------------------------------Main File-------------------------------------

clear all

clc

global etha phi x nx dx

% Constants

const;

% Creating Vectors & Step Sizes & Dimensionless Variable

y=zeros(nt,nr);

r=linspace(0,R,nr);

t=linspace(0,tf,nt);

x=r/R;

tau=t/(R^2/D);

phi=K\*R^2/D;

etha=0.5\*Kc\*R/D;

nx=nr;

dx=dr/R;

% Initial Condition

y0(1:nr-1,1)=Ci/C0;

% Solver

[tau,y2]=ode23s(@pdefun,tau,y0);

y(:,2:nr)=y2;

% Adding Boundary Conditions

y(:,1)=(4\*y(:,2)-y(:,3))/3;

y(:,nr)=(4\*y(:,nr-1)-y(:,nr-2)+2\*etha)/(3+2\*etha);

% Creating Final Vectors

C=y\*C0;

t=(R^2/D)\*tau;

% Plotting results

[rr,tt]=meshgrid(r,t);

surf(rr,tt,C)

xlabel('r(cm)')

ylabel('t(s)')

zlabel('C(mol/m^3)')

figure

plot(r,C,'r')

xlabel('r(cm)')

ylabel('C(mol/m^3)')

axis tight

------------------------------------------------------------pdefun---------------------------------------------------------------------

function dy=pdefun(t,y)

global phi etha x nx dx

for i=1:nx-1

if i==1

dy(i)=(-2/(3\*dx^2)-2/(3\*x(i+1)\*dx)-phi\*y(i))\*y(i)+(2/(3\*dx^2)+2/(3\*x(i+1)\*dx))\*y(i+1);

elseif i==nx-1

dy(i)=(1/dx^2-1/(2\*x(i-1)\*dx))\*y(i-1)-(2/dx^2+phi\*y(i))\*y(i)+(1/dx^2+1/(2\*x(i+1)\*dx))\*(4\*y(i)-y(i-1)+2\*etha\*dx)/(3+2\*etha\*dx);

else

dy(i)=(1/dx^2+1/(2\*x(i+1)\*dx))\*y(i+1)+(1/dx^2-1/(2\*x(i)\*dx))\*y(i-1)-(2/dx^2+phi\*y(i))\*y(i);

end

end

dy=dy';

------------------------------------------------------Constant-------------------------------------------------------------------------

% Constants in SI Unit

Ci=0; % mol/m^3

C0=1; % mol/m^3

D=1e-4; % m^2/s

K=1e-3; % m^3/mol.s

Kc=0.1; % m/s

R=1; % m

dr=0.1; % m

dt=25; % s

tf=1000; % s

nt=tf/dt+1;

nr=R/dr+1;