

**ESO-208A**

## **Computational Methods in Engineering**

### **Programming Assignment – 1**

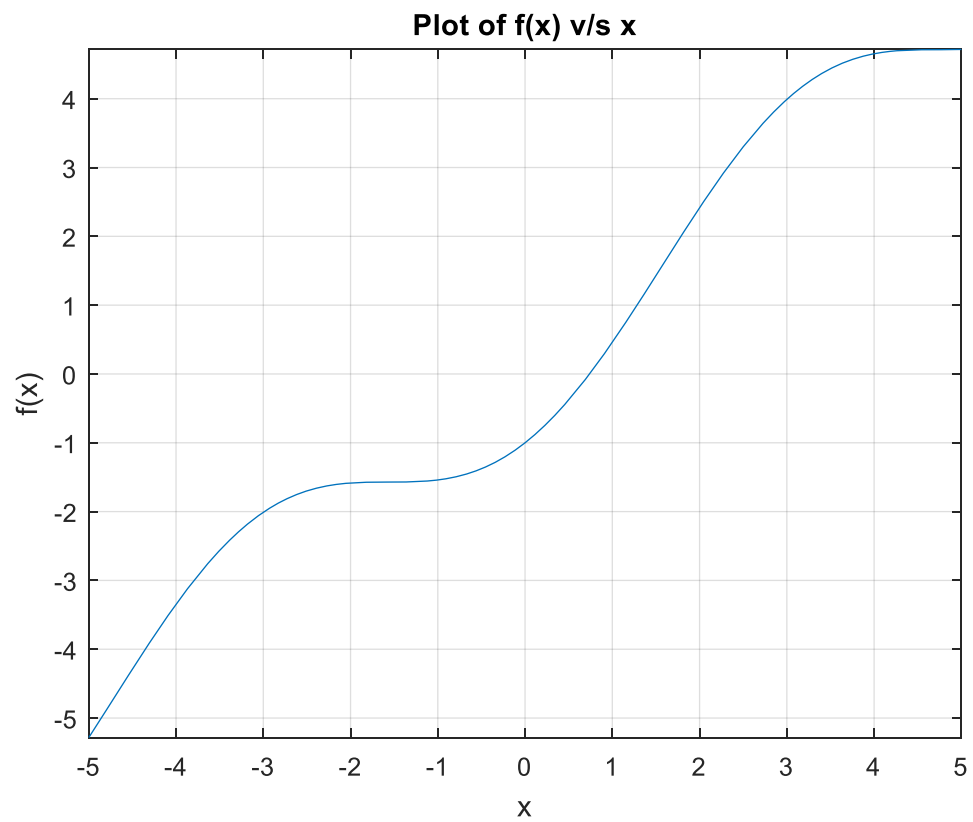
Name – Kishan Shukla

Roll No. – 170342

Section – O6

E-Mail – kshukla@iitk.ac.in

1.)  $F(x) = x - \cos(x)$



## 1.) Bisection Method

Initial Bracket : (0,1)

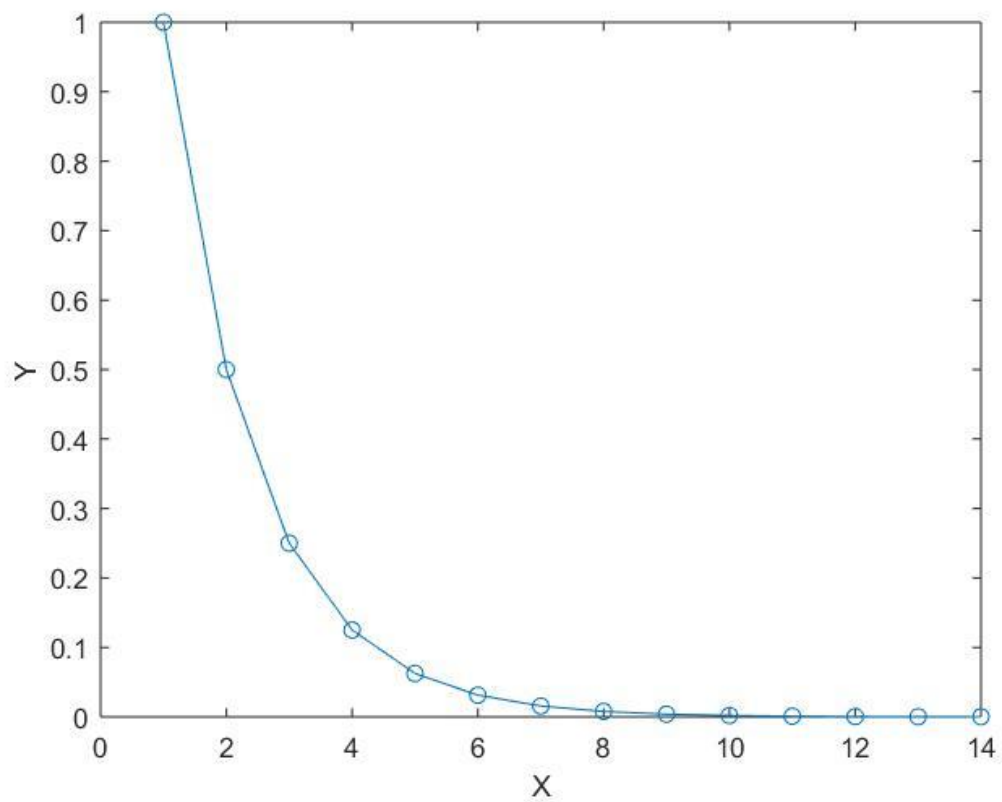
Maximum iterations = 50

Maximum convergence relative error (in %)= 0.01

Closeness to root = 0.00000001

Stopping criteria is Convergence Relative error

Root = 0.7390747



## 2.) False Position

Initial Bracket : (0,1)

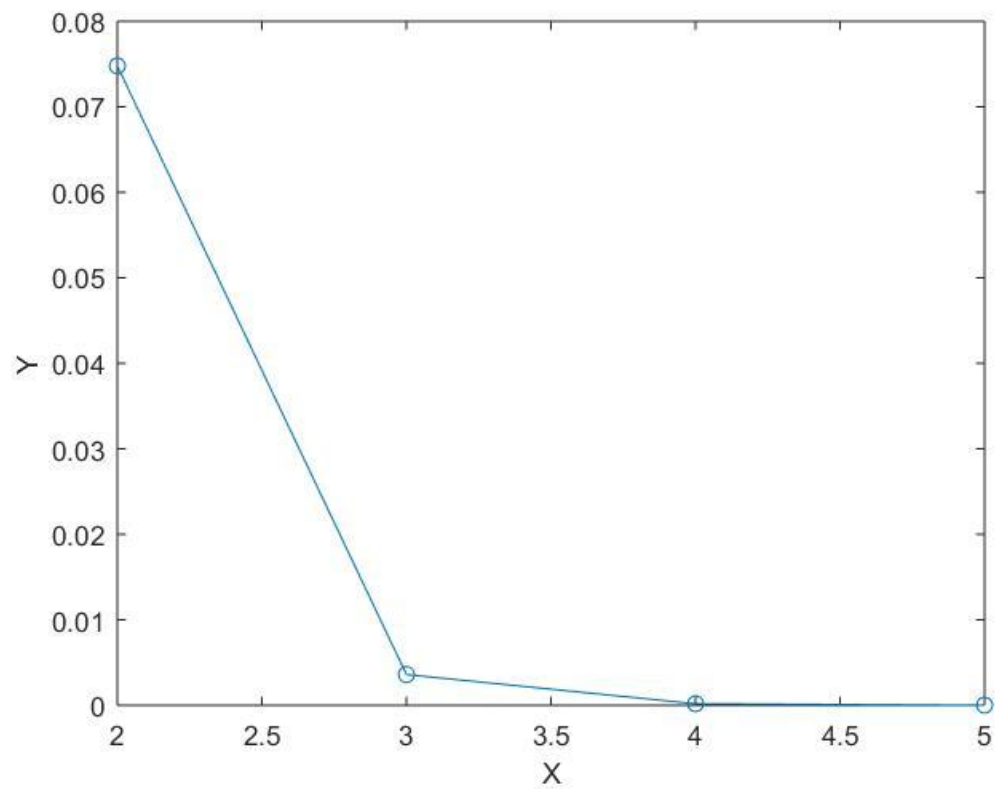
Maximum iterations = 50

Maximum length of interval = 0.0001

Closeness to root = 0.00000001

Stopping criteria is Convergence Relative error

Root = 0.7390847824



### 3.) Fixed Point

Starting guess value = 0

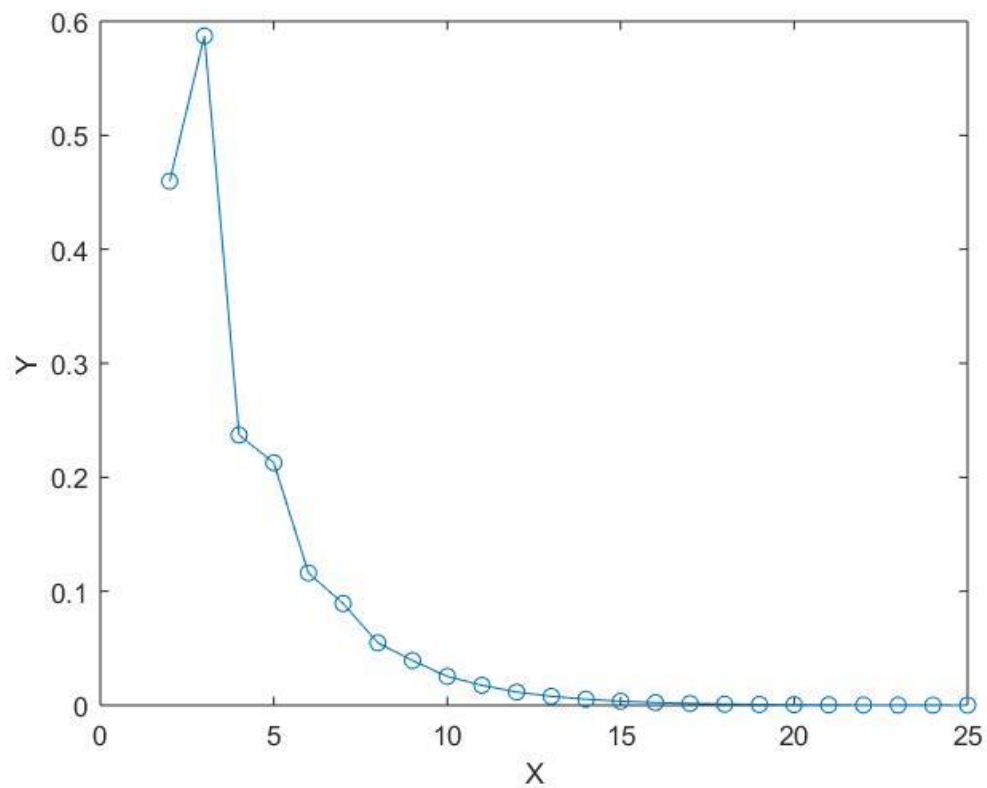
Stopping Convergence relative error (in %) = 0.01%

Closeness to Root = 0.00000001

Maximum Allowed iterations = 50

Stopping criteria is Convergence relative error

Root is 0.739055



#### 4.) Newton - Raphson

Starting guess value = 0

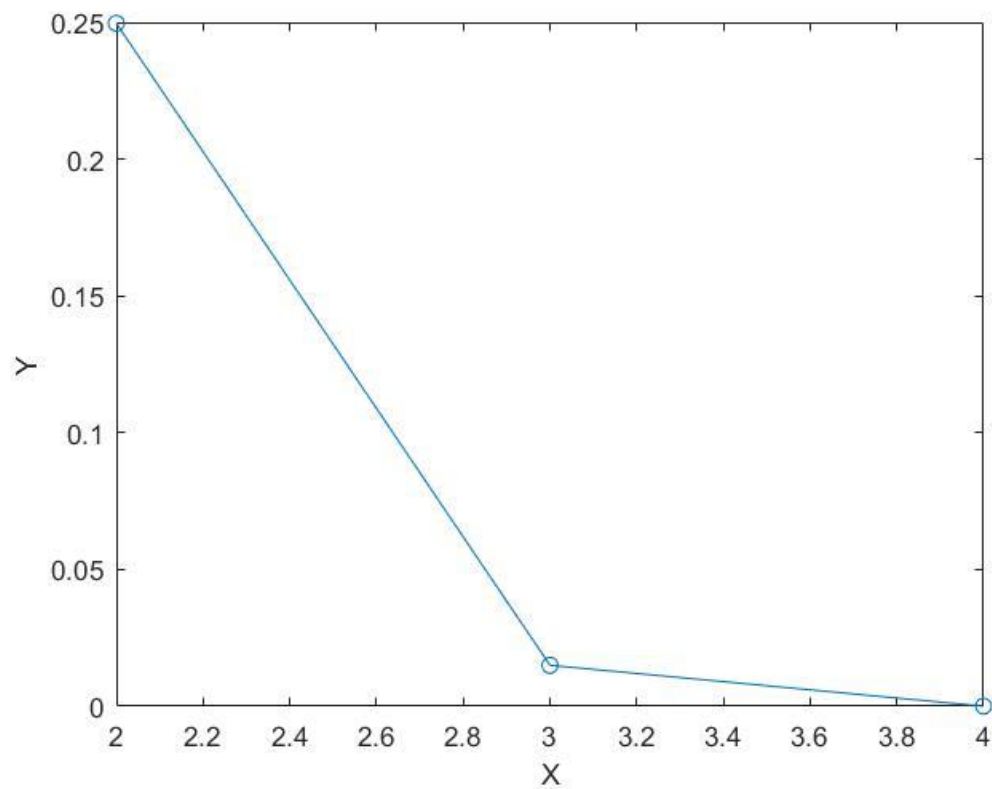
Stopping approximate relative error (in %) = 0.01%

Closeness to root = 0.00000001

Maximum Allowed iterations = 50

Stopping criteria is convergence relative error

Root is 0.739085



## 5.) Secant

First guess = 0

Second guess = 1

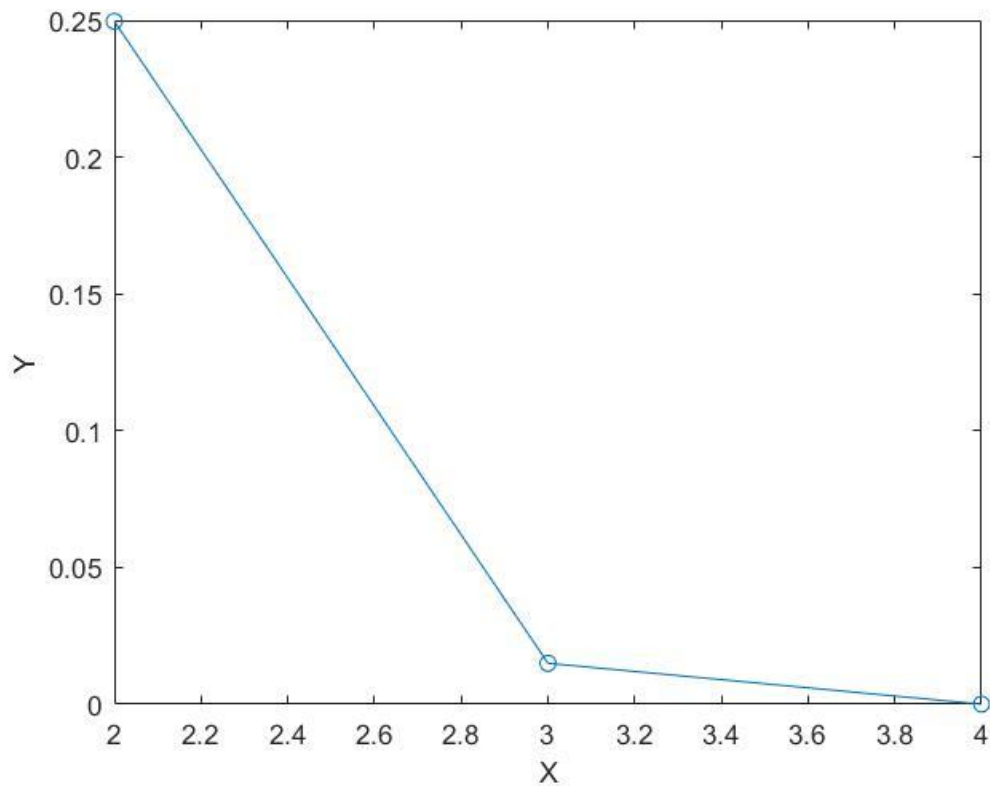
Stopping approximate relative error (in %) = 0.01%

Closeness to Root = 0.00000001

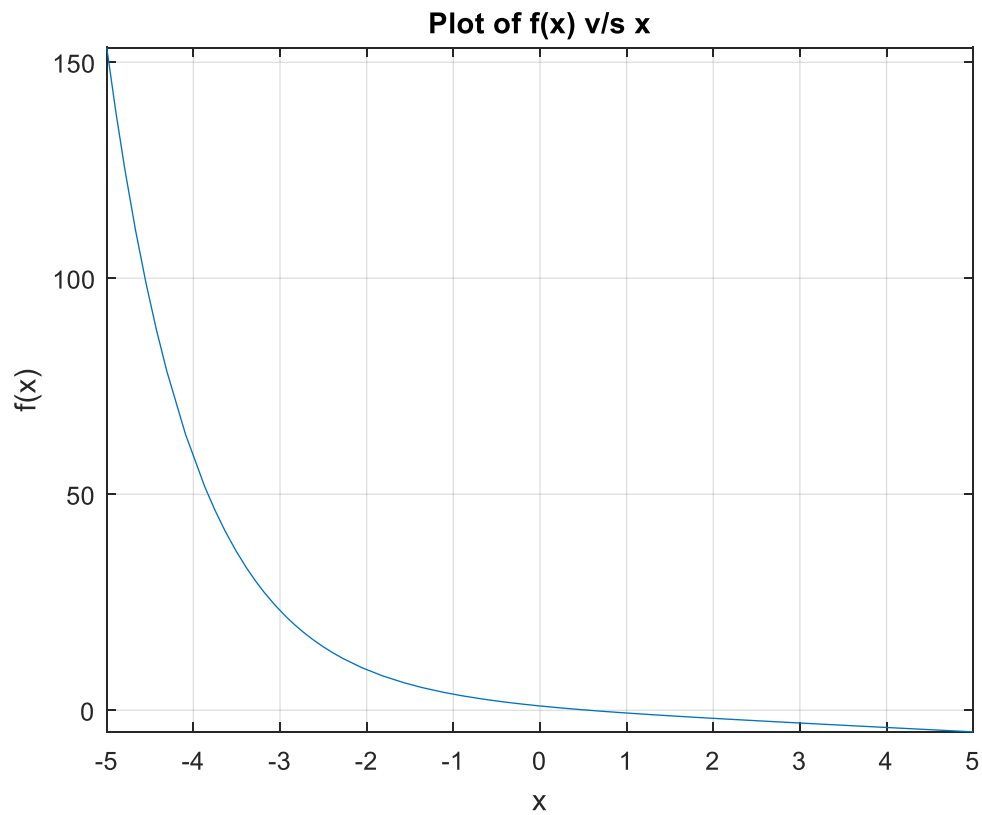
Maximum Allowed iterations = 50

Stopping criteria is Closeness to Root

Root is 0.7390851332



2.)  $F(x) = \exp(-x) - x$





## 1.) Bisection Method

Initial Bracket : (0,1)

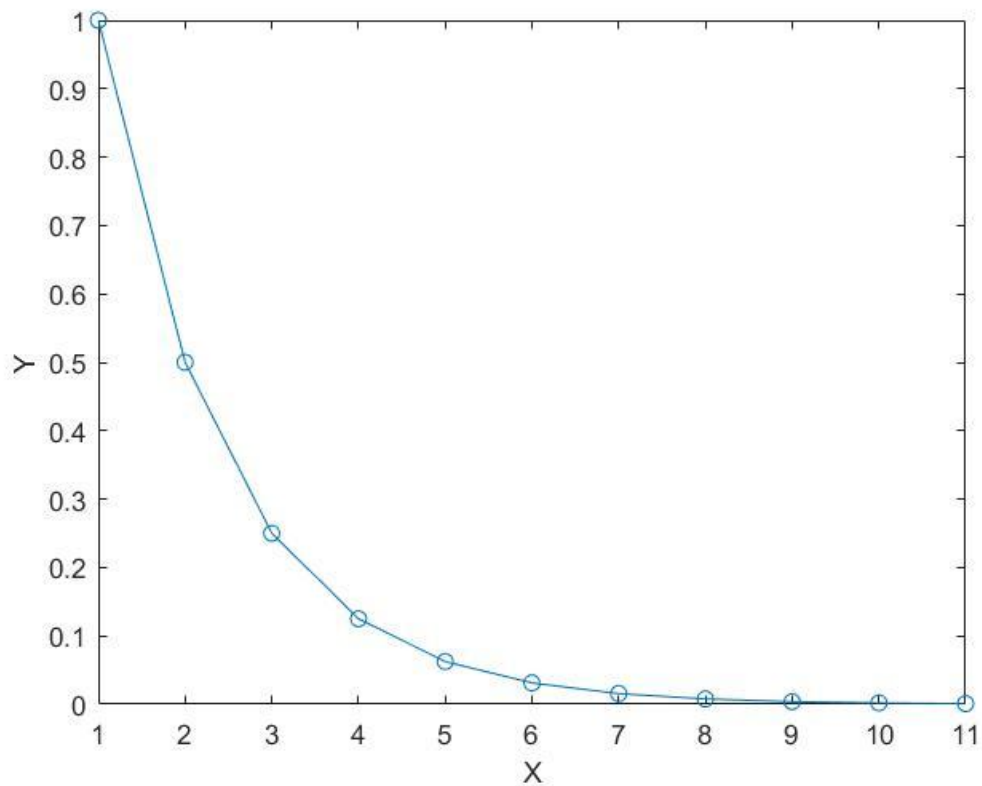
Maximum iterations = 50

Maximum length of interval  $s = 0.05$

Tolerance = 0.00000001

Stopping criteria is interval length

Root = 0.56668945



## 2.) False Position

Initial Bracket : (0,1)

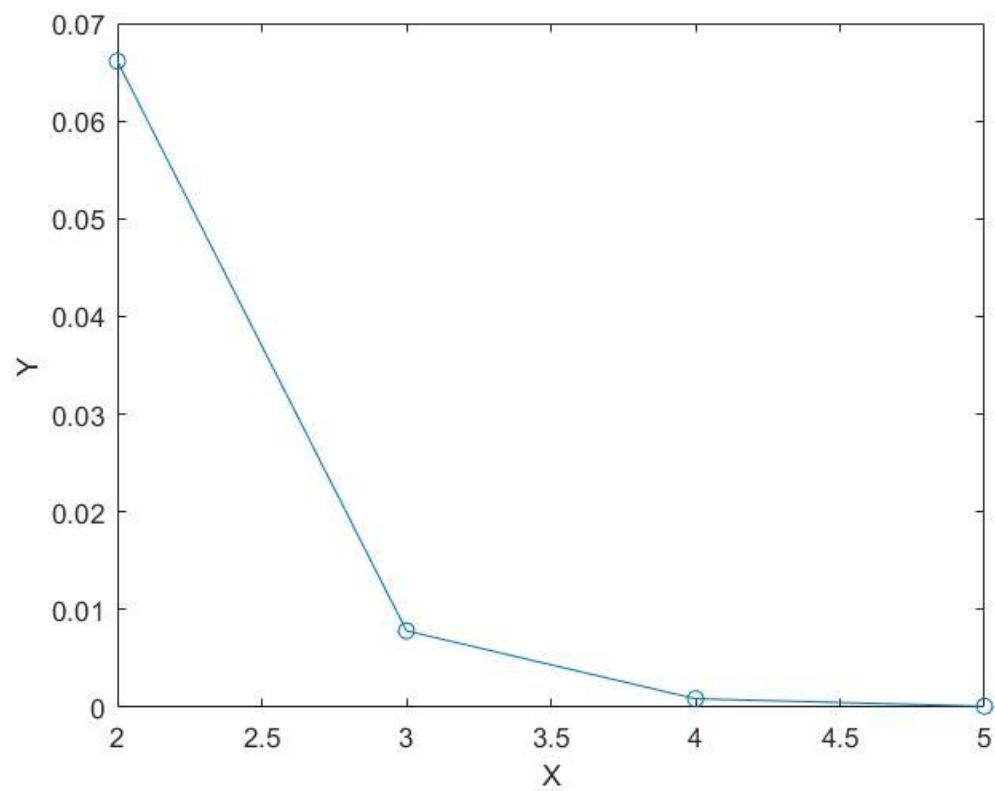
Maximum iterations = 50

Maximum length of interval = 0.05

Tolerance = 0.00000001

Stopping criteria is tolerance

Root = 0.5671502142



### 3.) Fixed Point

Starting guess value = 0

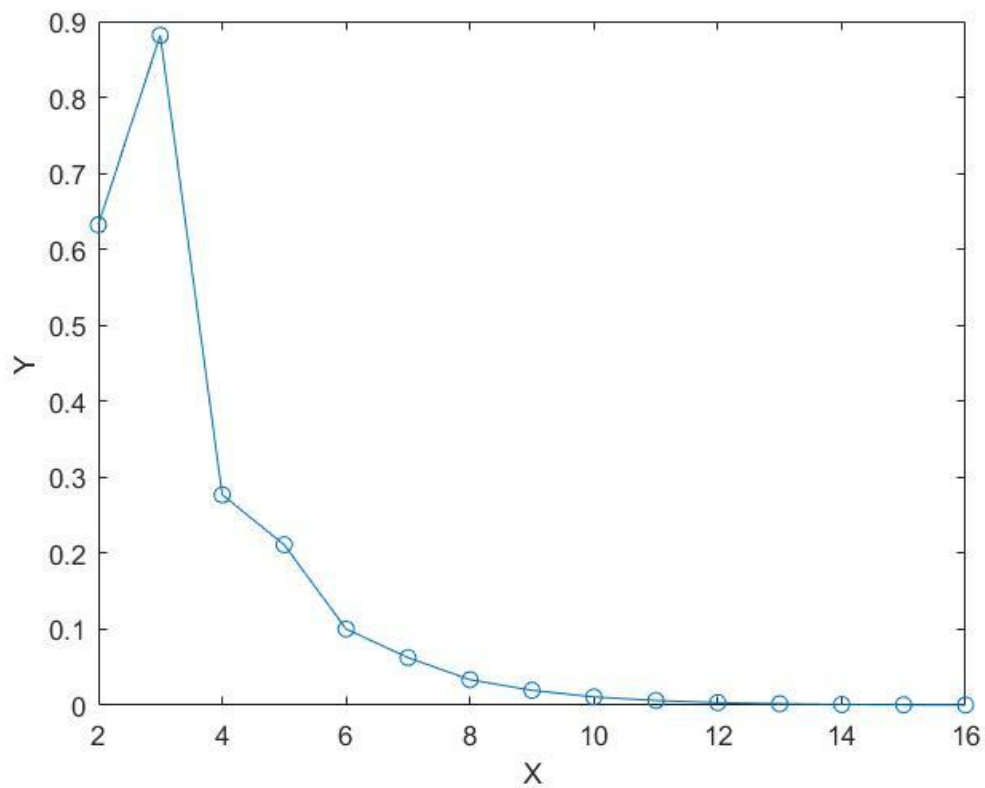
Stopping approximate relative error (in %) = 0.05%

Tolerance = 0.000001

Maximum Allowed iterations = 50

Stopping criteria is approximate relative error

Root is 0.567276



#### 4.) Newton - Raphson

Starting guess value = 0

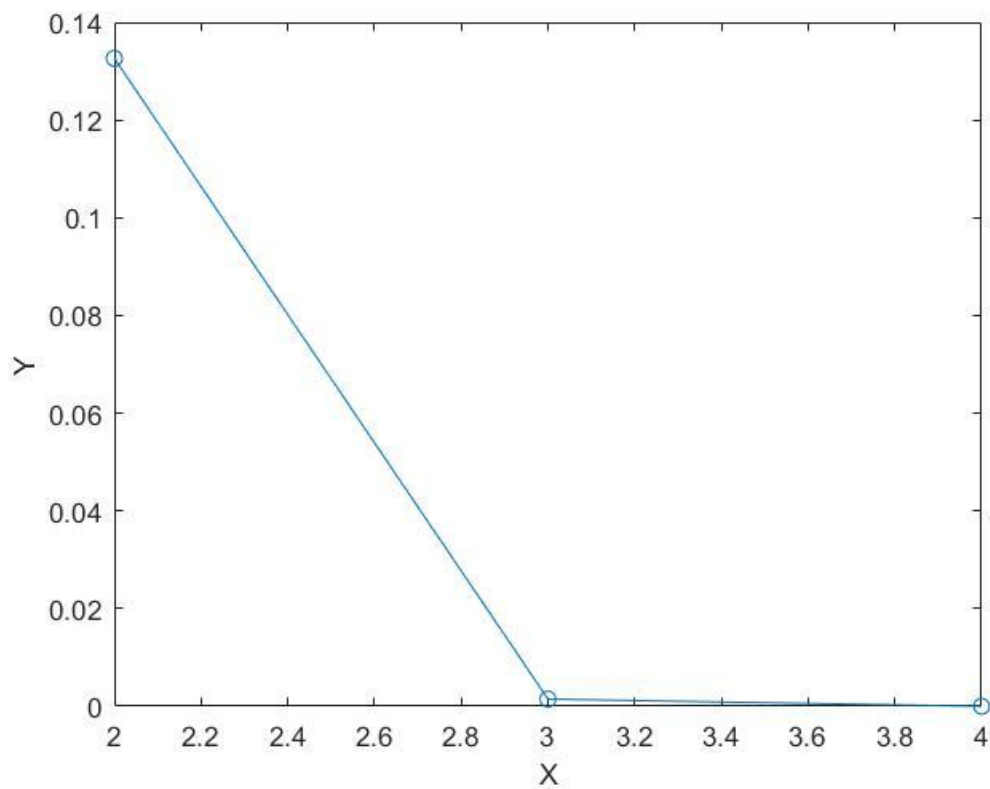
Stopping approximate relative error (in %) = 0.05%

Tolerance = 0.000001

Maximum Allowed iterations = 50

Stopping criteria is approximate relative error

Root is 0.567143



## 5.) Secant

$X_1 = 0$

$X_2 = 1$

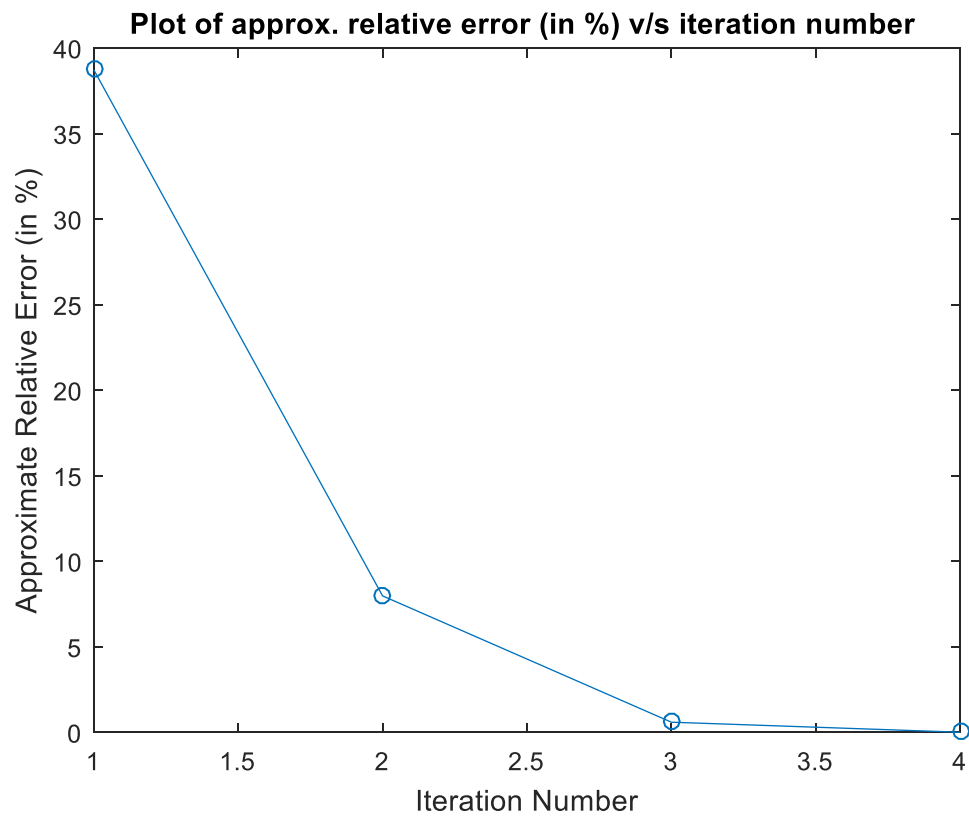
Stopping approximate relative error (in %) = 0.01%

Tolerance = 0.000001

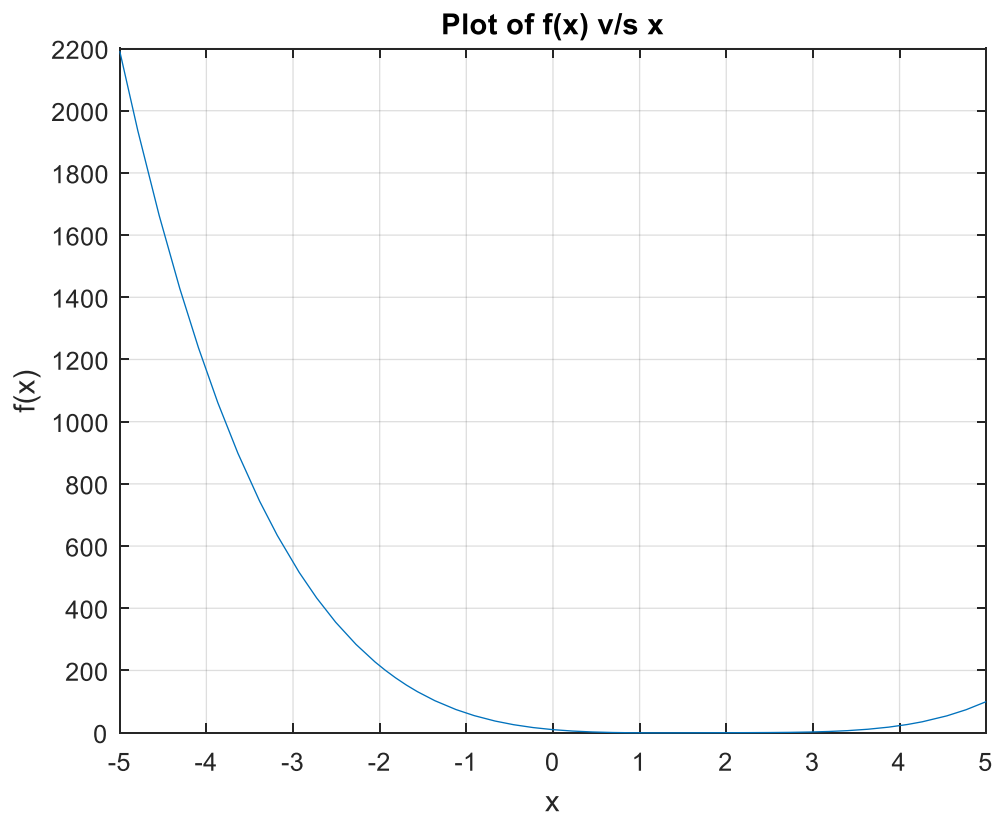
Maximum Allowed iterations = 50

Stopping criteria is approximate relative error

Root is 0.5671432904



3.)  $F(x) = x^4 - 7.4x^3 + 20.44x^2 - 24.184x + 9.6448$



- Order of polynomial = 4
- coefficients vector in the form  $[a_0, a_1, \dots, a_n]$  , with  $n$  as degree :  
 $[9.6448, -24.184, 20.44, -7.4, 1]$

## 1.) Muller Method

$x_0 = -1$

$x_1 = 0$

$x_2 = 1$

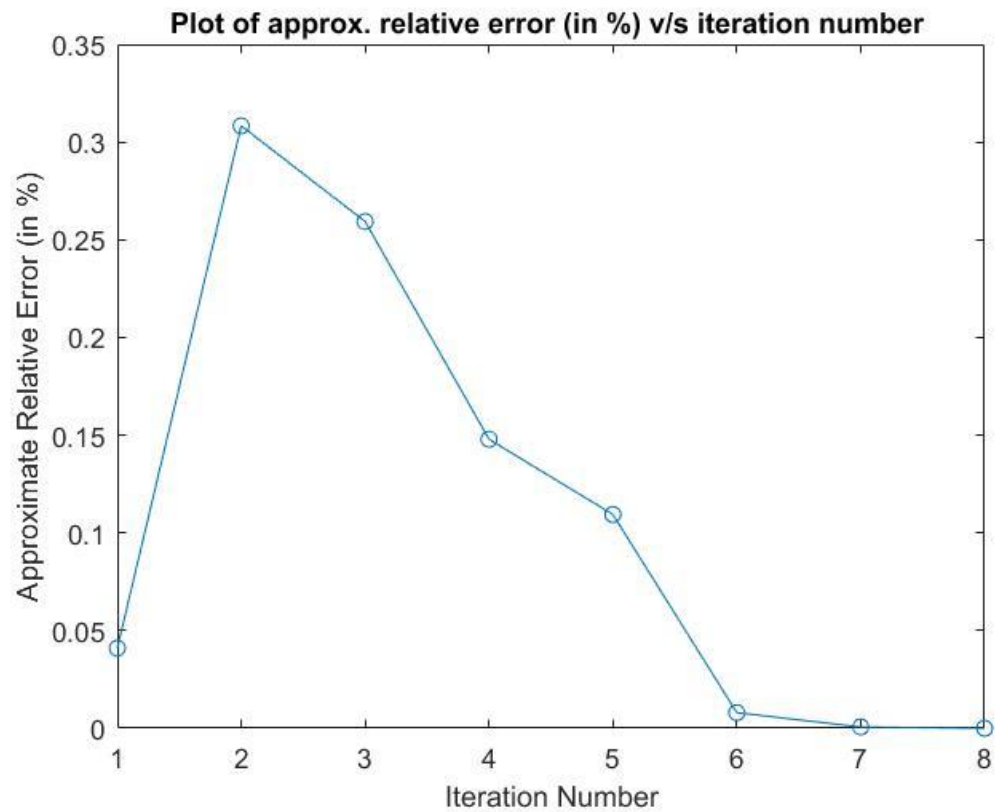
Stopping approximate relative error (in %) = 0.01

Tolerance = 0.000001

Maximum allowed iterations = 50

Stopping criteria is approximate relative error

Root is 2.199993



## 2.) Bairstow Method

$$r = 2$$

$$s = -2$$

Maximum Number of iterations = 50

Maximum relative error (in %) = 0.01

Tolerance limit = 0.000001

Stopping criteria is Maximum approximate relative error for root 1 & root 2

Root 1 = 2.2000

Root 2 = 0.8000

Stopping criteria is Maximum approximate relative error for root 1 & root 2

Root 3 =  $2.2000 + 0.8000i$

Root 4 =  $2.2000 - 0.8000i$

