Birla institute of technology Mesra,Ranchi

Numerical method

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Write one application with example in each module (I-V) of Numerical method in EEE.

MODULE-1

Bisection Method

The method is applicable in the Thermistor.

It measures temperature by measuring the electrical resistance with a change in temperature. Bisection method can be applied to determine the resistance value with the equation:

1/T=1.129241 x 10^3+2.341077 x 10^-3 In(R) + 8.775468 x 10^-8(In(R))^3

MODULE-2

Gauss Seidal Method

Gauss-Seidal Method is very simple and uses in digital computer for computing.

Gauss-Seidal Method is used to calculate the unknown value of voltage.

MODULE-3

Interpolation

It is used in rigid transformation of images by rigid transformation we mean a linear transformation of the pixel coordinator.

Interpolation technique are also used for rooming digital images

MODULE-4

Simpson's Rule

It is used for calculating static and dynamic reaction forces on areas and volumes. Simpson's Rule is also used for calculating the average power over an Integral number of cycles of voltages and current.

Ex: Average Power-1/T/ Voltage(r)Current()dt

MODULE-5

Euler's Method

This method is used to account for the behaviour of electric circuits using alternating current(AC).

It is used in the mon practical sense for working with radiative decay.

1.Write syntax for breaking infinite loops by the use of break a statement in the body of the while statement.

```
while (test_condition)

{

   statement1;

   if (condition )

         break;

   statement2;
```

```
}
```

2.Write syntax for decision making instructions in C:

- **The if statement**

```
if ( expression)
  {

     statements;

  }
```

- **The if –else statement**

```
if (expression)
  {

     statement1;

  }

else

  {

     statement2;

  }
```

- **The switch statement**

```
        switch(expression)

              {

              case exp1:

                           code block1;
```

```
        break;
case exp2:
        code block2;
        break;
.......
default:
        default code block;
}
```

3.Write syntax for loop control structure in C:

- **Using a for statement**

```
for ( statement1; statement2; statement3)
    {
        //body of for loop
    }
```

- **Using a while statement**

```
while (condition)
{
    //block of code to be executed
}
```

- **Using a do-while statement**

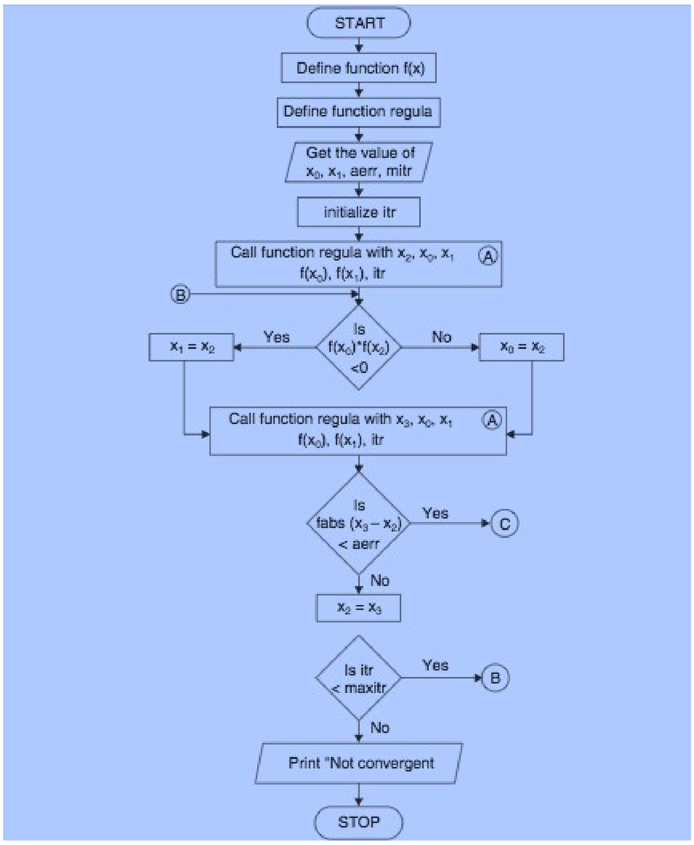
```
do
 {

           //block of code to be executed

 } while (condition);
```

4.Write the name of which method the following segment of algorithm is associated and making flow chart of its method

If (f(x2) not equal to 0) then
if f(x0)*f(x2) < 0
x1□ x2
else
x0 □ x2

This algorithm is associated with Regula falsi method.

The flow chart of this method is given below-



5. What shall be output by the following program segment :

```
sum = 0 ;
        for(i=1;  i<=5; i++)
            { sum = sum + i ;  }
    cout<<sum<<i   ;
```

OUTPUT : 156

6.Find the syntax/logical errors in the following program segment of Gauss Elimination method :

```
for(   p = 0 ; p<= 1;p++)
   for(i=p+1 ;i<=2;i++)
       for(j=0 ; j<=2; j++)

           a[i][j]  = a[i][j]  - (a[i][p]*a[j][p])/a[p][p]    ;
```

Due to space between the last two statement the matrix operationis outside of the loop body.

```
for(   p = 0 ; p<= 1;p++)
         for(i=p+1 ;i<=2;i++)
             for(j=0 ; j<=2; j++)
                 a[i][j]  = a[i][j]  - (a[i][p]*a[j][p])/a[p][p]  ;
```

7.Find the error in the following program segment :--

```
 # define f(x) = (x*x*x -28)

 void   main()
{  float a , b ;
          a =   2.5 ; b = 1.25 ;
c = f(a)/f(b)   ;
          }
```

Due to equal to sign in (# define f(x) = (x*x*x -28)) f(x) is not defined properly and data type of c is not define.

```
# define f(x) x*x*x -28
          void   main()
          {  float a , b ,c ;
                 a =   2.5 ; b = 1.25 ;
         c = f(a)/f(b)   ;
```

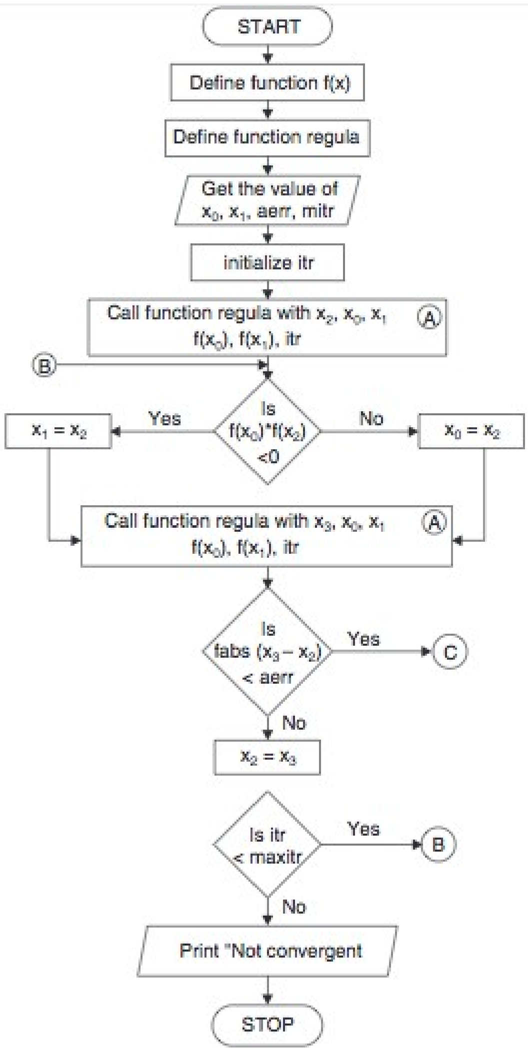
.....
....

}

8.Write the name of which method the following segment of algorithm is associated and making flow chart of its method

If (f(x2) not equal to 0) then
if f(x0)*f(x2) < 0
x1□ x2
else
x0 □ x2

Regula Falsi method



Algorithm

```
Initialize: x1, x2, E, n         // E = convergence indicator
calculate f(x1),f(x2)

if(f(x1) * f(x2) = E);           //repeat the loop until the convergence
    print 'x0'                   //value of the root
    print 'n'                    //number of iteration
}
else
    print "can not found a root in the given interval"
```

9.Write the output using C or, C++ as evaluating $\int_0^1 \frac{x^2}{1+x^3}dx$ using Simpson's 1/3 rule (taking h = 0.1).

```
 h=x[1]-x[0];
n=n-1;
sum = sum + y[0];
 for(i=1;i<n;i++)
{
if(k==0)
{
sum = sum + 4 * y[i]; k=1;
}
else
{
sum = sum + 2 * y[i]; k=0;
}
}
```

```
sum = sum + y[i];
 sum = sum * (h/3);

}
```
Output:I =0.231050

10.Make the necessary correction/addition/deletion in the following back substitution algorithm—

Xn □--$a_{n,n+1}$/$a_{n,n}$
For i= n-1 to 1 in steps of -1 do
For j= i+1 to n in steps of 1 do
Sum □- sum + aijxj endfor
Xi □-($a_{i,n+1}$ – sum)/a_{ii}
End for

Ans-

For i= n-1 to 1 in steps of -1 do

Xn ←--$a_{(n),(n+1)}$/$a_{(n,n)}$

For j= i+1 to n in steps of 1 do

Sum←- sum + $a_{(ij)}x_{(j)}$

Xi←-($a_{(i,n+1)}$ – sum)/$a_{(ii)}$

End for
End for

11. How many iterations , execution of the following loop shall terminate

```
e = 0.1 ;
  do

{  x0  1 ; x1  3 ; x0  x1 ;

}
    while(fabs(x0-x1)>= e )
```

one iterations (1)

12.Find the error in the following :--

```
          void main()

{   float   a[3][3] ; int i,j ;

       for(i=0; i<= 3 ; i++)
                     for(j=0; j<= 3 ; j++)
                         cin<<       a[i][j] ; ........ ; }
```

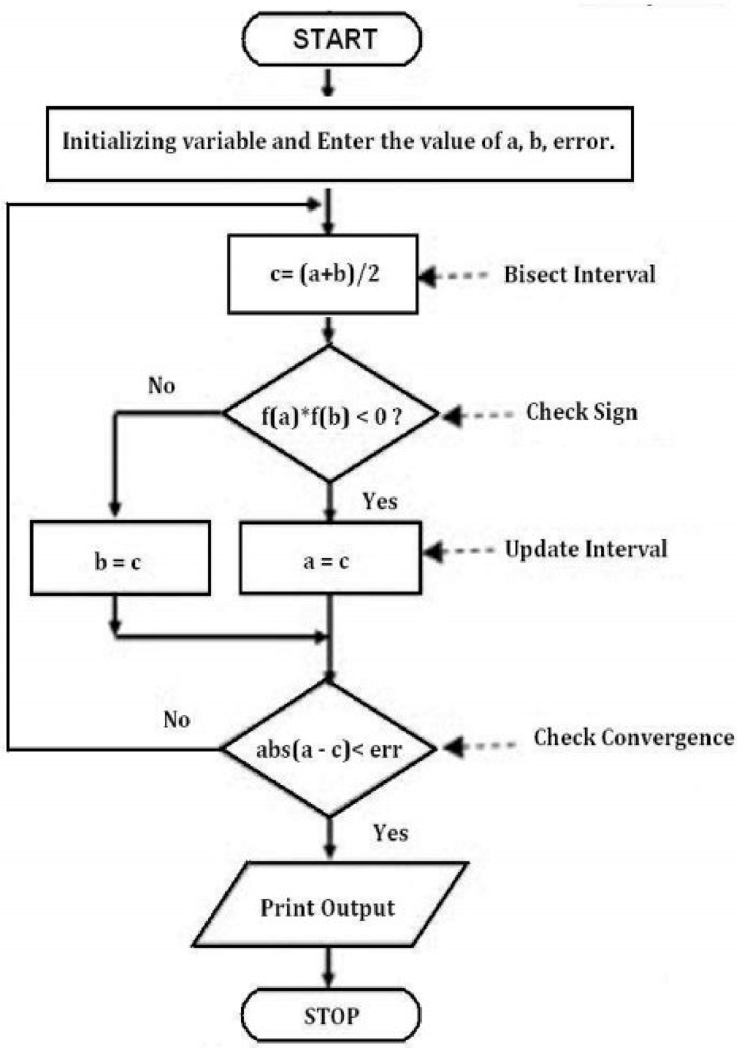
```
void main()

{   float   a[3][3] ; int i,j ;

       for(i=0; i<= 3 ; i++)
                     for(j=0; j<= 3 ; j++)
                         cin>> a[i][j] ;
                        ........ ;
 }
```

Write any 10 Programs in C:

BISECTION METHOD

ALGORITHM: -

- Start
- Define function F(x) and error e=0.001.
- Enter the initial guesses A and B.
- Calculate f1 & f2 where, f1=F(A) & f2=F(B).
- Now check if f1*f2<0. If yes then go to step 5, else go to step 10.
- Calculate new approximated root x 0 as $(A+B)/2$ and its corresponding value of function as f3.
- Then check
- If f3*f1 < 0 then B 0 =x
- If f3*f1 > 0 then A 0 = x
- Repeat step 6 & 7 till (B-A) > e.
- Display 0 x as root.
- Stop



PROGRAM

Equation f (x) = x^3 + x – 1 = 0, using Bisection method.

```
#include <stdio.h>
#include<math.h>
#define e 0.001
#define F(x) x*x*x + x -1
int main()
{
int i;
float A,B,x0;
double f1,f2,f3;
```

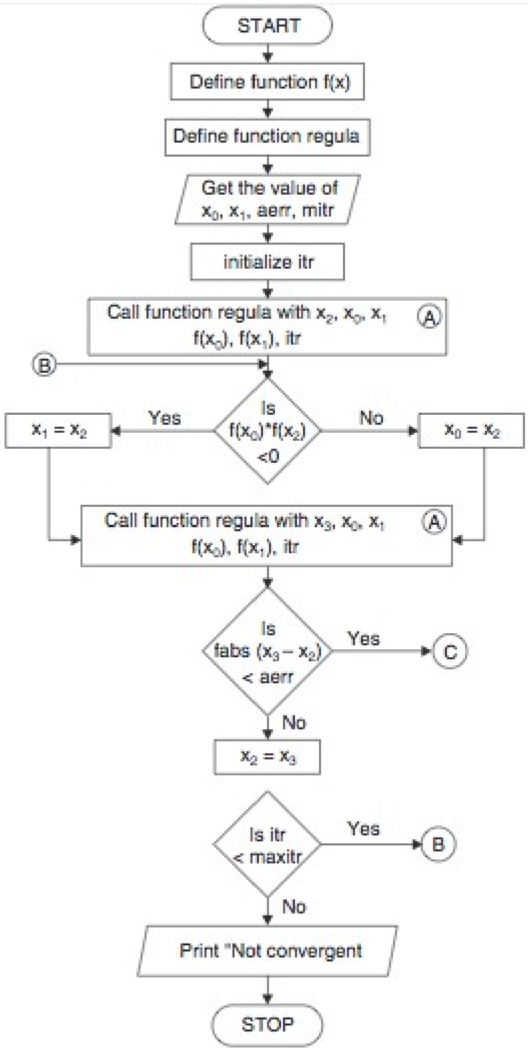
```
printf("\nENTER THE VALUE OF A:");
scanf("%f",&A);printf("\nENTER THE VALUE OF B:");
scanf("%f",&B);
f1 = F(A);
f2 = F(B);
if (f1*f2>0)
printf("REAL ROOT DOES NOT EXIST BETWEEN %f and %f",A,B);
else
{
printf("ITERATION NO. \tVALUE OF A \tVALUE OF B \tVALUE OF X
\tVALUE OF F(X)");
for(i=1;(B-A)>=e;i++)
{
x0 = (A+B)/2;
f3 = F(x0);
printf("\n\t%d \t %f \t %f \t %f \t %f",i,A,B,x0,F(x0));
if(f3*f1<0)
{
B=x0;
}
else
{
A=x0;
}
}
printf("\n\n\nHENCE THE ROOT OF THE EQUATION IS %f",x0);}
return 0;
}
```

```
ENTER THE VALUE OF A: 0

ENTER THE VALUE OF B: 1
ITERATION NO.   VALUE OF A      VALUE OF B      VALUE OF X      VALUE OF F(X)
        1        0.000000        1.000000        0.500000        -0.375000
        2        0.500000        1.000000        0.750000        0.171875
        3        0.500000        0.750000        0.625000        -0.130859
        4        0.625000        0.750000        0.687500        0.012451
        5        0.625000        0.687500        0.656250        -0.061127
        6        0.656250        0.687500        0.671875        -0.024830
        7        0.671875        0.687500        0.679688        -0.006314
        8        0.679688        0.687500        0.683594        0.003037
        9        0.679688        0.683594        0.681641        -0.001646
        10       0.681641        0.683594        0.682617        0.000694


HENCE THE ROOT OF THE EQUATION IS 0.682617
--------------------------------
Process exited after 8.679 seconds with return value 0
Press any key to continue . . .
```

REGULA FALSI METHOD

ALGORITHM: -

- Start
- Define function F(x) and error e=0.001.
- Enter the initial guesses A and B. Also enter the maximum no. of iterations allowed.
- Calculate f1 & f2 where, f1=F(A) & f2=F(B).
- Now check if f1*f2<0. If yes then go to step 5, else go to step 10.
- Calculate new approximated root x 0 as $=(A*f2-B*f1)/(f2-f1)$ and its corresponding value
- of function as f3.
- Then check
- If f3*f1 < 0 then B 0 = & x f2 = f3.
- If f3*f1 > 0 then A 0 = & x f1 = f3.
- Repeat step 6 & 7 till the loop not reaches to maximum no. of iterations.
- Display 0 x as root.
- Stop

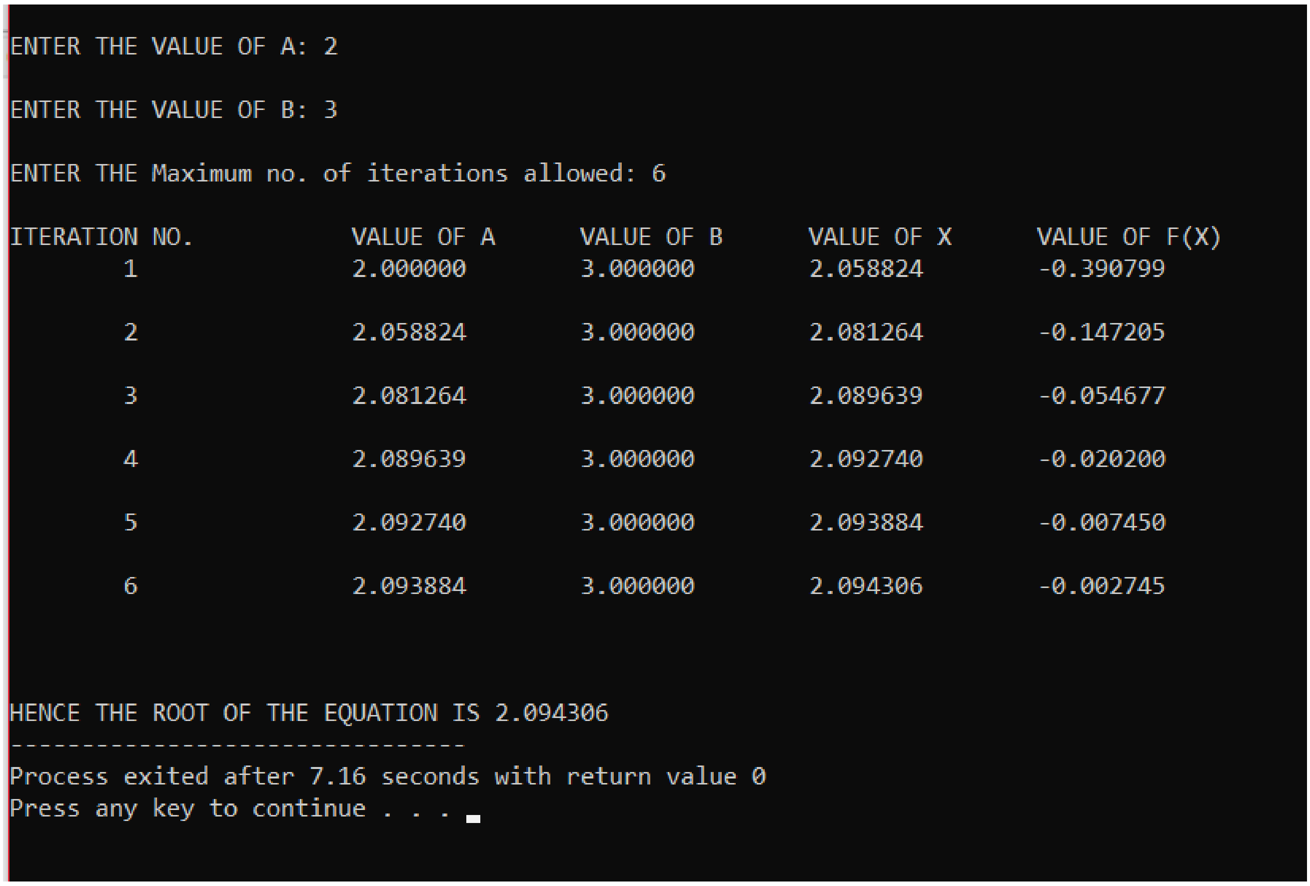


PROGRAM -

Equation f (x) = x^3 – 2x – 5 = 0 by method of False position.

```
#include<stdio.h>
#include<math.h>
#define F(x) x*x*x - 2*x -5
#define e 0.001
int main()
{
float A, B, x0, f1, f2, f3;
int i,maxitr;
printf("\nENTER THE VALUE OF A:");
scanf("%f",&A);printf("\nENTER THE VALUE OF B:");
scanf("%f",&B);
printf("\nENTER THE Maximum no. of iterations allowed:");
scanf("%d",&maxitr);
f1 = F(A);
f2 = F(B);
if( f1*f2 >0)
{
printf("REAL ROOT DOES NOT EXIST BETWEEN %f and %f",A,B);
```

```
}
else
{
printf("\nITERATION NO. \t \tVALUE OF A \tVALUE OF B \tVALUE OF X
\tVALUE OF F(X)");
for(i=1;i<=maxitr;i++)
{
x0 = ((A*f2)- (B*f1))/(f2-f1);
f3 = F(x0);
printf("\n\t%d\t\t%f\t%f\t%f\t%f\n",i, A, B, x0, f3);
if(f1*f3 < 0)
{
B = x0;
f2=f3;
}
else
{
A = x0;f1=f3;
}
}
printf("\n\n\nHENCE THE ROOT OF THE EQUATION IS %f",x0);
}
return 0;
}
```



```
ENTER THE VALUE OF A: 2

ENTER THE VALUE OF B: 3

ENTER THE Maximum no. of iterations allowed: 6

ITERATION NO.           VALUE OF A      VALUE OF B      VALUE OF X      VALUE OF F(X)
        1               2.000000        3.000000        2.058824        -0.390799

        2               2.058824        3.000000        2.081264        -0.147205

        3               2.081264        3.000000        2.089639        -0.054677

        4               2.089639        3.000000        2.092740        -0.020200

        5               2.092740        3.000000        2.093884        -0.007450

        6               2.093884        3.000000        2.094306        -0.002745



HENCE THE ROOT OF THE EQUATION IS 2.094306
--------------------------------
Process exited after 7.16 seconds with return value 0
Press any key to continue . . .
```

GAUSS ELIMINATION METHOD

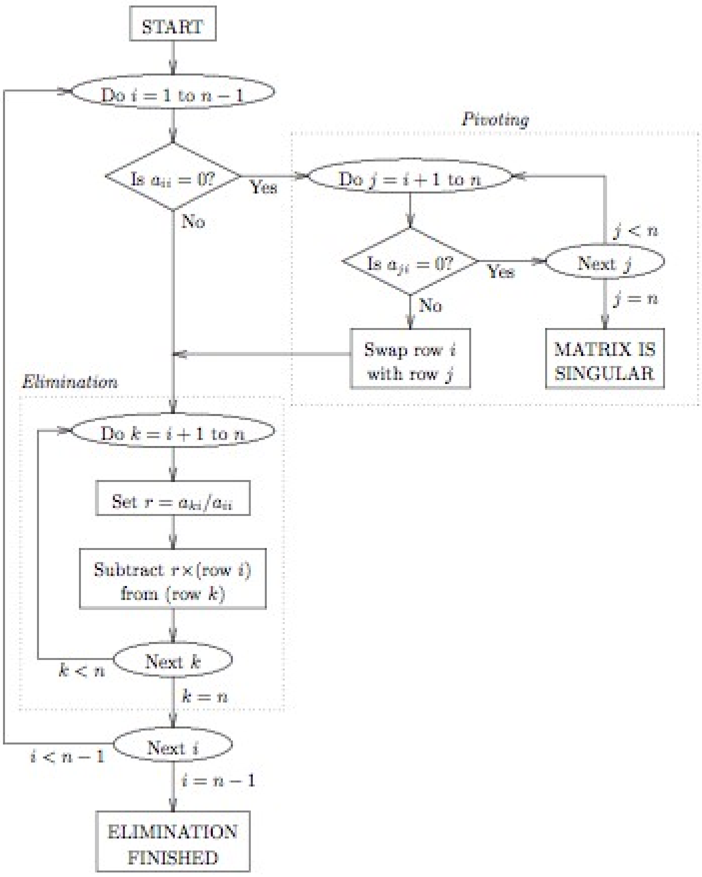
ALGORITHM:

1. Start the program
2. Read the order of the matrix n
3. Read the elements of the augmented matrix
4. For j=1 to j<=n and for i=1 to i<=n; if (i>j) then c=a[i][j]/a[j][j]
5. For k=1 to k<=n+1 ,a[i][k]=a[i][k]-c*a[j][k] ,k=k+1
6. Compute x[n]=a[n][n+1]/a[n][n]
7. For i=n-1 to i>=1 sum=0
8. For j=i+1 to j<=n, sum=sum+a[i][j]*x[j]
9. Compute x[i]=(a[i][n+1]-sum)/a[i][i]

10.For i=1 to i<=n

11.11 display the result x[i];i=i+1

12.stop



CODE:

```
  #include<stdio.h>
#include<conio.h>
void main()
{
int i,j,k,n;
float a[20][20],c,x[10],sum=0.0;
clrscr();
printf("\n enter the order of matrix:");
scanf("%d",&n);
printf("\n Enter the elememts of augmented matrix row-wise:\n\n");
for(i=0;i<=n;i++)
{
for(j=1;j<=(n+1);j++)
{
printf("a[%d][%d]:",i,j);
scanf("%f",&a[i][j]);
}
}
for(j=1;j<=n;j++)
{
for(i=1;i<=n;i++)
{if(i>j)
{
c=a[i][j]/a[j][j];
for(k=1;k<=n+1;k++)
{
a[i][k]=a[i][k]-c*a[j][k];
}
}
}
}
x[n]=a[n][n+1]/a[n][n];for(i=n-1;i>=1;i--)
{
sum=0;
for(j=i+1;j<=n;j++)
{
```

```
sum=sum+a[i][j]*x[j];
}
x[i]=(a[i][n+1]-sum)/a[i][i];
}
printf("\n the solution is:\n");
for(i=1;i<=n;i++)
{
printf("\n x%d=%f\t",i,x[i]);
}
getch();
}
```

```
 enter the order of matrix:3

 Enter the elememts of augmented matrix row-wise:

a[1][1]:2
a[1][2]:2
a[1][3]:1
a[1][4]:6
a[2][1]:4
a[2][2]:2
a[2][3]:3
a[2][4]:4
a[3][1]:1
a[3][2]:-1
a[3][3]:1
a[3][4]:0

 the solution is:

 x1=9.000000
 x2=-1.000000
 x3=-10.000000
```

GAUSS JORDAN METHOD

ALGORITHM:

1. start
2. read the order pf matrix n
3. read the elements of augmented matrix
4. for j=1;j<=n and for i=1 to i<=n; repeat steps 5 to 10.
5. If(i!=j) then compute c=a[i][j]/a[i][i]
6. For k=1 to k<=n+1
7. Compute a[i][k]=a[i][k]-c*a[j][k]
8. K=k+1
9. I=i+1

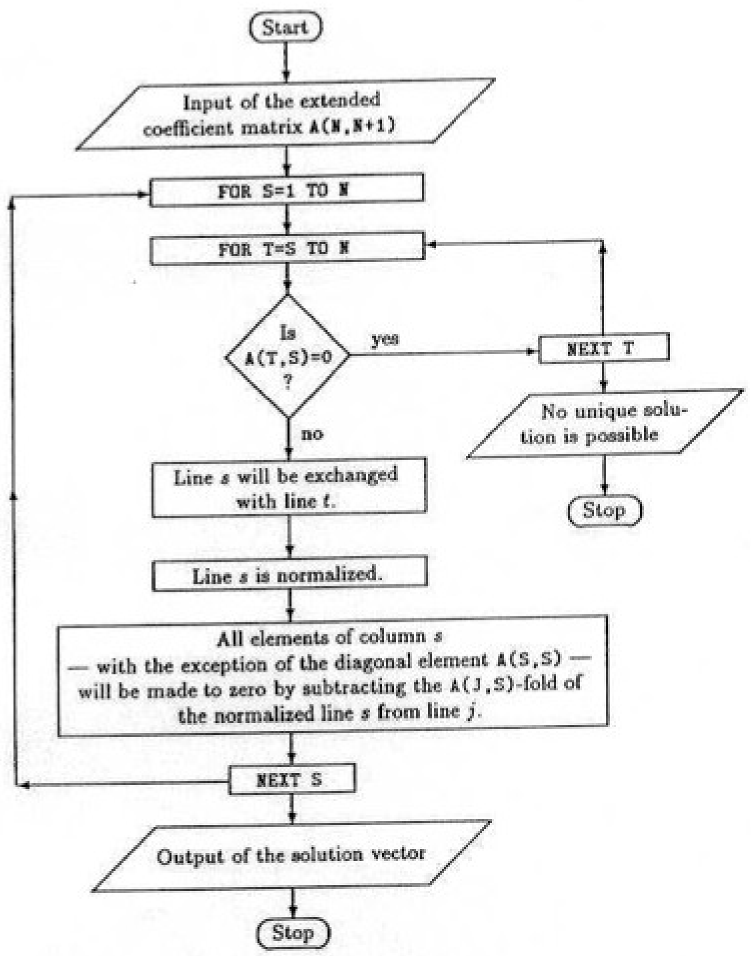
10.J=j+1

11.For i=1 to i<=n repeat step 12 and 13

12.Compute x[i]=a[i][n+1]/a[i][i]

13.Print the solution is x[i], i=i+2

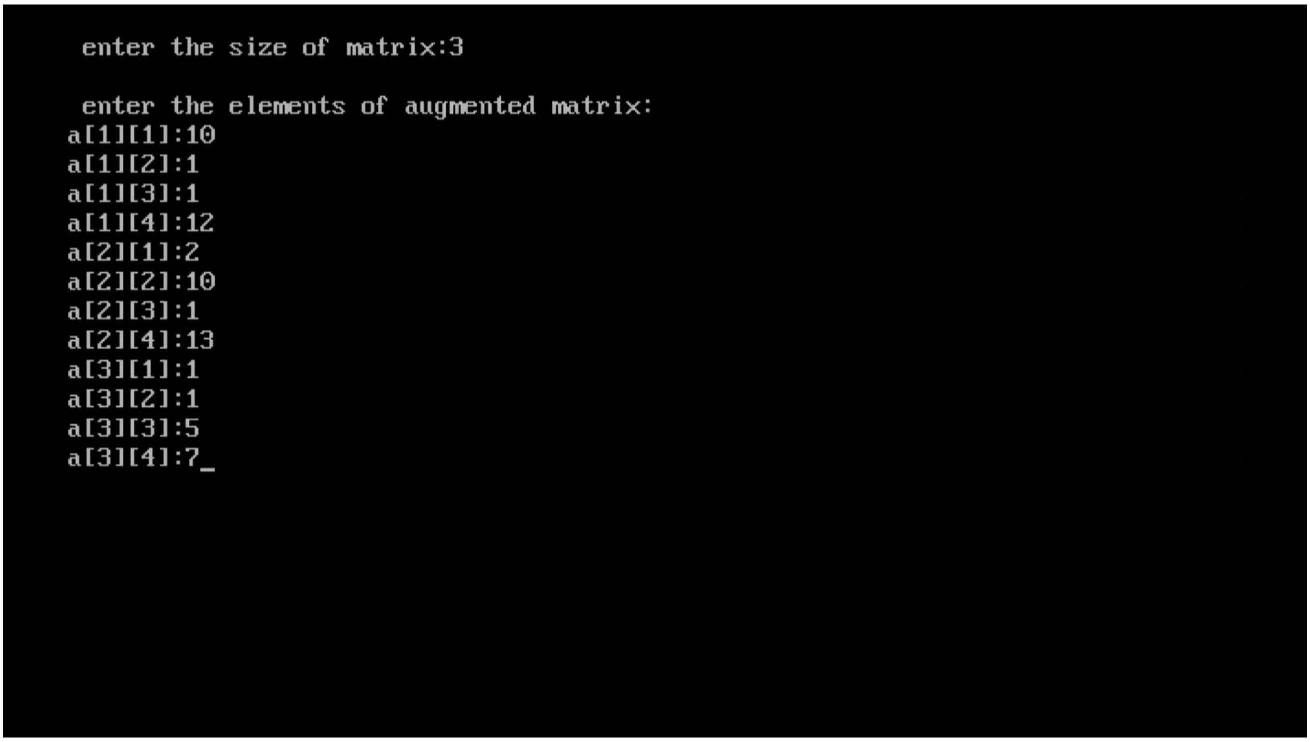
14.Stop



CODE:

```
#include<stdio.h>
#include<conio.h>
void main()
{
int i,j,k,n;
float a[20][20],c,x[10];
clrscr();
printf("\n enter the size of matrix:");
scanf("%d",&n);
printf("\n enter the elements of augmented matrix:\n");
for(i=1;i<=n;i++)
{
for(j=1;j<=(n+1);j++)
{
printf("a[%d][%d]:",i,j);
scanf("%f",&a[i][j]);
}
}
for(j=1;j<=n;j++)
{
for(i=1;i<=n;i++)
{
if(i!=j)
{
c=a[i][j]/a[j][j];
for(k=1;k<=n+1;k++)
{
a[i][k]=a[i][k]-c*a[j][k];}
}
}
printf("\n the solution is :\n");
for(i=1;i<=n;i++)
{
x[i]=a[i][n+1]/a[i][i];
printf("\n x%d=%f\n",i,x[i]);
```

```
}
}
getch();
}
```



Newton Forward Method

Algorithm:

1. Start
2. Read number of data (n)
3. Read data points for x and y:
   For i = 0 to n-1
      Read Xi and Yi,0
   Next i
4. Read calculation point where derivative is required (xp)
5. Set variable flag to 0

6. Check whether given point is valid data point or not. If it is valid point then get its position at variable index

```
For i = 0 to n-1

    If |xp - Xi| < 0.0001
        index = i
        flag = 1
        break from loop
    End If
Next i
```

7. If given calculation point (xp) is not in x-data then terminate the process.

```
If flag = 0
    Print "Invalid Calculation Point"
    Exit
End If
```

8. Generate forward difference table

```
For i = 1 to n-1
    For j = 0 to n-1-i
        Yj,i = Yj+1,i-1 - Yj,i-1
    Next j
Next i
```

9. Calculate finite difference: h = X1 - X0

10. Set sum = 0 and sign = 1

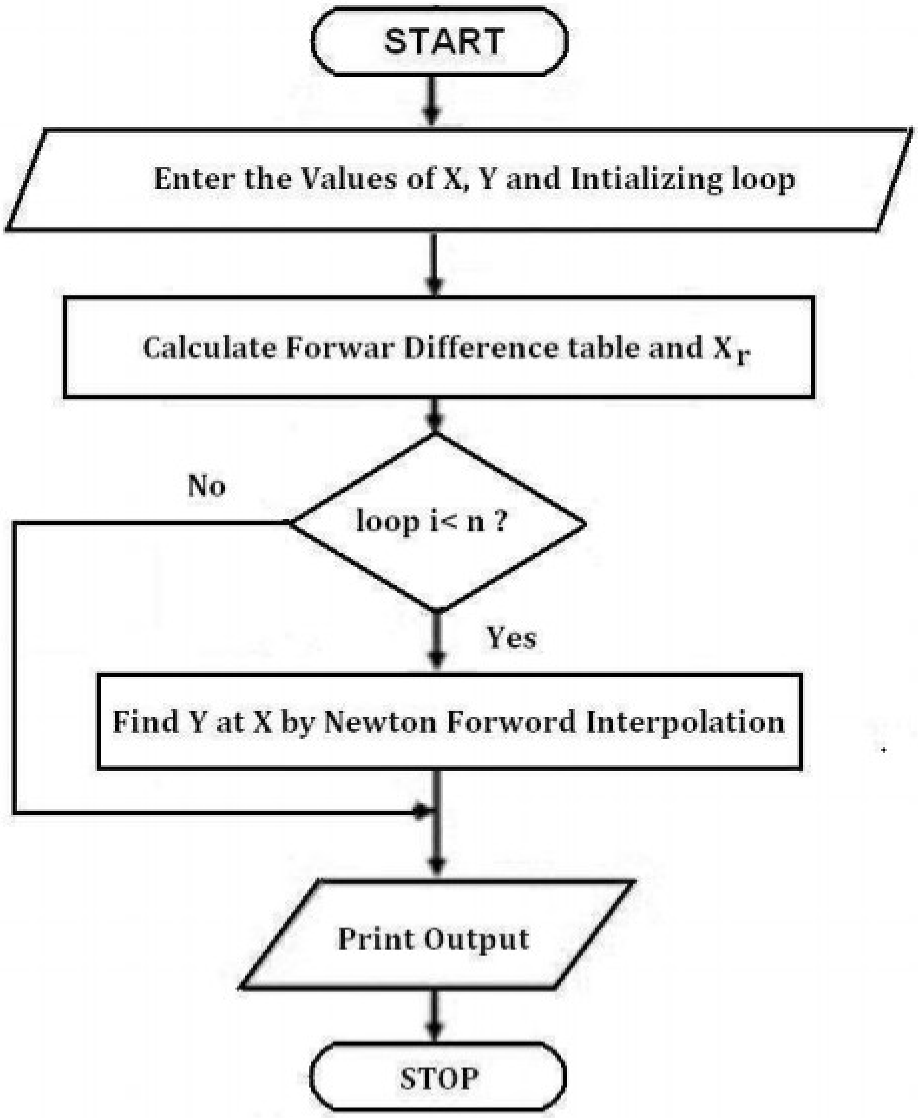
11. Calculate sum of different terms in formula to find derivatives using Newton's forward difference formula:

```
For  i = 1 to n-1-index
    term = (Yindex, i)i / i
    sum = sum + sign * term
    sign = -sign
Next i
```

12. Divide sum by finite difference (h) to get result first_derivative = sum/h

13. Display value of first_derivative

14. Stop



Code:

```
#include<stdio.h>
#include<conio.h>
#define MAXN 100
#define ORDER 4

main()
```

```
    {
        float ax[MAXN+1], ay [MAXN+1], diff[MAXN+1]
    [ORDER+1], nr=1.0, dr=1.0,x,p,h,yp;
        int n,i,j,k;
        printf("\nEnter the value of n:\n");
        scanf("%d",&n);

        printf("\nEnter the values in form x,y:\n");
        for (i=0;i<=n;i++)
        scanf("%f %f",&ax[i],&ay[i]);
        printf("\nEnter the value of x for which the value of y is wanted:
    \n");
        scanf("%f",&x);
        h=ax[1]-ax[0];
        for (i=0;i<=n-1;i++)
            diff[i][1] = ay[i+1]-ay[i];
        for (j=2;j<=ORDER;j++)
            for(i=0;i<=n-j;i++)
            diff[i][j] = diff[i+1][j-1] - diff[i][j-1];
        i=0;
        while (!(ax[i]>x))
            i++;
        i--;
        p = (x-ax[i])/h;
        yp = ay[i];
        for (k=1;k<=ORDER;k++)
        {
            nr *=p-k+1;
            dr *=k;
            yp +=(nr/dr)*diff[i][k];
        }
        printf("\nWhen x = %6.1f, corresponding y = %6.2f\n",x,yp);
    getch();
    return 0;
}
```

```
Enter the value of n:
6

Enter the values in form x,y:
100 10.63
150 13.03
200 15.04
250 16.81
300 18.82
350 19.90
400 21.27

Enter the value of x for which the value of y is wanted:
218

When x =  218.0, corresponding y =  15.48
```

Newton Backward Method

Algorithm:

1. Start
2. Read number of data (n)
3. Read data points for x and y:

```
    For i = 0 to n-1
        Read Xi and Yi,0
    Next i
```

4. Read calculation point where derivative is required (xp)
5. Set variable flag to 0
6. Check whether given point is valid data point or not.
   If it is valid point then get its position at variable index

```
    For i = 0 to n-1

        If |xp - Xi| < 0.0001
            index = i
            flag = 1
            break from loop
        End If

    Next i
```

7. If given calculation point (xp) is not in
   x-data then terminate the process.

```
    If flag = 0
        Print "Invalid Calculation Point"
```

```
        Exit
    End If
```

8. Generate backward difference table

```
    For i = 1 to n-1

        For j = n-1 to i (Step -1)
            Yj,i = Yj,i-1 - Yj-1,i-1
        Next j

    Next i
```

9. Calculate finite difference: h = X1 - X0

10. Set sum = 0

11. Calculate sum of different terms in formula to find derivatives using Newton's backward difference formula:

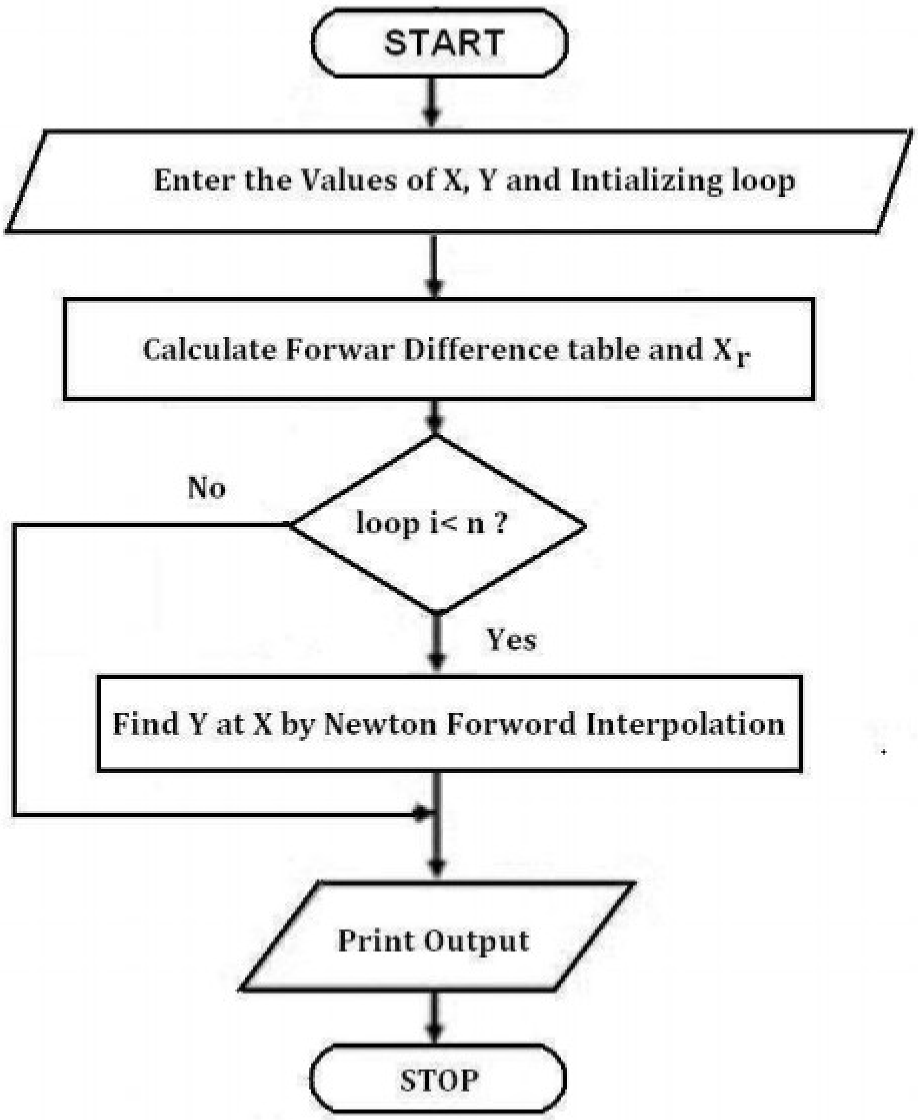
```
     For  i = 1 to index
         term = (Yindex, i)i / i
         sum = sum + term
     Next i
```

12. Divide sum by finite difference (h) to get result

```
     first_derivative = sum/h
```

13. Display value of first_derivative

14. Stop

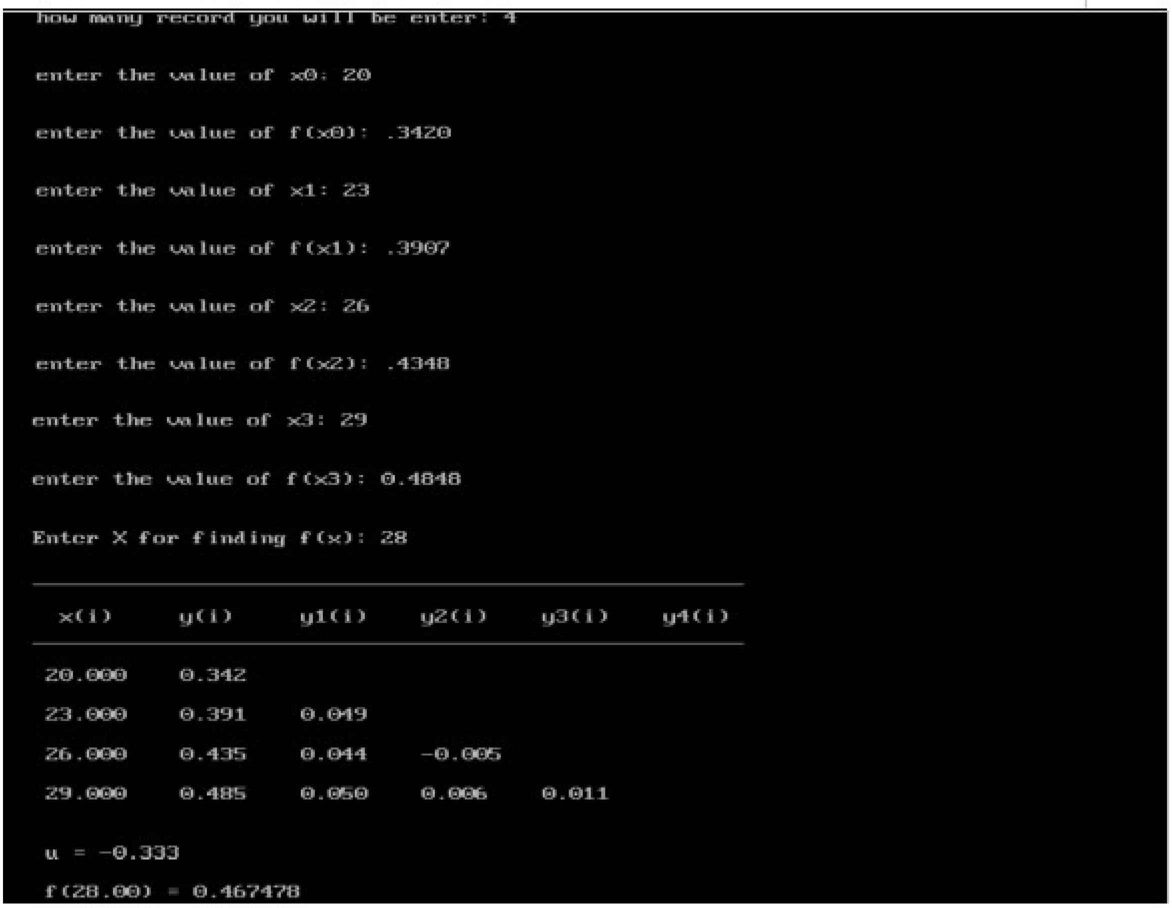


Code:

```
#include<stdio.h>
#include<conio.h>
#include<math.h>
void main()
{
  float x[10],y[10][10],sum,p,u,temp;
  int i,n,j,k=0,f,m;
  float fact(int);
  clrscr();
  printf("\nhow many record you will be enter: ");
```

```
  scanf("%d",&n);
  for(i=0; i<n; i++)
  {
   printf("\n\nenter the value of x%d: ",i);
   scanf("%f",&x[i]);
   printf("\n\nenter the value of f(x%d): ",i);
   scanf("%f",&y[k][i]);
  }
  printf("\n\nEnter X for finding f(x): ");
  scanf("%f",&p);

  for(i=1;i<n;i++)
  {
    for(j=i;j<n;j++)
    {
     y[i][j]=y[i-1][j]-y[i-1][j-1];
    }
  }
  printf("\
n______________________________________________________________\
n");
  printf("\n  x(i)\t   y(i)\t    y1(i)    y2(i)    y3(i)    y4(i)");
  printf("\
n______________________________________________________________\
n");
  for(i=0;i<n;i++)
  {
    printf("\n %.3f",x[i]);
    for(j=0;j<=i;j++)
    {
     printf("   ");
     printf(" %.3f",y[j][i]);
    }
   printf("\n");
  }

  i=0;
  do
  {
   if(x[i]<p && p<x[i+1])
    k=1;
   else
```

```
    i++;
   }while(k != 1);
  f=i+1;
  u=(p-x[f])/(x[f]-x[f-1]);
  printf("\n\n u = %.3f ",u);

  n=n-i+1;
  sum=0;
  for(i=0;i<n;i++)
  {
   temp=1;
   for(j=0;j<i;j++)
   {
    temp = temp * (u + j);
   }
    m=fact(i);
    sum = sum + temp*(y[i][f]/m);
  }
  printf("\n\n f(%.2f) = %f ",p,sum);
  getch();
}

float fact(int a)
{
  float fac = 1;

  if (a == 0)
   return (1);
  else
   fac = a * fact(a-1);

  return(fac);
}
```



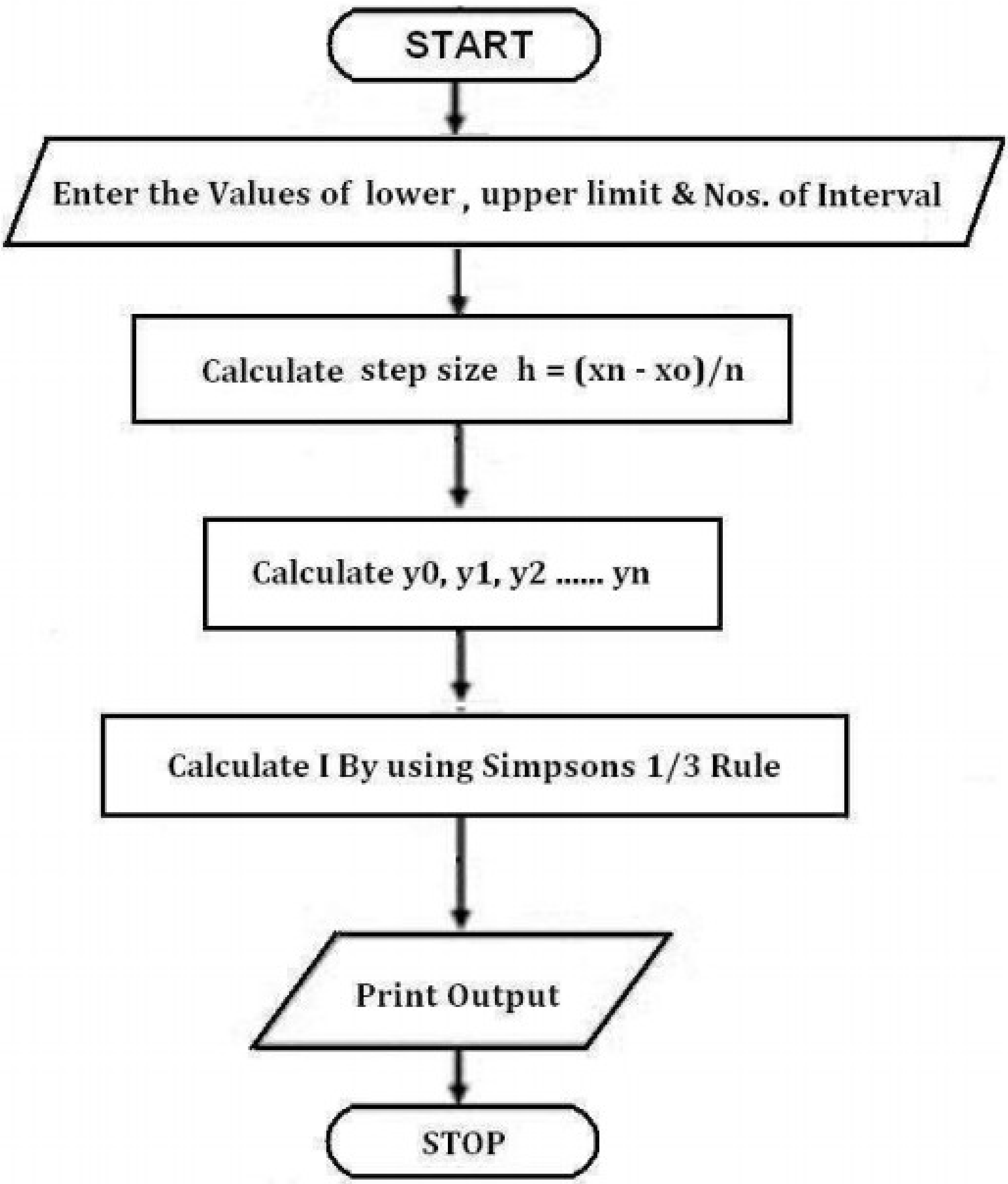
```
how many record you will be enter: 4

enter the value of x0: 20

enter the value of f(x0): .3420

enter the value of x1: 23

enter the value of f(x1): .3907

enter the value of x2: 26

enter the value of f(x2): .4348

enter the value of x3: 29

enter the value of f(x3): 0.4848

Enter X for finding f(x): 28

____________________________________________________________
  x(i)      y(i)      y1(i)     y2(i)     y3(i)     y4(i)
____________________________________________________________
 20.000    0.342
 23.000    0.391     0.049
 26.000    0.435     0.044     -0.005
 29.000    0.485     0.050     0.006     0.011

 u = -0.333
 f(28.00) = 0.467478
```

Simpson’s 1/3rd rule

Algorithm:

1. Start.
2. Define an equation for f(x).
3. Define a method by the name of simpsonsRule().
4. Take the values of lower and upper limits of integration as well as the number of sub-intervals as inputs from the user.
5. Initialize a variable ifx with 0.
6. Find the value of h. [h = (b-a)/n]
7. Add the values of f(a) and f(b) to ifx.
8. Set the value of i = a+h.
9. Multiply the value of f(i) by 4 and add the result to ifx.
10. Add (2*h) to the existing value of i.
11. Repeat steps 8, 9 and 10 till the value of i is less than b.
12. Set the value of j = a+(2*h).
13. Multiply the value of f(j) by 2 and add the result to ifx.
14. Add (2*h) to the existing value of j.
15. Repeat steps 12, 13 and 14 till the value of j is less than b.

16. Multiply the final value of ifx with h and divide the result by 3 and store it back in ifx.
17. Print the value of integration ifx.
18. Stop.



Program:

```
#include<stdio.h>
```

```
#include<conio.h>
 float y(float x)
 {
     return x*x/(1+x*x*x);
 }
void main()
{
    float x0,xn,h,s,sum;
    int i,n;
    puts("\n Enter number of subdivision i.e n");
    scanf("%d",&n);
    puts("\n Enter lower limit of integrals i.e x0");
    scanf("%f",&x0);
    puts("\n Enter upper limit of integral i.e xn");
    scanf("%f",&xn);

    h = (xn-x0)/n;
    s = y(x0)+ y(xn)+ 4*y(x0+h);

    for(i=3;i<=n-1;i+=2)
        s+=4*y(x0+i*h)+2*y(x0+(i-1)*h);
    sum=s*(h/3);
    printf("\n Value of integral is %0.31f \n",sum);
}
```

Trapezoidal rule

Algorithm:

1. Start
2. Input Lower limit a
3. Input Upper Limit b
4. Input number of sub intervals n
5. h=(b-a)/n

6.sum=0

7.sum=fun(a)+fun(b)

8.fori=1; i<n; i++

9.sum +=2*fun(a+i)

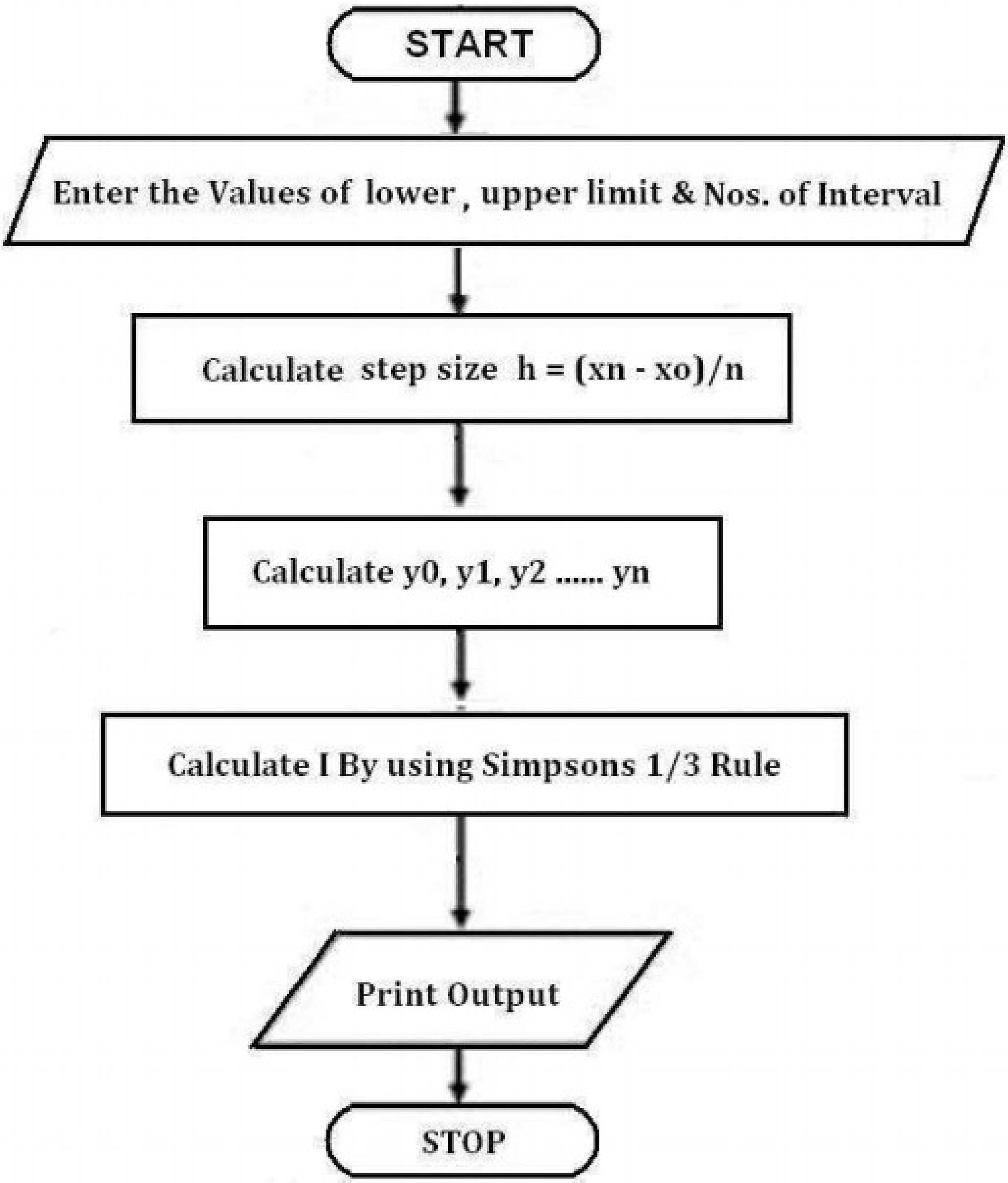
10. End Loop i

11.result =sum*h/2;

12. Print Output result
13. End of Program
14. Start of Section fun

15.temp = 1/(1+(x*x))

16. Return temp
17. Stop



code:

```
#include<math.h>
#define f(x) 1/(1+pow(x,2))

int main()
{
float lower, upper, integration=0.0, stepSize, k;
int i, subInterval;

printf("Enter lower limit of integration: ");
scanf("%f", &lower);
```

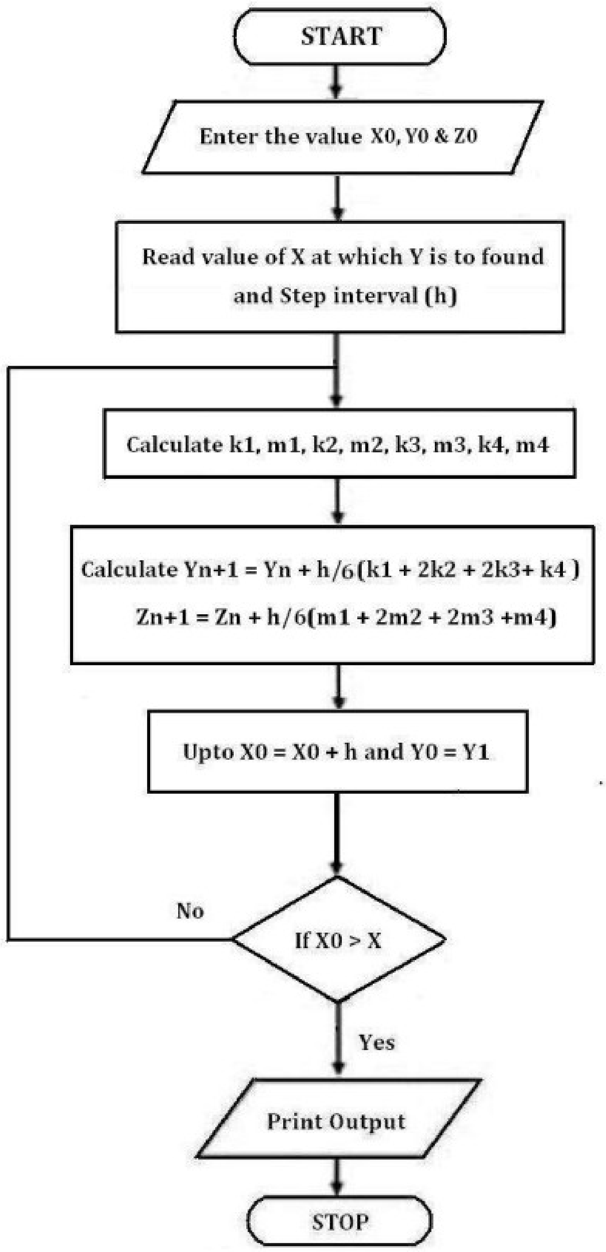
```
printf("Enter upper limit of integration: ");
scanf("%f", &upper);
printf("Enter number of sub intervals: ");
scanf("%d", &subInterval);

stepSize = (upper - lower)/subInterval;
integration = f(lower) + f(upper);
for(i=1; i<= subInterval-1; i++)
{
k = lower + i*stepSize;
integration = integration + 2 * f(k);
printf("%f\t %f\n",k,integration);
}
integration = integration * stepSize/2;
printf("\nRequired value of integration is: %.3f", integration);
getch();
return 0;
}
```

```
Enter lower limit of integration: 0
Enter upper limit of integration: 1
Enter number of sub intervals: 10
0.100000        3.480198
0.200000        5.403275
0.300000        7.238137
0.400000        8.962276
0.500000        10.562276
0.600000        12.032864
0.700000        13.375146
0.800000        14.594658
0.900000        15.699630

Required value of integration is: 0.785
Process returned 0 (0x0)   execution time : 25.197 s
Press any key to continue.
```

Euler's Method

Algorithm:

Step 1. Start;
Step 2. Input function f(x, y);
Step 3. Read x0, y0, xn, h;
/* x0, y0 are initial values and xn is the last value of x where the process will terminate, h is the step size */
Step 4. for x = x0 to xn step h do
y = y0 + h * f(x, y0);
Print x, y;
y0 = y;
end for loop;
Step 5. Stop;



Code:

```
include<stdio.h>
#include<conio.h>
float fun(float x,float y)
{
    float f;
    f=y*y-x*x;
    return f;
}
main()
{
    float a,b,x,y,h,t,k;
    clrscr();
    printf("\nEnter x0,y0,h,xn: ");
    scanf("%f%f%f%f",&a,&b,&h,&t);
    x=a;
    y=b;
    printf("\n  x\t  y\n");
    while(x<=t)
    {
        k=h*fun(x,y);
        y=y+k;
        x=x+h;
        printf("%0.3f\t%0.3f\n",x,y);
    }
getch();
return 0;
}
```

Output:

Runge-Kutta 4th order method

Algorithm:

1. Start

2. Define function f(x,y)

3. Read values of initial condition(x0 and y0), number of steps (n) and calculation point (xn)

4. Calculate step size (h) = (xn - x0)/n

5. Set i=0

6. Loop

    k1 = h * f(x0, y0)
    k2 = h * f(x0+h/2, y0+k1/2)
    k3 = h * f(x0+h/2, y0+k2/2)
    k4 = h * f(x0+h, y0+k3)

    k = (k1+2*k2+2*k3+k4)/6

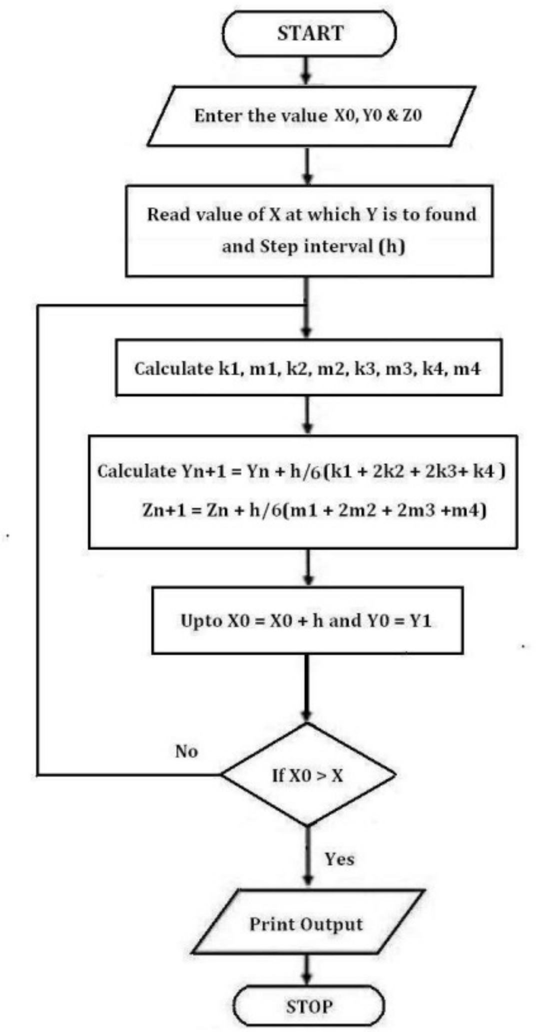
    yn = y0 + k

    i = i + 1
    x0 = x0 + h
    y0 = yn

   While i < n

7. Display yn as result

8. Stop



Code:

```
#include<stdio.h>
#include <math.h>
#include<conio.h>
#define F(x,y)  y-x
void main()
{
    double y0,x0,y1,n,h,f,k1,k2,k3,k4;
    clrscr();
    printf("\nEnter the value of x0: ");
    scanf("%lf",&x0);
    printf("\nEnter the value of y0: ");
    scanf("%lf",&y0);
    printf("\nEnter the value of h: ");
    scanf("%lf",&h);
    printf("\nEnter the value of last point: ");
    scanf("%lf",&n);
    for(; x0<n; x0=x0+h)
    {
        f=F(x0,y0);
        k1 = h * f;
        f = F(x0+h/2,y0+k1/2);
        k2 = h * f;
        f = F(x0+h/2,y0+k2/2);
        k3 = h * f;
        f = F(x0+h/2,y0+k2/2);
        k4 = h * f;
        y1 = y0 + ( k1 + 2*k2 + 2*k3 + k4)/6;
        printf("\n\n  k1 = %.4lf  ",k1);
        printf("\n\n  k2 = %.4lf ",k2);
        printf("\n\n  k3 = %.4lf ",k3);
        printf("\n\n  k4 = %.4lf ",k4);
        printf("\n\n  y(%.4lf) = %.3lf ",x0+h,y1);
        y0=y1;
    }
    getch();
}
```

```
Enter the value of x0: 0

Enter the value of y0: 2

Enter the value of h: 0.1

Enter the value of last point: 0.4_

  k3 = 0.2276

  k4 = 0.2276

  y(0.2000) = 2.438

  k1 = 0.2238

  k2 = 0.2399

  k3 = 0.2407

  k4 = 0.2407

  y(0.3000) = 2.675

  k1 = 0.2375

  k2 = 0.2544

  k3 = 0.2552

  k4 = 0.2552

  y(0.4000) = 2.927 _
```