Scientific Computing Lab MA – 322 Lab – 3

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Branch – Mathematics and Computing

1) fixed-point iteration method

$x_0 = 2$

$$f(x) = x^4 - x - 10 \qquad g(x) = (x+10)^{\frac{1}{4}}$$

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Fixed Point Iteration method for Question 1
No. of iterations       Approximate solution        Error |X_n - X_n-1|
    0                   2.000000000000000           --
    1                   1.861209718204199           0.138790281795801
    2                   1.855804597039777           0.005405121164422
    3                   1.855593139618166           0.000211457421611
    4                   1.855584865579022           0.000008274039144
Solution found after 4 iterations
Solution is: 1.85558487
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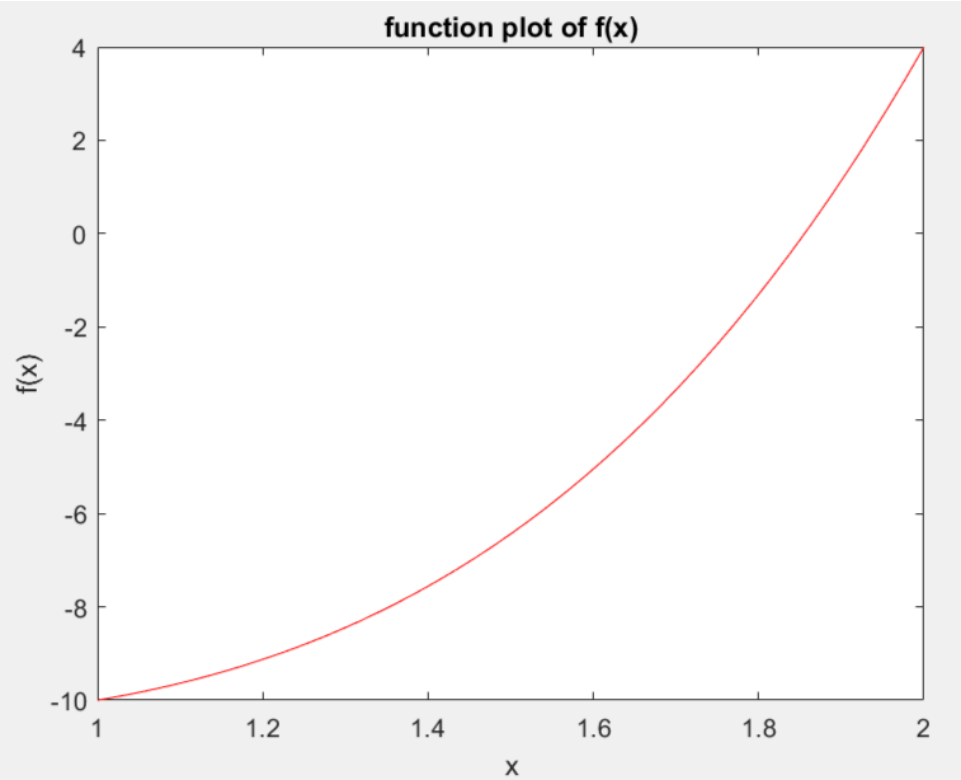

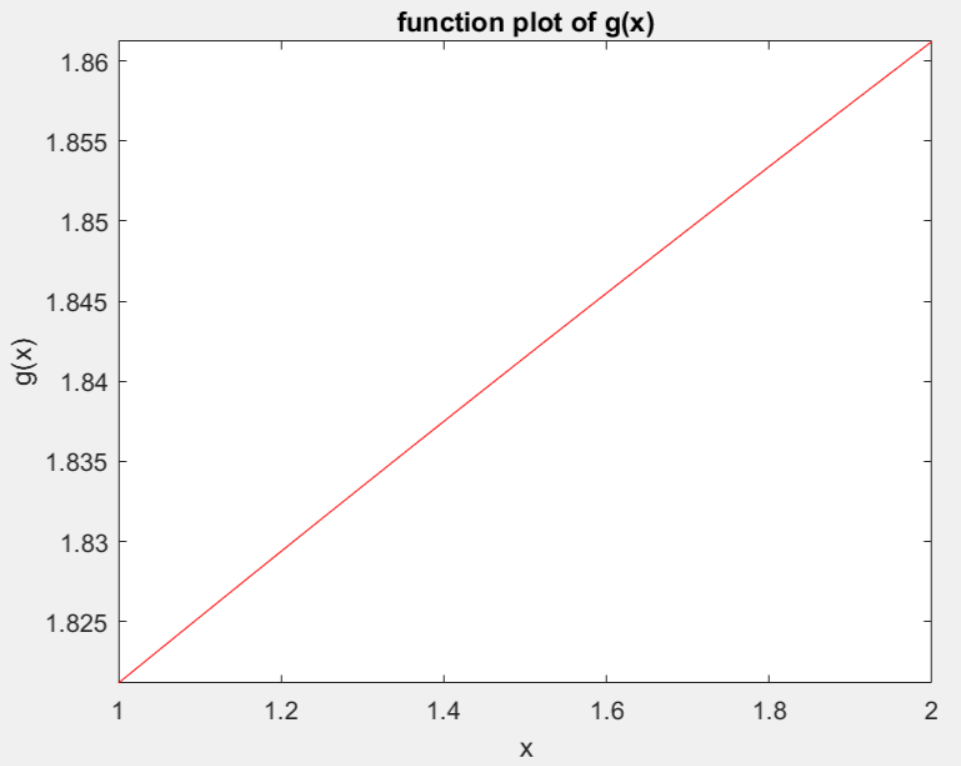

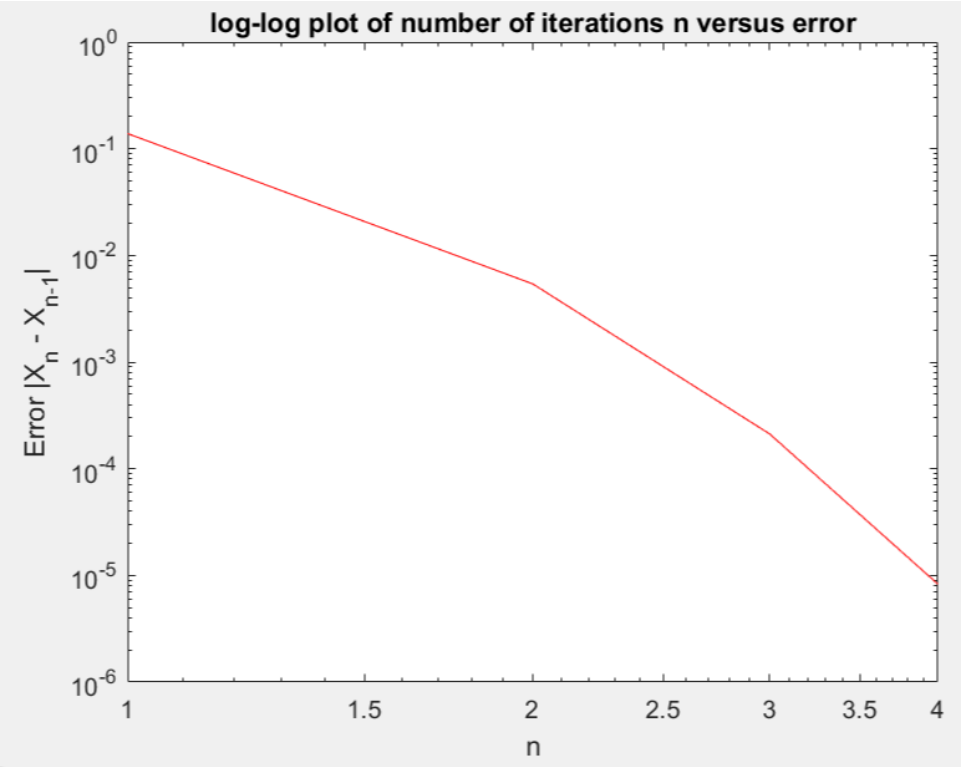

2) Modified Newton's method

a) $x_0 = 1.5$

$$f(x) = x^4 - 8x^2 - x + 16$$

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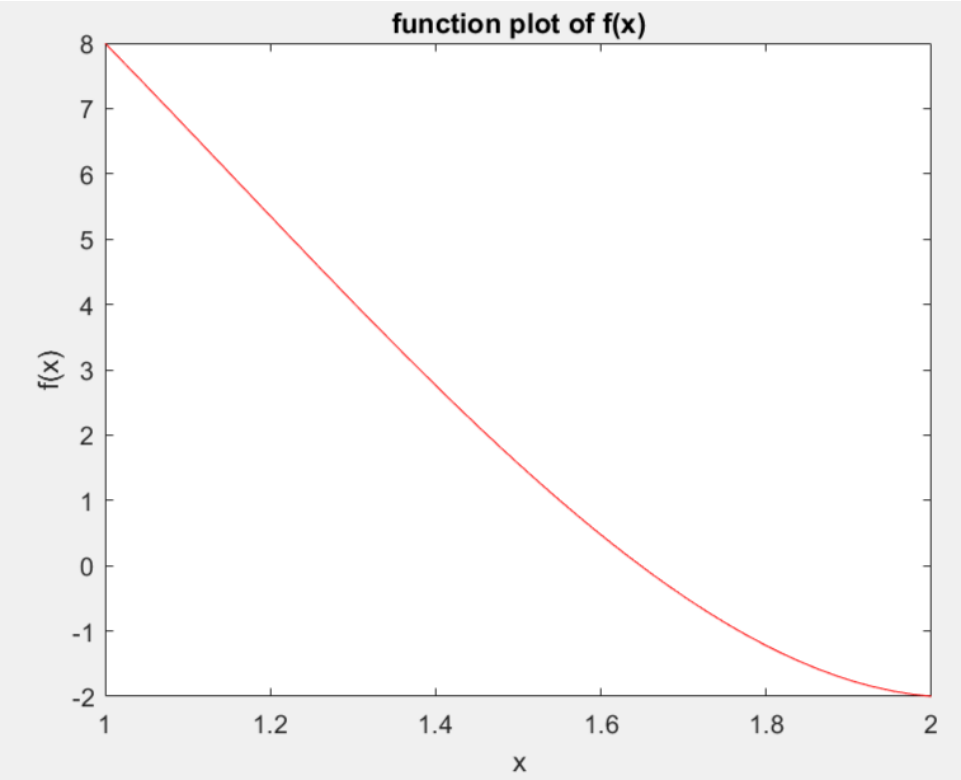
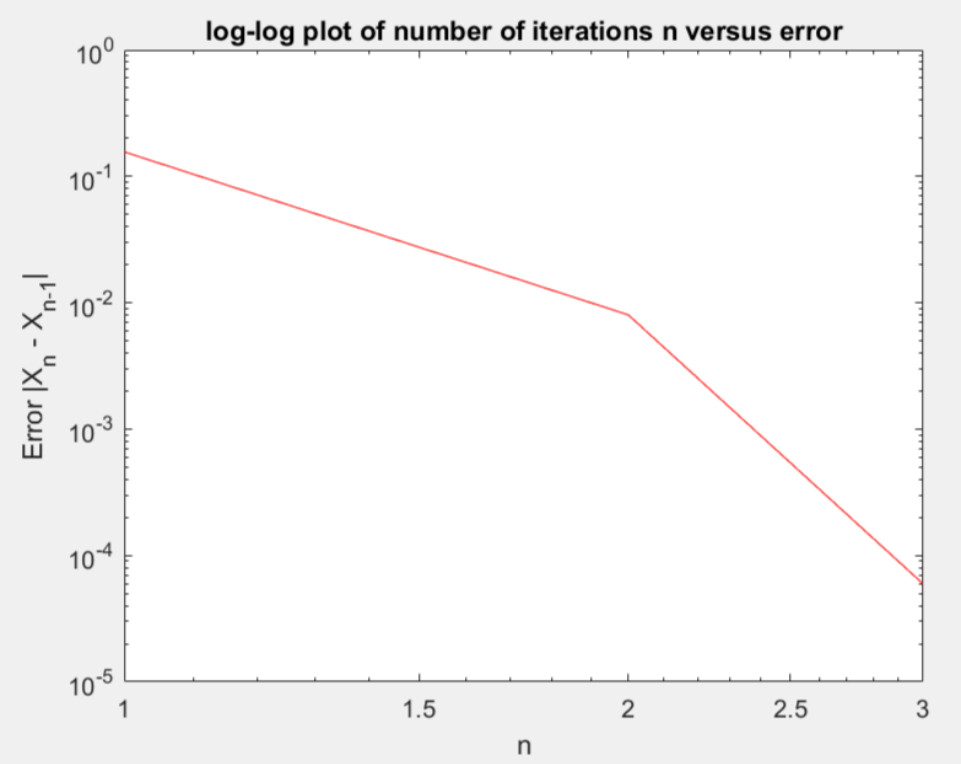
Modified Newton's method for Question 2 part a
No. of iterations       Approximate solution        Error |X_n - X_n-1|
    0                   1.500000000000000           --
    1                   1.656165127648017           0.156165127648017
    2                   1.648154764024911           0.008010363623106
    3                   1.648095368701767           0.000059395323145
Solution found after 3 iterations
Solution is: 1.64809537
```

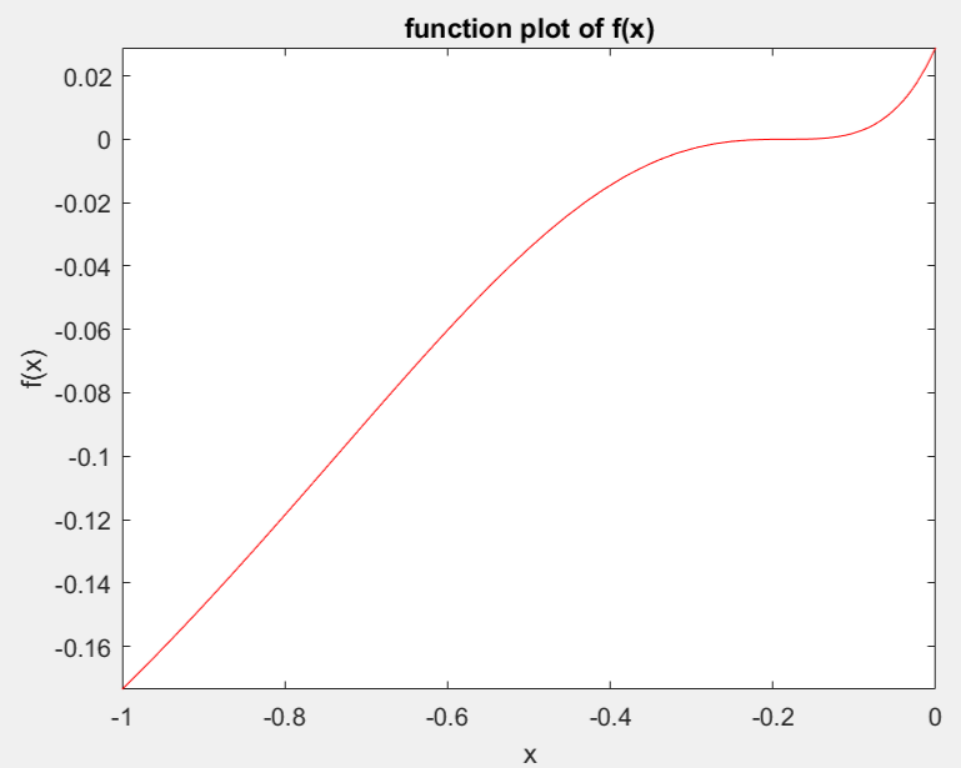


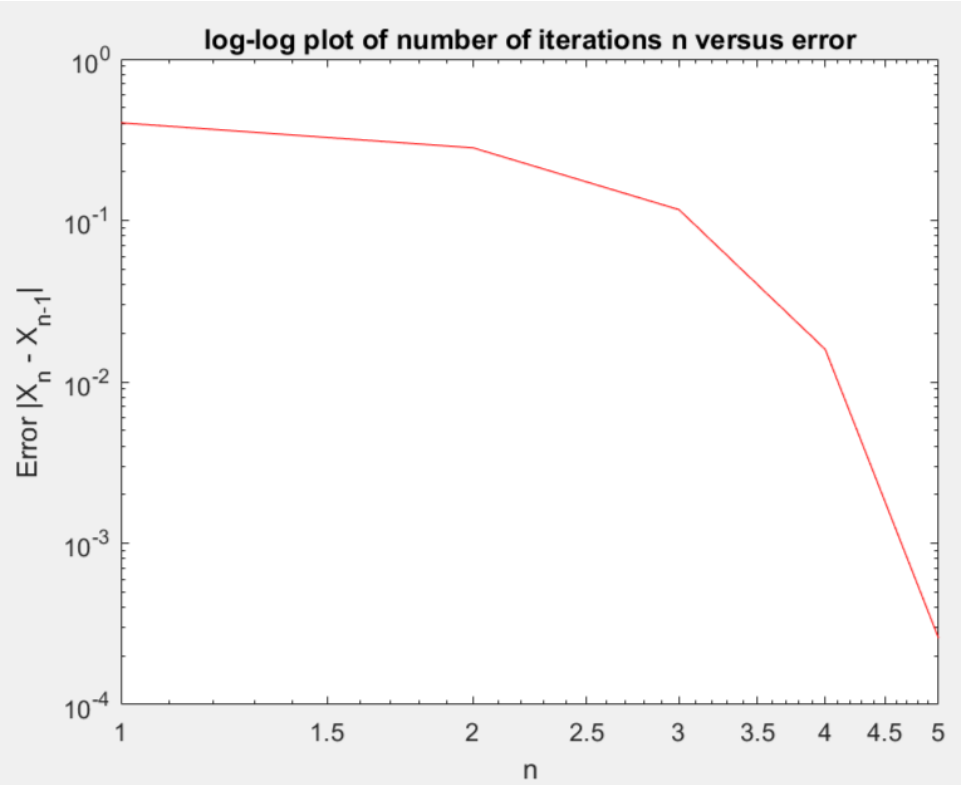


b) $x_0 = -1$

$$f(x) = e^{6x} + 3(ln\ 2)^2 e^{2x} - (ln\ 8)e^{4x} - (ln\ 2)^3$$

```
Modified Newton's method for Question 2 part b
No. of iterations       Approximate solution        Error |X_n - X_n-1|
    0                   -1.000000000000000          --
    1                   -0.597623770991382          0.402376229008618
    2                   -0.315924472491960          0.281699298499422
    3                   -0.199398569173855          0.116525903318105
    4                   -0.183514246382248          0.015884322791607
    5                   -0.183256523940214          0.000257722442034
Solution found after 5 iterations
Solution is: -0.18325652
```





3) Muller's method

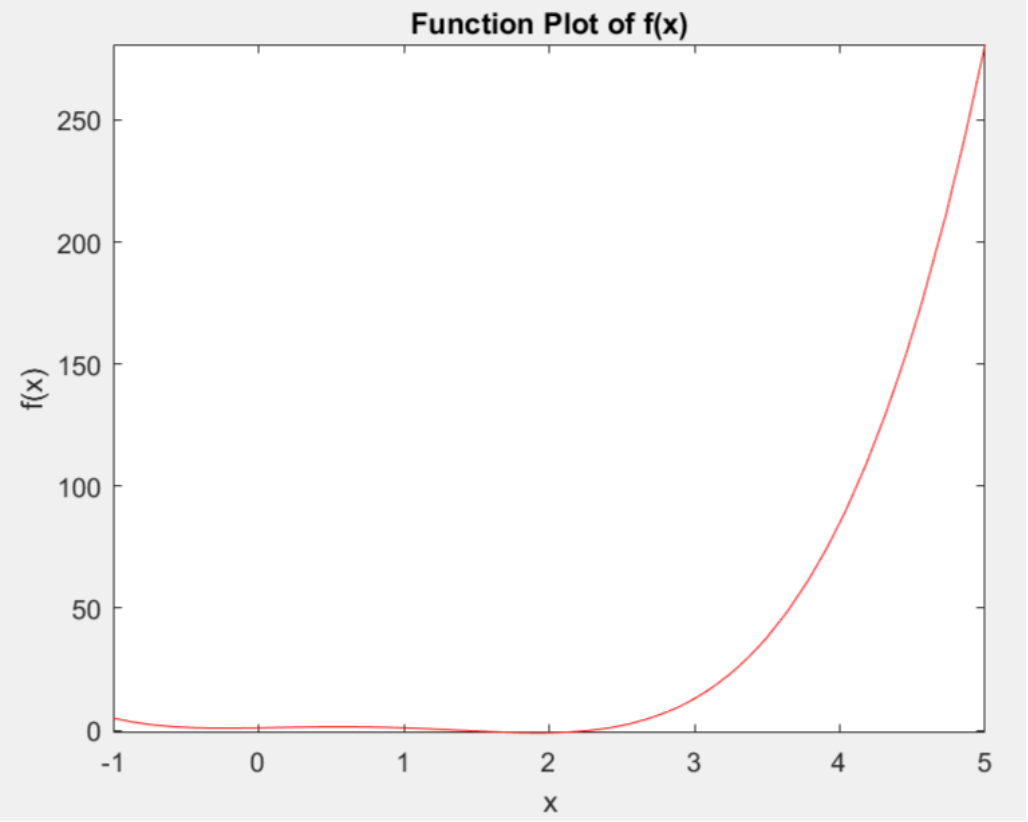
a) $x_0 = -0.5$ $x_1 = 0$ $x_2 = 0.5$

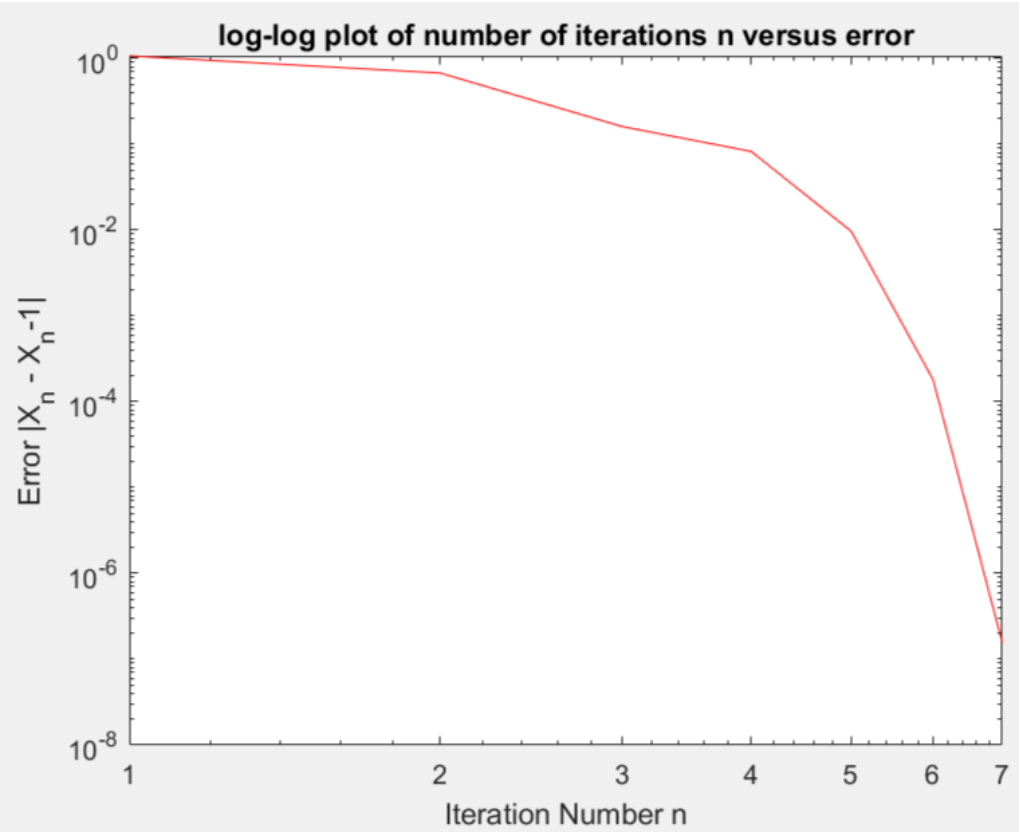
$$f(x) = x^4 - 3x^3 + x^2 + x + 1$$

Muller's method for Question 3 part a

No. of Iterations	Approximate solution	Error |X_n - X_n-1|
1	-0.1-0.88882i	1.0724
2	-0.28802-0.23825i	0.67719
3	-0.37441-0.37424i	0.16111
4	-0.34704-0.4522i	0.08263
5	-0.33922-0.4465i	0.0096806
6	-0.33909-0.44663i	0.00018065
7	-0.33909-0.44663i	1.5694e-07

Solution found after 7 iterations
Solution is: -0.33909284 + -0.44663010i.





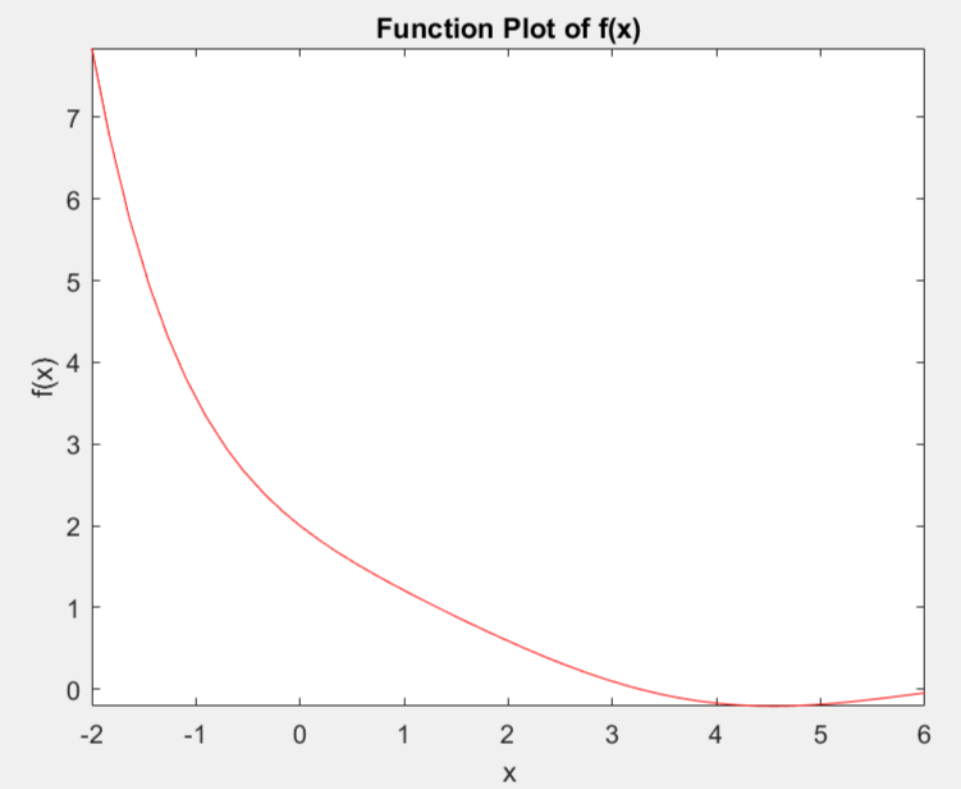
b) $x_0 = -0.5$ $x_1 = 0.1$ $x_2 = 0.5$

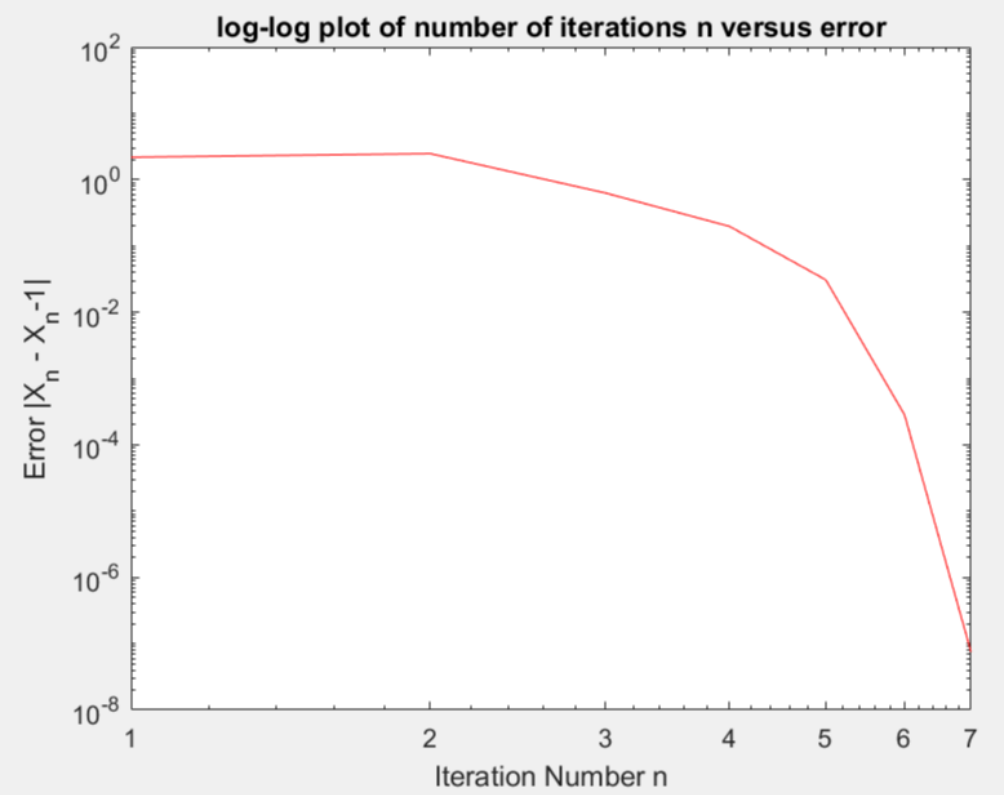
$$f(x) = \frac{sin(x)}{x} + e^{-x}$$

Muller's method for Question 3 part b

No. of Iterations	Approximate solution	Error |X_n - X_n-1|
1	1.5813-1.8924i	2.1795
2	2.5209+0.38995i	2.4682
3	3.0428+0.037602i	0.62968
4	3.2357-0.0033364i	0.19724
5	3.2663+0.00016696i	0.030749
6	3.2665+4.8147e-08i	0.00028303
7	3.2665+2.0862e-14i	7.4473e-08

Solution found after 7 iterations
Solution is: 3.26650044 + 0.00000000i.





4) fixed-point iteration method to approximate square root of 31

$x_0 = 5$

$$f(x) = x - \sqrt{31}$$

$$g(x) = \frac{1}{2}\left(x + \frac{31}{x}\right)$$

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Fixed Point Iteration method for Question 4
No. of iterations       Approximate solution        Error |X_n - X_n-1|
    0                   5.000000000000000           --
    1                   5.600000000000000           0.600000000000000
    2                   5.567857142857143           0.032142857142857
    3                   5.567764363603042           0.000092779254101
Solution found after 3 iterations
Solution is: 5.56776436
```
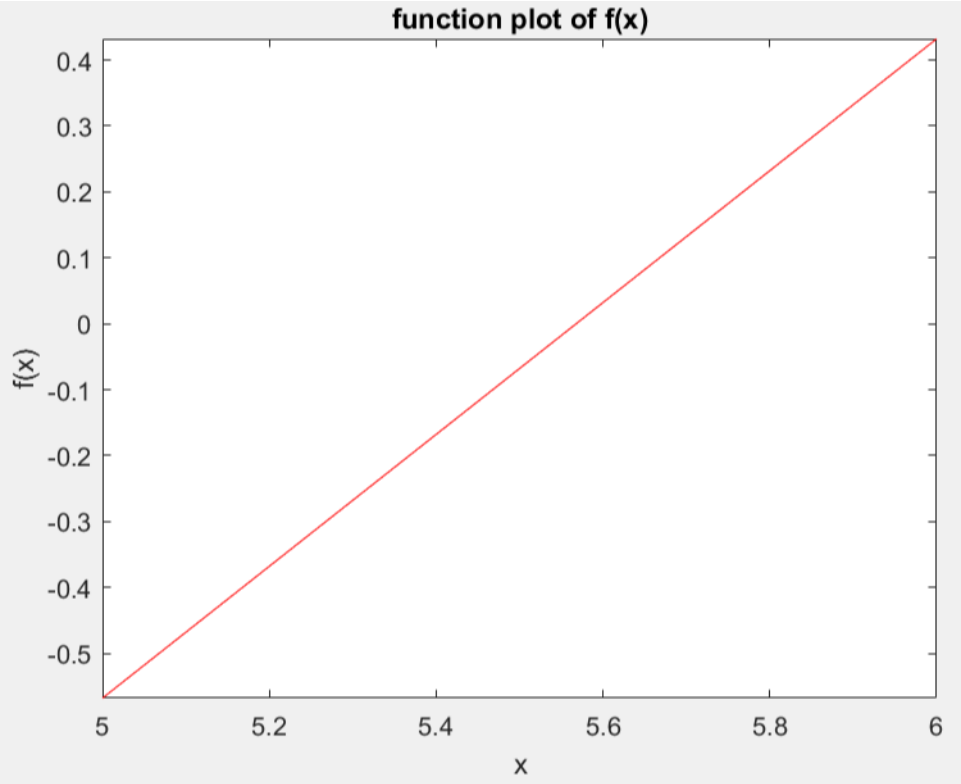
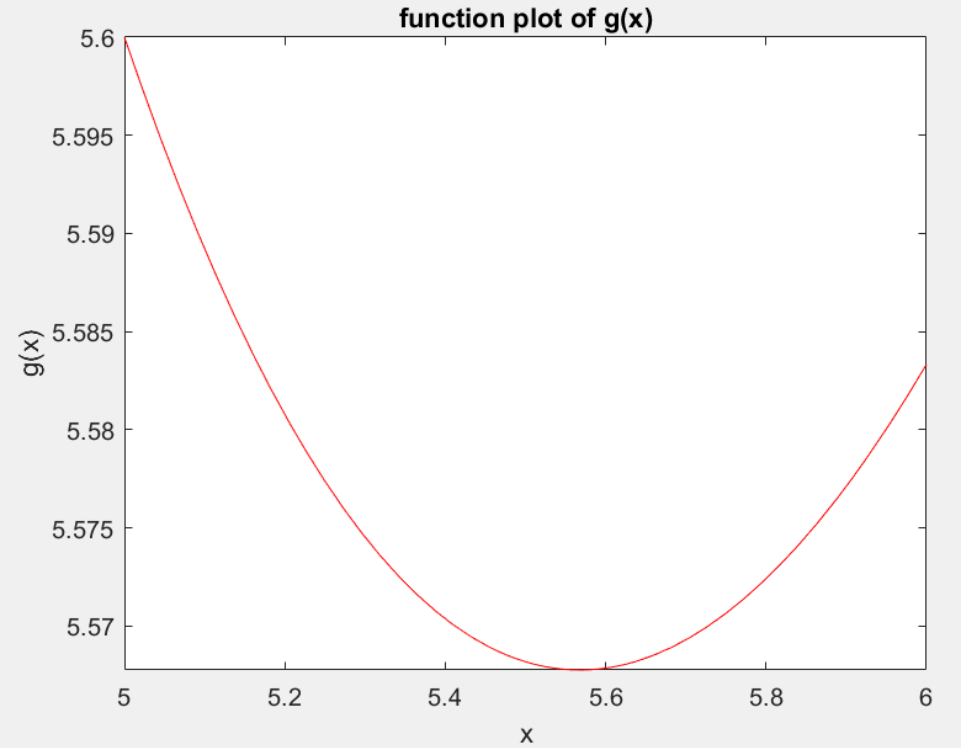
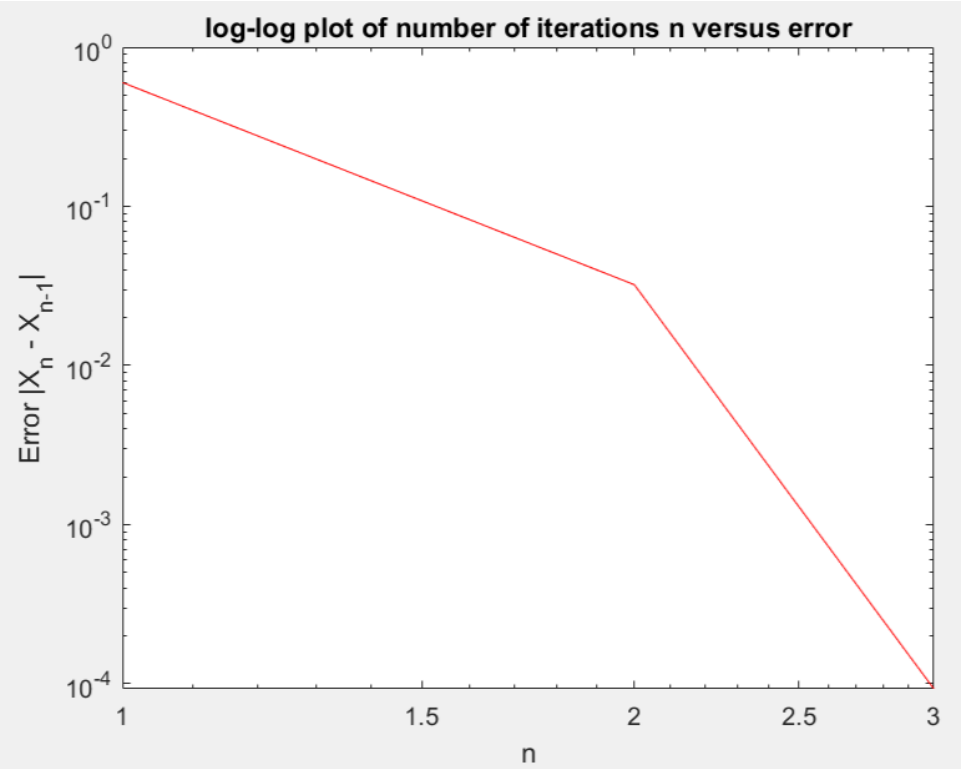




function plot of g(x)
5.6
5.595
5.59
5.585
5.58
5.575
5.57
g(x)
5
5.2
5.4
5.6
5.8
6
x


log-log plot of number of iterations n versus error
10^{0}
10^{-1}
10^{-2}
10^{-3}
10^{-4}
Error $|X_n - X_{n-1}|$
1
1.5
2
2.5
3
n