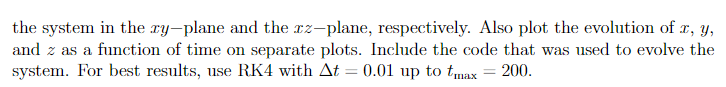
ME 594 – Numerical Methods – HW09

Viral Panchal | Due Date: 11/30

“I pledge my honor that I have abided by the Stevens Honor System”

Graphical user interface, text

Description automatically generated



**MATLAB code:**

* ***RK4 function:***

% Function to imple Runge-Kutta method

function [x,y,z] = RK4(ODE,a,b,h,x0,y0,z0)

n = (b-a)/h;

t = zeros(1,n+1);

x = zeros(1,n+1);

y = zeros(1,n+1);

z = zeros(1,n+1);

K = zeros(3,4);

t(1) = a;

x(1) = x0;

y(1) = y0;

z(1) = z0;

for i = 1:n

t(i+1) = t(i) + h;

[K(:,1)] = feval(ODE,x(i),y(i),z(i));

[K(:,2)] = feval(ODE,x(i)+0.5\*K(1,1)\*h,y(i)+0.5\*K(2,1)\*h,z(i)+0.5\*K(3,1)\*h);

[K(:,3)] = feval(ODE,x(i)+0.5\*K(1,2)\*h,y(i)+0.5\*K(2,2)\*h,z(i)+0.5\*K(3,2)\*h);

[K(:,4)] = feval(ODE,x(i)+K(1,3)\*h,y(i)+K(2,3)\*h,z(i)+K(3,3)\*h);

x(i+1) = x(i) + 1/6\*(K(1,1)+2\*K(1,2)+2\*K(1,3)+K(1,4))\*h;

y(i+1) = y(i) + 1/6\*(K(2,1)+2\*K(2,2)+2\*K(2,3)+K(2,4))\*h;

z(i+1) = z(i) + 1/6\*(K(3,1)+2\*K(3,2)+2\*K(3,3)+K(3,4))\*h;

end

plot(t,x);

xlabel('t');

ylabel('x');

axis padded

grid on

figure

plot(t,y)

xlabel('t')

ylabel('y')

axis padded

grid on

figure

plot(t,z)

xlabel('t')

ylabel('z')

axis padded

grid on

figure

plot(x,y)

xlabel('x')

ylabel('y')

axis padded

grid on

figure

plot(x,z)

xlabel('x')

ylabel('z')

axis padded

grid on

fprintf('Equilibrium point: \n\n')

disp([x(n+1),y(n+1),z(n+1)])

* ***Script for Lorentz function:***

% Function to implement Lorentz method

function dVdt = lorentz(x,y,z)

r = 21;

b = 8/3;

sigma = 10;

dVdt(1) = sigma\*(-x+y);

dVdt(2) = r\*x-y-x\*z;

dVdt(3) = -b\*z + x\*y;

* ***Driver for Q1:***

% Driver for Q1  
  
close all  
clear all  
clc  
  
a = 0;  
b = 200;  
h = 0.01;  
  
x0 = 5;  
y0 = 5;  
z0 = 10;  
  
[x,y,z] = RK4('lorentz',a,b,h,x0,y0,z0);

* ***MATLAB output:***

Equilibrium point:   
  
 7.302967393526780 7.302967675198756 19.999999541614901

Chart

Description automatically generated

Chart, histogram

Description automatically generated

Chart, histogram

Description automatically generated

Chart

Description automatically generated

Diagram, histogram

Description automatically generated

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**Text, letter

Description automatically generated**

**MATLAB code:**

* ***Script for Runge-Kutta Method:***

% Runge Kutta function

function [x,f2] = RK4(ODE,a,b,h,f1\_0,f2\_0,f3\_0)

n = (b-a)/h;

x = zeros(1,n+1);

f1 = zeros(1,n+1);

f2 = zeros(1,n+1);

f3 = zeros(1,n+1);

K = zeros(3,4);

x(1) = a;

f1(1) = f1\_0;

f2(1) = f2\_0;

f3(1) = f3\_0;

for i = 1:n

x(i+1) = x(i) + h;

[K(:,1)] = feval(ODE,x(i),f1(i),f2(i),f3(i));

[K(:,2)] = feval(ODE,x(i)+0.5\*h,f1(i)+0.5\*K(1,1)\*h,f2(i)+0.5\*K(2,1)\*h,f3(i)+0.5\*K(3,1)\*h);

[K(:,3)] = feval(ODE,x(i)+0.5\*h,f1(i)+0.5\*K(1,2)\*h,f2(i)+0.5\*K(2,2)\*h,f3(i)+0.5\*K(3,2)\*h);

[K(:,4)] = feval(ODE,x(i)+h,f1(i)+K(1,3)\*h,f2(i)+K(2,3)\*h,f3(i)+K(3,3)\*h);

f1(i+1) = f1(i) + 1/6\*(K(1,1)+2\*K(1,2)+2\*K(1,3)+K(1,4))\*h;

f2(i+1) = f2(i) + 1/6\*(K(2,1)+2\*K(2,2)+2\*K(2,3)+K(2,4))\*h;

f3(i+1) = f3(i) + 1/6\*(K(3,1)+2\*K(3,2)+2\*K(3,3)+K(3,4))\*h;

end

* ***Script for Blasius method:***

% Implementing Blasius method

function fp = blasius(x,f1,f2,f3)

fp(1) = f2;

fp(2) = f3;

fp(3) = -0.5\*f1\*f3;

* ***Driver to run the above functions:***

% Driver for Q2  
  
close all  
clear all  
clc  
  
format long  
  
a = 0;  
b = 10;  
h = 0.1;  
n = (b-a)/h;  
  
f1\_0 = 0;  
f2\_0 = 0;  
B = 1;  
  
tolerance = 10^(-6);  
xf30(1) = 0;  
xf30(2) = 2;  
  
[x,f2] = RK4('blasius',a,b,h,f1\_0,f2\_0,xf30(1));  
yf210(1) = f2(n+1);  
  
[x,f2] = RK4('blasius',a,b,h,f1\_0,f2\_0,xf30(2));  
yf210(2) = f2(n+1);  
  
error = abs(yf210(2) - B);  
i = 3;  
  
while(error>tolerance)  
 xf30(i) = xf30(i-1) + (1-yf210(i-1))\*(xf30(i-1)-xf30(i-2))/(yf210(i-1)-yf210(i-2));  
 [x,f2]=RK4('blasius',a,b,h,f1\_0,f2\_0,xf30(i));  
 yf210(i) = f2(n+1);  
  
 error = abs(yf210(i)-B);  
 i = i+1;  
end  
  
fprintf('Error:\n')  
disp(error)  
  
fpp\_0 = xf30(i-1);  
fprintf('fpp\_0: \n')  
disp(fpp\_0)  
  
plot(f2,x)  
xlabel('u/U')  
ylabel('eta')  
axis padded  
grid on

* ***MATLAB output:***

Error:  
 3.604962106606990e-09  
  
fpp\_0:   
 0.332057347406128

Chart, line chart

Description automatically generated

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