Assignment1

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1 1D case

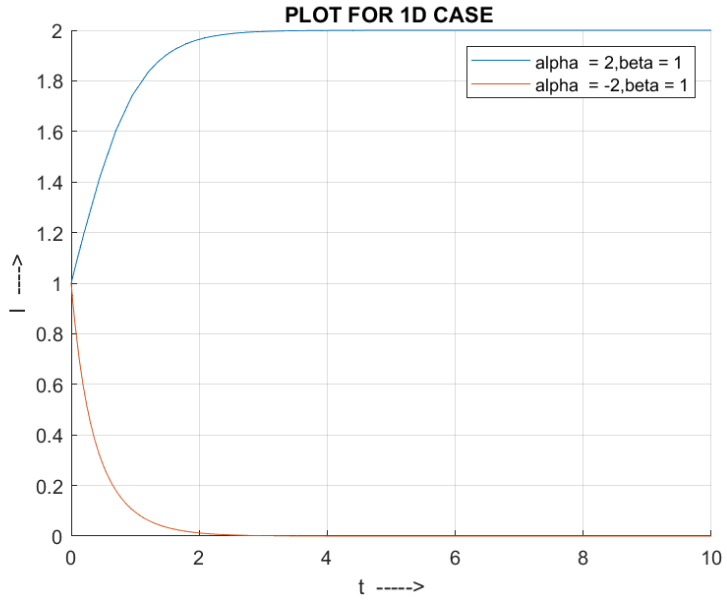
1.1 Equation

$\dot{I} = (\alpha - \beta I)$

1.2 MATLAB code

```
clc;
clear all;

i0=1;
tspan=[0 10];

figure;
hold on;
a=2;
b=1;
[t,i]=ode45(@(t,i) (a-b*i)*i,tspan,i0);
plot(t,i);
labels1 = num2str([a,b],['alpha  = %d,beta = %d']);

a=-2;
b=1;
[t,i]=ode45(@(t,i) (a-b*i)*i,tspan,i0);
plot(t,i);
labels2 = num2str([a,b],['alpha  = %d,beta = %d']);
legend (labels1,labels2);
xlabel('t  ----->');
ylabel('I  ---->');
title('PLOT FOR 1D CASE ');
grid on;
```

1.3 Plot



2 2D case

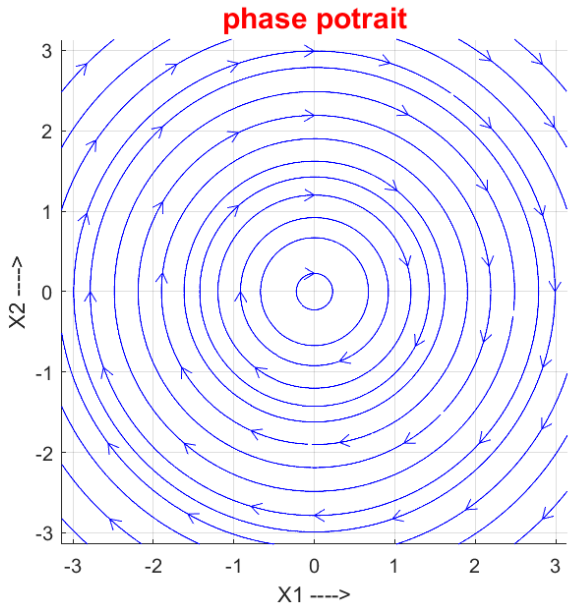
2.1 Example1

$\dot{x}1 = x2$
$\dot{x}2 = -x1$

MATLAB CODE

```
clear all;
clc;
[x,y]=meshgrid(-pi:0.01:pi);
u=y;
v=-x;
streamslice(x,y,u,v);
title('phase potrait','FontSize',15,'Color','r');
xlabel('X1 ---->');
ylabel('X2 ---->');
axis tight square;
grid on;
```

PLOT



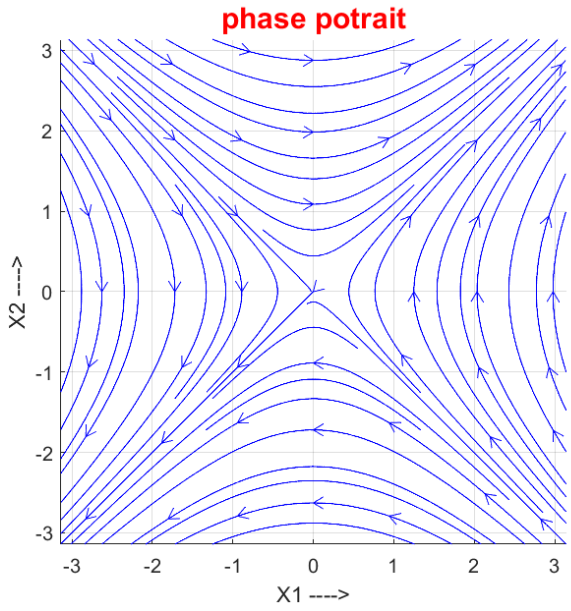
2.2 Example2

$\dot{x}1 = x2$
$\dot{x}2 = x1$

MATLAB CODE

```
clear all;
clc;
[x,y]=meshgrid(-pi:0.01:pi);
u=y;
v=x;
streamslice(x,y,u,v);
title('phase potrait','FontSize',15,'Color','r');
xlabel('X1 ---->');
ylabel('X2 ---->');
axis tight square;
grid on;
```

PLOT



2.3 Example3

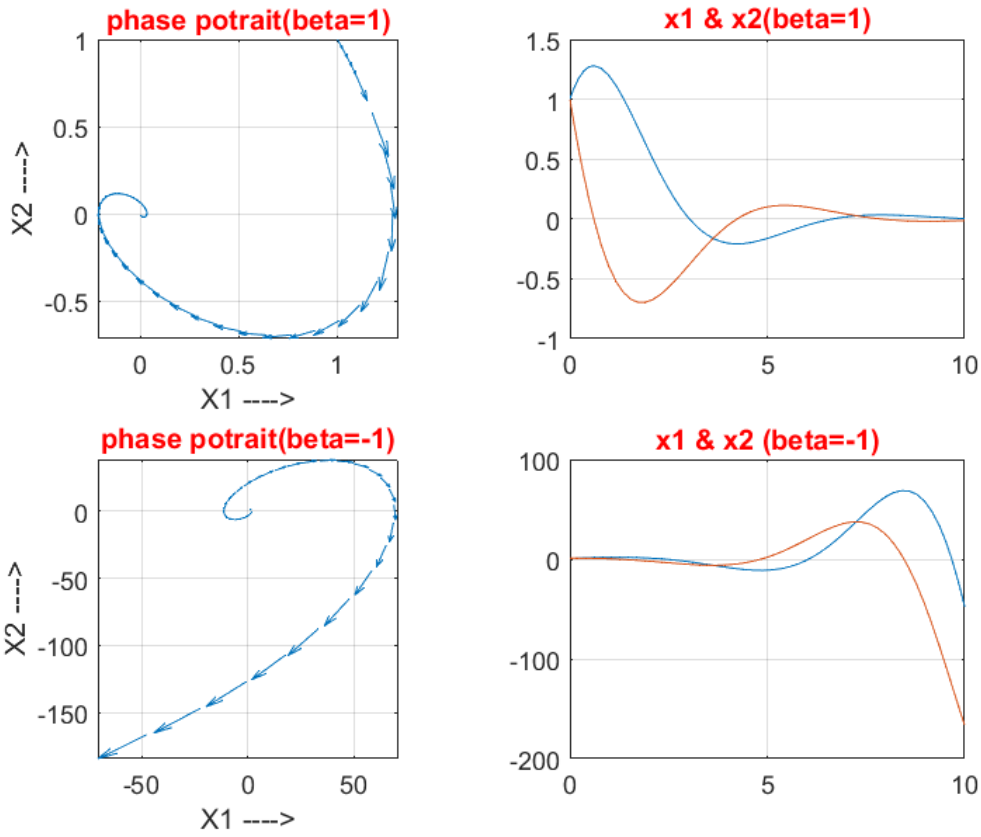
$\dot{x}1 = x2$
$\dot{x}2 = -x1 - \beta x2$

MATLAB CODE

```
clc;
clear all;
b=1;
tspan=[0,10];
y0=[1;1];
plotarrow=@(m) quiver(m(:,1),m(:,2),gradient(m(:,1)),gradient(m(:,2)));

figure;
subplot(2,2,1);
[t,y]=ode45(@(t,y)f1(t,y,b),tspan,y0);
plotarrow(y);
title('phase potrait(beta=1)','FontSize',10,'Color','r');
xlabel('X1 ---->');
ylabel('X2 ---->');
axis tight square;
grid on;

subplot(2,2,2);
plot(t,y(:,1),t,y(:,2));
title('x1 & x2(beta=1)','FontSize',10,'Color','r');
grid on;

subplot(2,2,3);
b=-1;
[t,y]=ode45(@(t,y)f1(t,y,b),tspan,y0);
plotarrow(y);
title('phase potrait(beta=-1)','FontSize',10,'Color','r');
xlabel('X1 ---->');
```

```
ylabel('X2 ---->');
grid on;
axis tight square;
subplot(2,2,4);
plot(t,y(:,1),t,y(:,2));
title('x1 & x2 (beta=-1)','FontSize',10,'Color','r');
grid on;


function d=f1(t,y,b)
d=zeros(2,1);
d(1)=y(2);
d(2)=-y(1)-b*y(2);
end
```

PLOT



2.4 Example4: Limit cycle

$\ddot{x} + \dot{x}\left(x^2 + \dot{x}^2 - 1\right) + x = 0$

Equivalent to two first order equation.

$\dot{x} = y$

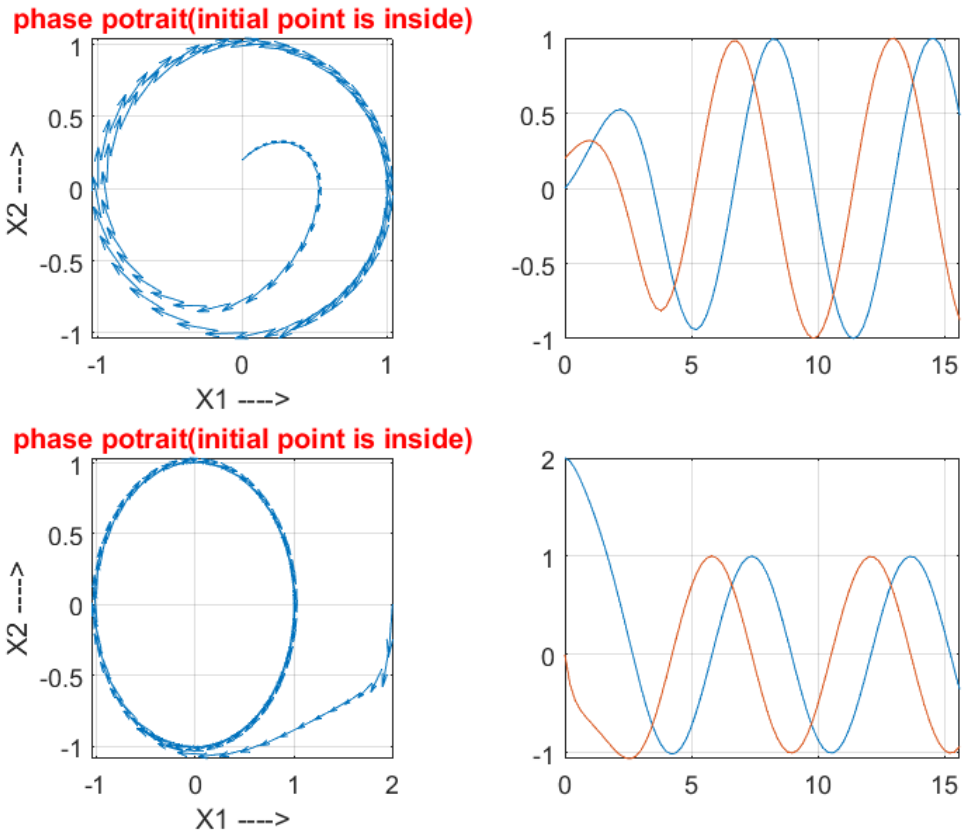
$\dot{y} = -x - y(x^2 - y^2 - 1)$

MATLAB CODE:

```
%limit cycyle

clc;
clear;
```

```
tspan=[0:0.2:5*pi];
plotarrow=@(m) quiver(m(:,1),m(:,2),gradient(m(:,1)),gradient(m(:,2)));

figure;
subplot(2,2,1);
x0=[0;0.2];
[t,x]=ode45(@(t,y)f1(t,y),tspan,x0);
plotarrow(x);
title('phase potrait(initial point is inside)','Color','r');
xlabel('X1 ---->');
ylabel('X2 ---->');
axis tight square;
grid on;
subplot(2,2,2);
plot(t,x(:,1),t,x(:,2));
grid on;

subplot(2,2,3);
y0=[2;0];
[t,y]=ode45(@(t,y)f1(t,y),tspan,y0);
plotarrow(y);
title('phase potrait(initial point is inside)','Color','r');
xlabel('X1 ---->');
ylabel('X2 ---->');
axis tight square;
grid on;

subplot(2,2,4);
plot(t,y(:,1),t,y(:,2));
grid on;

function d=f1(t,y)
d=zeros(2,1);
d(1)=y(2);
d(2)=-y(2)*(y(1)*y(1)+y(2)*y(2)-1)-y(1);
end
```

PLOT


phase potrait(initial point is inside)
X2 ---->
X1 ---->
phase potrait(initial point is inside)
X2 ---->
X1 ---->