MA322 – Scientific Computing Laboratory

Lab - 04

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- Function plots are only done for que – 2(a) and 2(b) as que 1 and 3 will require 4D-plots.
- For termination by number of iterations, I took tolerance as 0(almost never achievable) and for termination by tolerance, I took max. iterations as a integer big enough like 1000.
- Run output_file.m to run the code.

Ques – 1

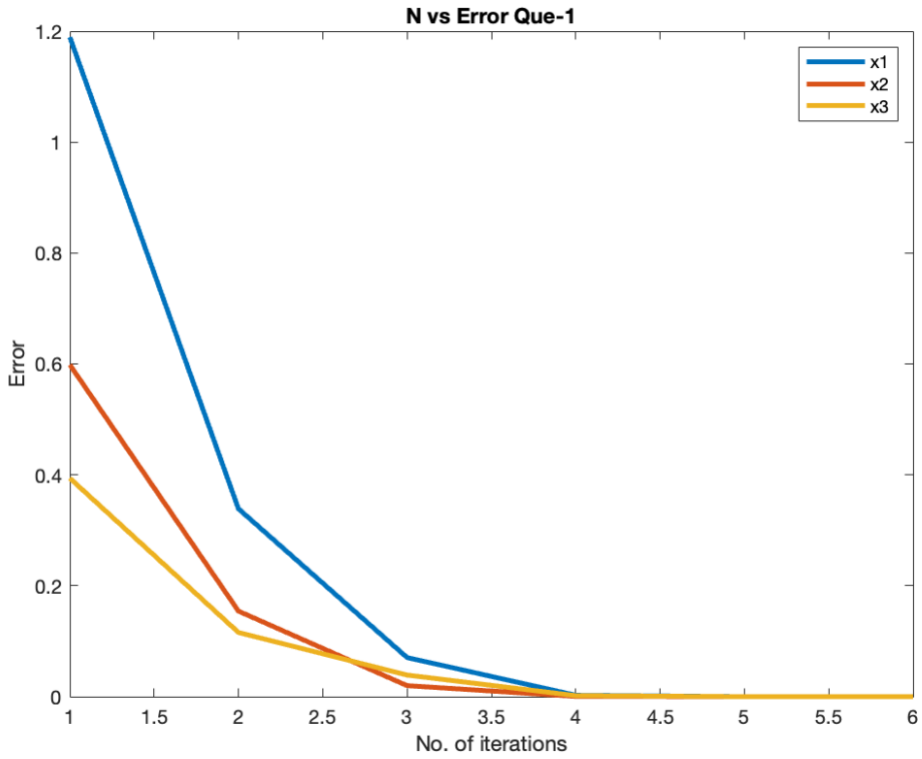
$$x_1 x_2 = x_3^2 + 1,$$

$$x_1 x_2 x_3 + x_2^2 = x_1^2 + 2,$$

$$e^{x_1} + x_3 = e^{x_2} + 3.$$

6 iterations of Newton Method for given system of equations taking $x_0 = [1,1,1]^T$ as initial approximation: -

```
Newton Method for system of equations Que-1

Itr. No.                Approx Soln.                      Error
   1     [ 2.1893260966 1.5984751567 1.3939006266 ] [ 1.189326e+00 5.984752e-01 3.939006e-01 ]

   2     [ 1.8505896453 1.4442514160 1.2782240003 ] [ 3.387365e-01 1.542237e-01 1.156766e-01 ]

   3     [ 1.7801611962 1.4244359794 1.2392924404 ] [ 7.042845e-02 1.981544e-02 3.893156e-02 ]

   4     [ 1.7776747088 1.4239609255 1.2374738178 ] [ 2.486487e-03 4.750539e-04 1.818623e-03 ]

   5     [ 1.7776719180 1.4239605979 1.2374711177 ] [ 2.790810e-06 3.276209e-07 2.700089e-06 ]

   6     [ 1.7776719180 1.4239605979 1.2374711177 ] [ 3.140155e-12 4.218847e-14 4.413359e-12 ]
```



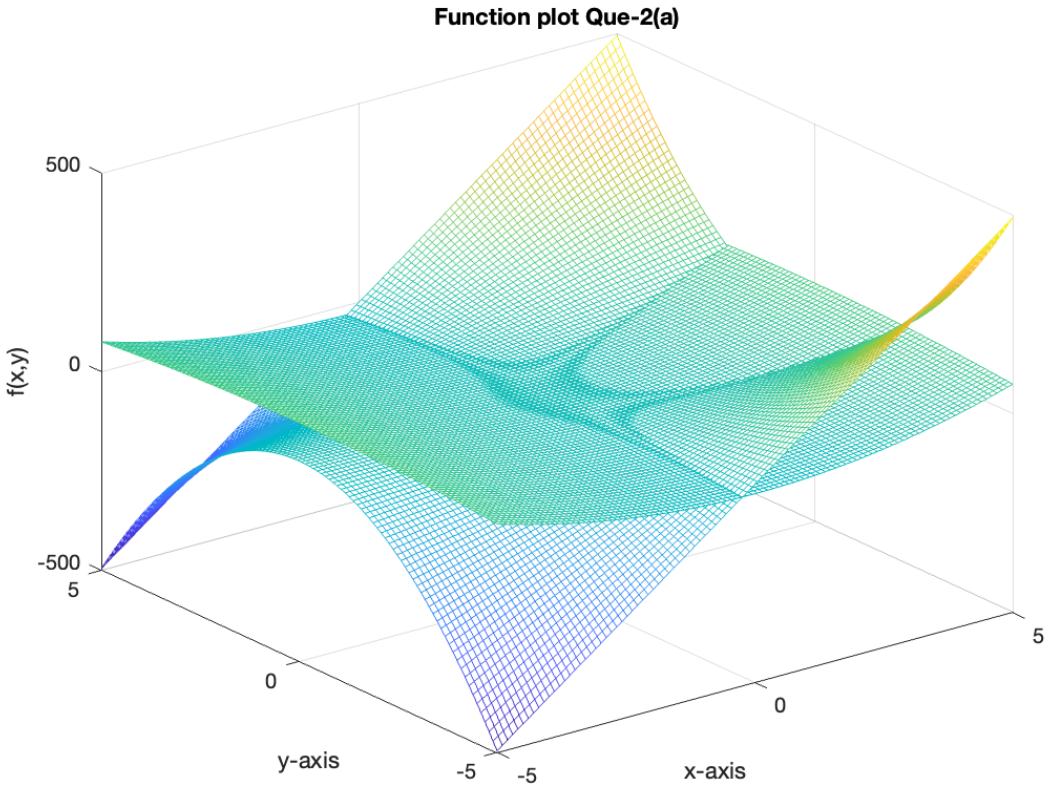
Ques – 2

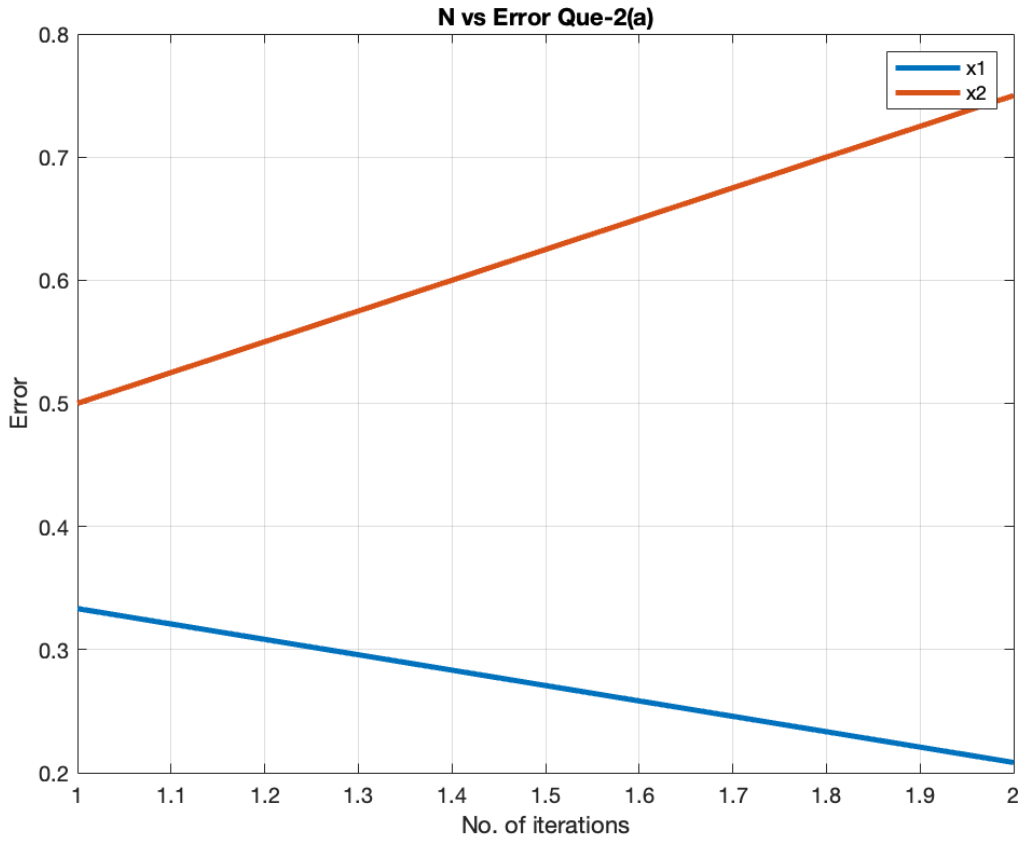
(a)

$$\begin{aligned} 4x_1^2 - x_2^2 &= 0, \\ 4x_1x_2^2 - x_1 &= 1. \end{aligned}$$

2 iterations of Newton Method for given system of equations taking $x_0 = [0,1]^T$ as initial approximation: -

```
Newton Method for system of equations Que-2(a)

Itr. No.                Approx Soln.                          Error
   1     [ 0.3333333333 0.5000000000 ] [ 3.333333e-01 5.000000e-01 ]

   2     [ 0.5416666667 1.2500000000 ] [ 2.083333e-01 7.500000e-01 ]
```


Function plot Que-2(a)
500
0
-500
f(x,y)
5
0
-5
y-axis
-5
0
5
x-axis

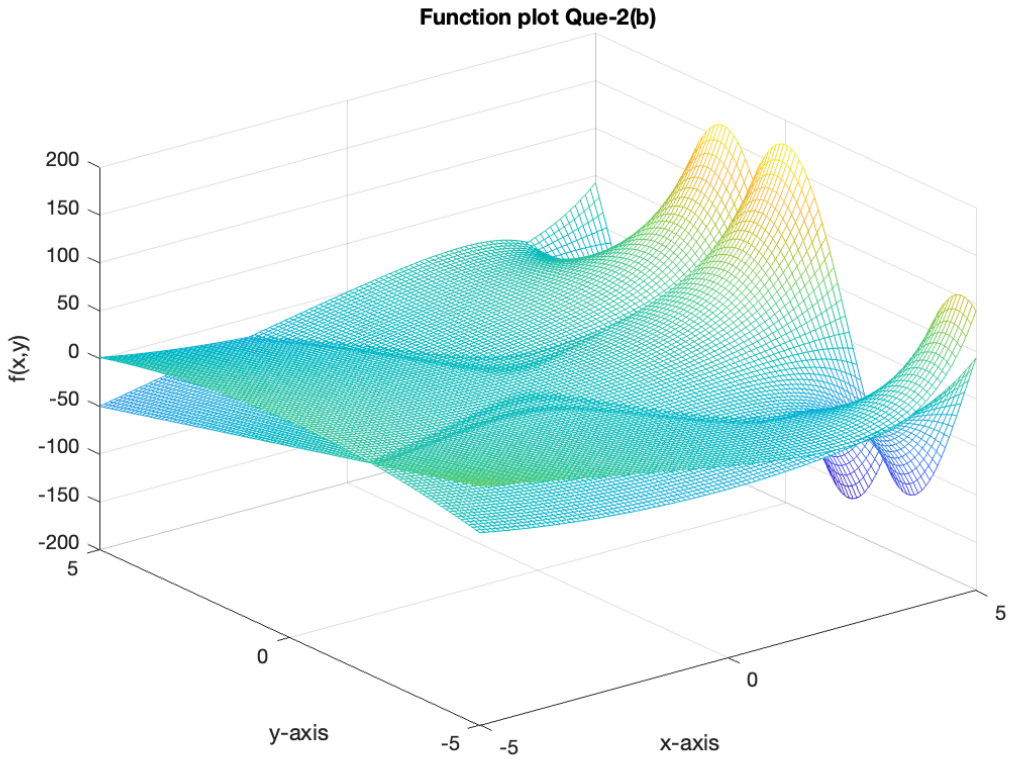

N vs Error Que-2(a)
x1
x2
Error
0.8
0.7
0.6
0.5
0.4
0.3
0.2
1
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2
No. of iterations

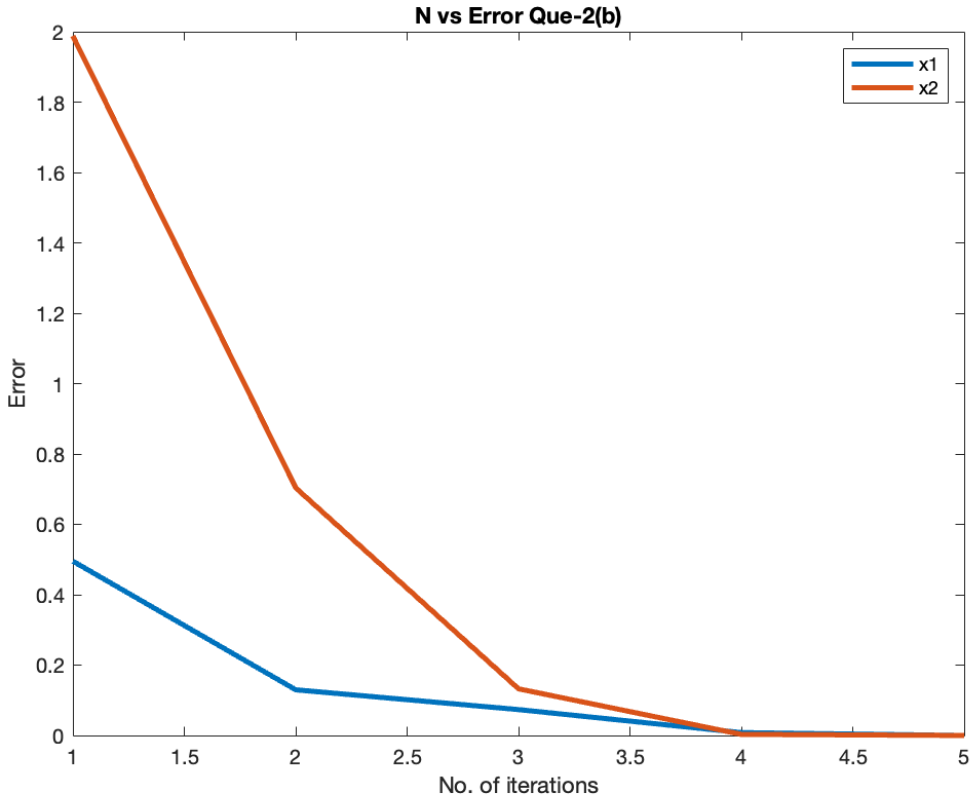
(b)

$$\begin{aligned} 1 + x^2 - y^2 + e^x \cos(y) &= 0, \\ 2xy + e^x \sin(y) &= 0. \end{aligned}$$

5 iterations of Newton Method for given system of equations taking $x_0 = [-1,4]^T$ as initial approximation: -

```
Newton Method for system of equations Que-2(b)

Itr. No.                  Approx Soln.                                  Error
   1      [ -0.5047031406 2.0120467417 ] [ 4.952969e-01 1.987953e+00 ]

   2      [ -0.3748671976 1.3083302261 ] [ 1.298359e-01 7.037165e-01 ]

   3      [ -0.3013070939 1.1757639036 ] [ 7.356010e-02 1.325663e-01 ]

   4      [ -0.2931780072 1.1726343621 ] [ 8.129087e-03 3.129542e-03 ]

   5      [ -0.2931626868 1.1726598179 ] [ 1.532037e-05 2.545579e-05 ]
```





Ques – 3

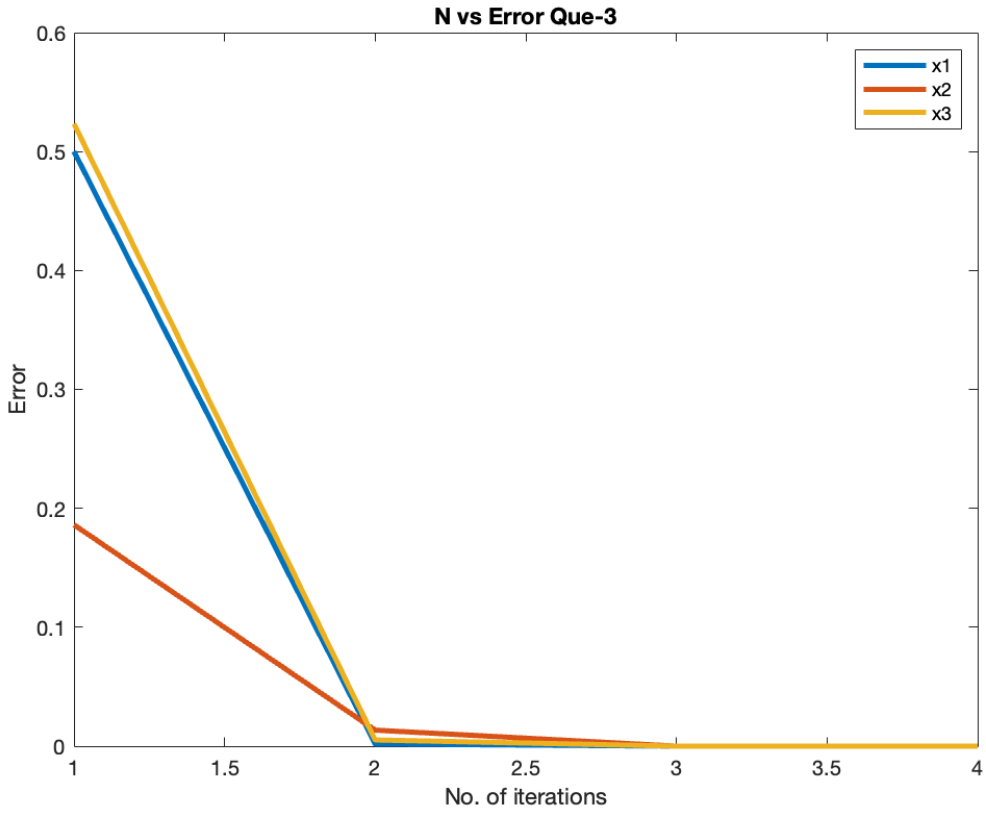
$$6x_1 - 2\cos(x_2x_3) - 1 = 0,$$

$$9x_2 + \sqrt{x_1^2 + \sin(x_3) + 1.06} + 0.9 = 0,$$

$$60x_3 + 3e^{-x_1x_2} + 10\pi - 3 = 0.$$

Newton Method for given system of equations taking $x_0 = [0,0,0]^T$ as initial approximation and tolerance = 10^{-6}.

```
Newton Method for system of equations Que-3

Itr. No.                Approx Soln.                        Error
   1     [ 0.5000000000 -0.1861566533 -0.5233333333 ] [ 5.000000e-01 1.861567e-01 5.233333e-01 ]

   2     [ 0.4981593927 -0.1996211036 -0.5285613619 ] [ 1.840607e-03 1.346445e-02 5.228029e-03 ]

   3     [ 0.4981462771 -0.1996201750 -0.5285609457 ] [ 1.311559e-05 9.285434e-07 4.162318e-07 ]

   4     [ 0.4981462771 -0.1996201750 -0.5285609457 ] [ 2.148282e-13 7.475492e-12 1.137979e-12 ]
```


N vs Error Que-3
x1
x2
x3
Error
No. of iterations
0.6
0.5
0.4
0.3
0.2
0.1
0
1
1.5
2
2.5
3
3.5
4