Aim: To find the root of an equation using Bisection Method.

Algorithm:

1. Enter the initial guesses: a and b.
2. Enter the accuracy, eps.
3. If f(a)*f(b)<0,

   then continue,

   else

   ask the user to enter different values of a and b.
4. While (|a-b|<eps)

   Calculate c= (a+b)/2.

   If f(a)*f(c)>0

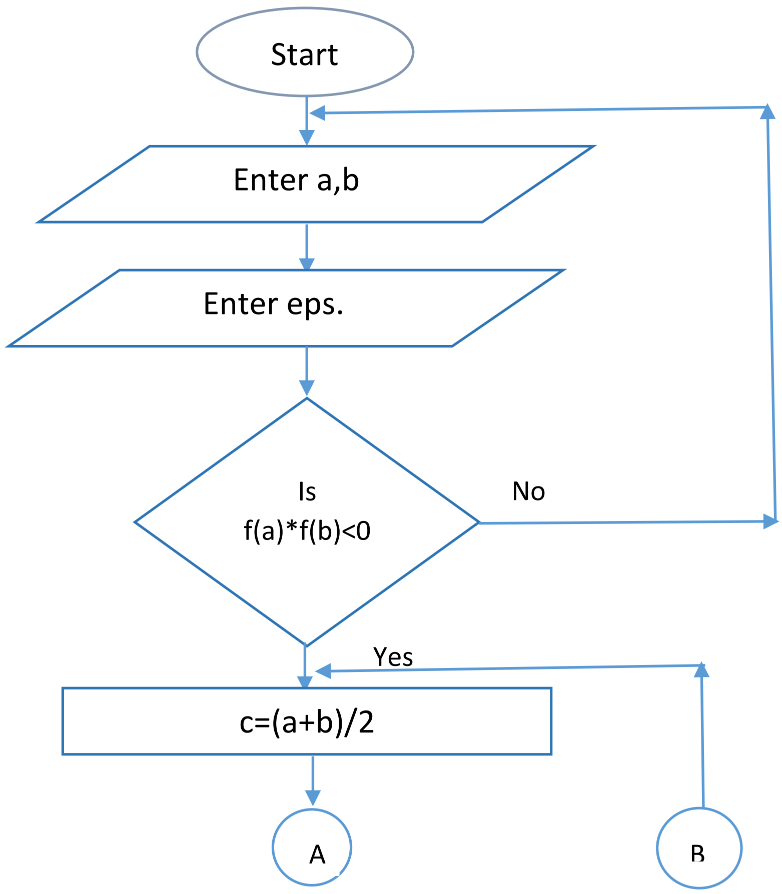
   b=c

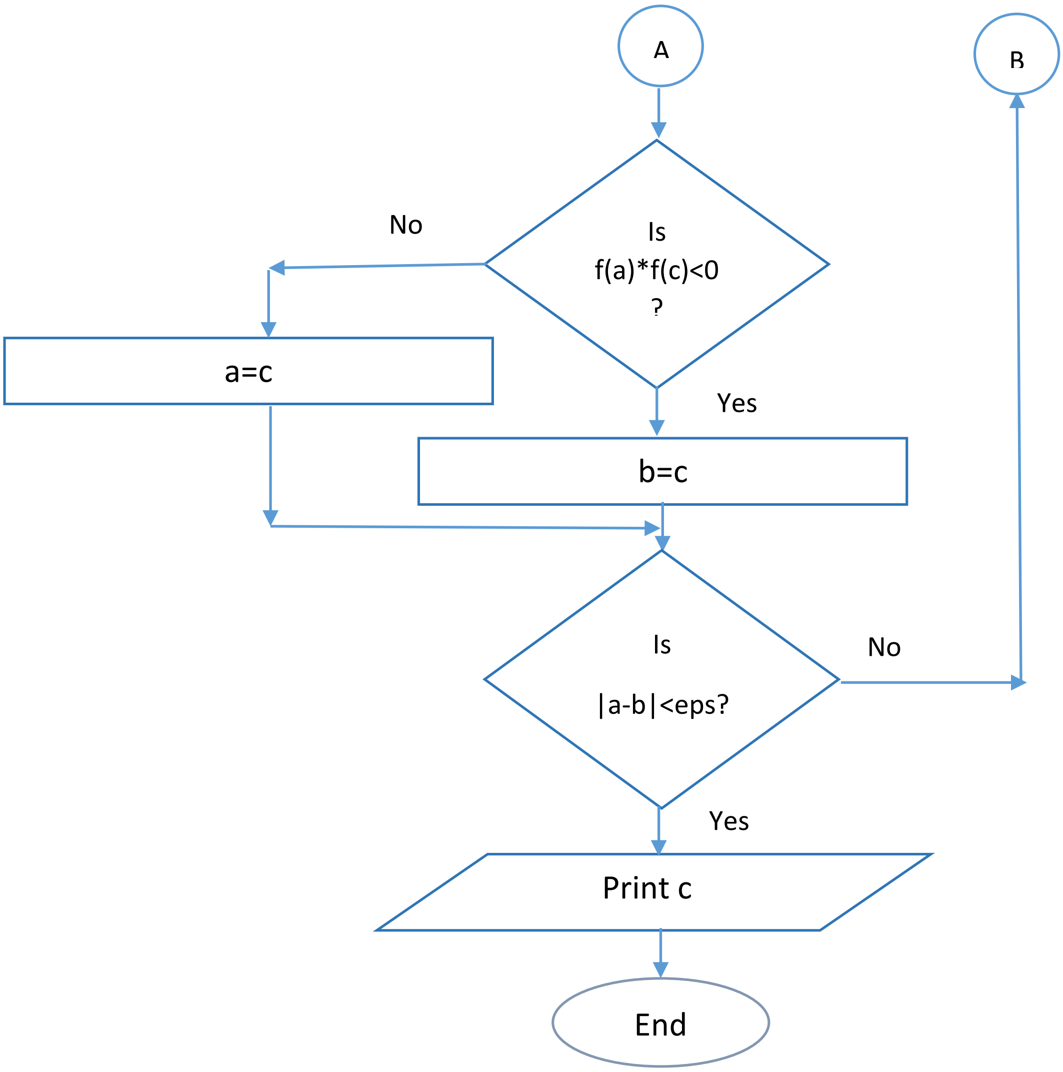
   Else

   a=c

   End While.
5. Print ‘c’ which is the required root between a & b.
6. End.

Flow Chart:





Program:

```
//bisection method
#include<iostream>
#include<cmath>
#include<iomanip>
using namespace std;
double f(double x);    //declare the function for the given equation
double f(double x)    //define the function here, ie give the equation
{
    double a=x*x-4.0;    //write the equation whose root is to be determined
    return a;
}
int main()
{
    cout.precision(5);        //set the precision
    cout.setf(ios::fixed);
    double a,b,c,e,fa,fb,fc;    //declare some needed variables
    a:cout<<"Enter the initial guesses:\na=";    //Enter the value of a(set a label('a:') for later use with
goto)
    cin>>a;
    cout<<"\nb=";            //Enter the value of b
    cin>>b;
    cout<<"\nEnter the degree of accuracy desired"<<endl;    //Enter the accuracy
    cin>>e;                //e stands for  accuracy
```

```
   int iter=0;
   if (f(a)*f(b)>0)        //Check if a root exists between a and b
   {               //If f(a)*f(b)>0 then the root does not exist between a and b
       cout<<"Please enter a different intial guess"<<endl;
       goto a;            //go back to 'a' ie 17 and ask for different values of a and b
   }
   else                //else a root exists between a and b
   {
   cout<<"Iter"<<setw(14)<<"a"<<setw(18)<<"b"<<setw(18)<<"c"<<setw(18)<<"f(c)"<<setw(18)<<"|a-
b|"<<endl;
   cout<<"----------------------------------------------------------------------------------------------\n";
   while (fabs(a-b)>=e)        /*if the mod of a-b is greater than the accuracy desired
keep                        bisecting the interval*/
   {
       c=(a+b)/2.0;        //bisect the interval and find the value of c
       fa=f(a);
       fb=f(b);
       fc=f(c);
       iter++;
       cout<<iter<<setw(18)<<a<<setw(18)<<b<<setw(18)<<c<<setw(18)<<fc<<setw(18)<<fabs(a-
b)<<endl;/*print the                          values of a,b,c and fc  after each iteration*/
       if (fc==0)        //if f(c)=0, that means we have found the root of the equation
       {
           cout<<"The root of the equation is "<<c<<endl;;    /*print the root of the
equation                                      and end program*/
           return 0;
       }

       if (fa*fc>0)    //if f(a)xf(c)>0, that means no root exist between a and c
       {
           a=c;    /*hence make a=c, ie make c the starting point of the interval and b
the                    end point*/
       }
       else if (fa*fc<0)
       {
           b=c;    /*this means that a root exist between a and c therfore make c the
end                     point of the interval*/
       }


   }
   }          //The loop ends when the difference between a and b becomes less than the desired
accuracy ie now the value stored in 'c' can be called the approximate root of the equation
   cout<<"The root of the equation is "<<c<<endl;;    //print the root
   return 0;
}
```

Output:

For f(x)=x^2-4:

```
Enter the initial guesses:
a=1

b=2.5

Enter the degree of accuracy desired
.01
Iter            a                 b                 c                f(c)              |a-b|
--------------------------------------------------------------------------------------------
1           1.00000           2.50000           1.75000           -0.93750           1.50000
2           1.75000           2.50000           2.12500            0.51562           0.75000
3           1.75000           2.12500           1.93750           -0.24609           0.37500
4           1.93750           2.12500           2.03125            0.12598           0.18750
5           1.93750           2.03125           1.98438           -0.06226           0.09375
6           1.98438           2.03125           2.00781            0.03131           0.04688
7           1.98438           2.00781           1.99609           -0.01561           0.02344
8           1.99609           2.00781           2.00195            0.00782           0.01172
The root of the equation is 2.00195
```

```
Enter the initial guesses:
a=3

b=4

Enter the degree of accuracy desired
.00001
Please enter a different intial guess
Enter the initial guesses:
a=
```

For f(x)= 3x+sinx-e^x

```
Enter the initial guesses:
a=0

b=1

Enter the degree of accuracy desired
.0001
Iter            a                 b                 c                f(c)              |a-b|
-----------------------------------------------------------------------------------------
1           0.00000           1.00000           0.50000           0.33070           1.00000
2           0.00000           0.50000           0.25000          -0.28662           0.50000
3           0.25000           0.50000           0.37500           0.03628           0.25000
4           0.25000           0.37500           0.31250          -0.12190           0.12500
5           0.31250           0.37500           0.34375          -0.04196           0.06250
6           0.34375           0.37500           0.35938          -0.00262           0.03125
7           0.35938           0.37500           0.36719           0.01689           0.01562
8           0.35938           0.36719           0.36328           0.00715           0.00781
9           0.35938           0.36328           0.36133           0.00227           0.00391
10           0.35938           0.36133           0.36035          -0.00018           0.00195
11           0.36035           0.36133           0.36084           0.00105           0.00098
12           0.36035           0.36084           0.36060           0.00044           0.00049
13           0.36035           0.36060           0.36047           0.00013           0.00024
14           0.36035           0.36047           0.36041          -0.00002           0.00012
The root of the equation is 0.36041
```