Appendix-A

MATLAB CODES

```
% program for finding range of Jacobi constant such that ydot is not imaginary.

clc
clear
format long;
global mu q
mu = input('Enter value of mu:');
c = input('Enter value of C:');
q = input('Enter value of q:');
A2 = input('Enter value of A2:');
n2 = 1 + 1.5 * A2;
n = sqrt(n2);
p = 1000;
for i = 1:p
x=[0:0.001:1];
r1(i) = x(i) + mu;
r2(i) = abs(x(i) + mu - 1);
temp1 = n2*((1-mu)*r1(i)^2 + mu*r2(i)^2);
temp2 = 2*q*(1-mu)/r1(i);
temp3 = 2*mu/r2(i);
temp4 = A2*mu/r2(i)^3;
ydot(i) = sqrt(temp1 + temp2 + temp3 + temp4 - c);
end
ydot

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%%%%%%%%%%%%%%
%program for finding Poincare surface section
clc
clear all
set(0,'DefaultLineLineWidth',2);
set(0,'DefaultaxesLineWidth',2);
set(0,'DefaultaxesFontSize',14);
set(0,'DefaultTextFontSize',14);
set(0,'DefaultTextFontName','Times');
format long;
global mu q  A2
mu = input('Enter value of mu:');
c = input('Enter value of C:');
q = input('Enter value of q:');
A2 = input('Enter value of A2:');
h = 0.001;
o2 = 1 + 1.5 * A2;
o3 = sqrt(o2);
n = abs(o3);
x = input('Enter initial Value of x: ');
p = input('Enter no of Iteration: ');
```

```
xreq = zeros(p,1500);
xdotreq = zeros(p,1500);
tspan = input('Enter time span : ');
for k = 1:p
y = zeros(tspan/h,4);
j=1;
r1 = x + mu;
r2 = abs(x + mu - 1);
ydot = sqrt(o2*((1-mu)*r1^2 + mu*r2^2)+2*q*(1-mu)/r1 + 2*mu/r2 + A2*mu/r2^3- c);
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
y(1,1) = x;
y(1,2) = 0;
y(1,3) = 0;
y(1,4) = ydot;
y1 = x;
y2 = 0;
y3 = 0;
y4 = ydot;
for i = 2:tspan/h
  tmp1 = y1;
  tmp2 = y2;
  tmp3 = y3;
  tmp4 = y4;
  k1 = h*tmp2;
  rr1 = ((tmp1+mu)^2+(tmp3)^2)^1.5;
  rr2 = ((tmp1-1+mu)^2+(tmp3)^2)^1.5;
  rr3 = ((tmp1-1+mu)^2+(tmp3)^2)^2.5;
  l1 = h*(2*n*tmp4+o2*tmp1-((1-mu)*(tmp1+mu)*q)/rr1-(mu*(tmp1+mu-1))/rr2-
(mu*(tmp1+mu-1)*1.5*A2)/rr3);
  m1 = tmp4*h;
  n1 = h*(-2*n*tmp2+o2*tmp3-((1-mu)*tmp3*q)/rr1-(mu*tmp3)/rr2-(mu*tmp3*1.5*A2)/rr3);

  tmp1 = y1+ k1*0.5;
  tmp2 = y2+ l1*0.5;
  tmp3 = y3+ m1*0.5;
  tmp4 = y4+ n1*0.5;
  k2 = h*tmp2;
  rr1 = ((tmp1+mu)^2+(tmp3)^2)^1.5;
  rr2 = ((tmp1-1+mu)^2+(tmp3)^2)^1.5;
  rr3 = ((tmp1-1+mu)^2+(tmp3)^2)^2.5;
  l2 = h*(2*n*tmp4+o2*tmp1-((1-mu)*(tmp1+mu)*q)/rr1-(mu*(tmp1+mu-1))/rr2-
(mu*(tmp1+mu-1)*1.5*A2)/rr3);
  m2 = tmp4*h;
  n2 = h*(-2*n*tmp2+o2*tmp3-((1-mu)*tmp3*q)/rr1-(mu*tmp3)/rr2-(mu*tmp3*1.5*A2)/rr3);
```

```
  tmp1 = (y1+ 0.5*k1*(-1+sqrt(2))+(1-0.5*sqrt(2))*k2);
  tmp2 = (y2+ l1*0.5*(-1+sqrt(2))+(1-0.5*sqrt(2))*l2);
  tmp3 = (y3+ m1*0.5*(-1+sqrt(2))+(1-0.5*sqrt(2))*m2);
  tmp4 = (y4+ n1*0.5*(-1+sqrt(2))+(1-0.5*sqrt(2))*n2);
  k3 = h*tmp2;
  rr1 = ((tmp1+mu)^2+(tmp3)^2)^1.5;
  rr2 = ((tmp1-1+mu)^2+(tmp3)^2)^1.5;
  rr3 = ((tmp1-1+mu)^2+(tmp3)^2)^2.5;
  l3 = h*(2*n*tmp4+o2*tmp1-((1-mu)*(tmp1+mu)*q)/rr1-(mu*(tmp1+mu-1))/rr2-
(mu*(tmp1+mu-1)*1.5*A2)/rr3);
  m3 = tmp4*h;
  n3 = h*(-2*n*tmp2+o2*tmp3-((1-mu)*tmp3*q)/rr1-(mu*tmp3)/rr2-(mu*tmp3*1.5*A2)/rr3);

  tmp1 = (y1- k2*0.5*sqrt(2)+(1+0.5*sqrt(2))*k3);
  tmp2 = (y2- l2*0.5*sqrt(2)+(1+0.5*sqrt(2))*l3);
  tmp3 = (y3- m2*0.5*sqrt(2)+(1+0.5*sqrt(2))*m3);
  tmp4 = (y4- n2*0.5*sqrt(2)+(1+0.5*sqrt(2))*n3);
  k4 = h*tmp2;
  rr1 = ((tmp1+mu)^2+(tmp3)^2)^1.5;
  rr2 = ((tmp1-1+mu)^2+(tmp3)^2)^1.5;
  rr3 = ((tmp1-1+mu)^2+(tmp3)^2)^2.5;
  l4 = h*(2*n*tmp4+o2*tmp1-((1-mu)*(tmp1+mu)*q)/rr1-(mu*(tmp1+mu-1))/rr2-
(mu*(tmp1+mu-1)*1.5*A2)/rr3);
  m4 = tmp4*h;
  n4 = h*(-2*n*tmp2+o2*tmp3-((1-mu)*tmp3*q)/rr1-(mu*tmp3)/rr2-(mu*tmp3*1.5*A2)/rr3);

  y1= y1 + 1/6*(k1 + (2-sqrt(2))*k2 + (2+sqrt(2))*k3 + k4);
  y2= y2 + 1/6*(l1 + (2-sqrt(2))*l2 + (2+sqrt(2))*l3 + l4);
  y3= y3 + 1/6*(m1 + (2-sqrt(2))*m2 + (2+sqrt(2))*m3 + m4);
  y4= y4 + 1/6*(n1 + (2-sqrt(2))*n2 + (2+sqrt(2))*n3 + n4);
  y(i,1) =y1;
  y(i,2) =y2;
  y(i,3) =y3;
  y(i,4)=y4;
end

% From y1, y2, y3 and y4, select those y1 and y2 for which y3 =0 and y4 >0 and then
% plot(y(:,1),y(:,2))


%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%%%%%%

% program for finding orbit .

clc
clear all
```

```
set(0,'DefaultLineLineWidth',2);
set(0,'DefaultaxesLineWidth',2);
set(0,'DefaultaxesFontSize',14);
set(0,'DefaultTextFontSize',14);
set(0,'DefaultTextFontName','Times');
format long;
global mu q  A2
mu = input('Enter value of mu:');
c = input('Enter value of C:');
q = input('Enter value of q:');
A2 = input('Enter value of A2:');
h = 0.0001;
o2 = 1 + 1.5 * A2;
o3 = sqrt(o2);
n = abs(o3);
x = input('Enter initial Value of x: ');
tspan = input('Enter time span : ');
y = zeros(tspan/h,4);
j=1;
r1 = x + mu;
r2 = abs(x + mu - 1);
ydot = sqrt(o2*((1-mu)*r1^2 + mu*r2^2)+2*q*(1-mu)/r1 + 2*mu/r2 + A2*mu/r2^3- c);
y(1,1) = x;
y(1,2) = 0;
y(1,3) = 0;
y(1,4) = ydot;
y1 = x;
y2 = 0;
y3 = 0;
y4 = ydot;
for i = 2:tspan/h
   tmp1 = y1;
   tmp2 = y2;
   tmp3 = y3;
   tmp4 = y4;
   k1 = h*tmp2;
   rr1 = ((tmp1+mu)^2+(tmp3)^2)^1.5;
   rr2 = ((tmp1-1+mu)^2+(tmp3)^2)^1.5;
   rr3 = ((tmp1-1+mu)^2+(tmp3)^2)^2.5;
   l1 = h*(2*n*tmp4+o2*tmp1-((1-mu)*(tmp1+mu)*q)/rr1-(mu*(tmp1+mu-1))/rr2-
(mu*(tmp1+mu-1)*1.5*A2)/rr3);
   m1 = tmp4*h;
   n1 = h*(-2*n*tmp2+o2*tmp3-((1-mu)*tmp3*q)/rr1-(mu*tmp3)/rr2-(mu*tmp3*1.5*A2)/rr3);

   tmp1 = y1+ k1*0.5;
   tmp2 = y2+ l1*0.5;
```

```
  tmp3 = y3+ m1*0.5;
  tmp4 = y4+ n1*0.5;
  k2 = h*tmp2;
  rr1 = ((tmp1+mu)^2+(tmp3)^2)^1.5;
  rr2 = ((tmp1-1+mu)^2+(tmp3)^2)^1.5;
  rr3 = ((tmp1-1+mu)^2+(tmp3)^2)^2.5;
  l2 = h*(2*n*tmp4+o2*tmp1-((1-mu)*(tmp1+mu)*q)/rr1-(mu*(tmp1+mu-1))/rr2-
(mu*(tmp1+mu-1)*1.5*A2)/rr3);
  m2 = tmp4*h;
  n2 = h*(-2*n*tmp2+o2*tmp3-((1-mu)*tmp3*q)/rr1-(mu*tmp3)/rr2-(mu*tmp3*1.5*A2)/rr3);

  tmp1 = (y1+ 0.5*k1*(-1+sqrt(2))+(1-0.5*sqrt(2))*k2);
  tmp2 = (y2+ l1*0.5*(-1+sqrt(2))+(1-0.5*sqrt(2))*l2);
  tmp3 = (y3+ m1*0.5*(-1+sqrt(2))+(1-0.5*sqrt(2))*m2);
  tmp4 = (y4+ n1*0.5*(-1+sqrt(2))+(1-0.5*sqrt(2))*n2);
  k3 = h*tmp2;
  rr1 = ((tmp1+mu)^2+(tmp3)^2)^1.5;
  rr2 = ((tmp1-1+mu)^2+(tmp3)^2)^1.5;
  rr3 = ((tmp1-1+mu)^2+(tmp3)^2)^2.5;
  l3 = h*(2*n*tmp4+o2*tmp1-((1-mu)*(tmp1+mu)*q)/rr1-(mu*(tmp1+mu-1))/rr2-
(mu*(tmp1+mu-1)*1.5*A2)/rr3);
  m3 = tmp4*h;
  n3 = h*(-2*n*tmp2+o2*tmp3-((1-mu)*tmp3*q)/rr1-(mu*tmp3)/rr2-(mu*tmp3*1.5*A2)/rr3);

  tmp1 = (y1- k2*0.5*sqrt(2)+(1+0.5*sqrt(2))*k3);
  tmp2 = (y2- l2*0.5*sqrt(2)+(1+0.5*sqrt(2))*l3);
  tmp3 = (y3- m2*0.5*sqrt(2)+(1+0.5*sqrt(2))*m3);
  tmp4 = (y4- n2*0.5*sqrt(2)+(1+0.5*sqrt(2))*n3);
  k4 = h*tmp2;
  rr1 = ((tmp1+mu)^2+(tmp3)^2)^1.5;
  rr2 = ((tmp1-1+mu)^2+(tmp3)^2)^1.5;
  rr3 = ((tmp1-1+mu)^2+(tmp3)^2)^2.5;
  l4 = h*(2*n*tmp4+o2*tmp1-((1-mu)*(tmp1+mu)*q)/rr1-(mu*(tmp1+mu-1))/rr2-
(mu*(tmp1+mu-1)*1.5*A2)/rr3);
  m4 = tmp4*h;
  n4 = h*(-2*n*tmp2+o2*tmp3-((1-mu)*tmp3*q)/rr1-(mu*tmp3)/rr2-(mu*tmp3*1.5*A2)/rr3);

  y1= y1 + 1/6*(k1 + (2-sqrt(2))*k2 + (2+sqrt(2))*k3 + k4);
  y2= y2 + 1/6*(l1 + (2-sqrt(2))*l2 + (2+sqrt(2))*l3 + l4);
  y3= y3 + 1/6*(m1 + (2-sqrt(2))*m2 + (2+sqrt(2))*m3 + m4);
  y4= y4 + 1/6*(n1 + (2-sqrt(2))*n2 + (2+sqrt(2))*n3 + n4);
  y(i,1) =y1;
  y(i,2) =y2;
  y(i,3) =y3;
  y(i,4)=y4;
end
```

```
plot(y(:,1),y(:,3))
grid on
xlabel('x')
ylabel('y')
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%program for finding semi major axis and eccentricity

clear all

clc

format long;
global mu q  A2
mu = input('Enter value of mu:');
c = input('Enter value of C:');
q = input('Enter value of q:');
A2 = input('Enter value of A2:');
h = 0.001;
o2 = 1 + 1.5 * A2;
o3 = sqrt(o2);
n = abs(o3);
j=1;
x = input('Enter initial Value of x: ');
for j = 1:1
r1(1,j) = x(1,j) + mu;
r2(1,j) = abs(x(1,j) + mu - 1);
ydot(1,j) = sqrt(o2*((1-mu)*(r1(1,j))^2 + mu*(r2(1,j))^2)+2*q*(1-mu)/(r1(1,j)) + 2*mu/(r2(1,j))
+ A2*mu/(r2(1,j))^3- c);
v(1,j) = ydot(1,j) + n*(x(1,j)+ mu);
h(1,j) = (x(1,j) + mu)*(ydot(1,j) + n*(x(1,j) + mu));
a(1,j) = 1/[(2/r1(1,j)) - ((v(1,j))^2/(1-mu))];
e(1,j) = sqrt(1 - ((h(1,j))^2/a(1,j)*(1-mu)));
end
format long
a
e
```