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## Table of Contents

.....	1
P2 .....	1
P3 b(1) .....	2
P3 b(2) .....	3
P3 c .....	4

```
%ME564 HW5
%Zhaoyi Jiang
clear all
close all
clc
```

## P2

```
A=[-10 10 0;
    28 -1 0;
    0 0 -8/3]
P2_b1=eig(A)

A=[-10 10 0;
    28 -1 -6*sqrt(2);
    6*sqrt(2) 6*sqrt(2) -8/3]
P2_b2=eig(A)

A=[-10 10 0;
    28 -1 6*sqrt(2);
    -6*sqrt(2) -6*sqrt(2) -8/3]
P2_b3=eig(A)

A =

    -10.0000    10.0000         0
    28.0000    -1.0000         0
         0         0    -2.6667

P2_b1 =

    -22.8277
     11.8277
    -2.6667

A =

    -10.0000    10.0000         0
    28.0000    -1.0000    -8.4853
```

---

```
8.4853      8.4853      -2.6667
```

```
P2_b2 =
```

```
-22.5584 + 0.0000i  
 4.4459 + 3.4859i  
 4.4459 - 3.4859i
```

```
A =
```

```
-10.0000    10.0000         0  
 28.0000    -1.0000    8.4853  
 -8.4853    -8.4853   -2.6667
```

```
P2_b3 =
```

```
-22.5584 + 0.0000i  
 4.4459 + 3.4859i  
 4.4459 - 3.4859i
```

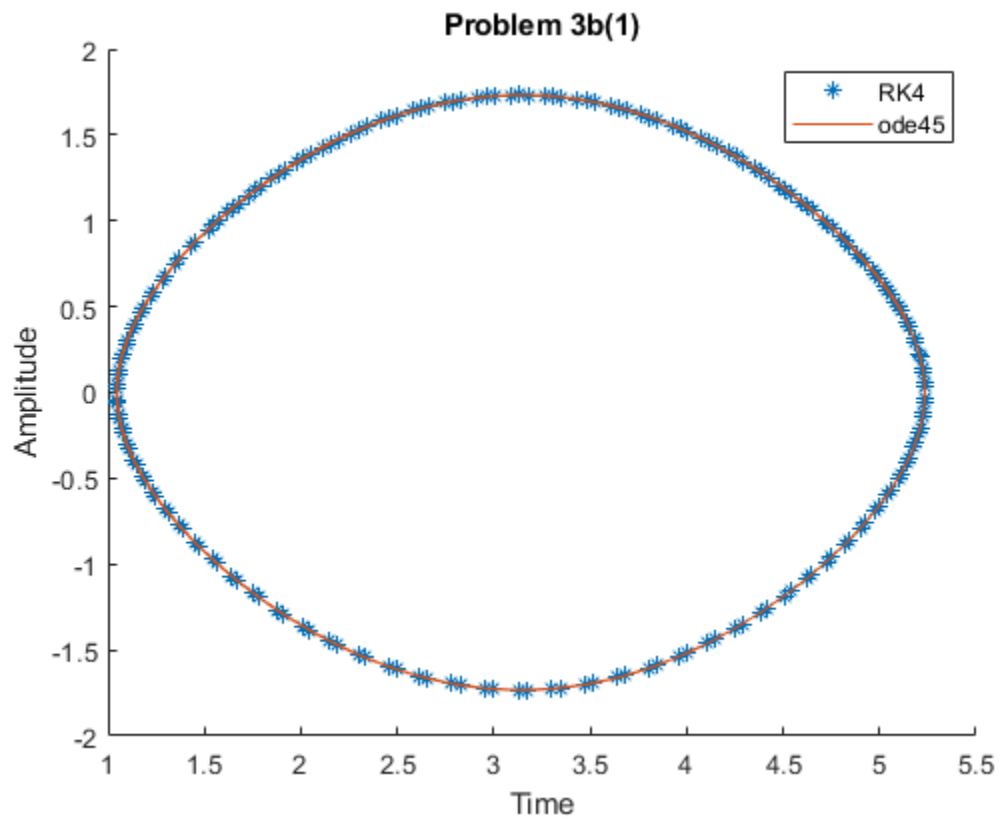
## P3 b(1)

```
alpha=0;  
beta=0;  
y0=[pi/2;1];  
dt=0.1;  
T=20;  
n=T/dt;  
tspan=[0,T];  
Y(:,1)=y0;  
yin=y0;  
for ii=1:n-1  
    time=(ii-1)*dt;  
    yout=rk4singlestep(@(t,y)pendulum(t,y,alpha,beta),dt,time,yin);  
    Y(:,ii+1)=yout;  
    yin=yout;  
end  
t=[0.1:0.1:20];  
figure  
hold on  
plot(Y(1,:),Y(2:,:), '*')  
  
fun=@(t,y)[y(2);sin(y(1))-alpha*y(1)-beta*y(2)]  
Y0=[pi/2;1];  
tspan=[0:0.1:20];  
[ode_t,ode_y]=ode45(fun,tspan,Y0);  
plot(ode_y(:,1),ode_y(:,2))  
xlabel('Time')  
ylabel('Amplitude')
```

```

legend('RK4','ode45');
title('Problem 3b(1)')
hold off

```



## P3 b(2)

```

alpha=3;
beta=1;
y0=[pi/2;1];
dt=0.1;
T=20;
n=T/dt;
tspan=[0,T];
Y(:,1)=y0;
yin=y0;
for ii=1:n-1
    time=(ii-1)*dt;
    yout=rk4singlestep(@(t,y)pendulum(t,y,alpha,beta),dt,time,yin);
    Y(:,ii+1)=yout;
    yin=yout;
end
t=[0.1:0.1:20];
figure
hold on
plot(Y(1,:),Y(2,:), '*')

```

---

```

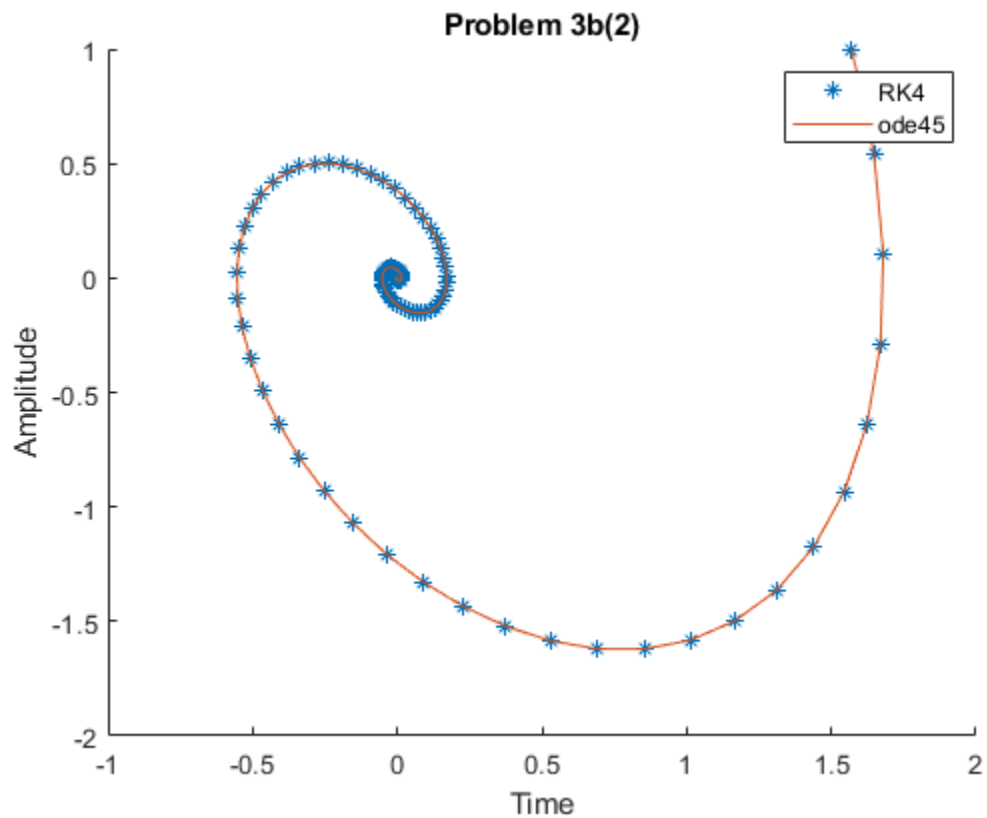
fun=@(t,y)[y(2);sin(y(1))-alpha*y(1)-beta*y(2)]
Y0=[pi/2;1];
tspan=[0:0.1:20];
[ode_t,ode_y]=ode45(fun,tspan,Y0);
plot(ode_y(:,1),ode_y(:,2))
xlabel('Time')
ylabel('Amplitude')
legend('RK4','ode45');
title('Problem 3b(2)')
hold off

```

*fun =*

*function\_handle with value:*

```
@(t,y)[y(2);sin(y(1))-alpha*y(1)-beta*y(2)]
```



## P3 c

```

A=[0 1;-1 0];
P3_c1=eig(A)

A=[0 1;-3 -1];
P3_c2=eig(A)

```

---

*P3\_c1* =

*0.0000 + 1.0000i*  
*0.0000 - 1.0000i*

*P3\_c2* =

*-0.5000 + 1.6583i*  
*-0.5000 - 1.6583i*

*%Functions*

*function* dy=pendulum(t,y,alpha,beta);

dy=[

    y(2);

    sin(y(1))-alpha\*y(1)-beta\*y(2);

];

*end*

*function* yout=rk4singlestep(fun,dt,time,yin);

k1=fun(time,yin);

k2=fun(time+dt/2, yin+(dt/2)\*k1);

k3=fun(time+dt/2, yin+(dt/2)\*k2);

k4=fun(time+dt, yin+dt\*k3);

yout=yin+dt\*(k1+2\*k2+2\*k3+k4)/6;

*end*

*fun* =

*function\_handle* with value:

*@(t,y)[y(2);sin(y(1))-alpha\*y(1)-beta\*y(2)]*

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