```
clear

clc

close all


% initialize

m = 10;

b = 1;

k = 5;

x0 = 1;

v0 = 0;

h = .5;

b_eq = b/m;

omega_n = sqrt(k/m);

zeta = b/(2*omega_n);

omega_d = omega_n*sqrt(1-zeta^2);

t = 0:.5:50;

x = zeros(1,101);

x(1) = 1;

xdouble = (1/m)*(-k*1);

x(2) = 1 +xdouble*((h^2)/2);

x_analytical = (((v0+zeta*omega_n*x0)/omega_d)*sin(omega_d.*t)+x0*cos(omega_d.*t)).*exp(-
zeta*omega_n.*t);


for i = 2:length(t)-1

   x(i+1) = (1/((m/(h^2))+(b/(2*h))))*(-k*x(i)+b*x(i-1)/(2*h)-(m/h^2)*(x(i-1)-2*x(i)));


end


for i = 1:length(t)
```

```
xa(i) = (exp(-zeta*omega_n*t(i)))*((zeta*omega_n/omega_d)*sin(omega_d*t(i))+cos(omega_d*t(i)));

end
% plot
plot(t,x)
hold on
plot(t,xa)
xlabel('time')
ylabel('x')
title('analytical v. numerical')
legend('numerical''analytical')
```

P2:

```
clear
close all
clc

m = 10;
L = 1;
g = 9.8;

t = linspace(0,10,100);
x = zeros(size(t));
h = t(2-t(1));
xdouble = zeros(size(t));
x(1) = deg2rad(179);
```

```
xdouble(1) = -sin(x(1))*g/L;


for i = 1:length(t)-1
  xdouble(i+1) = xdouble(i) + -h*g*sin(x(i))/L;
  x(i+1) = xdouble(i)*h + x(i);


end


yyaxis left
plot(t,x)
hold on
xlabel('time')
ylabel('theta')

yyaxis right
plot(t,xdouble)
ylabel('theta derivative')
```