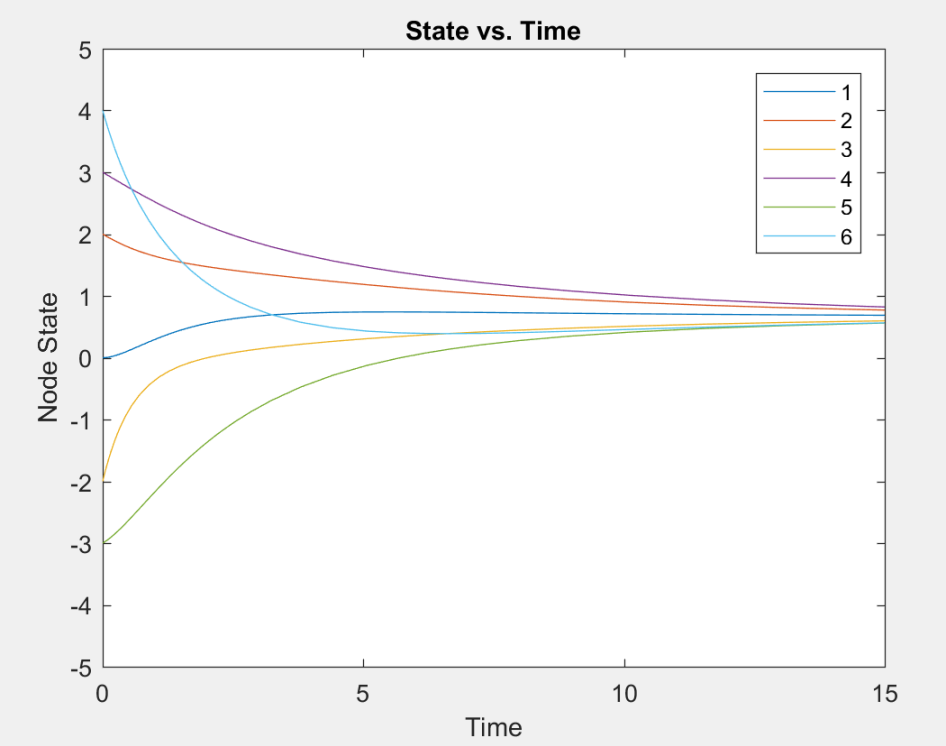
Result:



b)

```
%Solving for the second problem
a2= [0 0.5 0.5 0 0 0;
    0.5 0 0 0.5 0 0;
    0.5 0 0 0 0.5 0.5;
    0 0.5 0 0 0 0;
    0 0 0.5 0 0 0;
    0 0 0.5 0 0 0];
d2=diag(sum(a2,2));
l2=d2-a2;
conpro2=@(t2,x2)([-l2*x2]);      %Consensus Protocol
[T2,X2]=ode23(conpro2,[0 15],[0 2 -2 3 -3 4]');

%Plotting states Vs. Time

figure(2)
plot(T2,X2)
axis([0 15 -5 5]);
legend('1','2','3','4','5','6')
title('State vs. Time')
xlabel('Time');
ylabel('Node State');
hold on
```

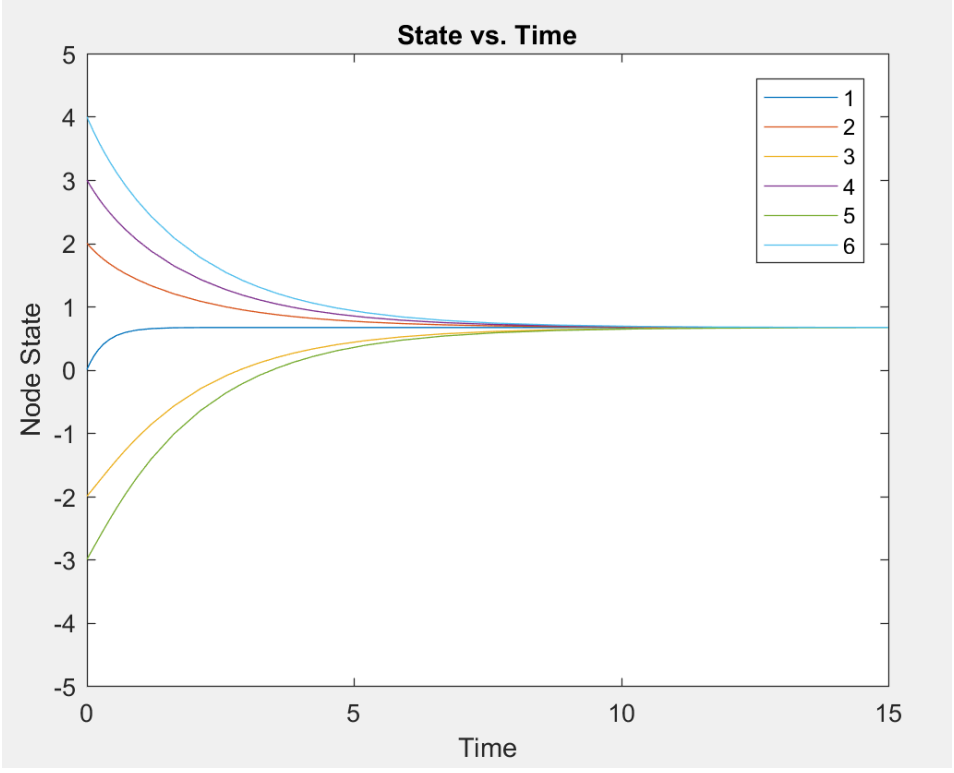
Result:



c)

```
%Solving for third problem
a3= [0 0.5 0.5 0.5 0.5 0.5;
    0.5 0 0 0 0 0;
    0.5 0 0 0 0 0;
    0.5 0 0 0 0 0;
    0.5 0 0 0 0 0;
    0.5 0 0 0 0 0];

d3=diag(sum(a3,2));
l3=d3-a3;
conpro3=@(t3,x3)([-l3*x3]);      %Consensus Protocol
[T3,X3]=ode23(conpro3,[0 15],[0 2 -2 3 -3 4]');

%Plotting states Vs. Time

figure(3)
plot(T3,X3)
axis([0 15 -5 5]);
legend('1','2','3','4','5','6')
title('State vs. Time')
xlabel('Time');
ylabel('Node State');
hold on
```

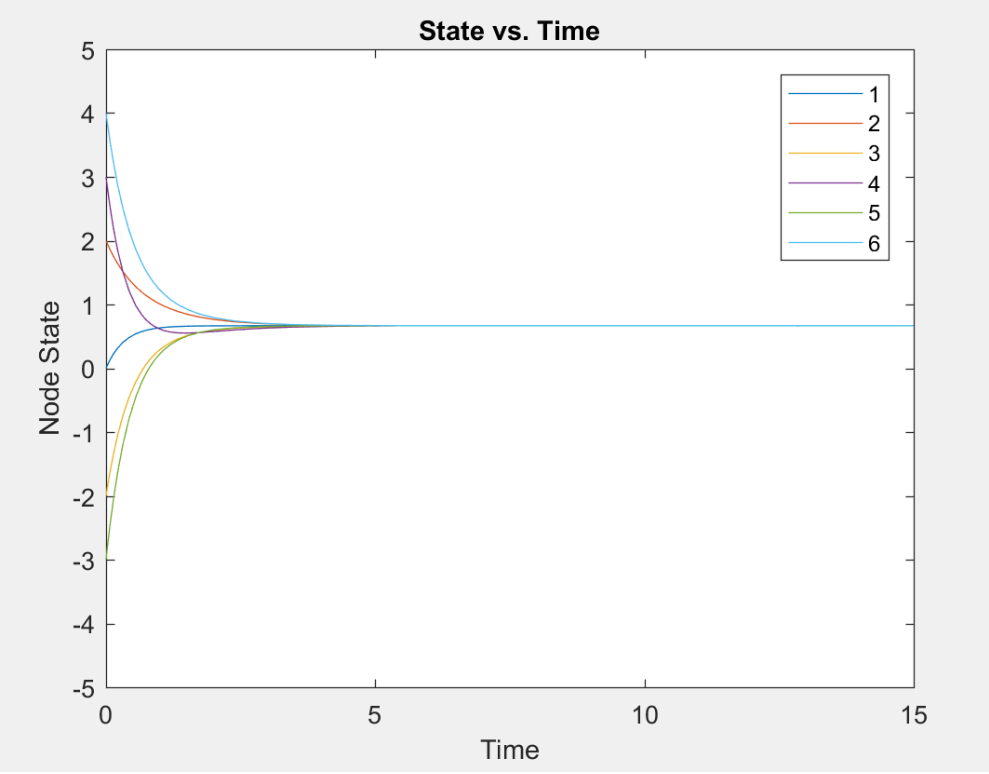
Result:



d)

```
%Solving for fourth problem
a4= [0 0.5 0.5 0.5 0.5 0.5;
    0.5 0 0.5 0 0 0.5;
    0.5 0.5 0 0.5 0 0;
    0.5 0 0.5 0 0.5 0;
    0.5 0 0 0.5 0 0.5;
    0.5 0.5 0 0 0.5 0];
d4=diag(sum(a4,2));
l4=d4-a4;
conpro4=@(t4,x4)([-l4*x4]);      %Consensus Protocol
[T4,X4]=ode23(conpro4,[0 15],[0 2 -2 3 -3 4]');

%Plotting states Vs. Time

figure(4)
plot(T4,X4)
axis([0 15 -5 5]);
legend('1','2','3','4','5','6')
title('State vs. Time')
xlabel('Time');
ylabel('Node State');
hold on
```

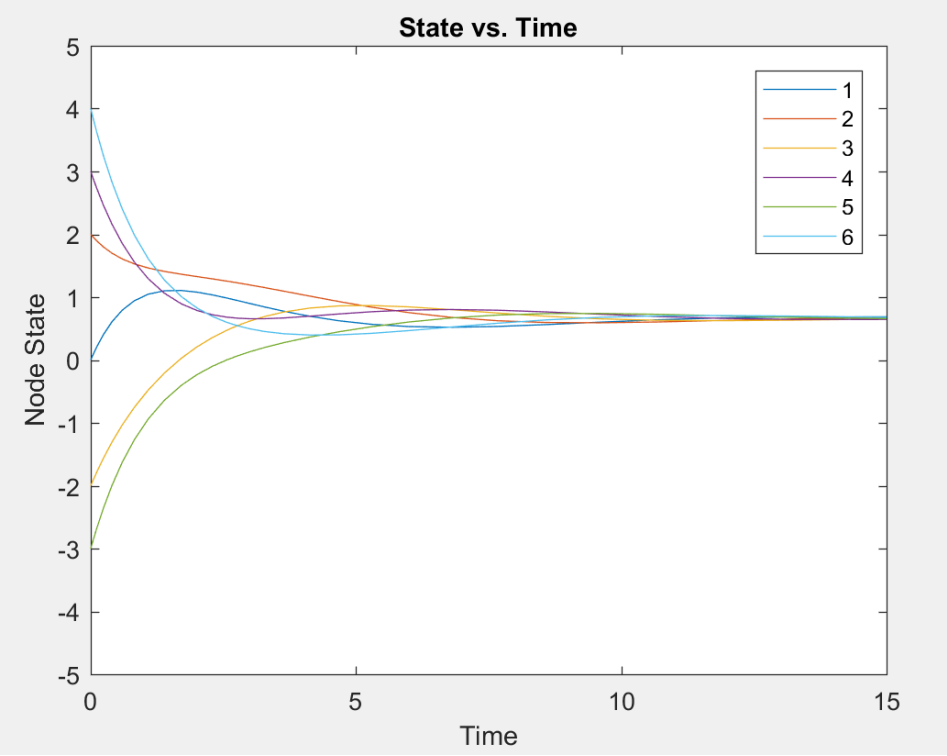
Result:



e)

```
%Solving for fifth problem
a5= [0 0 0 0 0 0.5;
    0.5 0 0 0 0 0;
    0 0.5 0 0 0 0;
    0 0 0.5 0 0 0;
    0 0 0 0.5 0 0;
    0 0 0 0 0.5 0];
d5=diag(sum(a5,2));
l5=d5-a5;
conpro5=@(t5,x5)([-l5*x5]);      %Consensus Protocol
[T5,X5]=ode23(conpro5,[0 15],[0 2 -2 3 -3 4]');

%Plotting states Vs. Time

figure(5)
plot(T5,X5)
axis([0 15 -5 5]);
legend('1','2','3','4','5','6')
title('State vs. Time')
xlabel('Time');
ylabel('Node State');
hold on
```

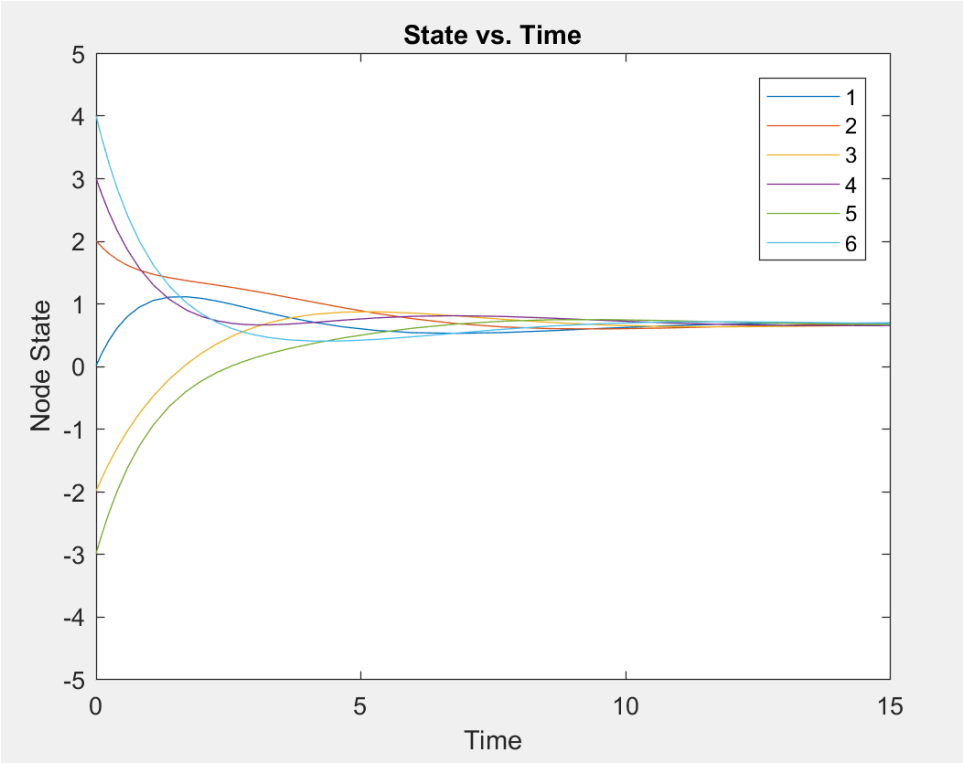
Result:



f)

```
%Solving for 6th problem
a6= [0 0.5 0 0 0 0.5;
    0.5 0 0.5 0 0 0;
    0 0.5 0 0.5 0 0;
    0 0 0.5 0 0.5 0;
    0 0 0 0.5 0 0.5;
    0.5 0 0 0 0.5 0];
d6=diag(sum(a6,2));
l6=d6-a6;
conpro6=@(t6,x6)([-l6*x6]);      %Consensus Protocol
[T6,X6]=ode23(conpro5,[0 15],[0 2 -2 3 -3 4]');

%Plotting states Vs. Time

figure(6)
plot(T6,X6)
axis([0 15 -5 5]);
legend('1','2','3','4','5','6')
title('State vs. Time')
xlabel('Time');
ylabel('Node State');
hold on
```

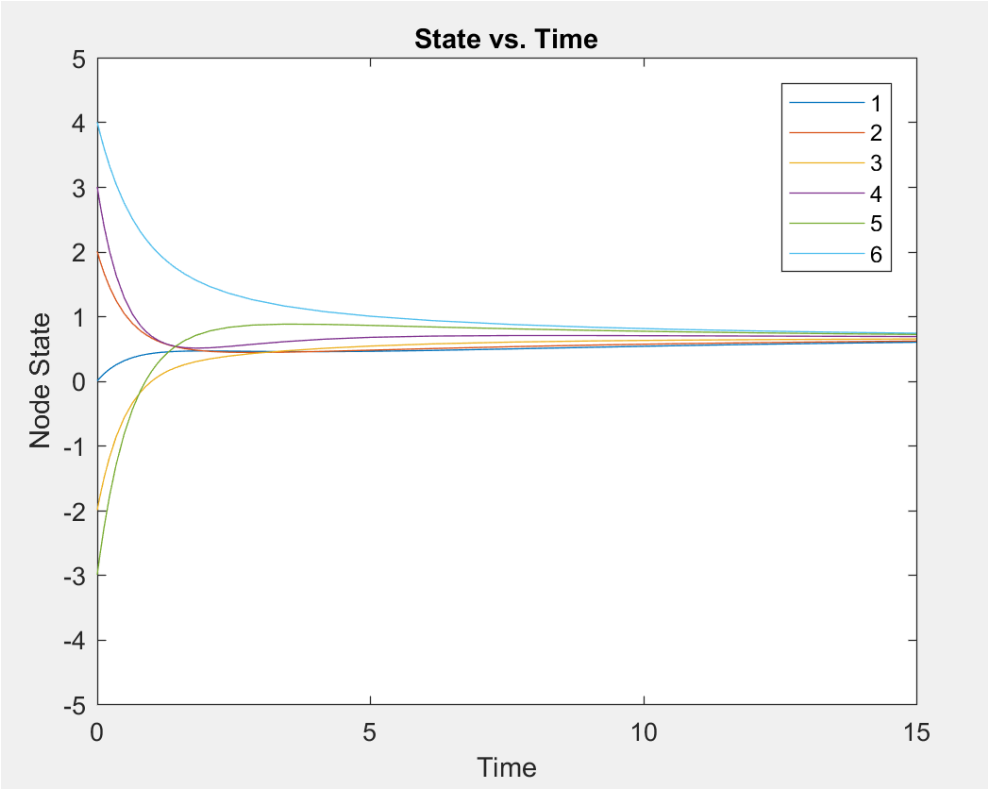
Result:



g)

```
%Solving for 7th problem
a7= [0 0.5 0 0 0 0;
    0.5 0 0.5 0 0 0;
    0 0.5 0 0.5 0 0;
    0 0 0.5 0 0.5 0;
    0 0 0 0.5 0 0.5;
    0 0 0 0 0.5 0];

d7=diag(sum(a7,2));
l7=d7-a7;
conpro7=@(t7,x7)([-l7*x7]);      %Consensus Protocol
[T7,X7]=ode23(conpro7,[0 15],[0 2 -2 3 -3 4]');

%Plotting states Vs. Time

figure(7)
plot(T7,X7)
axis([0 15 -5 5]);
legend('1','2','3','4','5','6')
title('State vs. Time')
xlabel('Time');
ylabel('Node State');
hold on
```

Result:

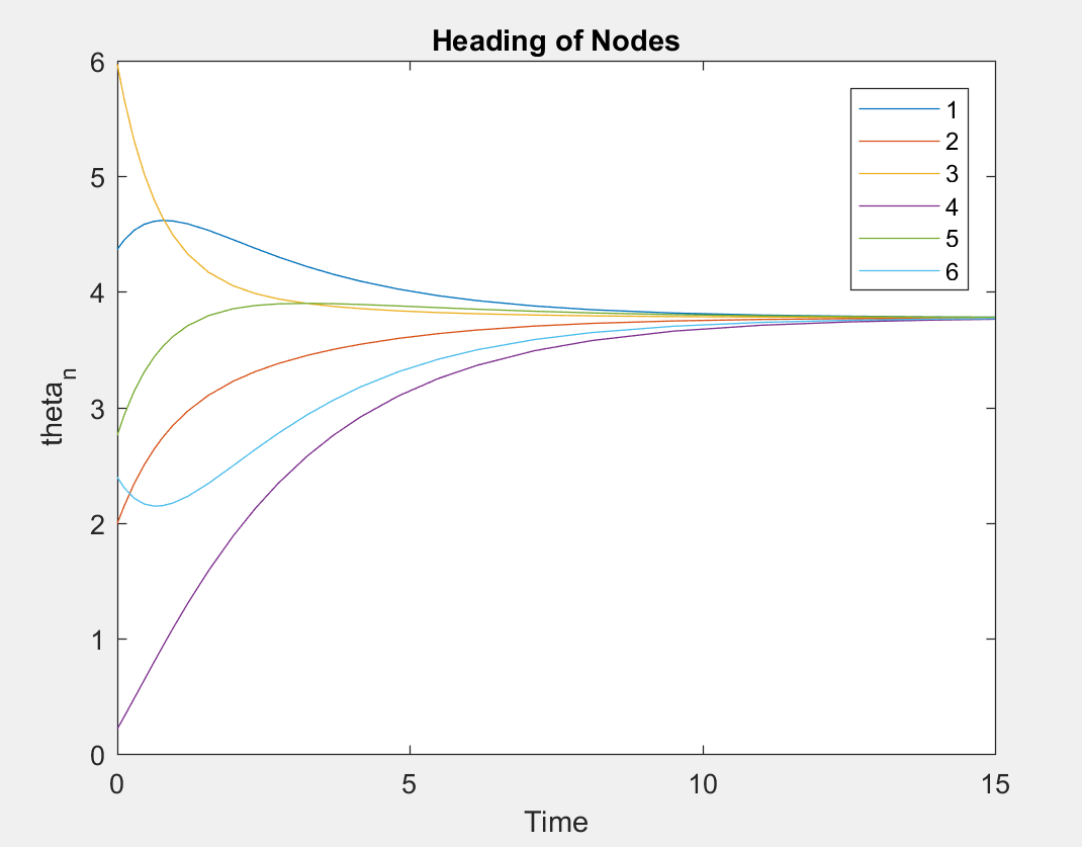


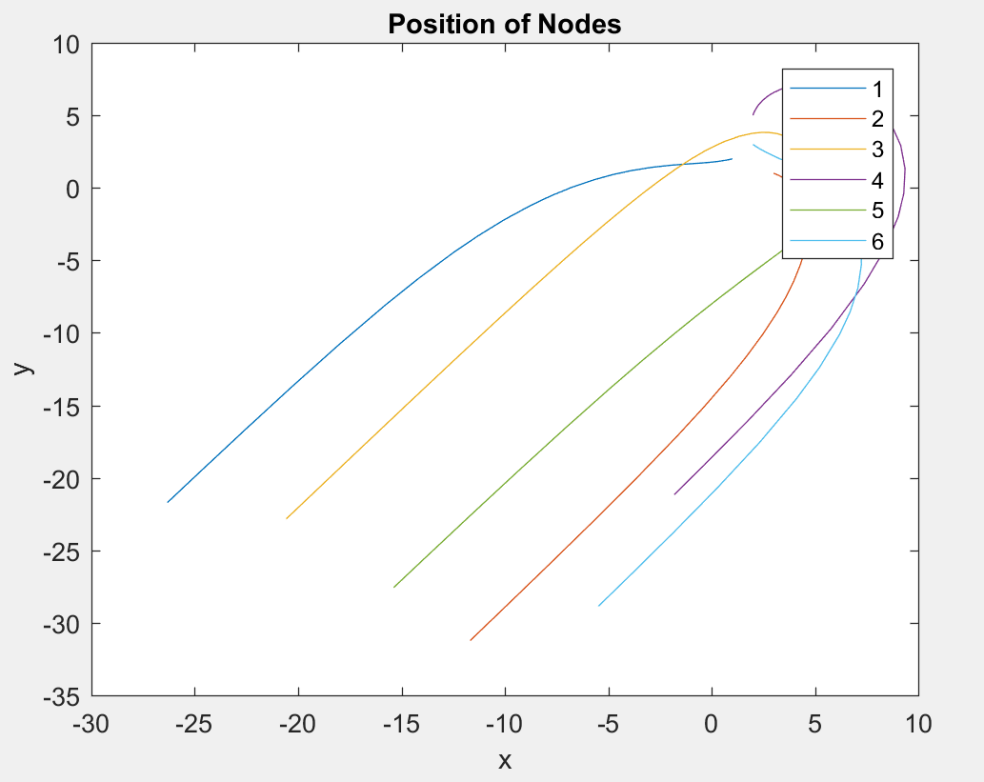
2. MATLAB CODE:

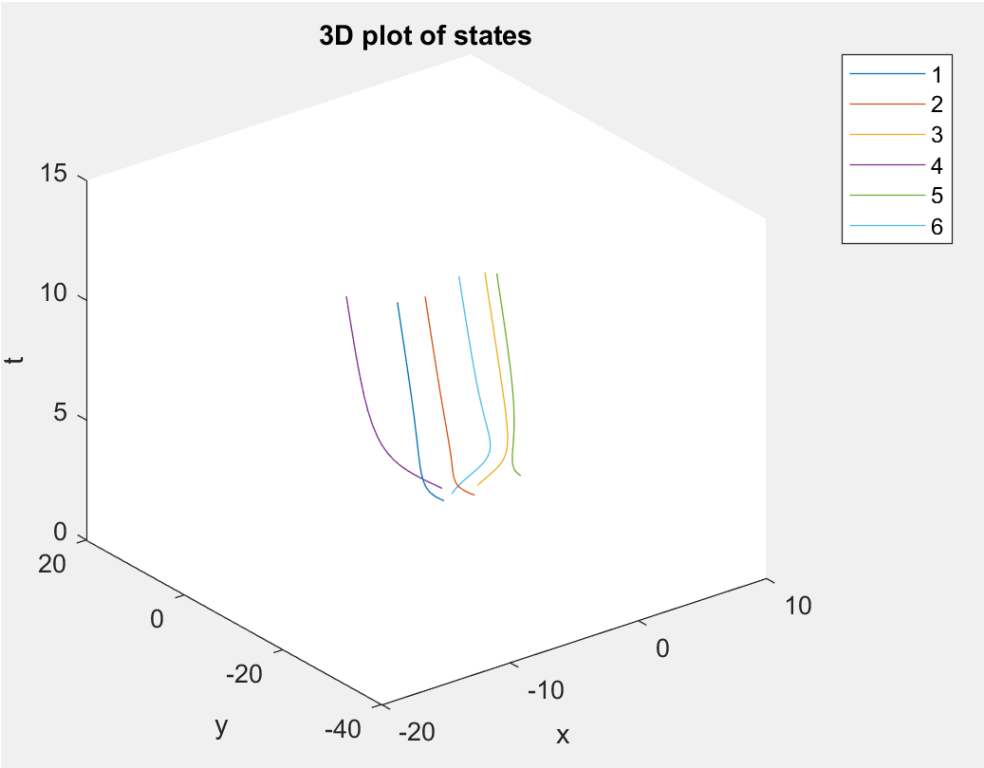
```
clear all;
clc;
close all;
theta_n = [2*pi*rand(1,6)]';
x1=[1;3;4;2;7;2];
y1=[2;1;3;5;2;3];
comb=[theta_n,x1,y1];
[t,xdot]=ode23('formcontrol',[0 15],comb);

figure;
plot(t,xdot(:,1:6));
xlabel('Time');
ylabel('theta_n');
title('Heading of Nodes')
legend('1','2','3','4','5','6')

hold on

figure;
plot(xdot(:,7:12),xdot(:,13:18))
xlabel('x');
ylabel('y');
title('Position of Nodes')
legend('1','2','3','4','5','6')
hold on

figure;
plot3(xdot(:,7:12),xdot(:,13:18),t)
xlabel('x');
ylabel('y');
title('3D plot of states')
legend('1','2','3','4','5','6')
```

```
function xdot = formcontrol(t,Theta)
a=[0 0 0.5 0 0 0;
    0.5 0 0 0 0 0.5;
    0.5 0.5 0 0 0 0;
    0 0.5 0 0 0 0;
    0 0 0.5 0 0 0;
    0 0 0 0.5 0.5 0;];
d=diag(sum(a,2));
l=d-a;
v=2.5;
Theta_dot=-l*Theta(1:6);
x_dot=v*sin(Theta(1:6));
y_dot=v*cos(Theta(1:6));
xdot = [Theta_dot;x_dot;y_dot];
```

Result:




Position of Nodes
10
5
0
-5
-10
-15
-20
-25
-30
-35
y
-30
-25
-20
-15
-10
-5
0
5
10
x
1
2
3
4
5
6


3D plot of states
15
10
5
0
t
20
0
-20
-40
y
-20
-10
0
10
x
1
2
3
4
5
6