Device Simulation Lab Report 2

EE22M303

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Q1: using matrix inversion method solve the following equations and verify answer using slash method.

(a) $2x+y+z=2,\ -x+y-z=3,\ x+2y+3z=-10$

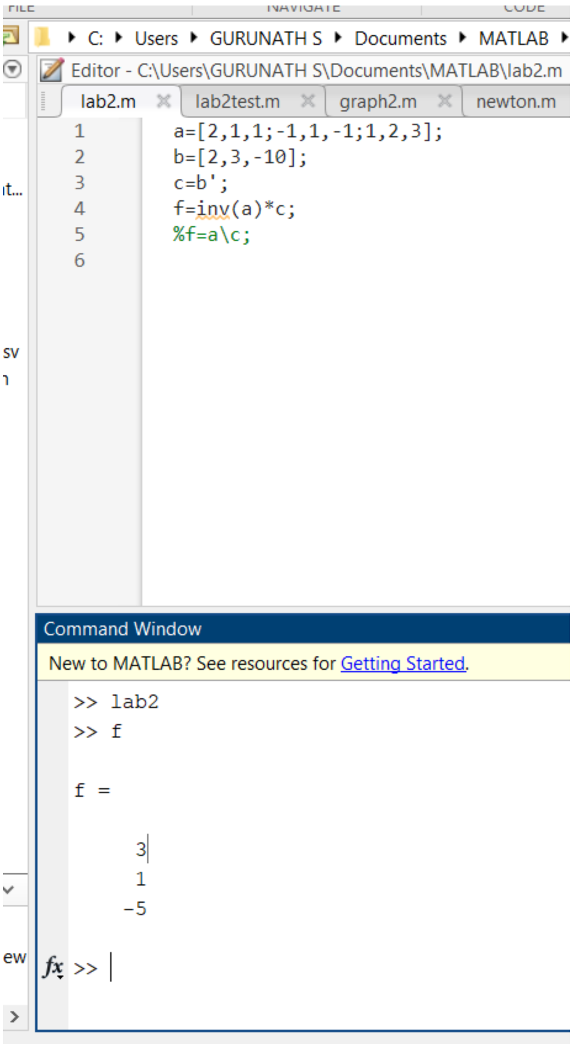
(b) $3x+4y-2z+2w=2;\ 4x+9y-3z+5w=8;\ -2x-3y+7z+6w=10;\ x+4y+6z+7w=2$

Code:

a)

```
a=[2,1,1;-1,1,-1;1,2,3];
b=[2,3,-10];
c=b';
f=inv(a)*c;
%f=a\c;
```

Output:



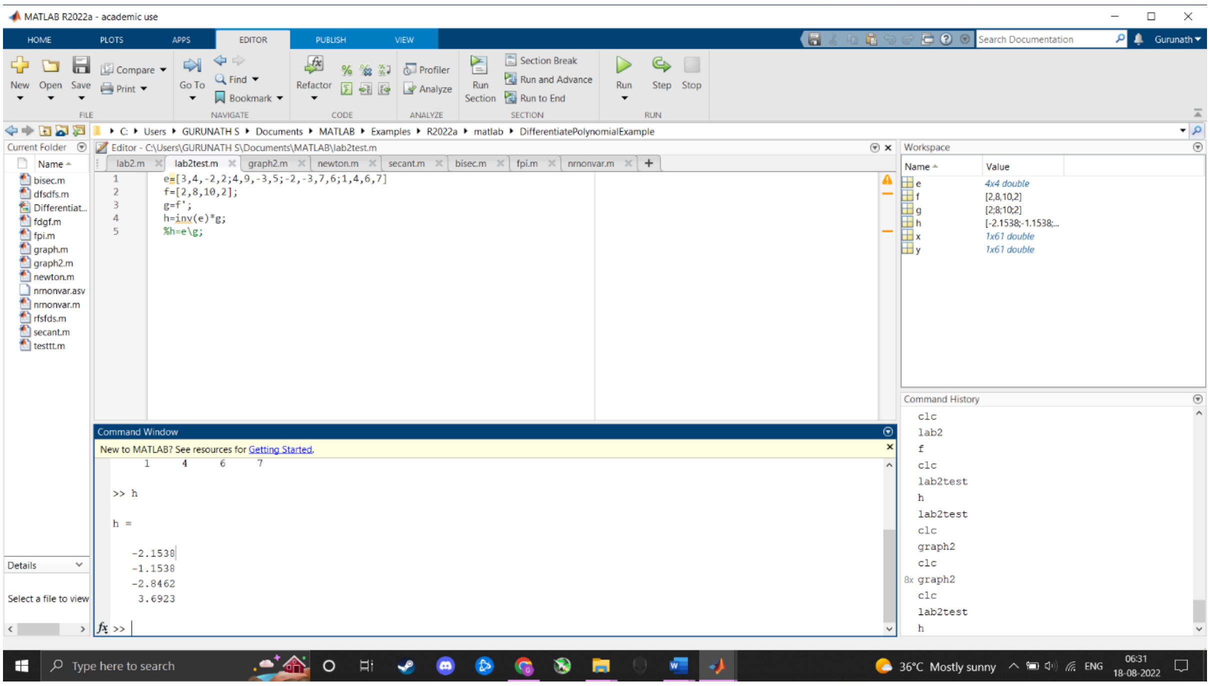
b)

code:

```
e=[3,4,-2,2;4,9,-3,5;-2,-3,7,6;1,4,6,7]
```

```
f=[2,8,10,2];
g=f';
h=inv(e)*g;
%h=e\g;
```

Output:



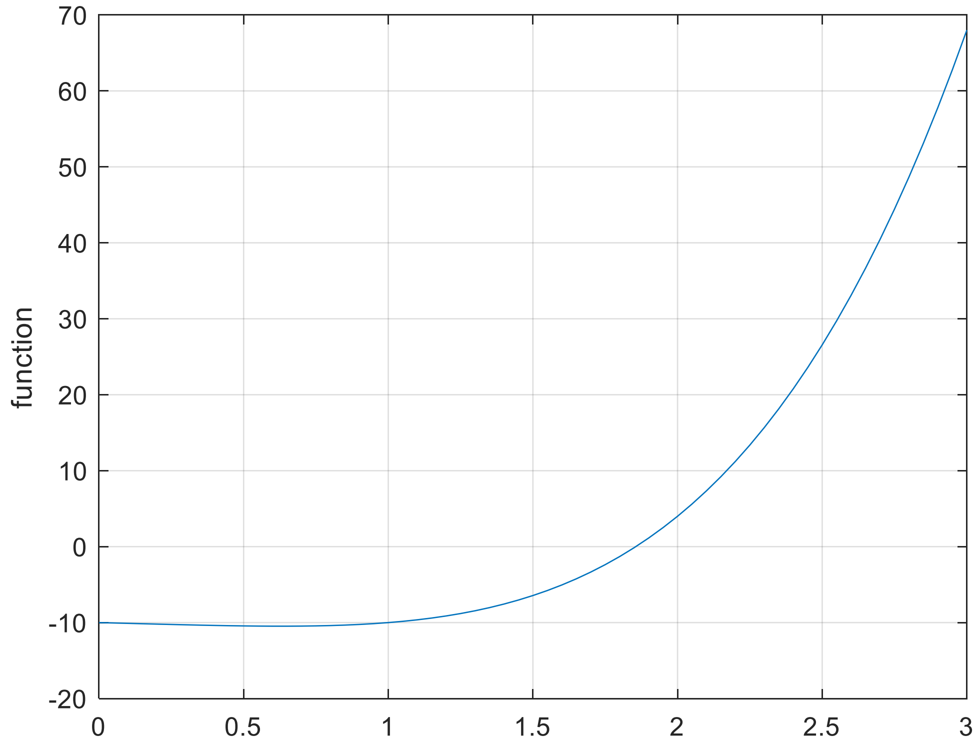
Q2: Consider the function $f(x)=x^4 -x-10$. Find out the roots of the function f(x)=0 using the methods mentioned below:

a) Plot the function and see where the value is becoming zero.

Code:

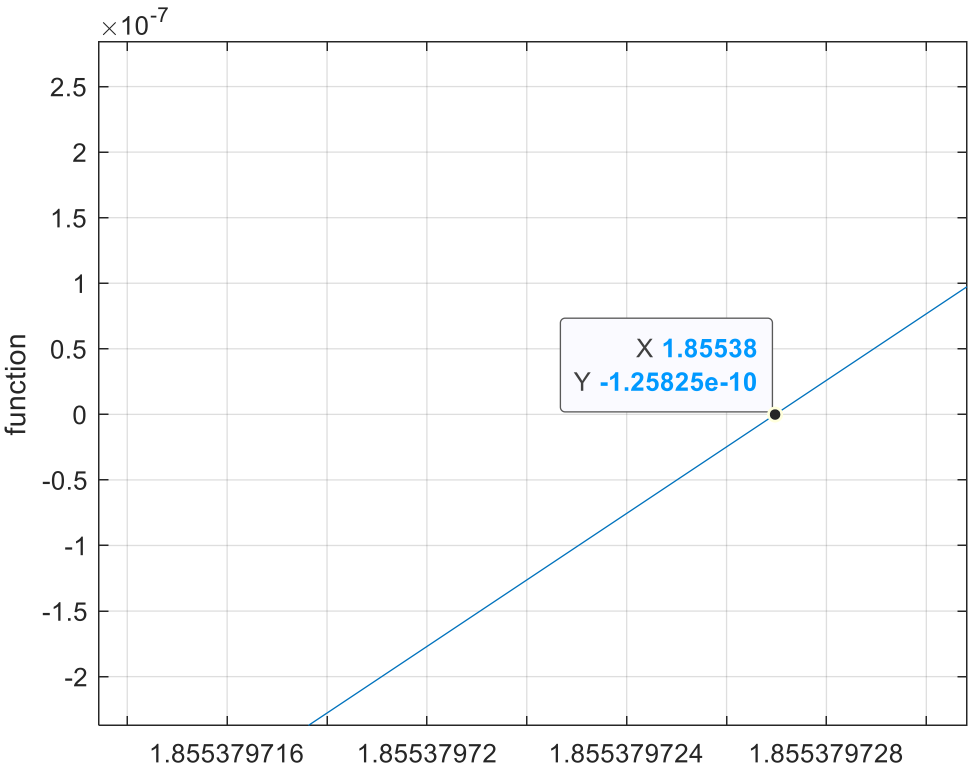
```
x = 0:0.05:3;
y =x.^4-x-10;
plot(x,y);
yline(0);
ylabel('function');
grid on;
```

output:



value

at which value becomes 0 :

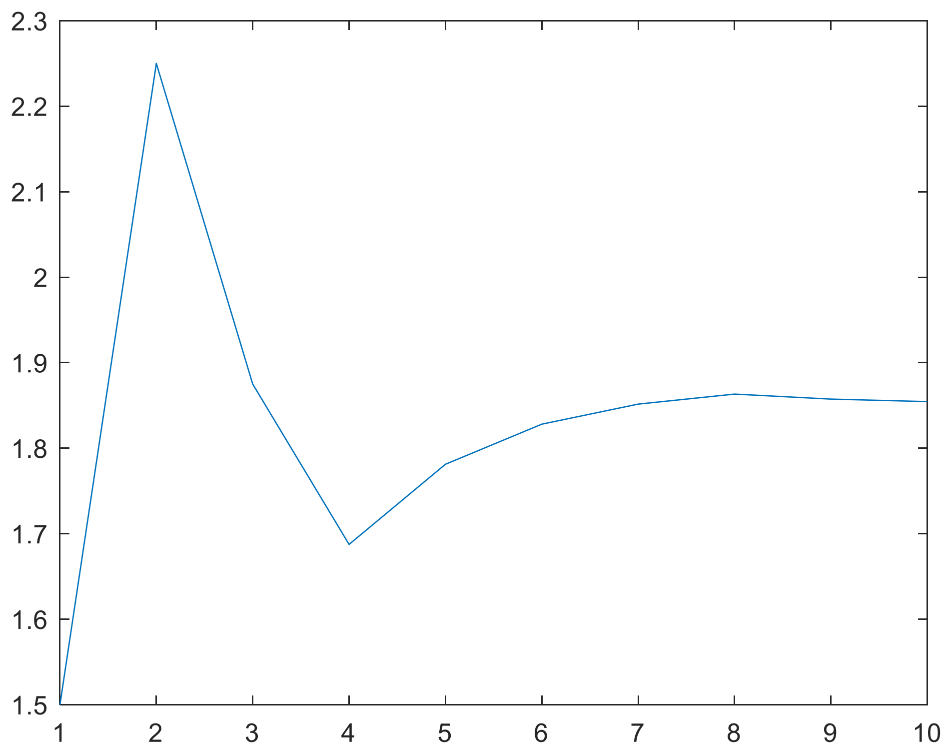


b) Bisection method (You can take a=1 and b=3. Can you obtain some other solution by choosing different values of a & b?). Plot the rate of convergence (that is value of c=0.5*(a+b) vs the iteration no.)

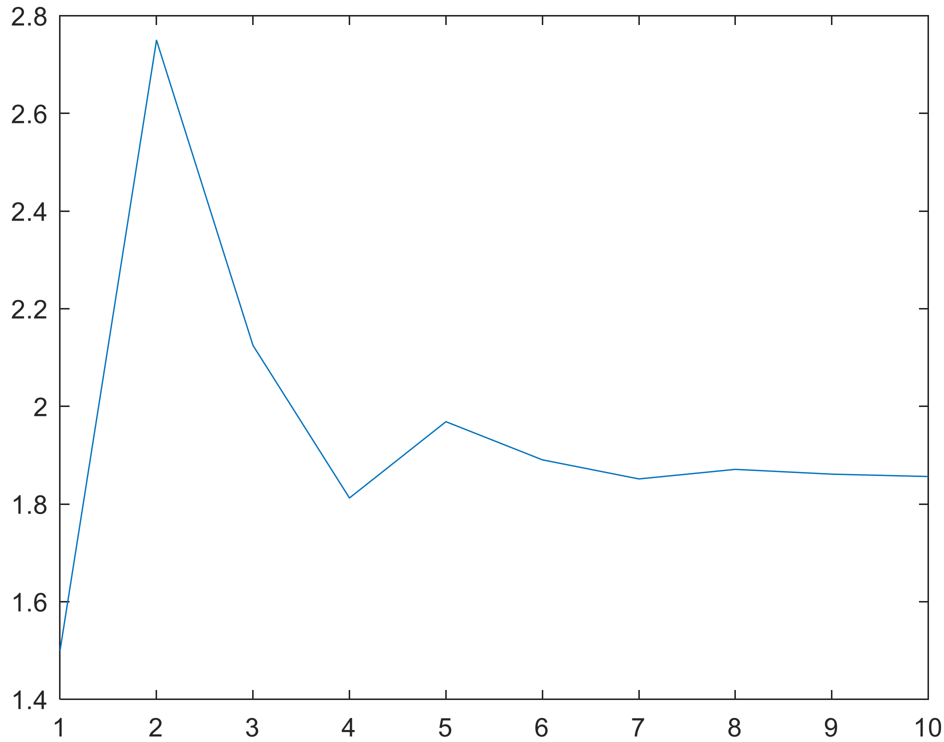
code: for a=1 and b=3

```
f=@(x) x^4-x-10;
a=0;    %a=-1,b=4 next
b=3;
k=[];
r=[];
if f(a)*f(b)<0
for n = 1:10
        c=(a+b)/2;
        k=[k c];
        r=[r n];
        if f(a)*f(c)<0
            b=c;
        else
            a=c;
        end
end
else
    disp('no roots')
end
%plot(c vs n)
plot(r,k);
```

plot:



code for a=-1 and b=4




```
Yes the same solution could be obtained
```

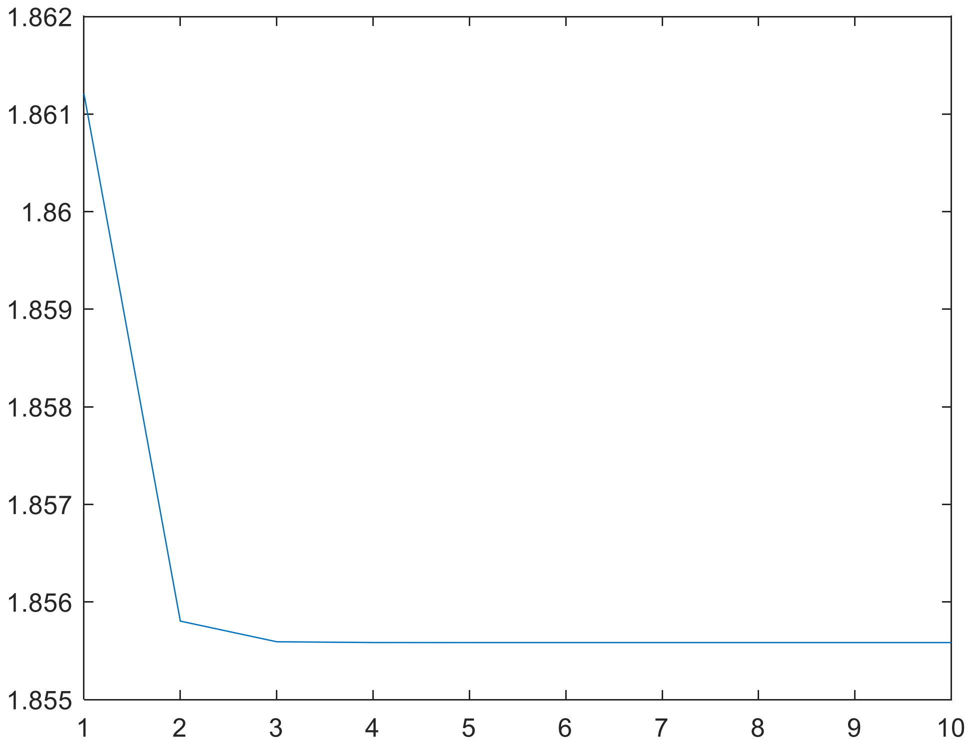
c) Fixed point iteration method (Take g(x) as $(x+10)^{0.25}$ and initial guess of 2. Do you see convergence to one solution? Take g(x) as $10/(x^3 -1)$ and initial guess of 2. Do you see convergence? Take g(x) as $(x+10)^{0.5}$ /x and initial guess of 2. Do you see convergence? Plot the rate of convergence for the cases where the solution is converging. Comment on the nature of convergence by finding out g'(x) at the initial guess value of x=2)

code:

```
g=@(x) (x+10)^(1/4);
h=@(x) 10/(x^3-1);
f=@(x)((x+10)^(1/2))/x;
gd=@(x) (1/4)*(x+10)^(-3/4);
hd=@(x) (-10/(x^3-1)^2)*3*(x^2);
fd=@(x) (1/2)*(((1/x)+10/(x^2))^(1/2))*((-1/(x^2))-20/(x^3));
%first function alone converges since mod of  derivative of other functions >1

%fpi for g(x)
k=2
r=[];
j=[];
for i = 1:10
   z=g(k);
   r=[r i];
   j=[j z];
   k=z;
end
```

```
%plot
plot(r,j);
```



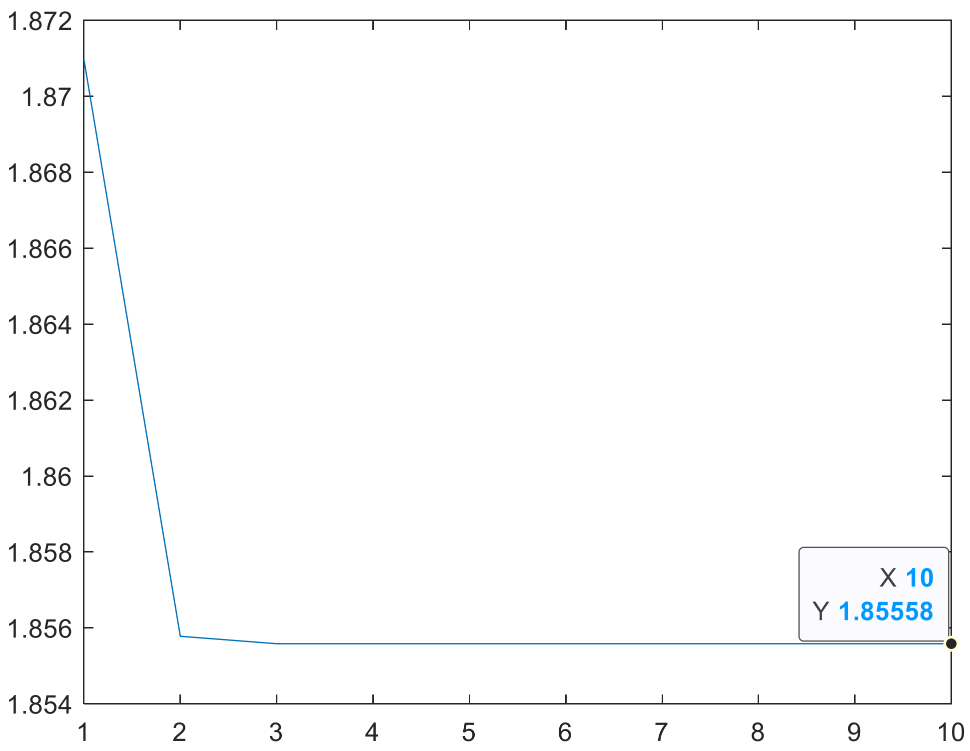
Since mod of derivative of g(x) is less than 1 it will converge as shown in the figureee

d) Newton's method (Take initial guess of 2 and see what solution you get. Can you obtain some other solution by choosing a different initial guess? Also plot the rate of convergence.)

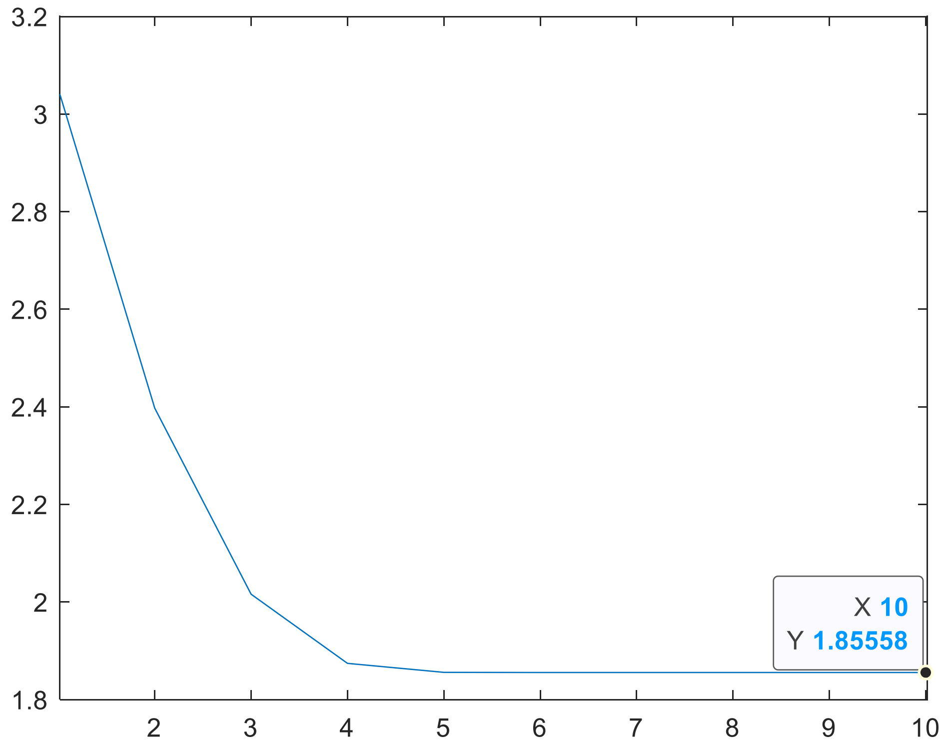
code:

for initial guess of 2

```
f = @(x) x^4-x-10;
df=@(x) 4*x^3-1;
z=2;
c=[];
it=[];
for n = 1:10
    y=z-f(z)/df(z)
    c=[c n];
   it=[it y];
   z=y;
end
%plot
plot(c,it);
```



For initial guess as 4



Here we can see for both initiall guess it converges to same value

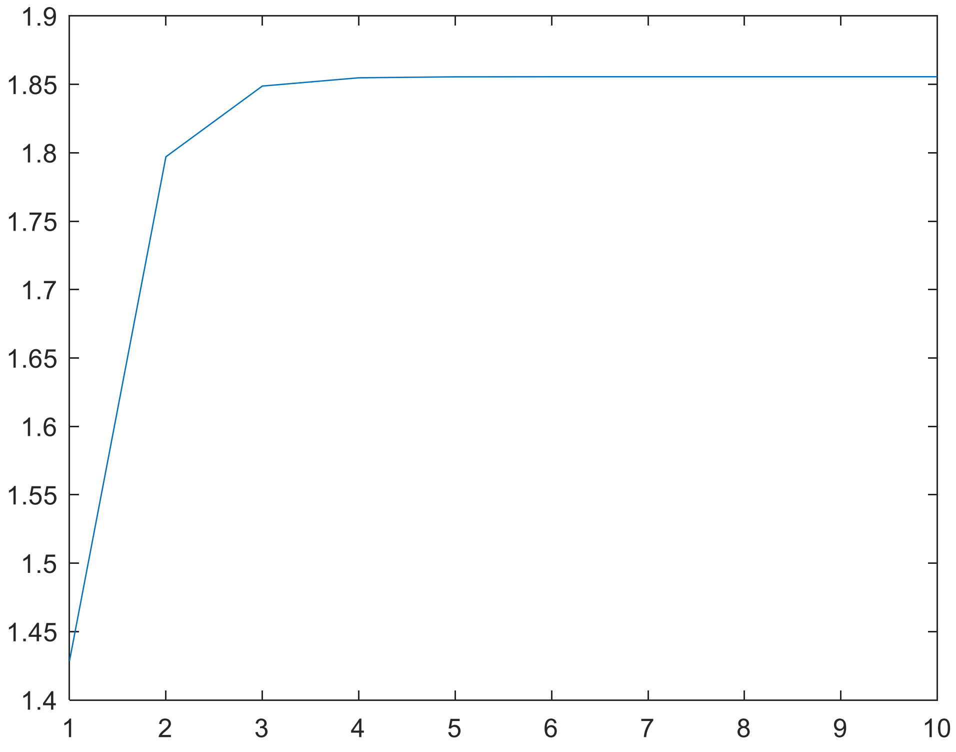
Secant method

Code:

```
f=@(x) x^4-x-10;
a=0;
b=2;
k=[]
r=[]
for n = 1:10
    z=(a.*f(b)-b.*f(a))/(f(b)-f(a));
    k=[k n];
    r=[r z];
    if f(a)*f(z)<0
        b=z;
    else
        a=z;
    end

end
plot(k,r);
```

plot:



Q4: Use the Newton's method to solve a system of non-linear equations given below

$x_1 + 2x_2 = 2$

$x_1^2 + 4x_2^2 = 4$

code:

```
syms x1 x2
z=[];
a1(x1,x2)=x1+2.*x2-2;
b2(x1,x2)=x1.^2+4.*x2.^2-4;
x=[-5;5];
a1x1(x1,x2)=diff(a1,x1);
a1x2(x1,x2)=diff(a1,x2);

b2x1(x1,x2)=diff(b2,x1);
b2x2(x1,x2)=diff(b2,x2);

a11=matlabFunction(a1);
b22=matlabFunction(b2);

a1x11=matlabFunction(a1x1);
a1x22=matlabFunction(a1x2);

b2x11=matlabFunction(b2x1);
b2x22=matlabFunction(b2x2);

for i=1:10
    F=[a11(x(1),x(2));b22(x(1),x(2))];
    J=[a1x11(x(1),x(2)),a1x22(x(1),x(2));b2x11(x(1),x(2)),b2x22(x(1),x(2))];
    y=-J\F;
    z=[z x];
x=x+y
end
```