Scientific Computing Lab MA – 322 Lab – 11

Name – Rasesh Srivastava

Roll Number – 210123072

Branch – Mathematics and Computing

For each part of all the questions, the five plots are as follows:

(i) t versus actual and approximate solutions

(ii) t versus absolute error

(iii) N versus Order of Convergence

(iv) loglog plot of t versus absolute error

(v) $\log(E_N)$ versus $\log(N)$

Where, N = (b-a)/h = Number of intervals

Order of convergence = $\log_2(E_N/E_{2N})$, where E_N and E_{2N} and the maximum errors obtained during the computation for that specific value of N

1)

The following methods are implemented:

(i) Implicit-Euler Method

(ii) Second-order Runge-Kutta method with:

- $c_2 = 1/2$ (Improved Tangent Method)
- $c_2 = 2/3$ (Optimal Method)
- $c_2 = 1$ (Euler-Cauchy Method)

(iii) Fourth-order Runge-Kutta method with:

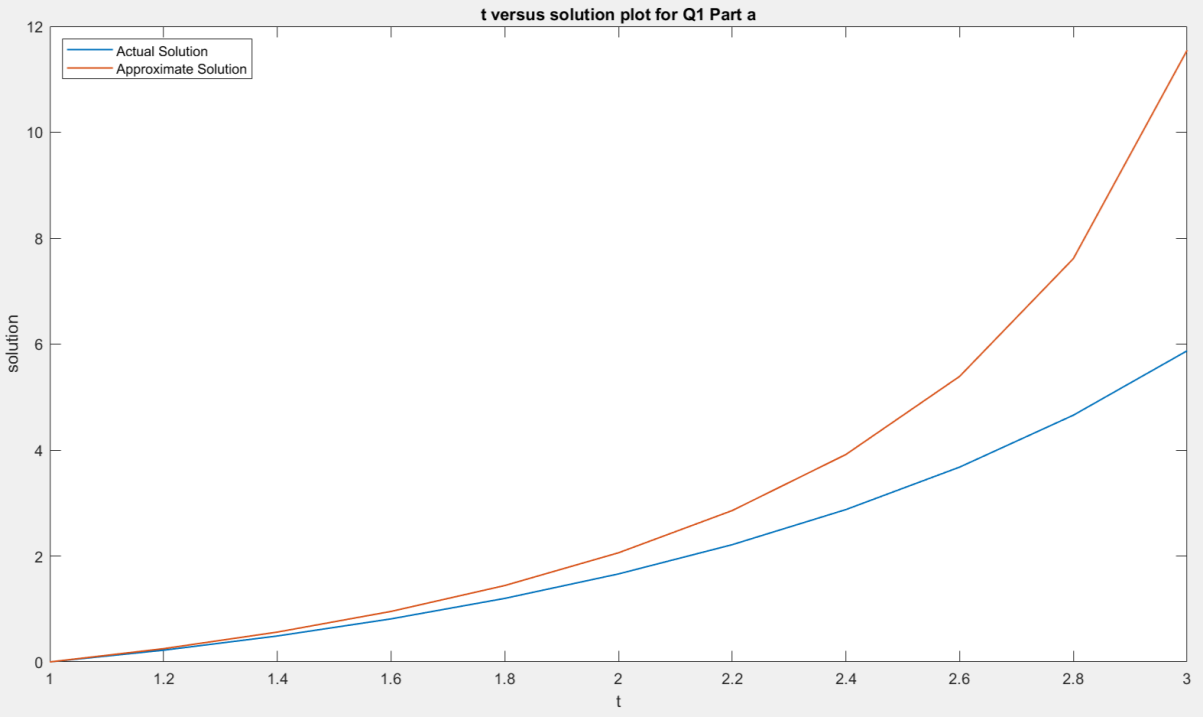
- $c_2 = 1/2$, $c_3 = 1/2$, $c_4 = 1$ (Classical Method)
- $c_2 = 1/3$, $c_3 = 2/3$, $c_4 = 1$ (Kutta Method)

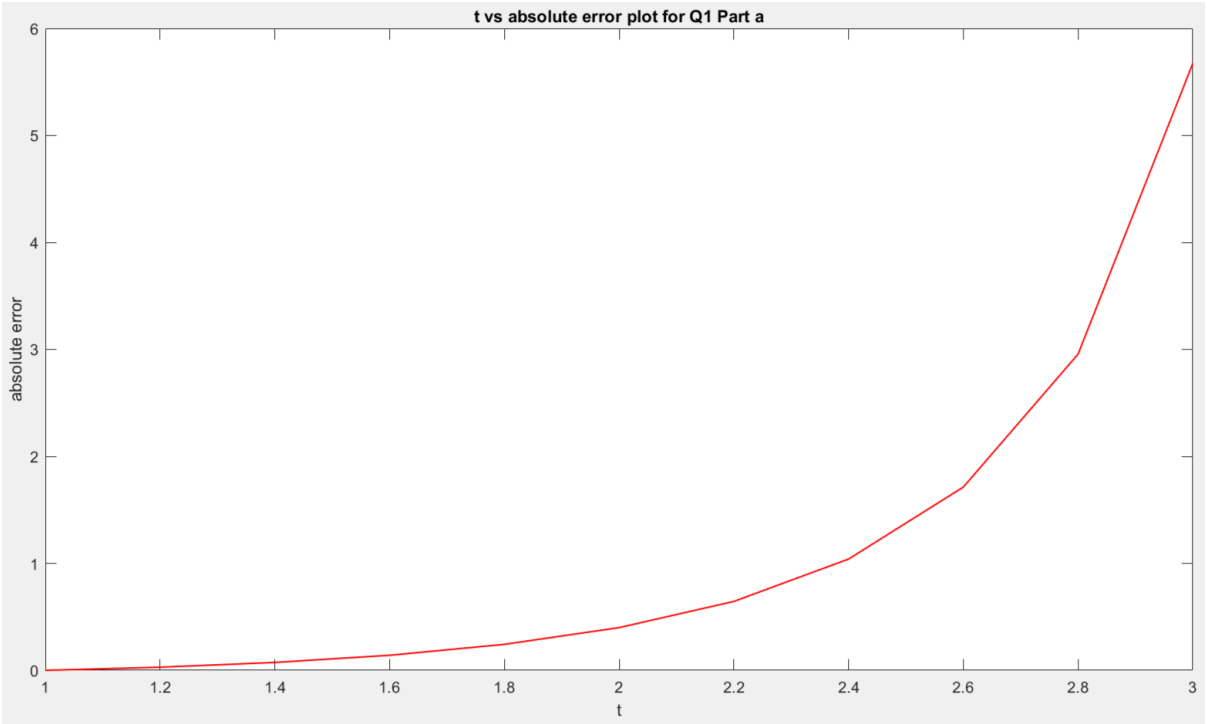
a)

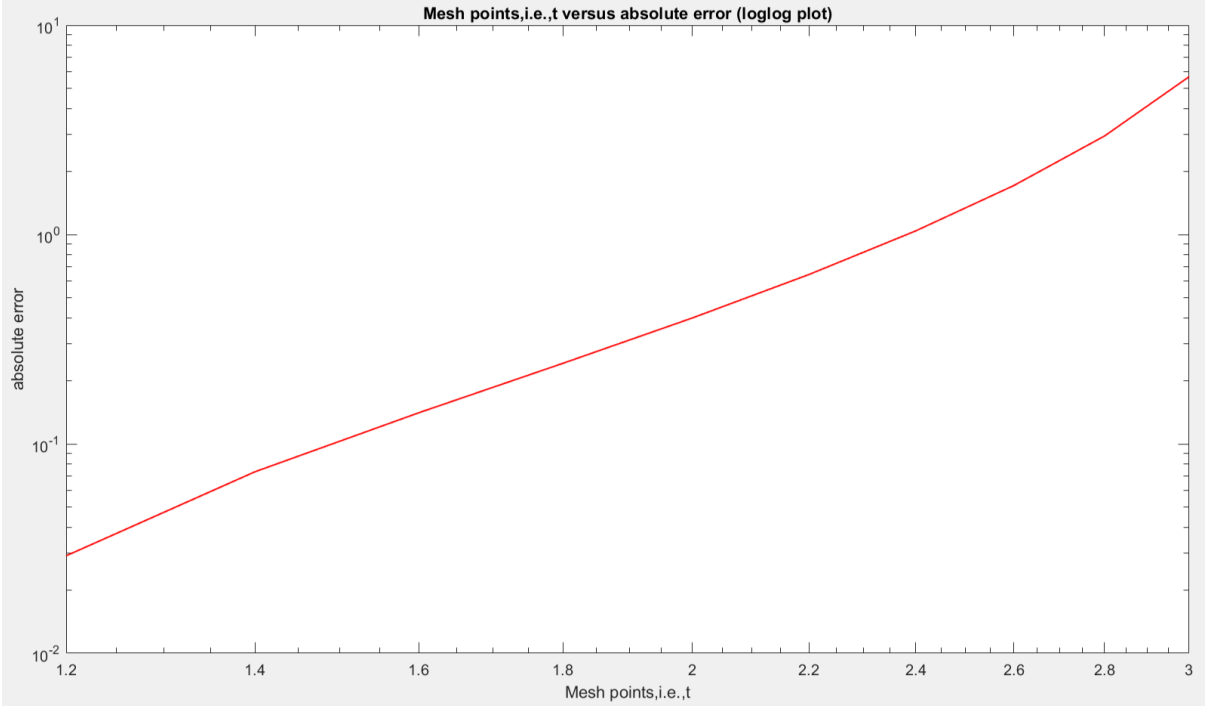
Question 1 Part a

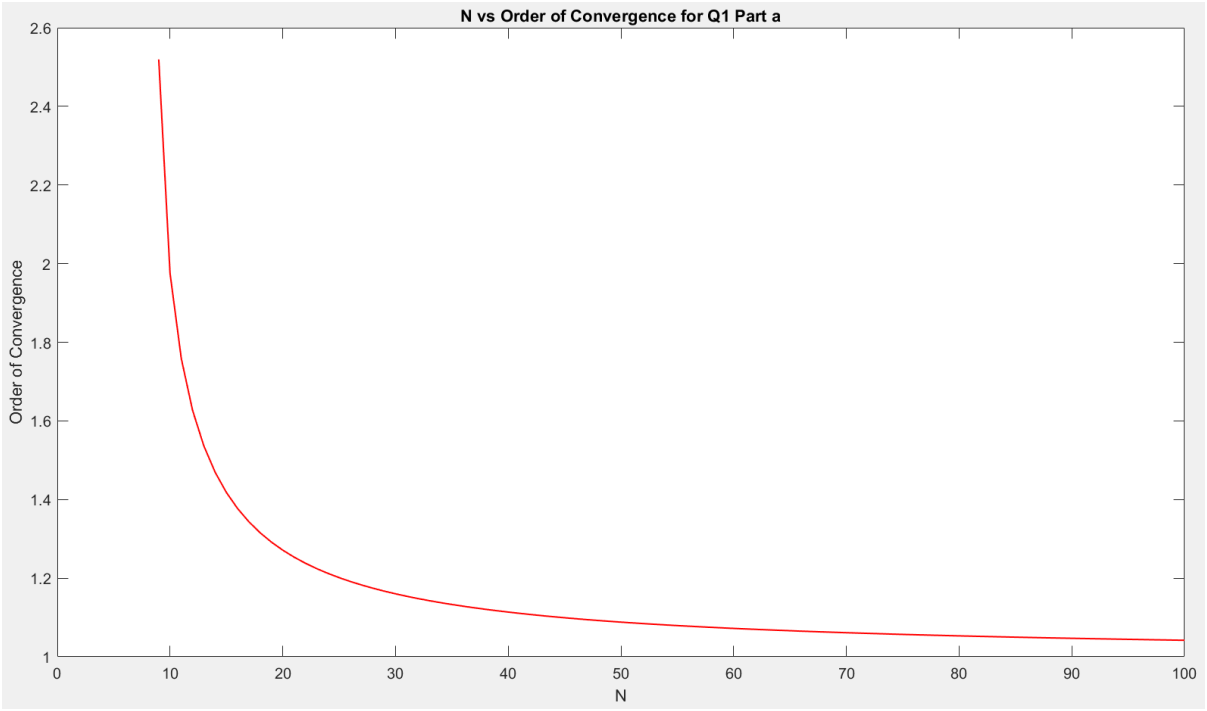
Using Implicit-Euler method for Q1 Part a

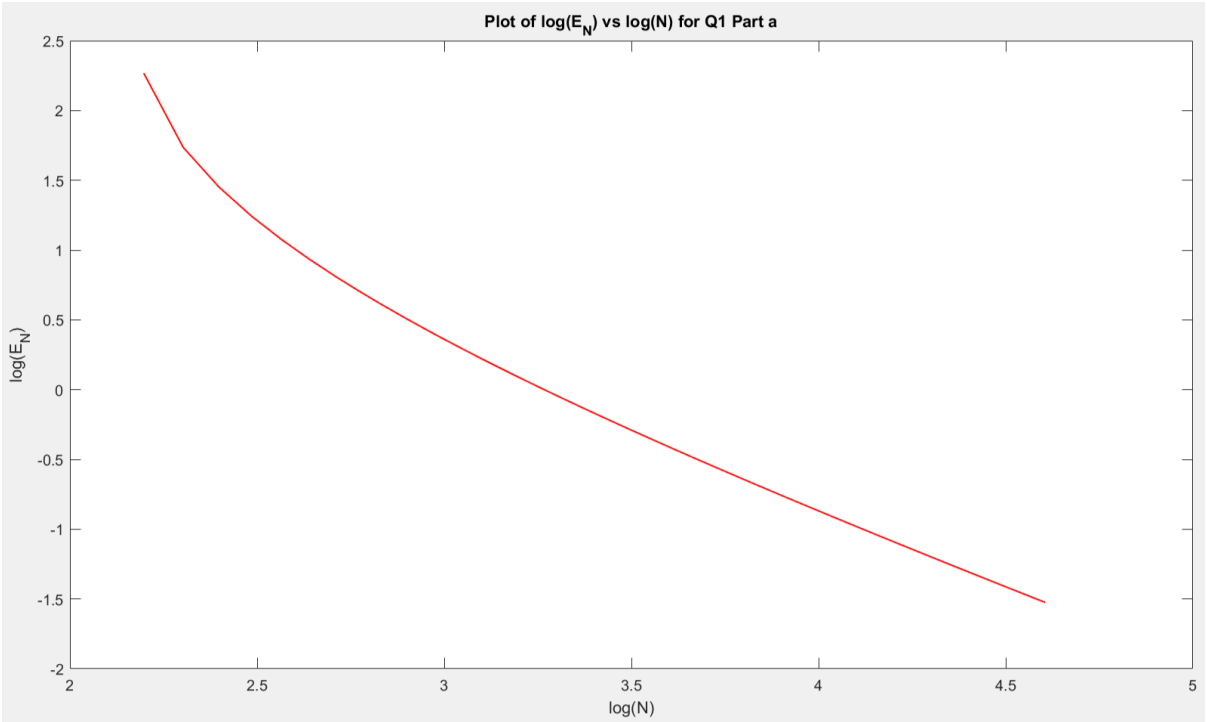
t	Approximate Solution	Exact Solution	Absolute Error
1.000000	0.000000	0.000000	0.000000
1.200000	0.250454	0.221243	0.029212
1.400000	0.563305	0.489682	0.073624
1.600000	0.953529	0.812753	0.140776
1.800000	1.442150	1.199439	0.242711
2.000000	2.060475	1.661282	0.399194
2.200000	2.857734	2.213502	0.644232
2.400000	3.916828	2.876551	1.040277
2.600000	5.391610	3.678475	1.713135
2.800000	7.614685	4.658665	2.956020
3.000000	11.548058	5.874100	5.673958




t vs absolute error plot for Q1 Part a
absolute error
t
0
1
2
3
4
5
6
1
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8
3

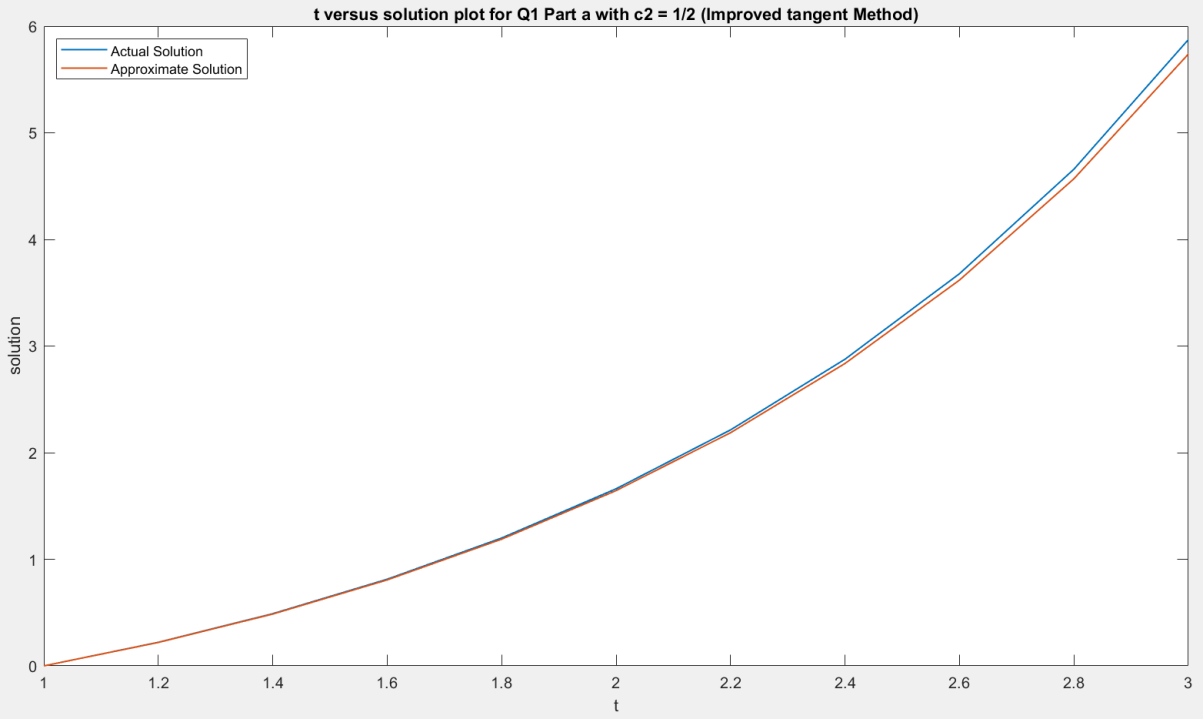

Mesh points,i.e.,t versus absolute error (loglog plot)
absolute error
Mesh points,i.e.,t
10^{1}
10^{0}
10^{-1}
10^{-2}
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8
3

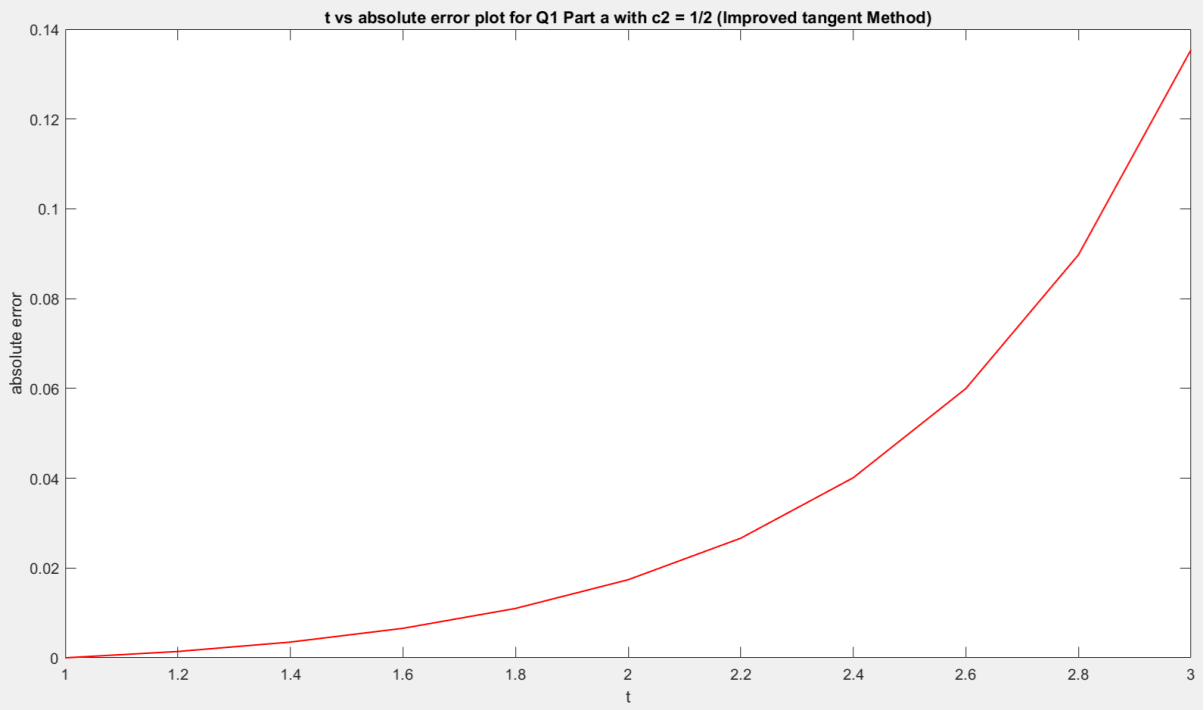

N vs Order of Convergence for Q1 Part a
Order of Convergence
N
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0
10
20
30
40
50
60
70
80
90
100

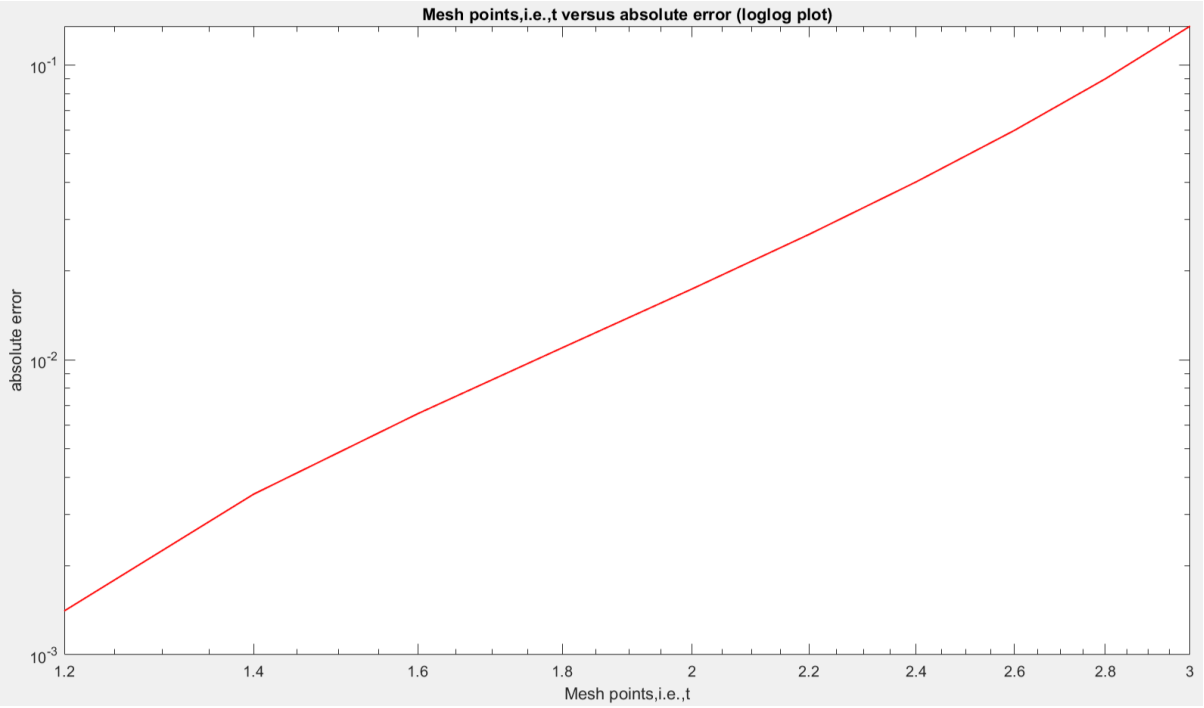

Plot of log(E_N) vs log(N) for Q1 Part a
log(E_N)
log(N)
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
2
2.5
3
3.5
4
4.5
5

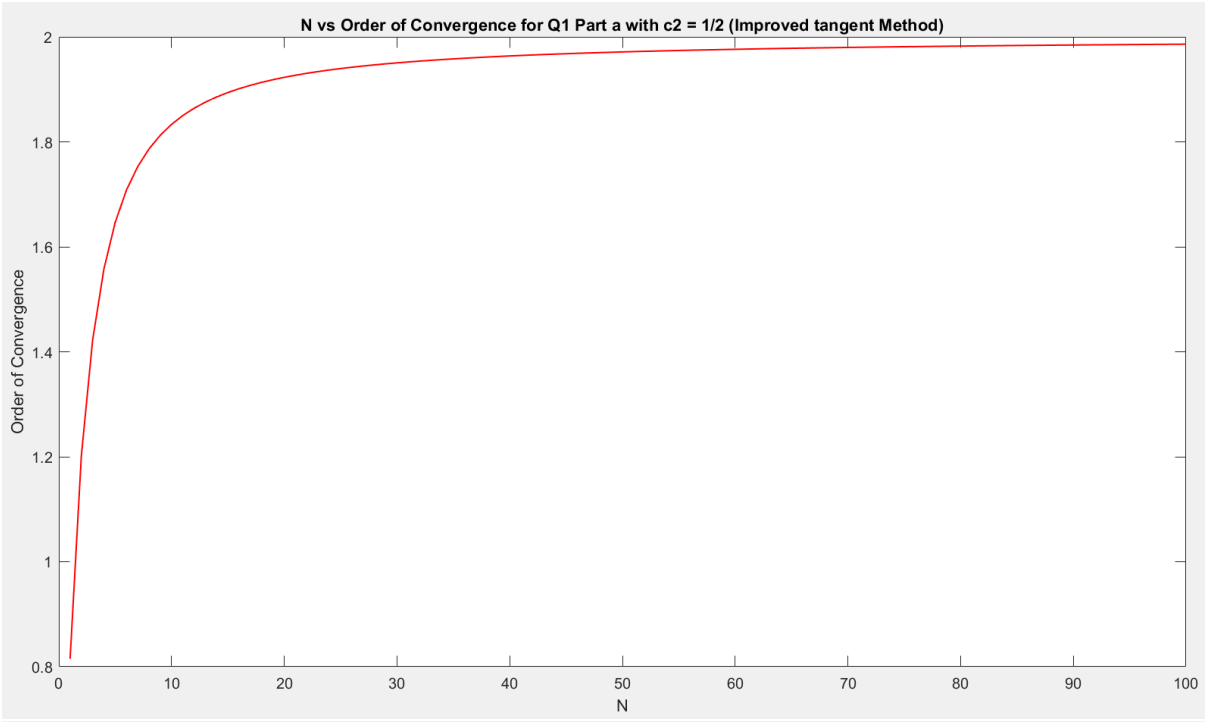
Using Second-order Runge-Kutta Method for Q1 Part a with c2 = 1/2 (Improved tangent Method)

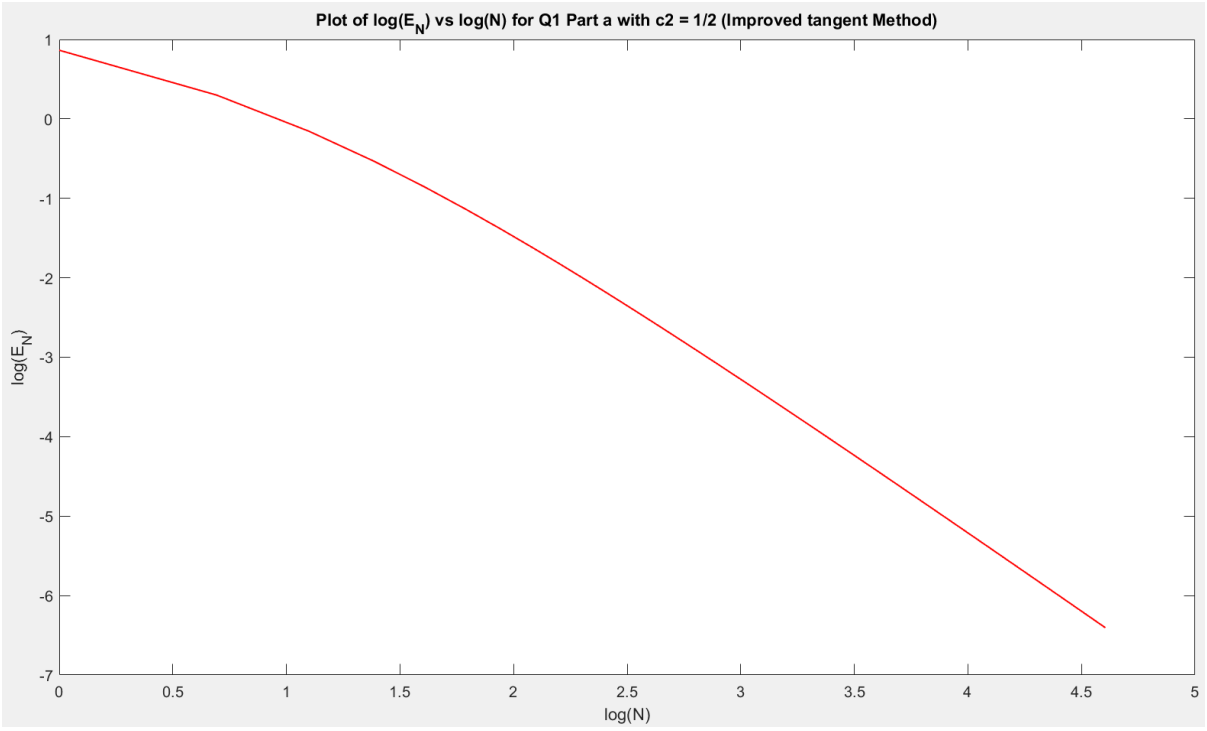
t	Approximate Solution	Exact Solution	Absolute Error
1.000000	0.000000	0.000000	0.000000
1.200000	0.219835	0.221243	0.001408
1.400000	0.486177	0.489682	0.003505
1.600000	0.806185	0.812753	0.006568
1.800000	1.188439	1.199439	0.010999
2.000000	1.643889	1.661282	0.017393
2.200000	2.186861	2.213502	0.026641
2.400000	2.836436	2.876551	0.040116
2.600000	3.618493	3.678475	0.059983
2.800000	4.568894	4.658665	0.089771
3.000000	5.738647	5.874100	0.135453




t vs absolute error plot for Q1 Part a with c2 = 1/2 (Improved tangent Method)
absolute error
t
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
1
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8
3

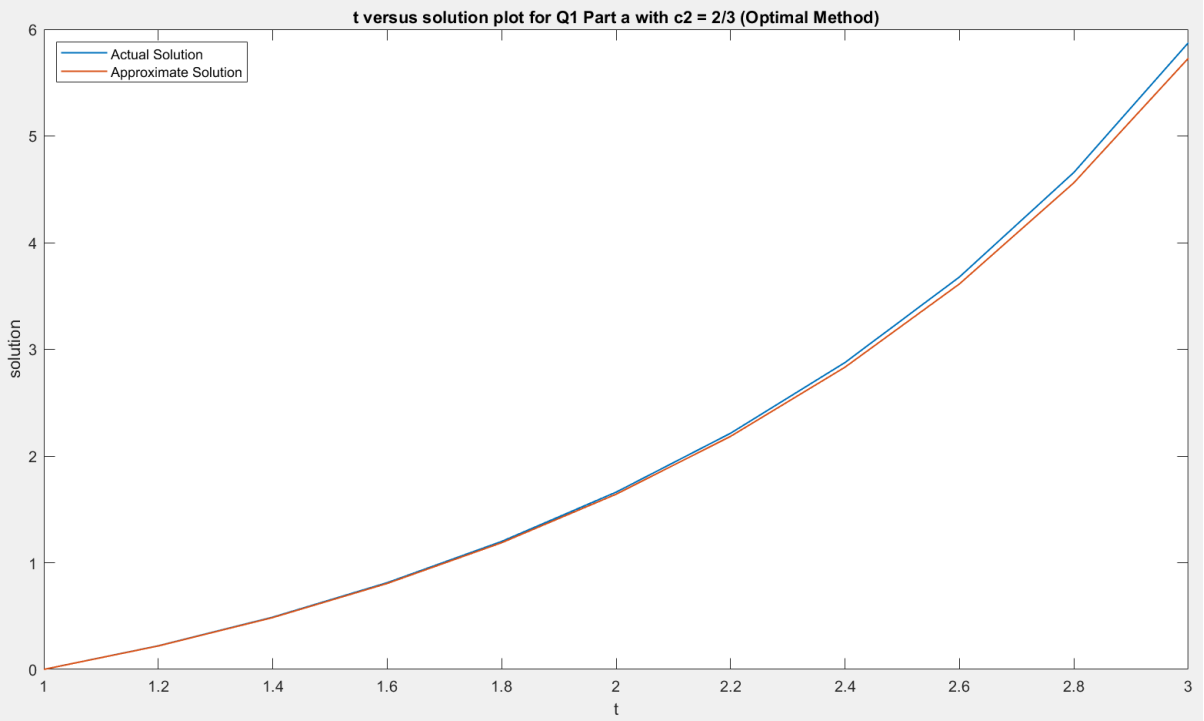

Mesh points,i.e.,t versus absolute error (loglog plot)
absolute error
Mesh points,i.e.,t
10^-1
10^-2
10^-3
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8
3

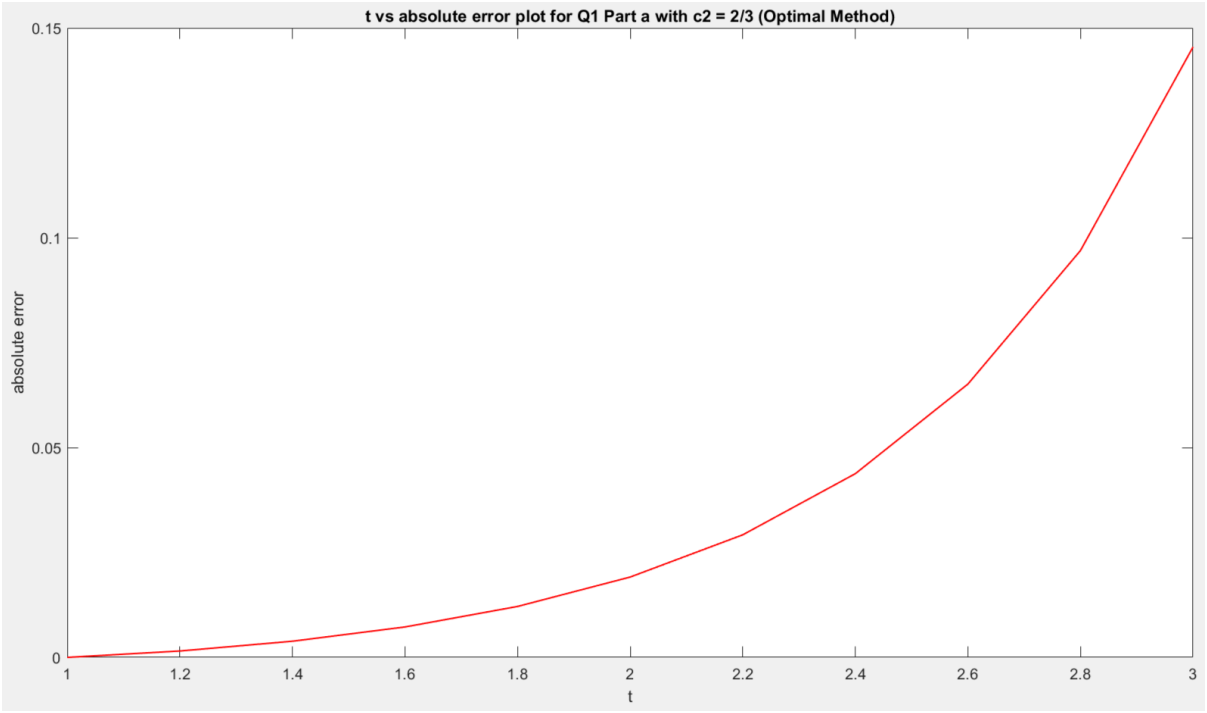

N vs Order of Convergence for Q1 Part a with c2 = 1/2 (Improved tangent Method)
Order of Convergence
N
2
1.8
1.6
1.4
1.2
1
0.8
0
10
20
30
40
50
60
70
80
90
100

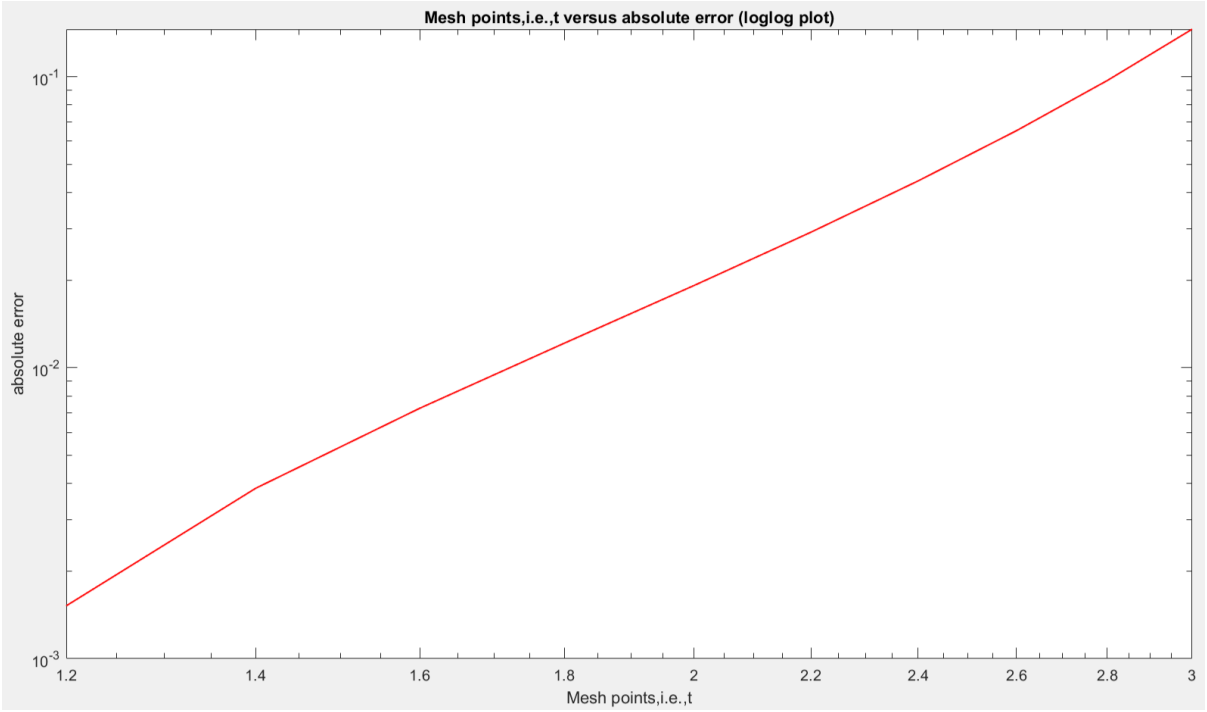

Plot of log(E_N) vs log(N) for Q1 Part a with c2 = 1/2 (Improved tangent Method)
log(E_N)
log(N)
1
0
-1
-2
-3
-4
-5
-6
-7
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

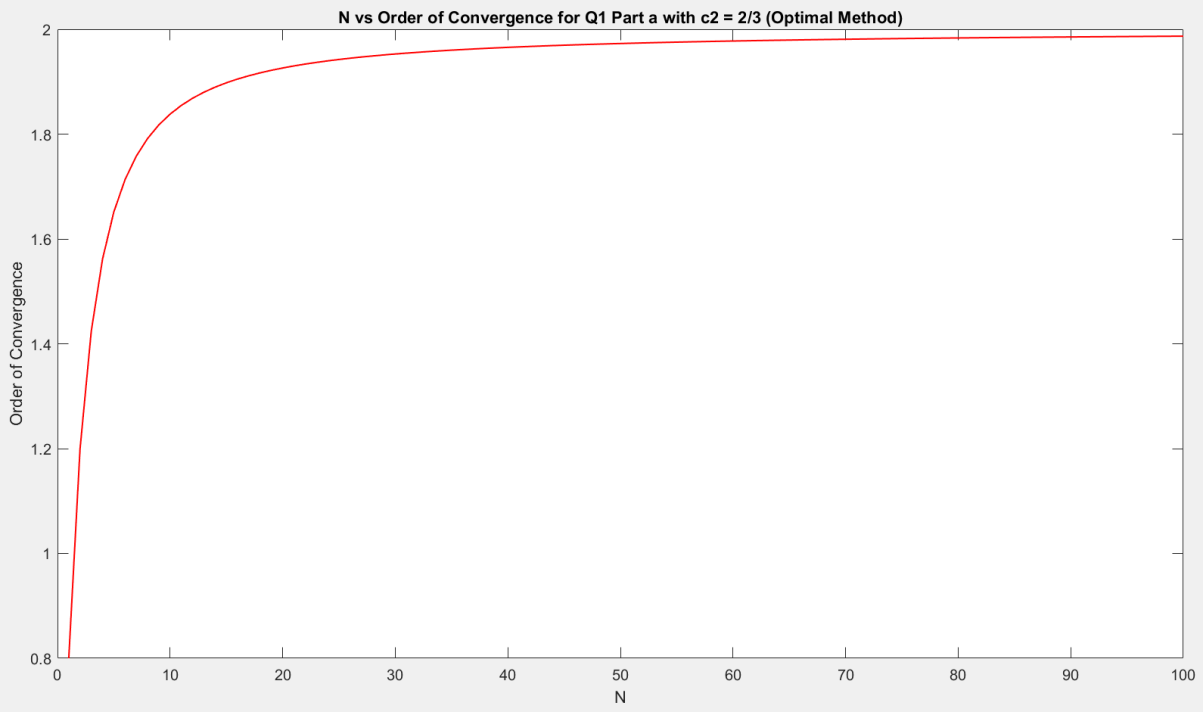
Using Second-order Runge-Kutta Method for Q1 Part a with c2 = 2/3 (Optimal Method)

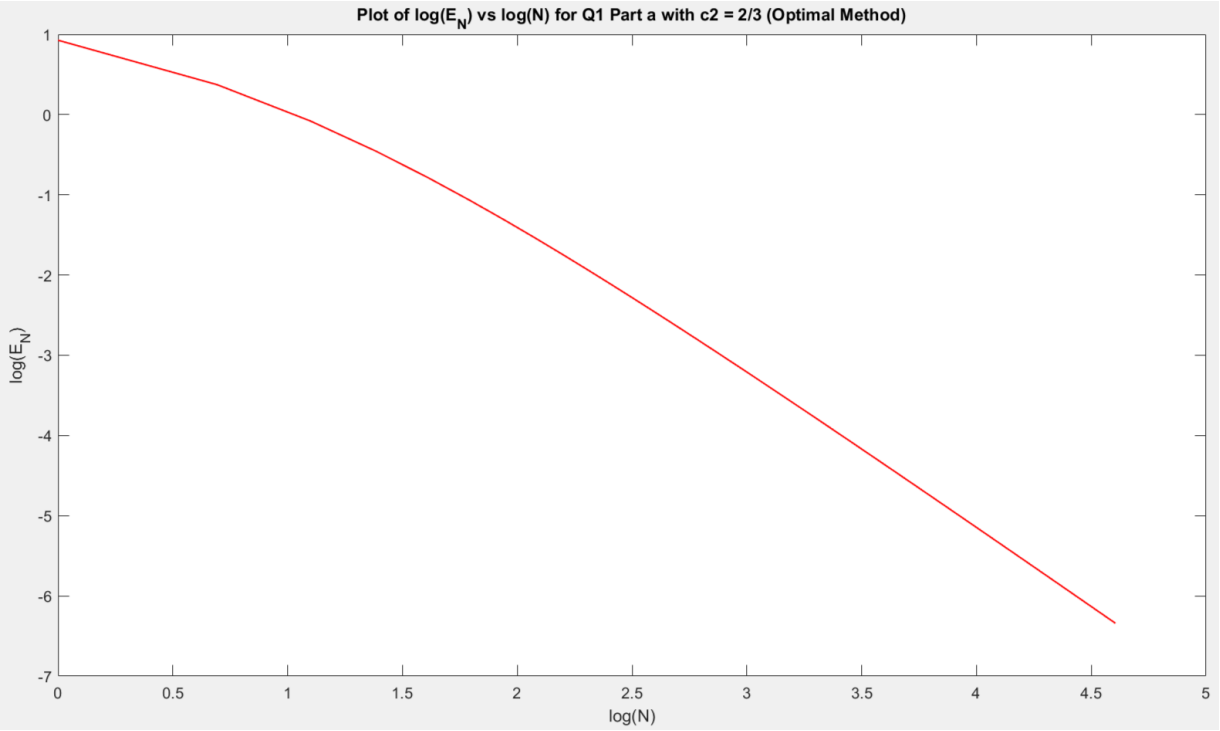
t	Approximate Solution	Exact Solution	Absolute Error
1.000000	0.000000	0.000000	0.000000
1.200000	0.219723	0.221243	0.001520
1.400000	0.485831	0.489682	0.003850
1.600000	0.805502	0.812753	0.007251
1.800000	1.187299	1.199439	0.012139
2.000000	1.642139	1.661282	0.019143
2.200000	2.184295	2.213502	0.029207
2.400000	2.832773	2.876551	0.043779
2.600000	3.613343	3.678475	0.065133
2.800000	4.561706	4.658665	0.096959
3.000000	5.728625	5.874100	0.145475




t vs absolute error plot for Q1 Part a with c2 = 2/3 (Optimal Method)
absolute error
t
0.15
0.1
0.05
0
1
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8
3

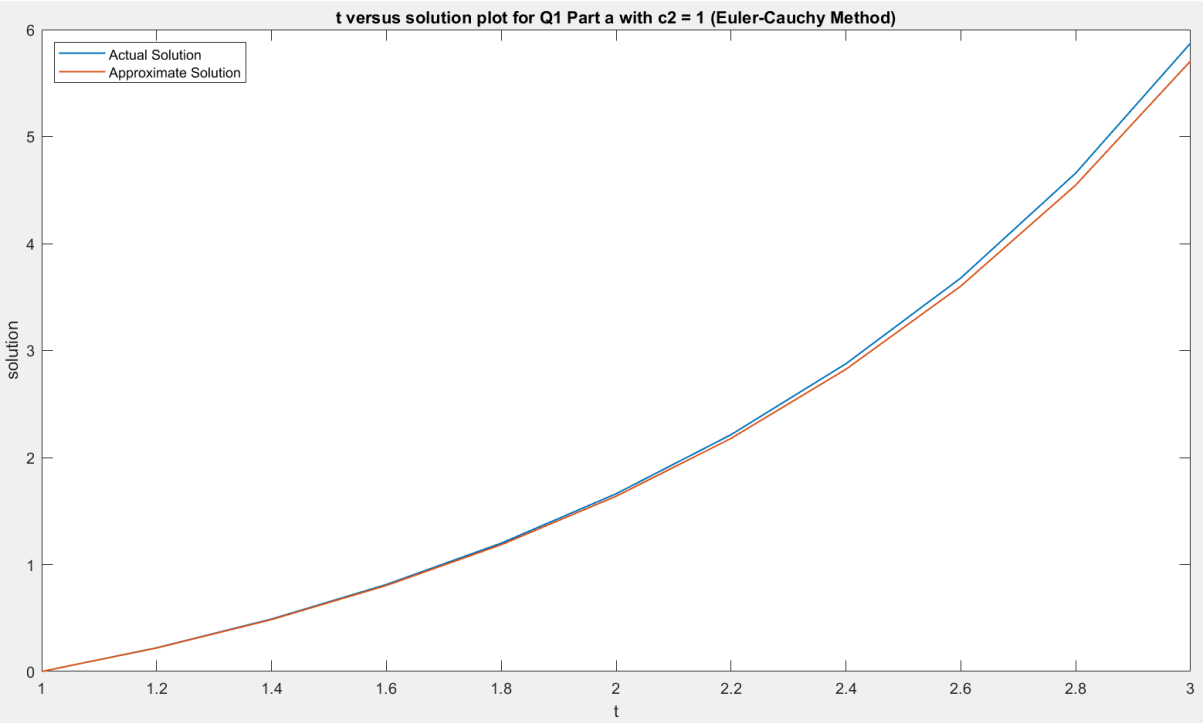

Mesh points,i.e.,t versus absolute error (loglog plot)
absolute error
Mesh points,i.e.,t
10^-1
10^-2
10^-3
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8
3

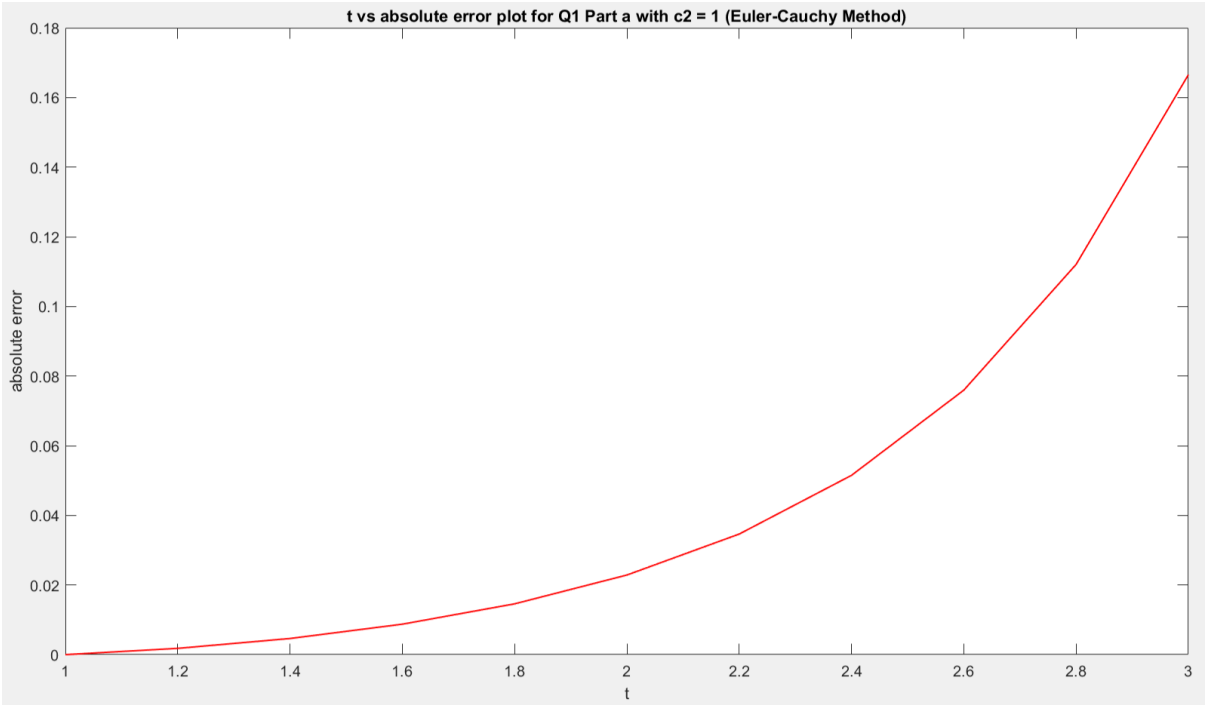

N vs Order of Convergence for Q1 Part a with c2 = 2/3 (Optimal Method)
Order of Convergence
N
2
1.8
1.6
1.4
1.2
1
0.8
0
10
20
30
40
50
60
70
80
90
100

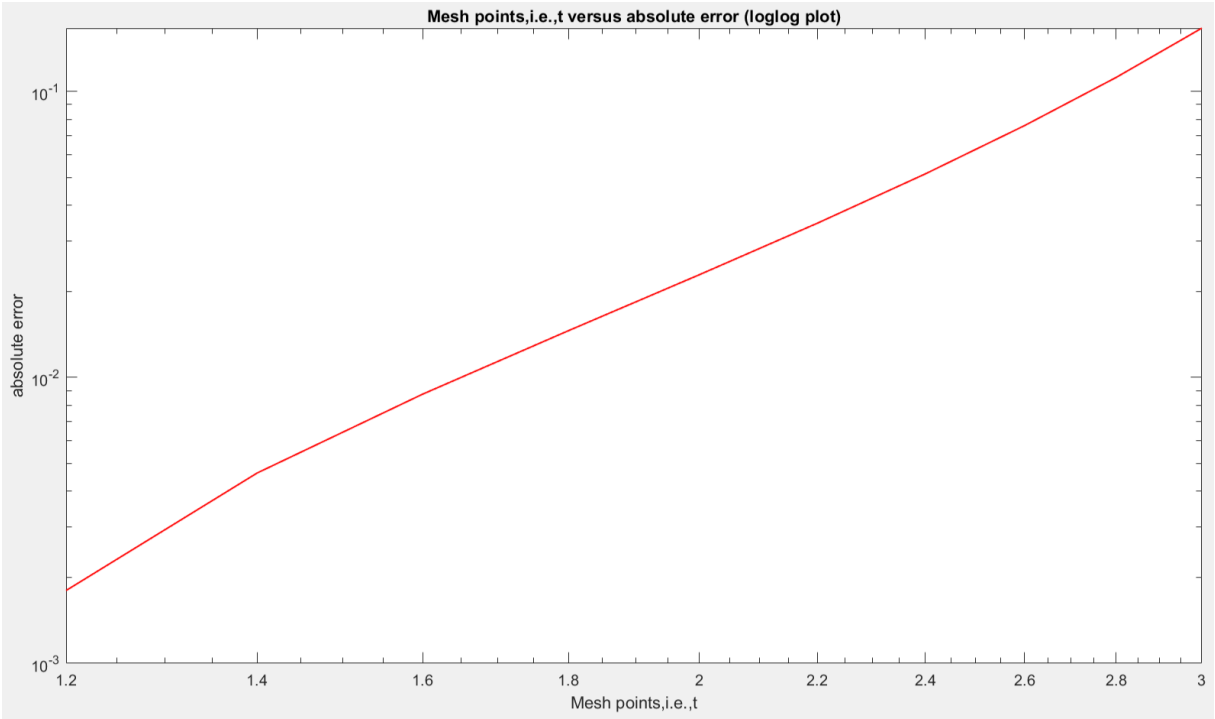

Plot of log(E_N) vs log(N) for Q1 Part a with c2 = 2/3 (Optimal Method)
log(E_N)
log(N)
1
0
-1
-2
-3
-4
-5
-6
-7
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

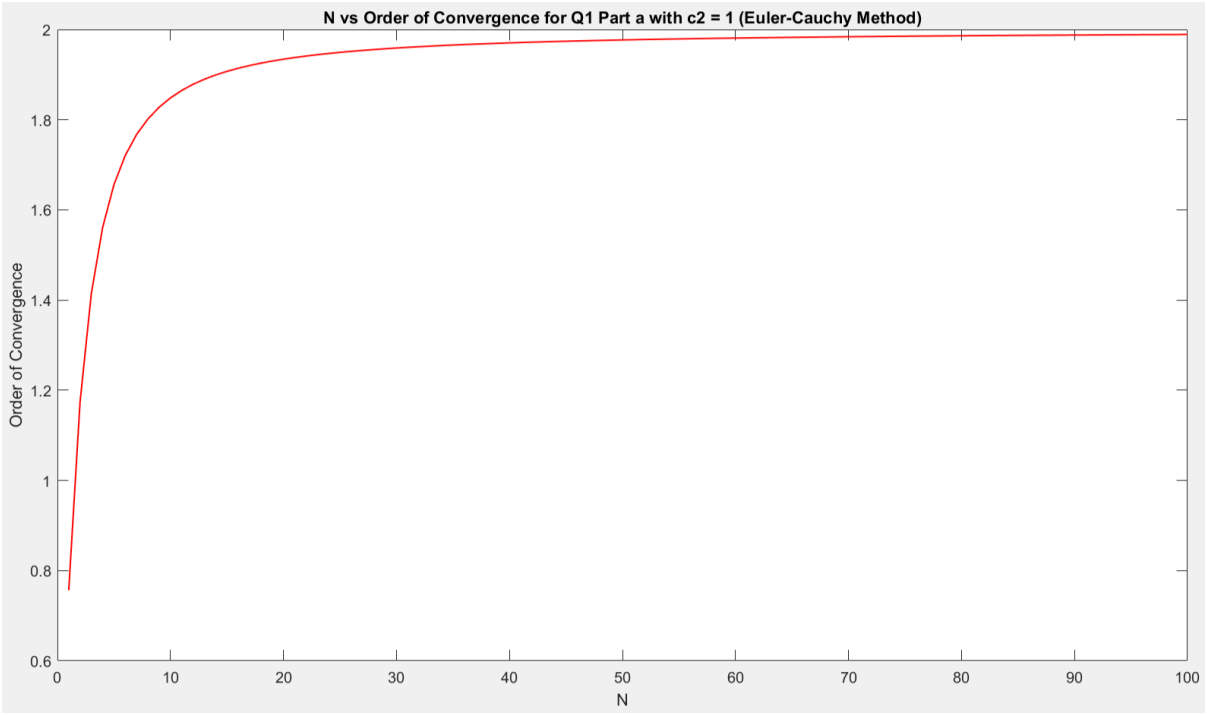
Using Second-order Runge-Kutta Method for Q1 Part a with c2 = 1 (Euler-Cauchy Method)

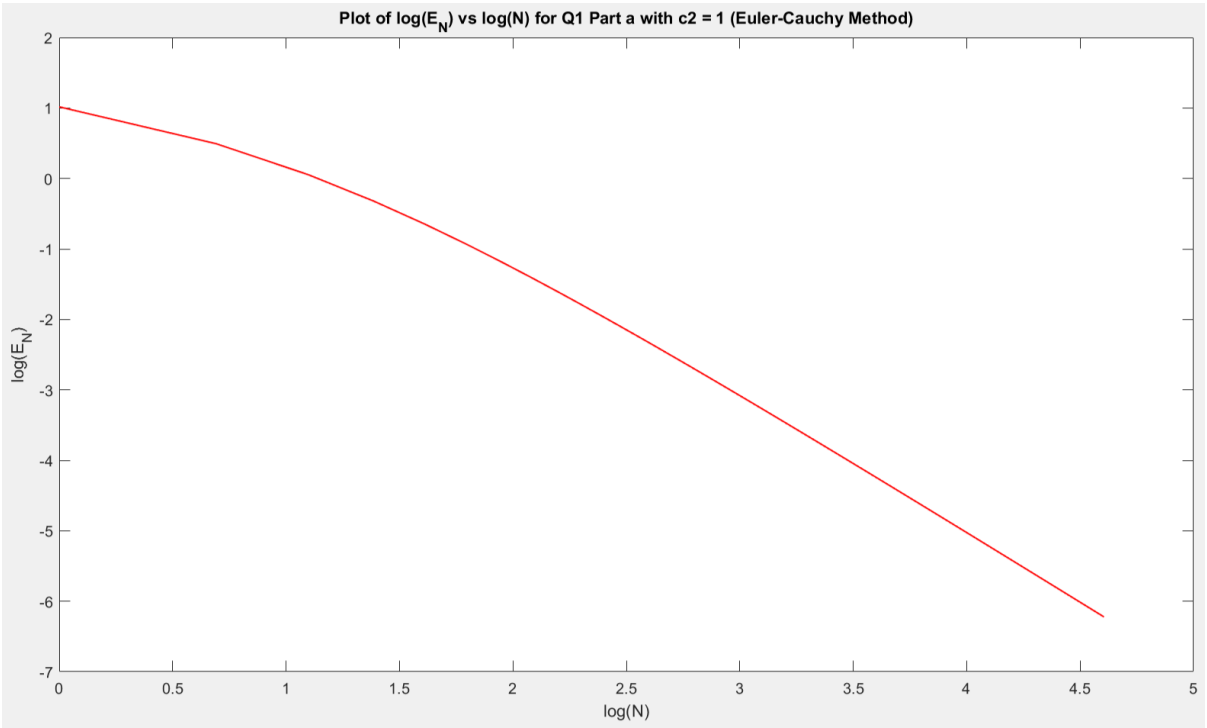
t	Approximate Solution	Exact Solution	Absolute Error
1.000000	0.000000	0.000000	0.000000
1.200000	0.219444	0.221243	0.001798
1.400000	0.485049	0.489682	0.004632
1.600000	0.804012	0.812753	0.008741
1.800000	1.184856	1.199439	0.014583
2.000000	1.638423	1.661282	0.022859
2.200000	2.178877	2.213502	0.034625
2.400000	2.825065	2.876551	0.051486
2.600000	3.602525	3.678475	0.075951
2.800000	4.546614	4.658665	0.112052
3.000000	5.707570	5.874100	0.166530




t vs absolute error plot for Q1 Part a with c2 = 1 (Euler-Cauchy Method)
absolute error
t
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
1
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8
3

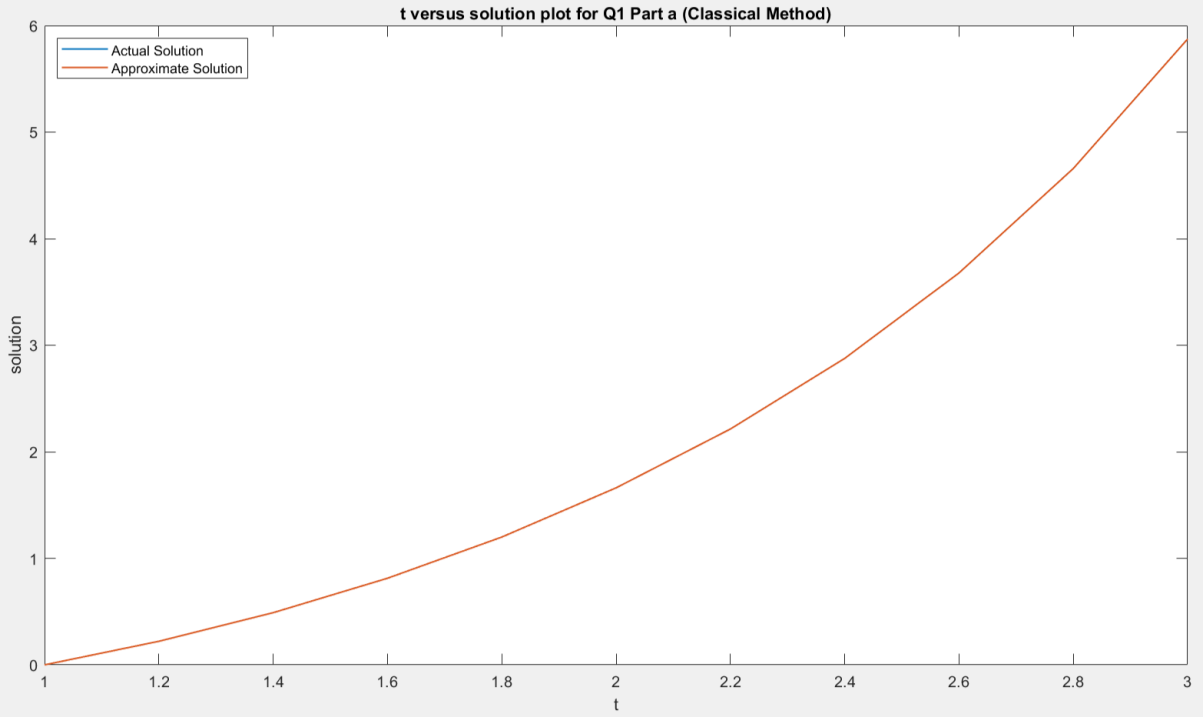

Mesh points,i.e.,t versus absolute error (loglog plot)
absolute error
Mesh points,i.e.,t
10^-1
10^-2
10^-3
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8
3

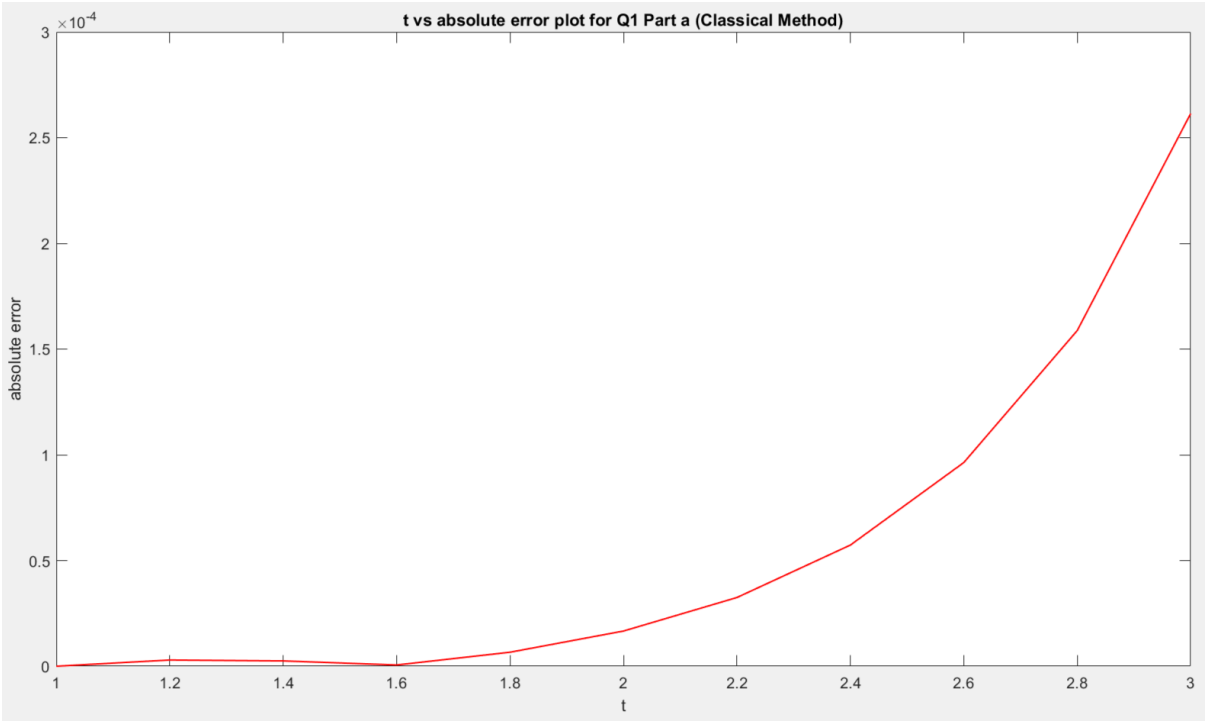

N vs Order of Convergence for Q1 Part a with c2 = 1 (Euler-Cauchy Method)
Order of Convergence
N
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0
10
20
30
40
50
60
70
80
90
100

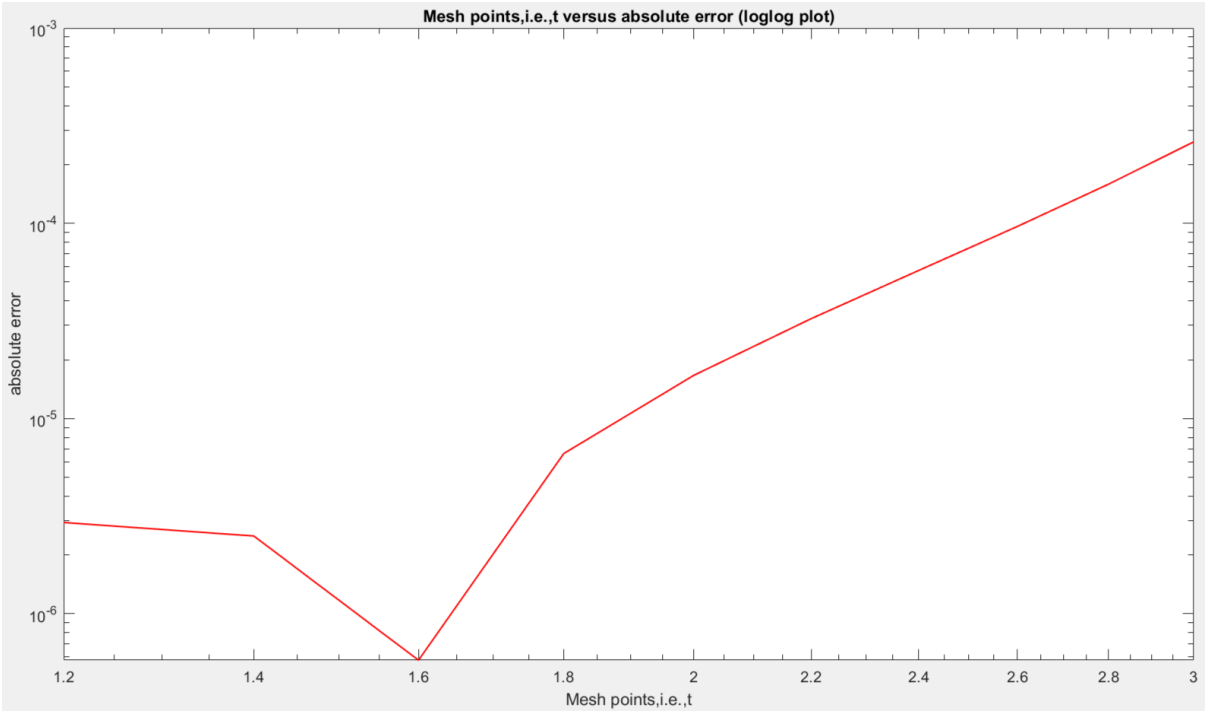

Plot of log(E_N) vs log(N) for Q1 Part a with c2 = 1 (Euler-Cauchy Method)
log(E_N)
log(N)
2
1
0
-1
-2
-3
-4
-5
-6
-7
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

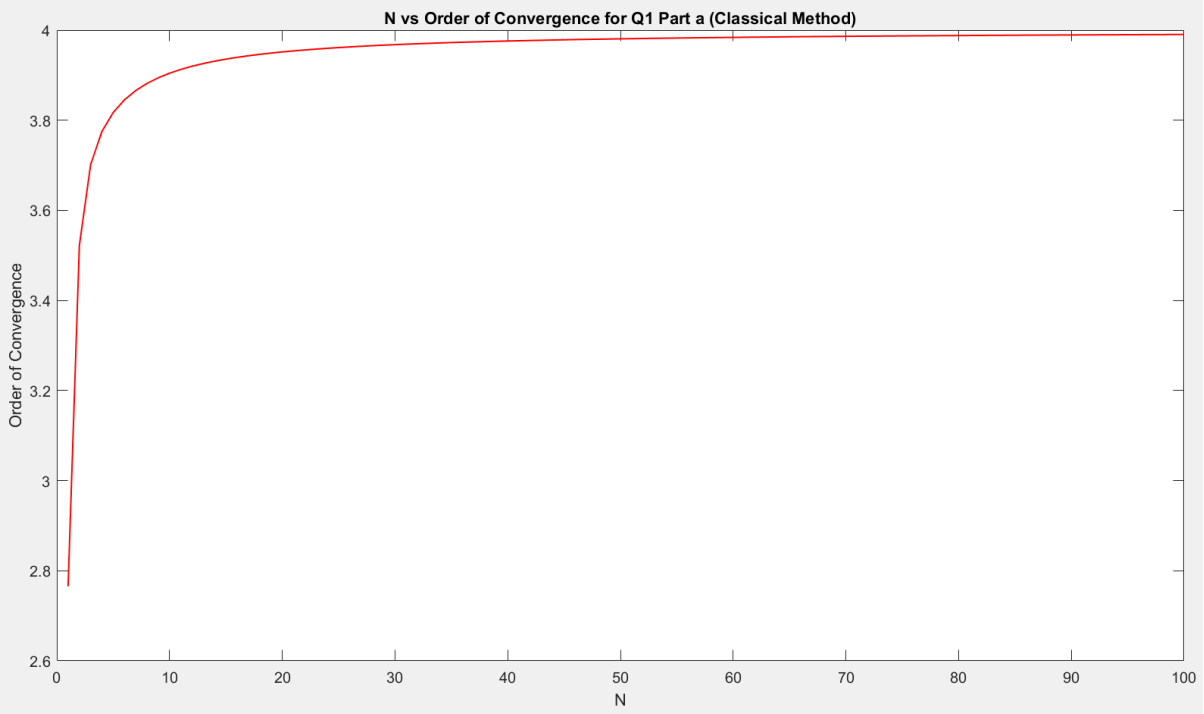
Using Fourth-order Runge-Kutta Method for Q1 Part a (Classical Method)

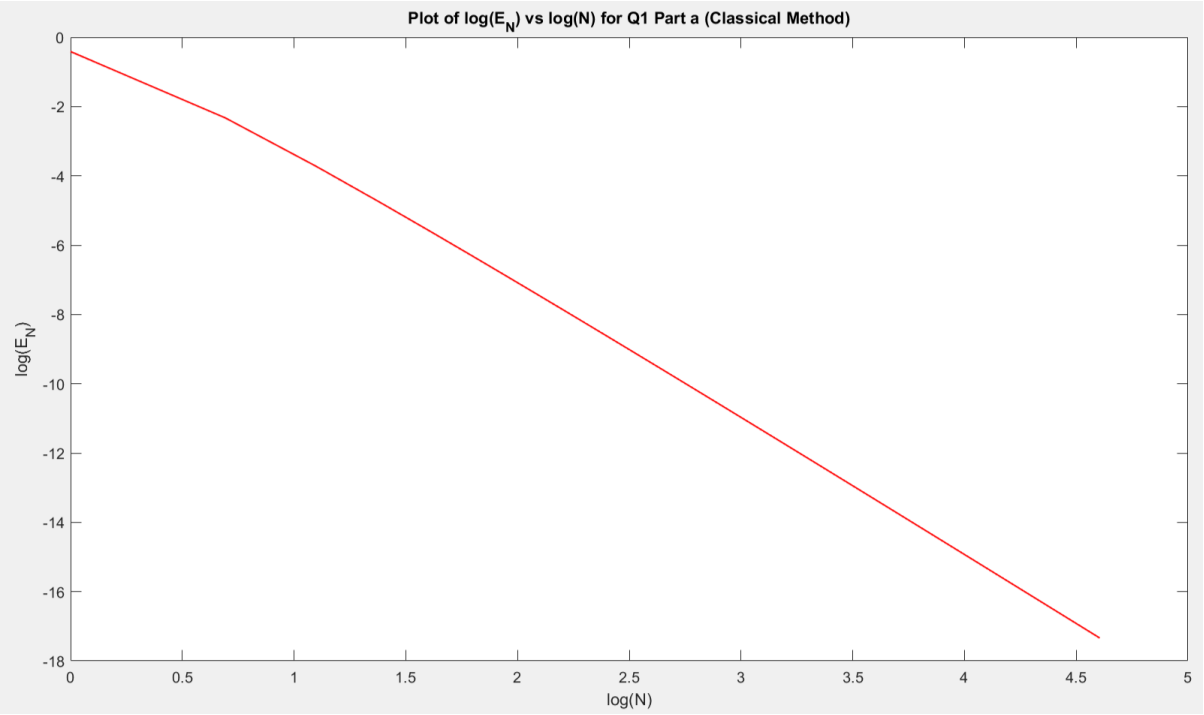
t	Approximate Solution	Exact Solution	Absolute Error
1.000000	0.000000	0.000000	0.000000
1.200000	0.221246	0.221243	0.000003
1.400000	0.489684	0.489682	0.000003
1.600000	0.812752	0.812753	0.000001
1.800000	1.199432	1.199439	0.000007
2.000000	1.661265	1.661282	0.000017
2.200000	2.213469	2.213502	0.000032
2.400000	2.876494	2.876551	0.000057
2.600000	3.678379	3.678475	0.000096
2.800000	4.658506	4.658665	0.000159
3.000000	5.873839	5.874100	0.000261




t vs absolute error plot for Q1 Part a (Classical Method)
×10^-4
absolute error
t
0
0.5
1
1.5
2
2.5
3
1
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8
3

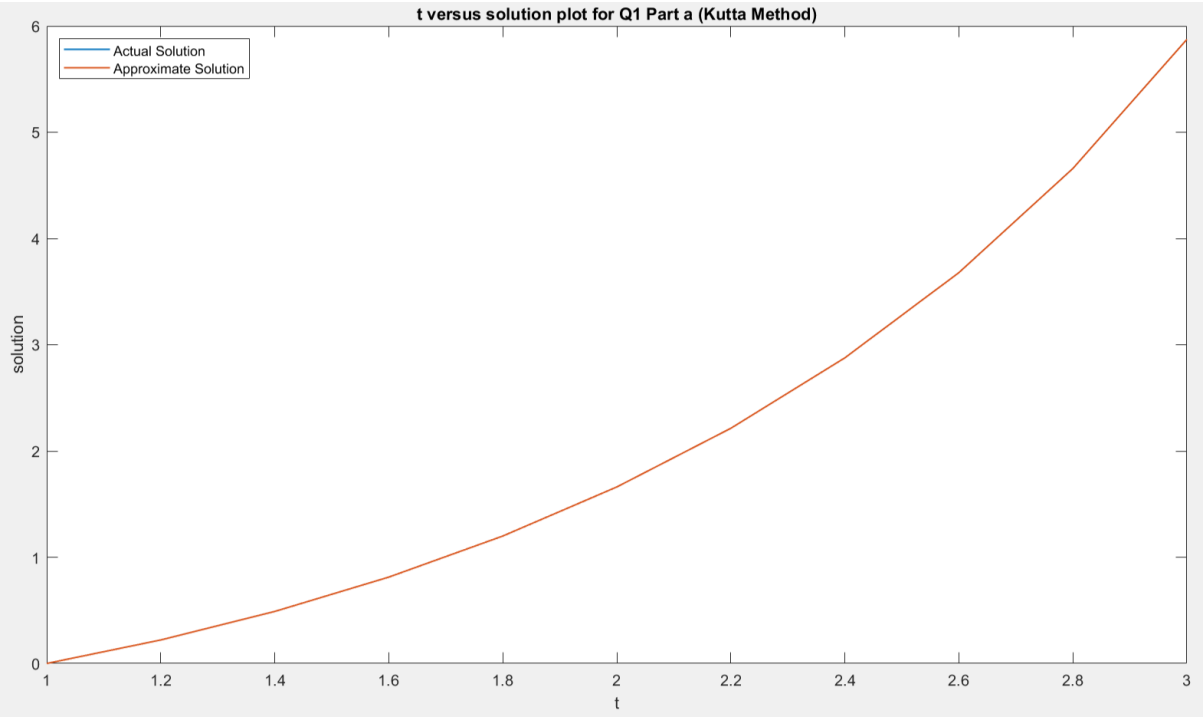

Mesh points,i.e.,t versus absolute error (loglog plot)
absolute error
Mesh points,i.e.,t
10^-3
10^-4
10^-5
10^-6
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8
3

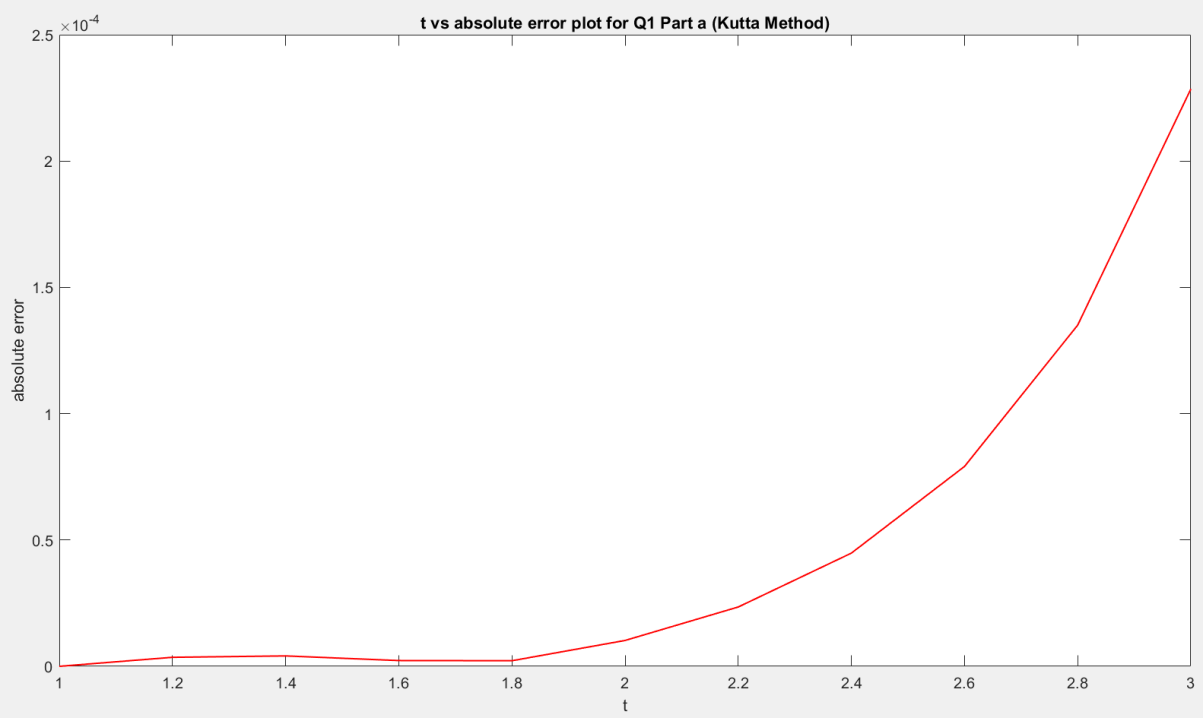

N vs Order of Convergence for Q1 Part a (Classical Method)
Order of Convergence
N
4
3.8
3.6
3.4
3.2
3
2.8
2.6
0
10
20
30
40
50
60
70
80
90
100

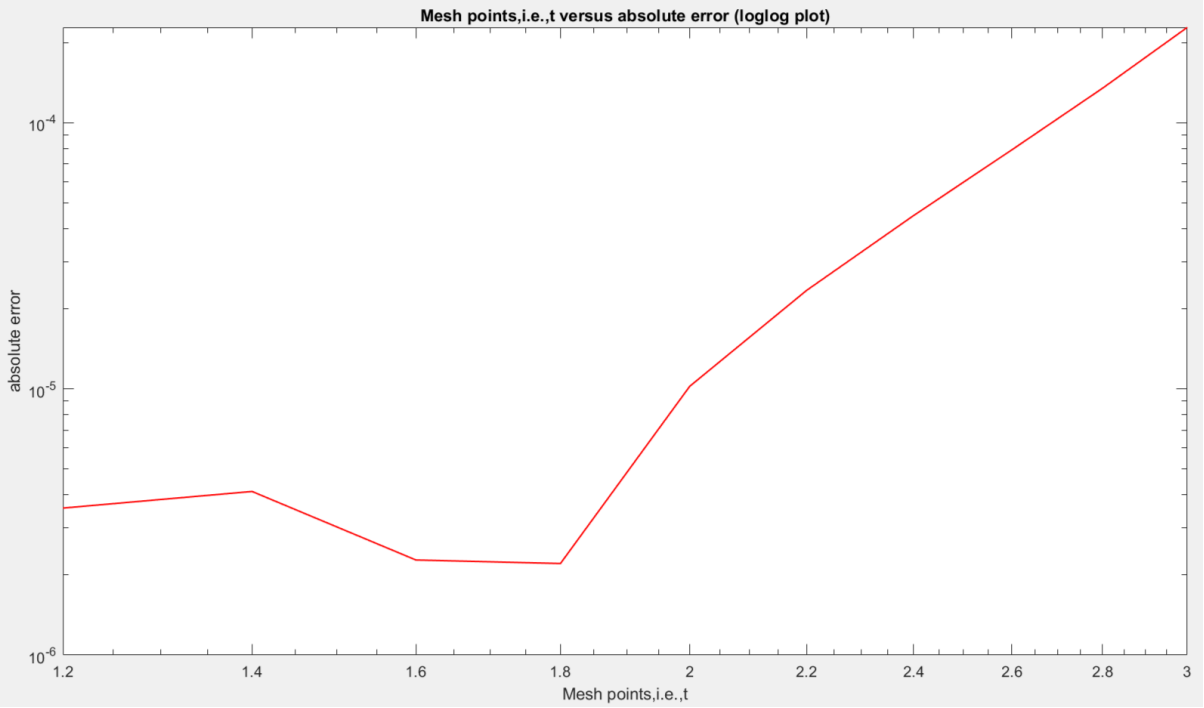

Plot of log(E_N) vs log(N) for Q1 Part a (Classical Method)
log(E_N)
log(N)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

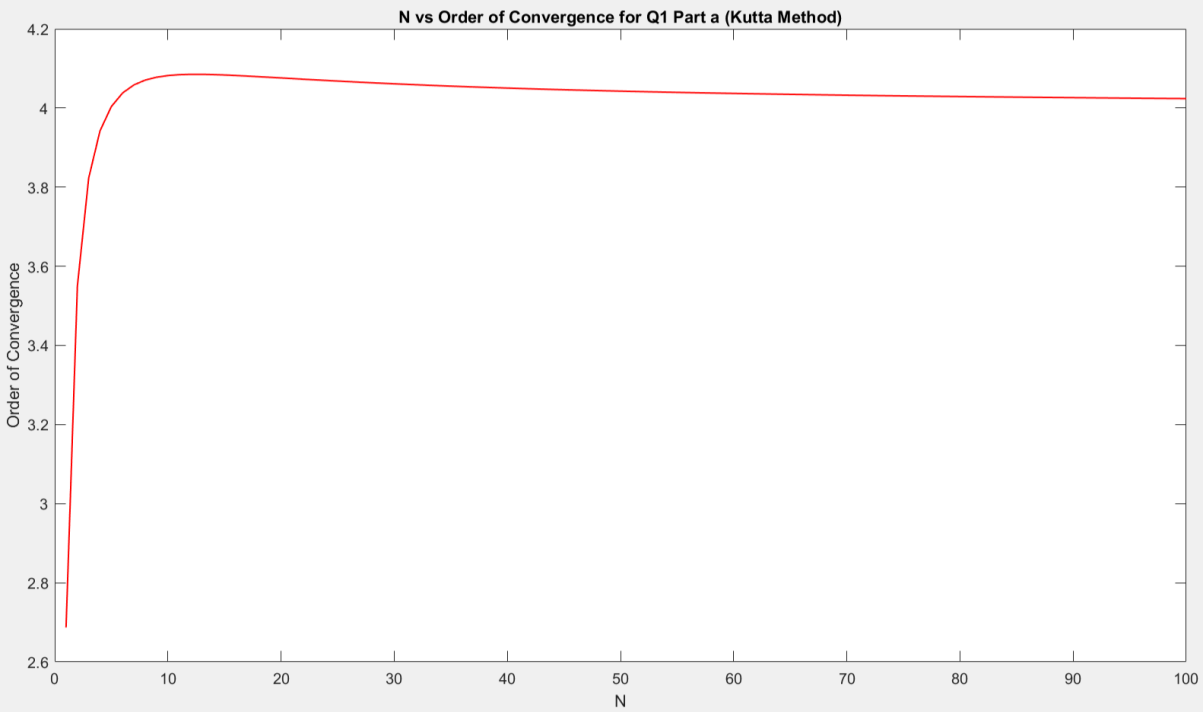
Using Fourth-order Runge-Kutta Method for Q1 Part a (Kutta Method)

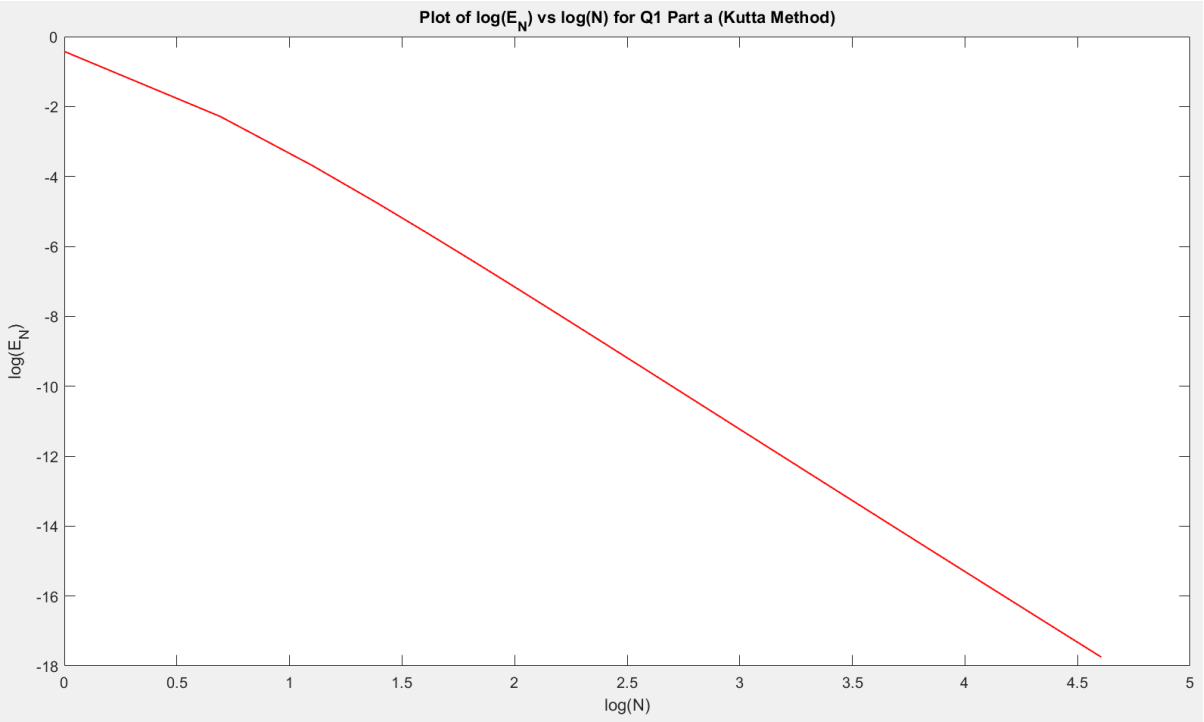
t	Approximate Solution	Exact Solution	Absolute Error
1.000000	0.000000	0.000000	0.000000
1.200000	0.221246	0.221243	0.000004
1.400000	0.489686	0.489682	0.000004
1.600000	0.812755	0.812753	0.000002
1.800000	1.199436	1.199439	0.000002
2.000000	1.661272	1.661282	0.000010
2.200000	2.213478	2.213502	0.000023
2.400000	2.876507	2.876551	0.000045
2.600000	3.678396	3.678475	0.000079
2.800000	4.658530	4.658665	0.000135
3.000000	5.873871	5.874100	0.000228




t vs absolute error plot for Q1 Part a (Kutta Method)
×10^-4
2.5
2
1.5
1
0.5
0
absolute error
1
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8
3
t


Mesh points,i.e.,t versus absolute error (loglog plot)
10^-4
10^-5
10^-6
absolute error
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8
3
Mesh points,i.e.,t


N vs Order of Convergence for Q1 Part a (Kutta Method)
Order of Convergence
N
4.2
4
3.8
3.6
3.4
3.2
3
2.8
2.6
0
10
20
30
40
50
60
70
80
90
100

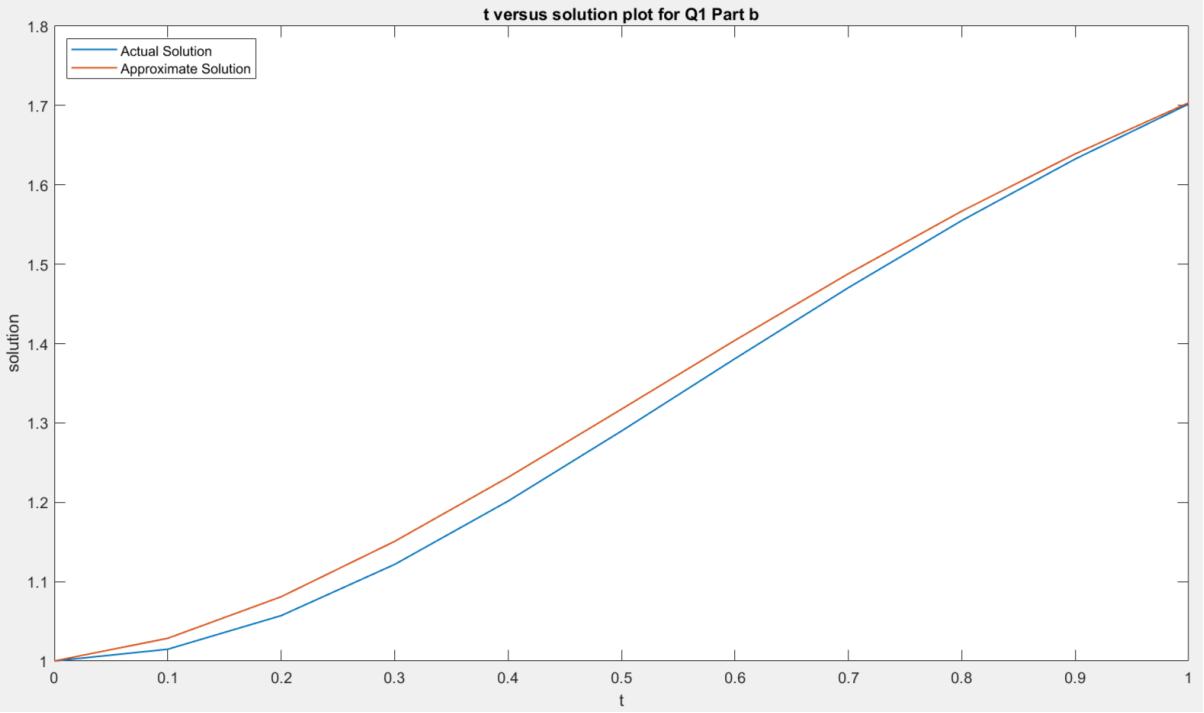

Plot of log(E_N) vs log(N) for Q1 Part a (Kutta Method)
log(E_N)
log(N)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

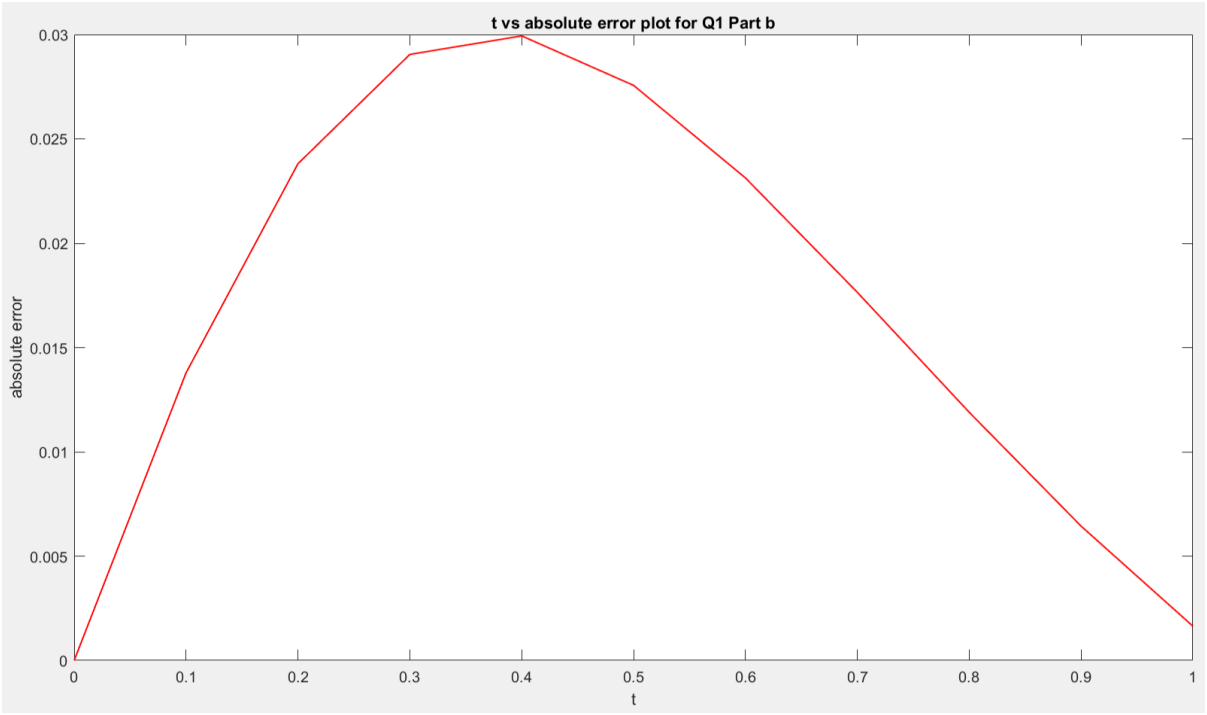
b)

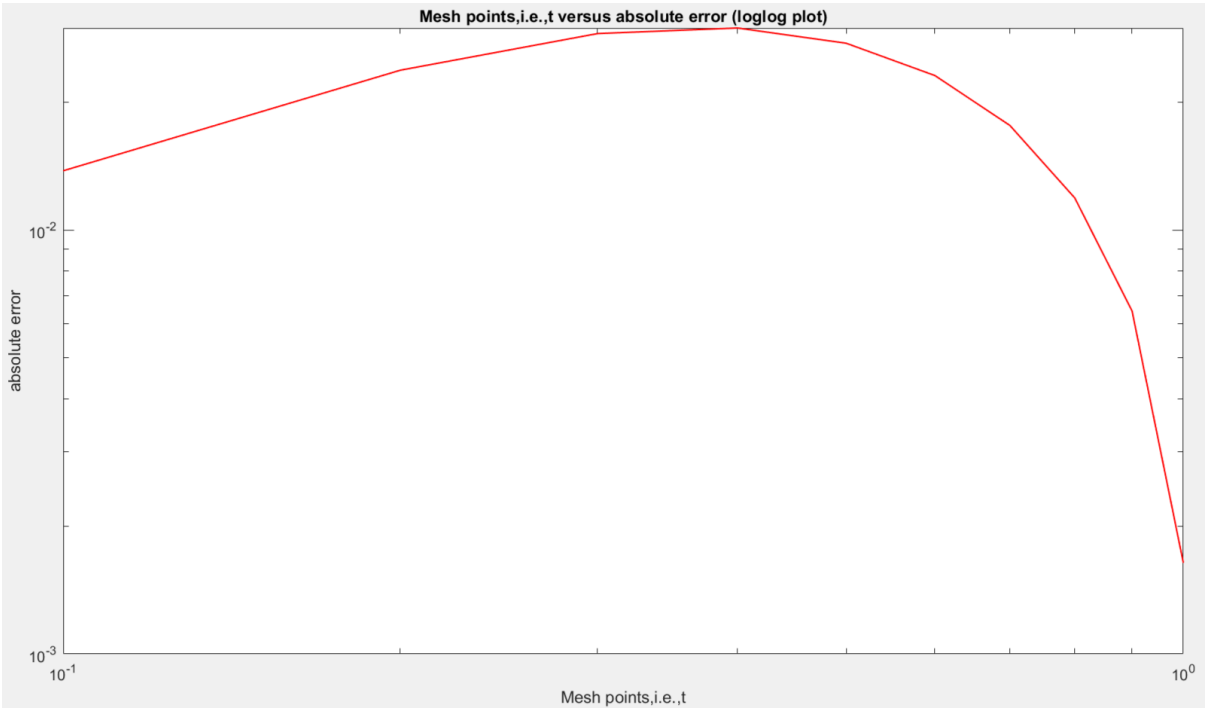
Question 1 Part b

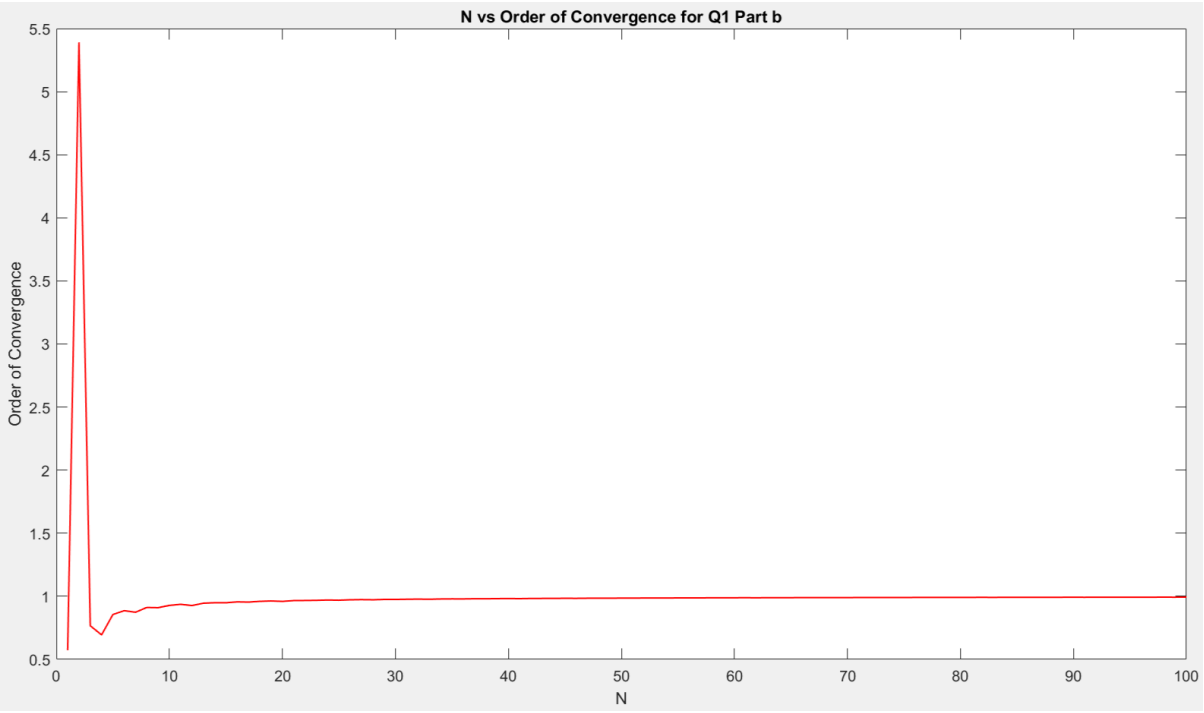
Using Implicit-Euler method for Q1 Part b

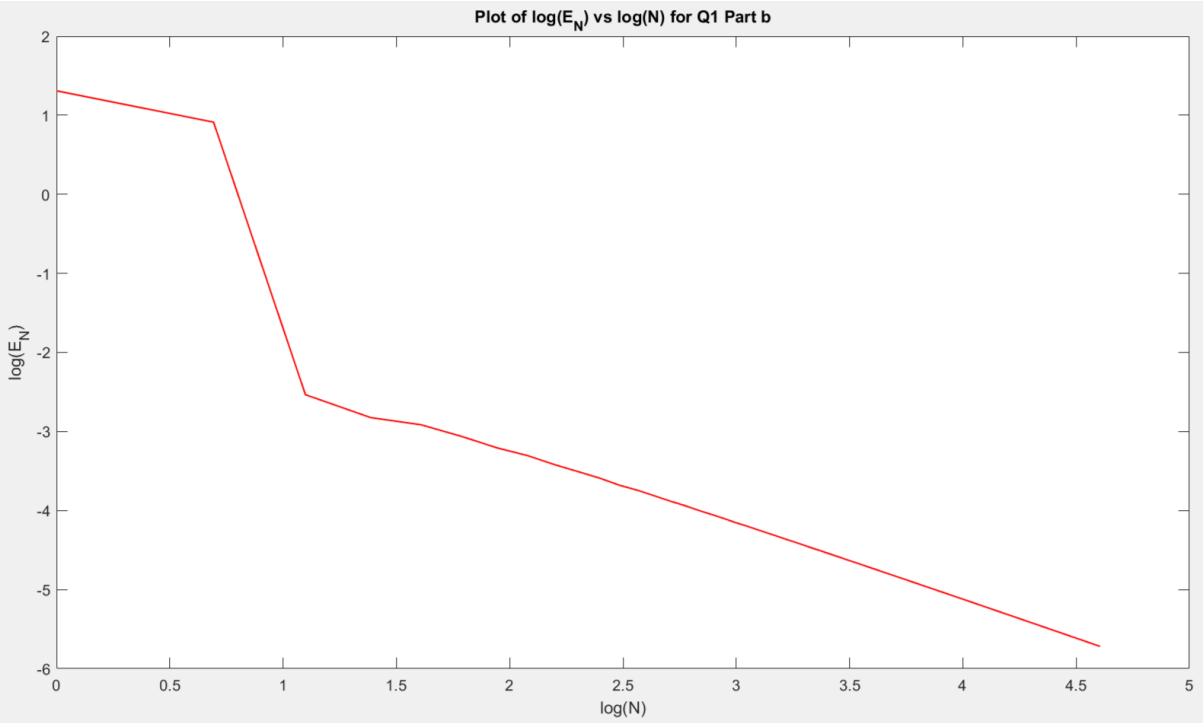
t	Approximate Solution	Exact Solution	Absolute Error
0.000000	1.000000	1.000000	0.000000
0.100000	1.028602	1.014815	0.013786
0.200000	1.080988	1.057181	0.023807
0.300000	1.150746	1.121698	0.029048
0.400000	1.231421	1.201486	0.029935
0.500000	1.317370	1.289805	0.027564
0.600000	1.404059	1.380931	0.023128
0.700000	1.488059	1.470415	0.017644
0.800000	1.566927	1.555031	0.011895
0.900000	1.639052	1.632613	0.006438
1.000000	1.703510	1.701870	0.001640




t vs absolute error plot for Q1 Part b
absolute error
t
0.03
0.025
0.02
0.015
0.01
0.005
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

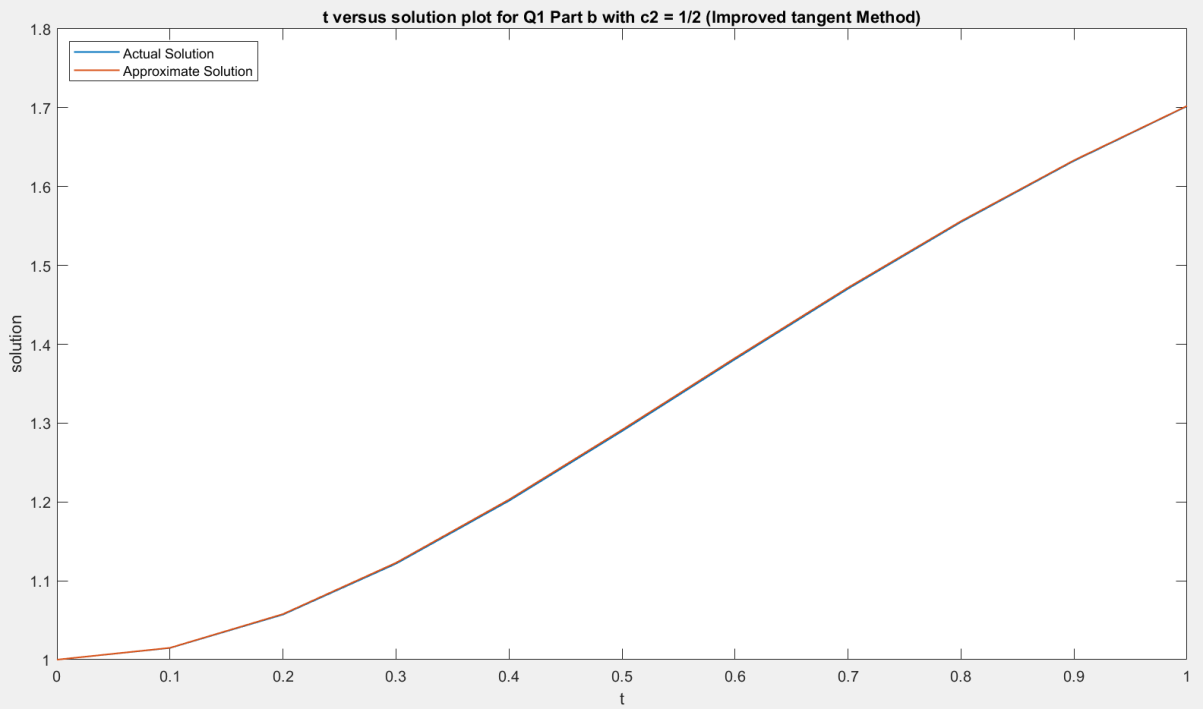

Mesh points,i.e.,t versus absolute error (loglog plot)
absolute error
Mesh points,i.e.,t
10^-2
10^-3
10^-1
10^0

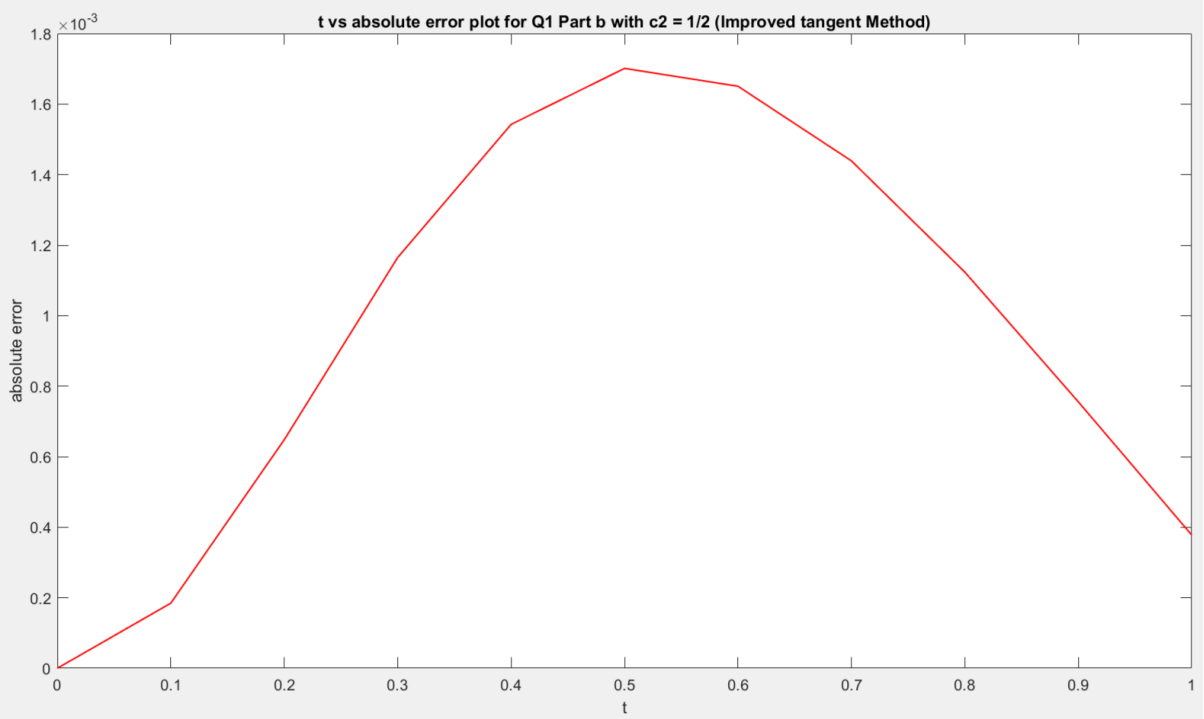

N vs Order of Convergence for Q1 Part b
Order of Convergence
N
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
10
20
30
40
50
60
70
80
90
100

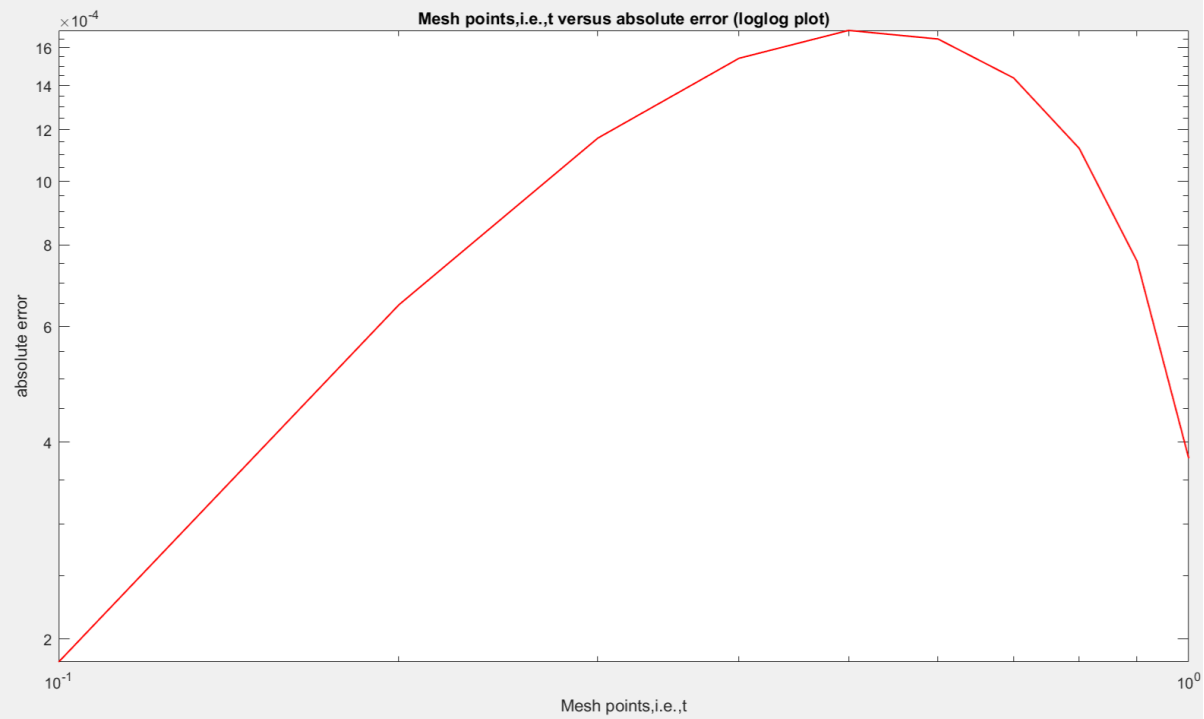

Plot of log(E_N) vs log(N) for Q1 Part b
log(E_N)
log(N)
2
1
0
-1
-2
-3
-4
-5
-6
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

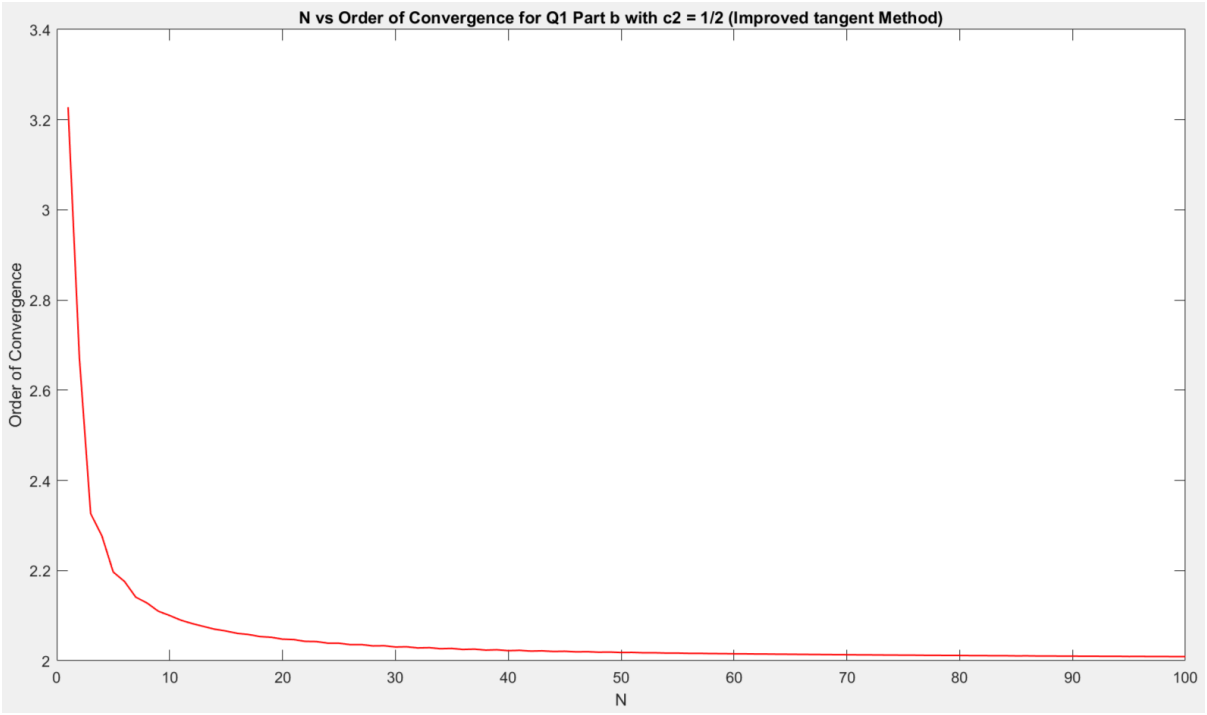
Using Second-order Runge-Kutta Method for Q1 Part b with c2 = 1/2 (Improved tangent Method)

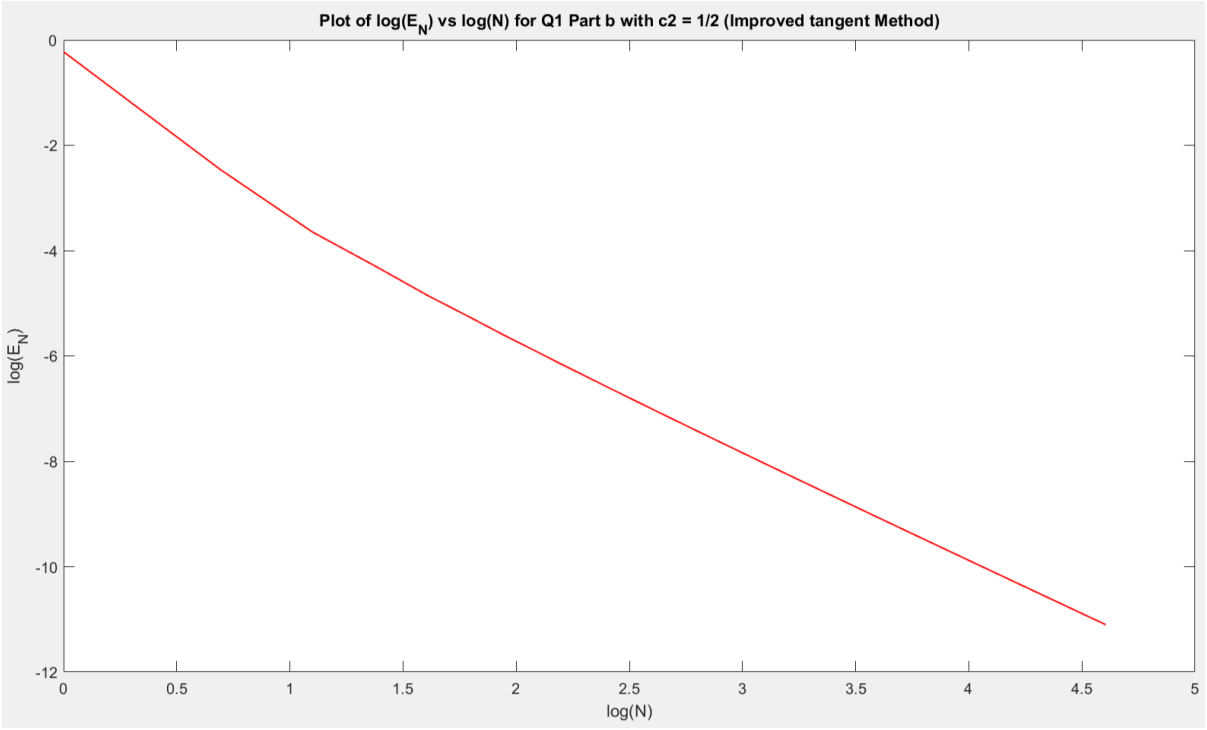
t	Approximate Solution	Exact Solution	Absolute Error
0.000000	1.000000	1.000000	0.000000
0.100000	1.015000	1.014815	0.000185
0.200000	1.057829	1.057181	0.000648
0.300000	1.122863	1.121698	0.001165
0.400000	1.203028	1.201486	0.001542
0.500000	1.291506	1.289805	0.001701
0.600000	1.382582	1.380931	0.001650
0.700000	1.471854	1.470415	0.001439
0.800000	1.556155	1.555031	0.001123
0.900000	1.633369	1.632613	0.000756
1.000000	1.702248	1.701870	0.000378




t vs absolute error plot for Q1 Part b with c2 = 1/2 (Improved tangent Method)
×10^-3
absolute error
t
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
0.1
0.3
0.5
0.7
0.9

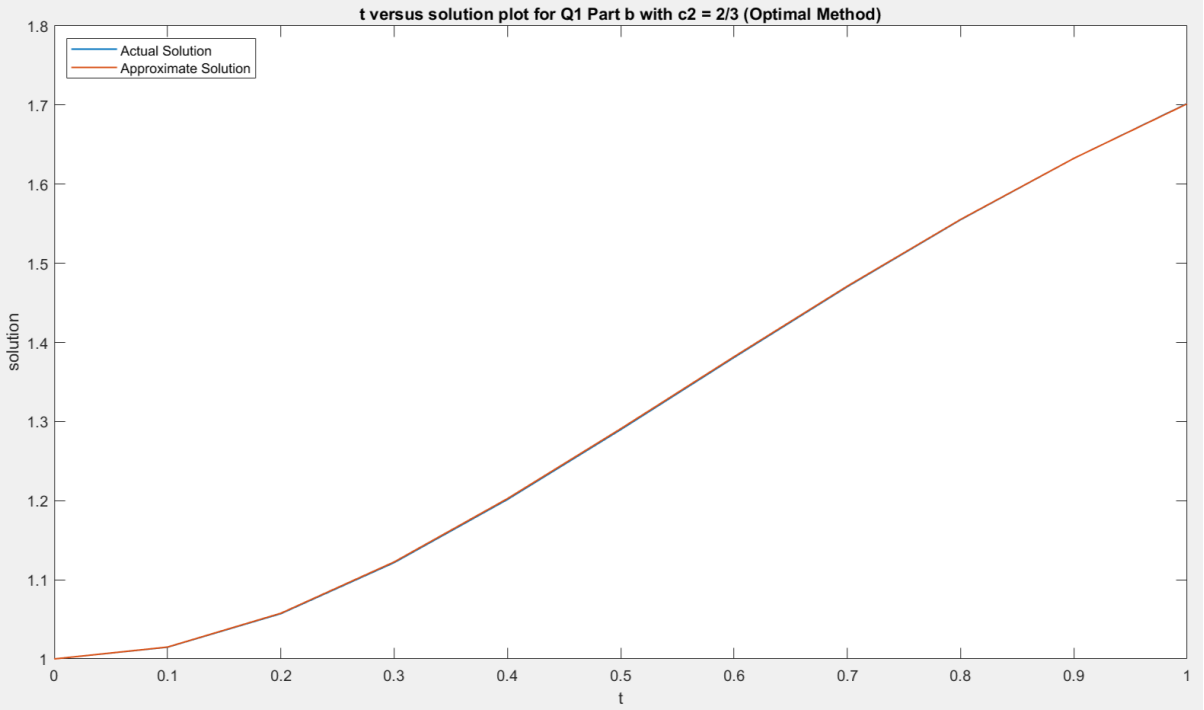

Mesh points,i.e.,t versus absolute error (loglog plot)
×10^-4
absolute error
Mesh points,i.e.,t
2
4
6
8
10
12
14
16
10^-1
10^0

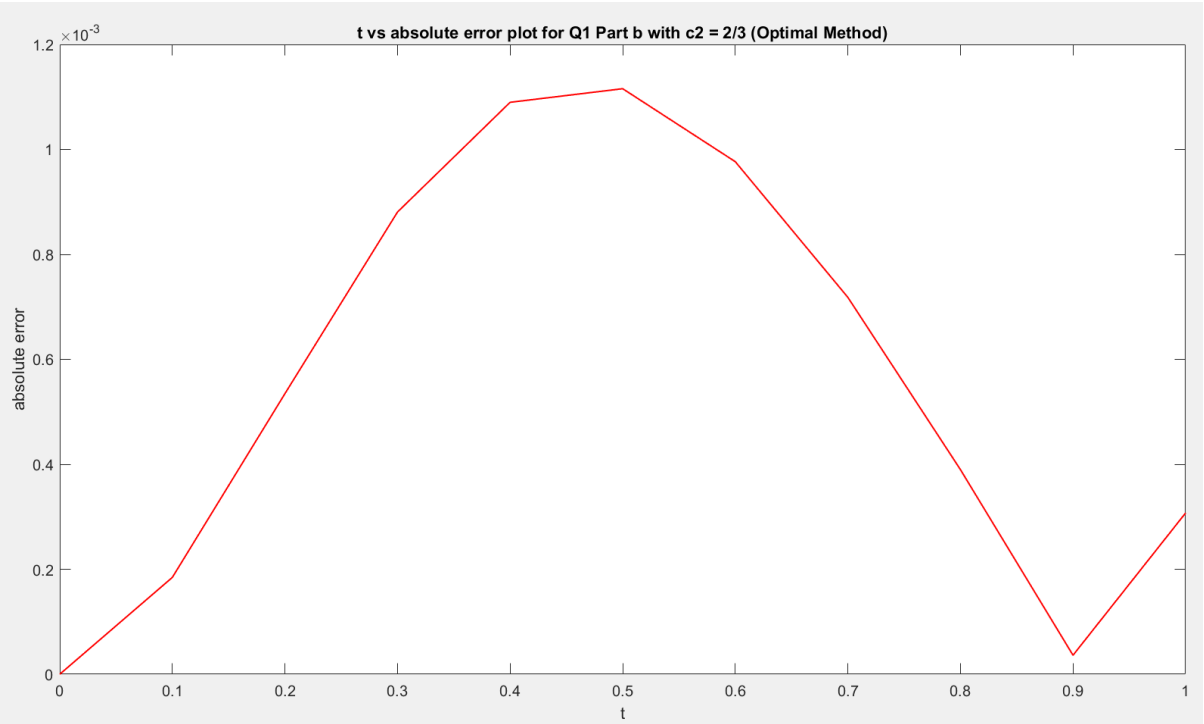

N vs Order of Convergence for Q1 Part b with c2 = 1/2 (Improved tangent Method)
Order of Convergence
N
3.4
3.2
3
2.8
2.6
2.4
2.2
2
0
10
20
30
40
50
60
70
80
90
100

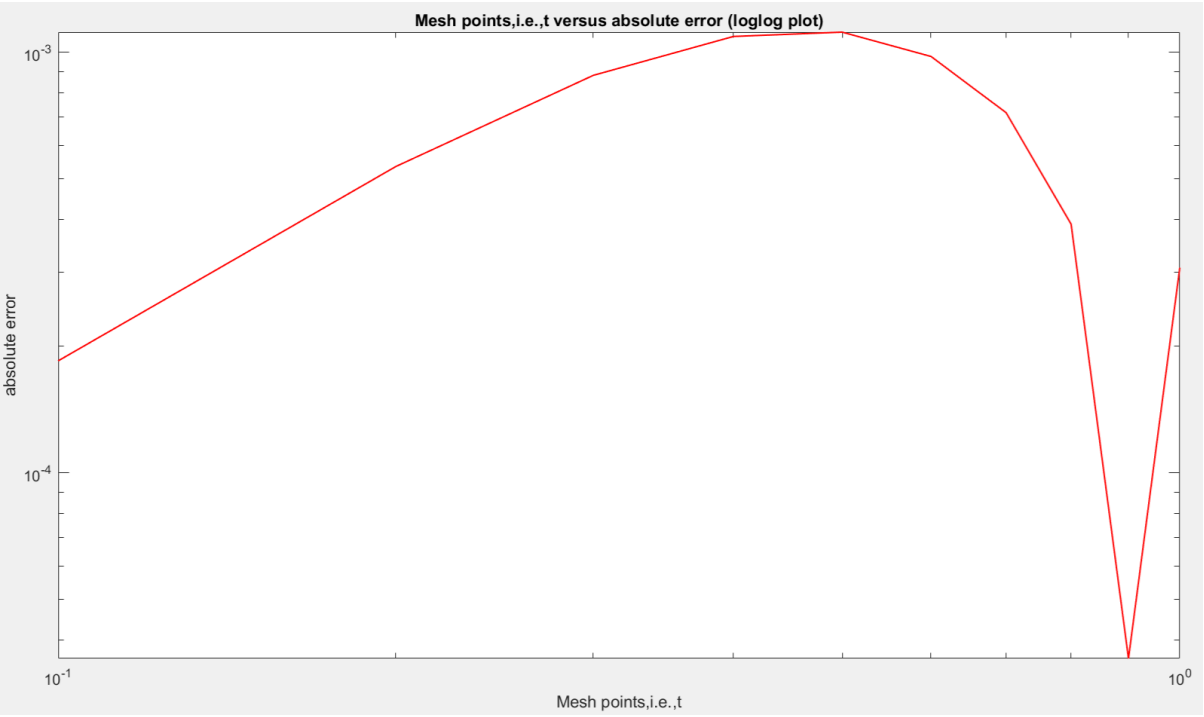

Plot of log(E_N) vs log(N) for Q1 Part b with c2 = 1/2 (Improved tangent Method)
log(E_N)
log(N)
0
-2
-4
-6
-8
-10
-12
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

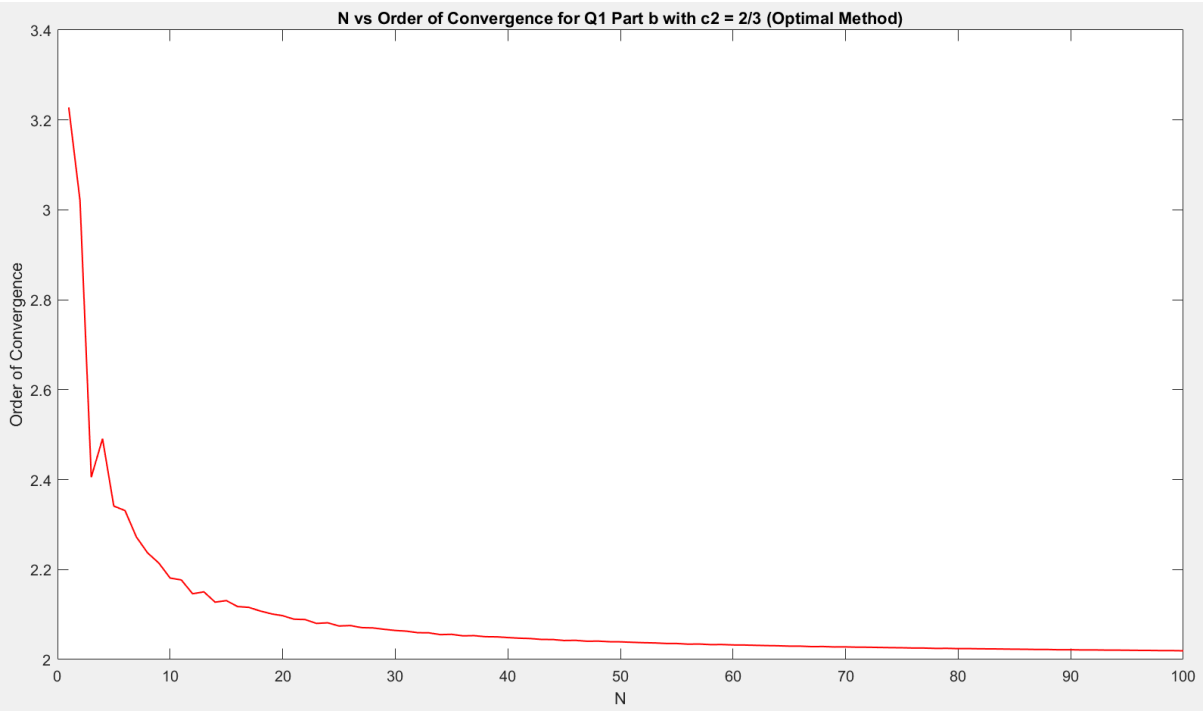
Using Second-order Runge-Kutta Method for Q1 Part b with c2 = 2/3 (Optimal Method)

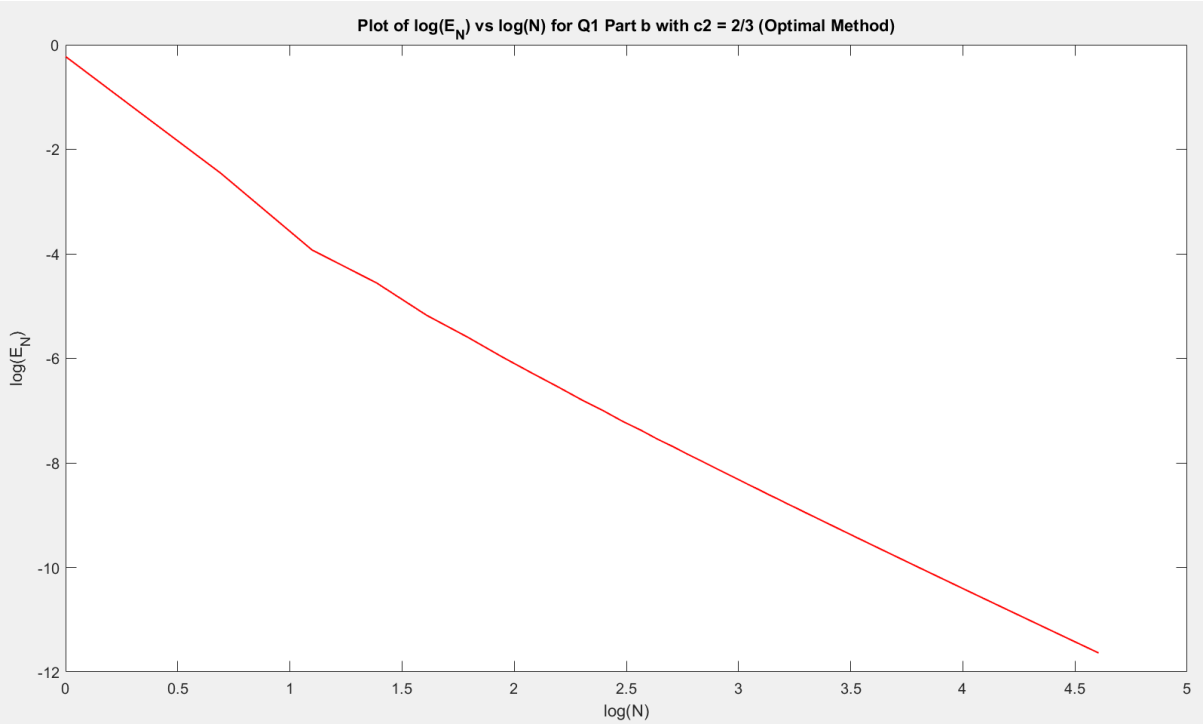
t	Approximate Solution	Exact Solution	Absolute Error
0.000000	1.000000	1.000000	0.000000
0.100000	1.015000	1.014815	0.000185
0.200000	1.057716	1.057181	0.000535
0.300000	1.122579	1.121698	0.000881
0.400000	1.202576	1.201486	0.001090
0.500000	1.290921	1.289805	0.001116
0.600000	1.381908	1.380931	0.000977
0.700000	1.471133	1.470415	0.000718
0.800000	1.555421	1.555031	0.000390
0.900000	1.632649	1.632613	0.000036
1.000000	1.701563	1.701870	0.000307




t vs absolute error plot for Q1 Part b with c2 = 2/3 (Optimal Method)
×10^-3
1.2
1
0.8
0.6
0.4
0.2
0
absolute error
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
t

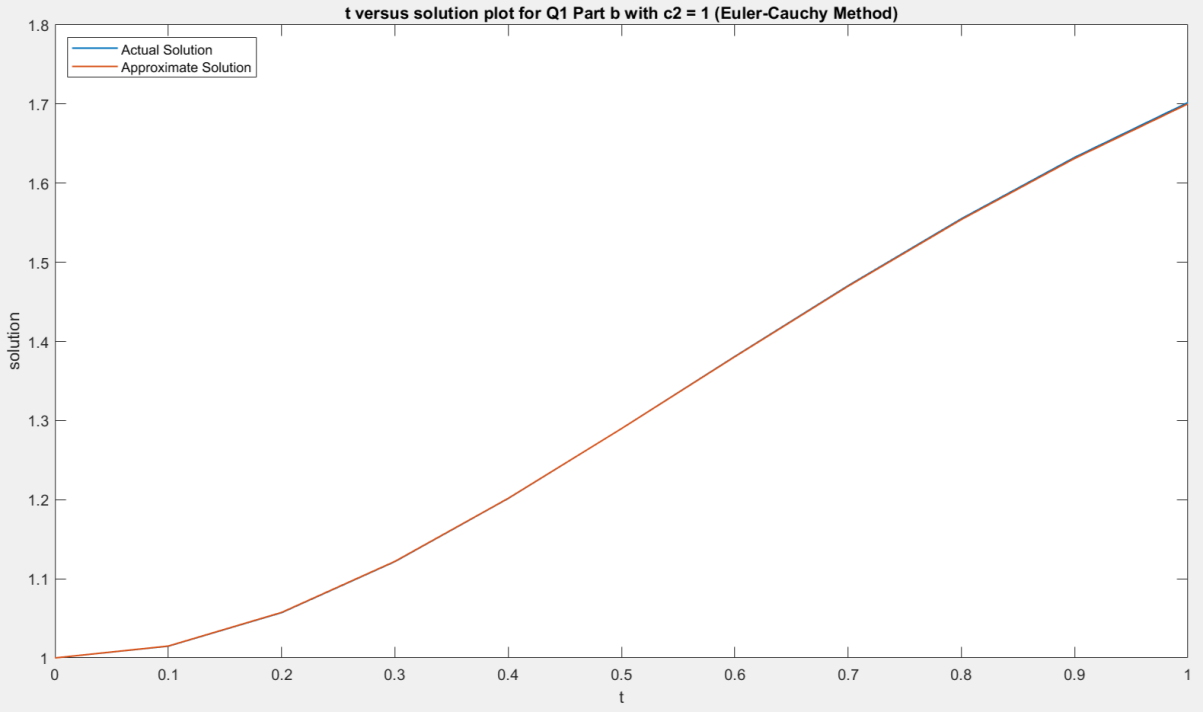

Mesh points,i.e.,t versus absolute error (loglog plot)
10^-3
10^-4
absolute error
10^-1
10^0
Mesh points,i.e.,t

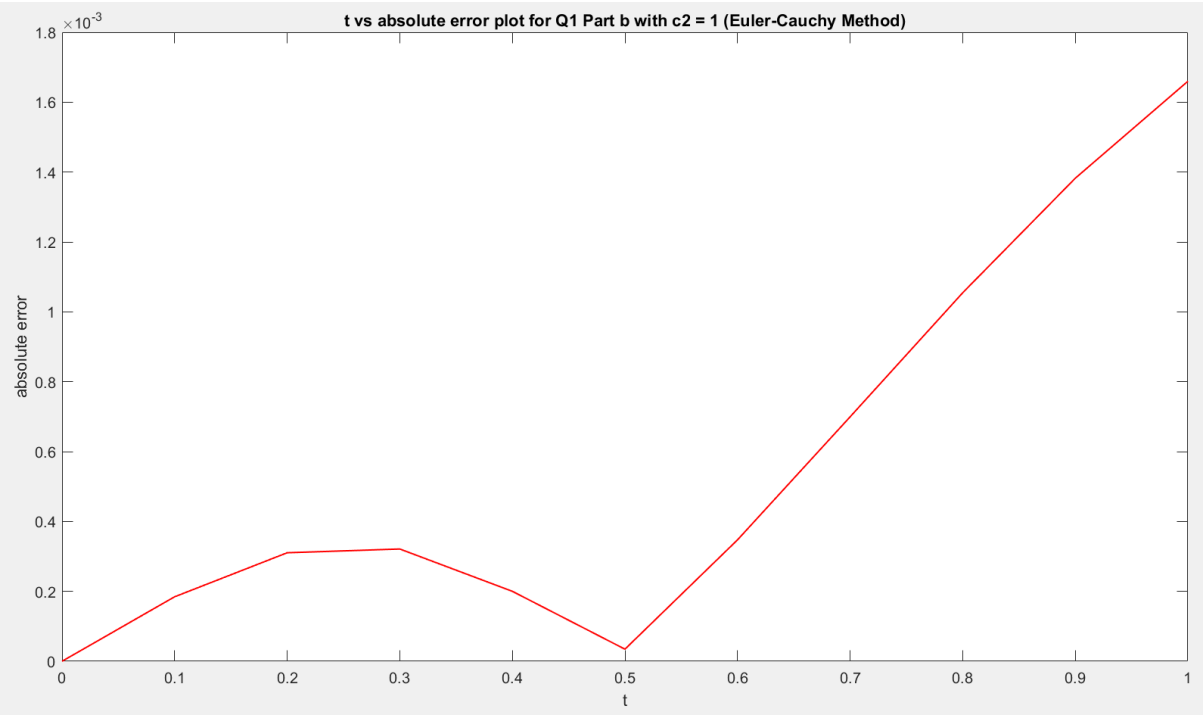

N vs Order of Convergence for Q1 Part b with c2 = 2/3 (Optimal Method)
Order of Convergence
N
3.4
3.2
3
2.8
2.6
2.4
2.2
2
0
10
20
30
40
50
60
70
80
90
100

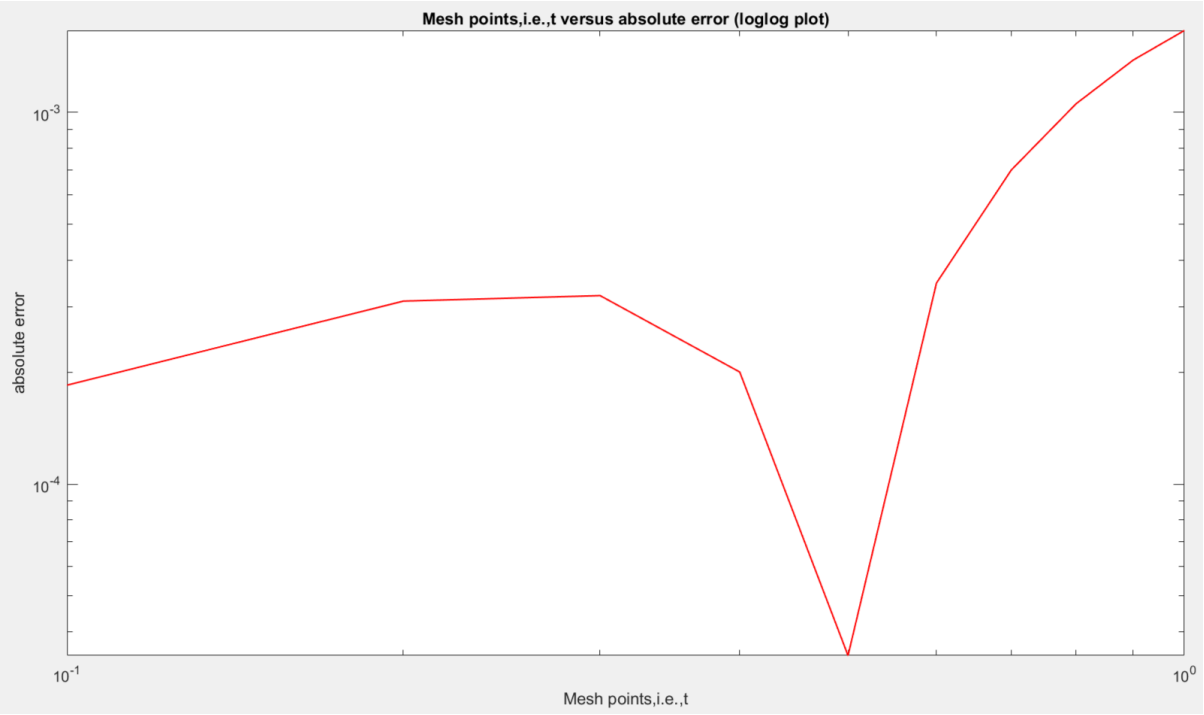

Plot of log(E_N) vs log(N) for Q1 Part b with c2 = 2/3 (Optimal Method)
log(E_N)
log(N)
0
-2
-4
-6
-8
-10
-12
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

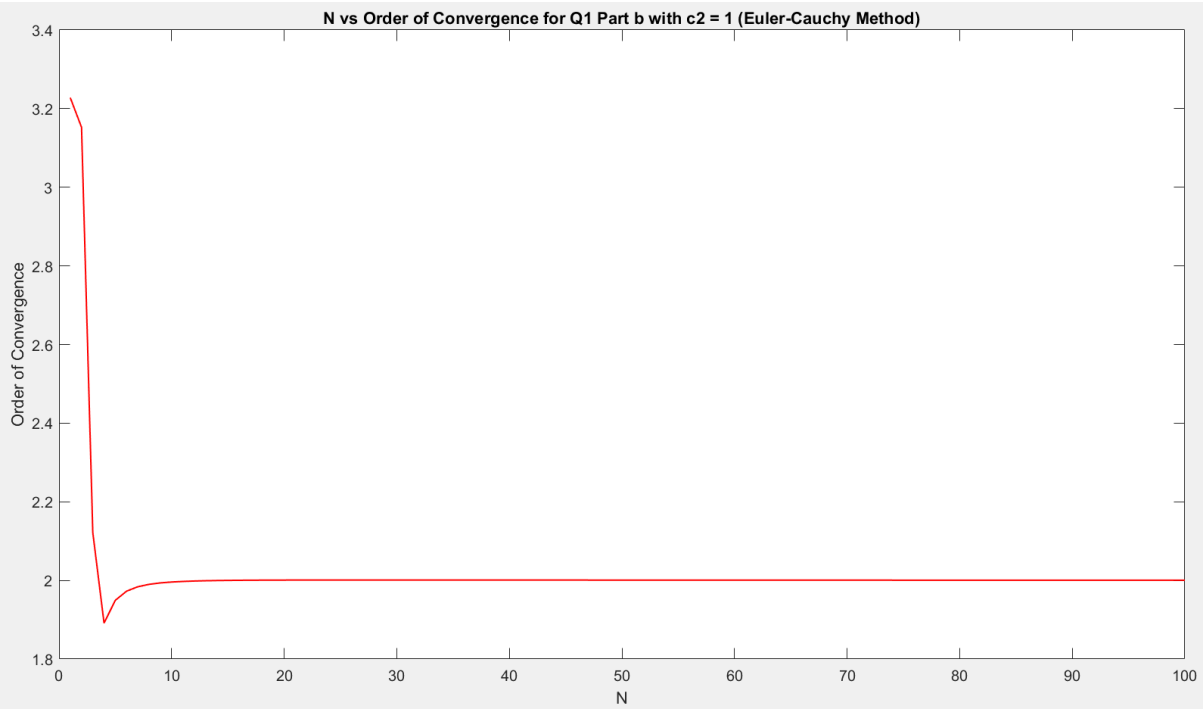
Using Second-order Runge-Kutta Method for Q1 Part b with c2 = 1 (Euler-Cauchy Method)

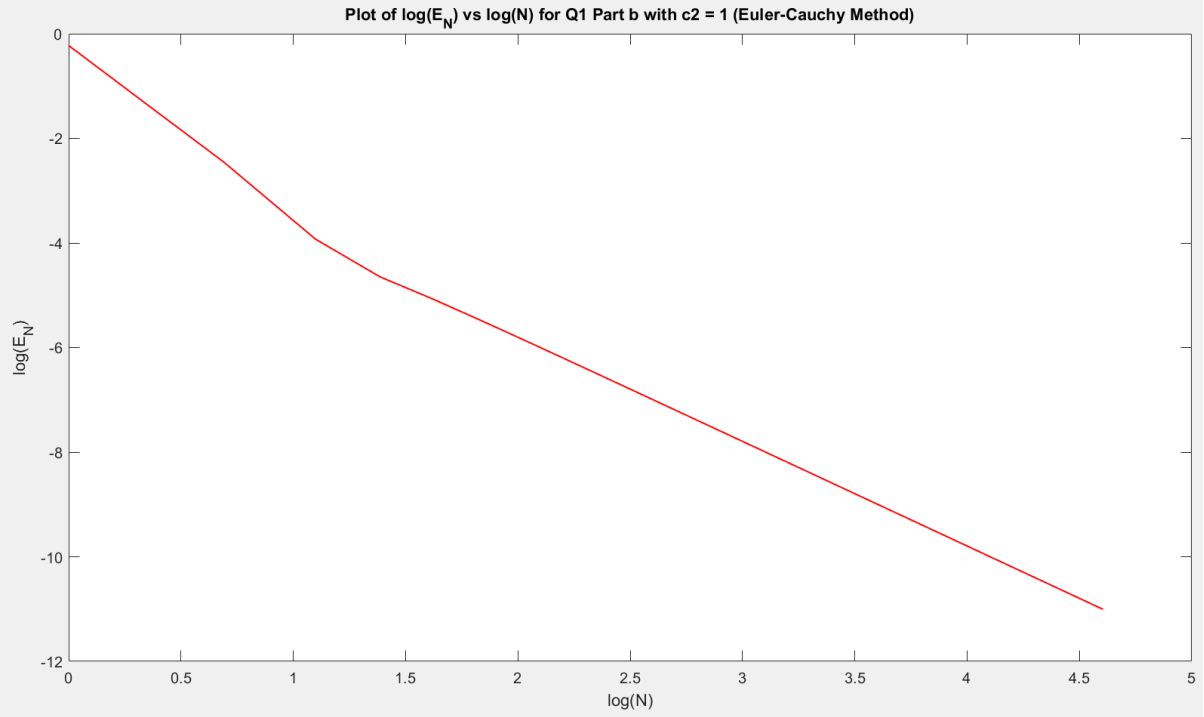
t	Approximate Solution	Exact Solution	Absolute Error
0.000000	1.000000	1.000000	0.000000
0.100000	1.015000	1.014815	0.000185
0.200000	1.057492	1.057181	0.000311
0.300000	1.122019	1.121698	0.000321
0.400000	1.201686	1.201486	0.000200
0.500000	1.289771	1.289805	0.000035
0.600000	1.380584	1.380931	0.000348
0.700000	1.469716	1.470415	0.000700
0.800000	1.553977	1.555031	0.001055
0.900000	1.631231	1.632613	0.001382
1.000000	1.700210	1.701870	0.001660




t vs absolute error plot for Q1 Part b with c2 = 1 (Euler-Cauchy Method)
×10^-3
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
absolute error
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
t

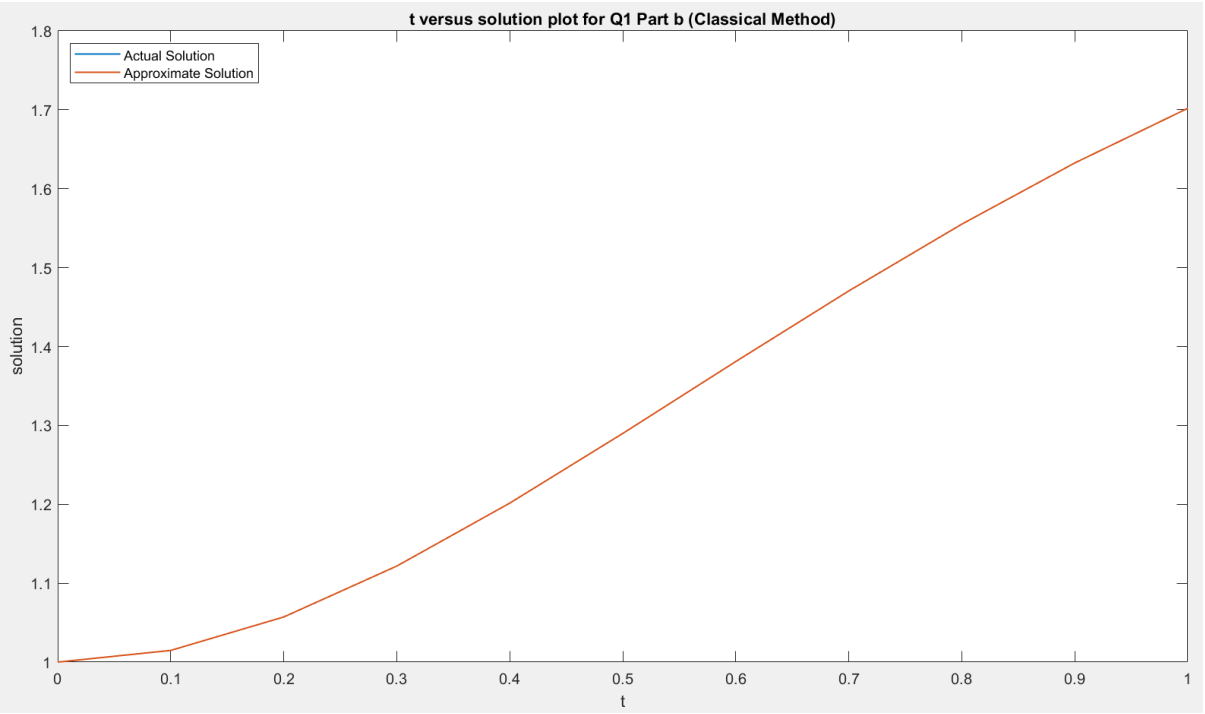

Mesh points,i.e.,t versus absolute error (loglog plot)
10^-3
10^-4
absolute error
10^-1
10^0
Mesh points,i.e.,t

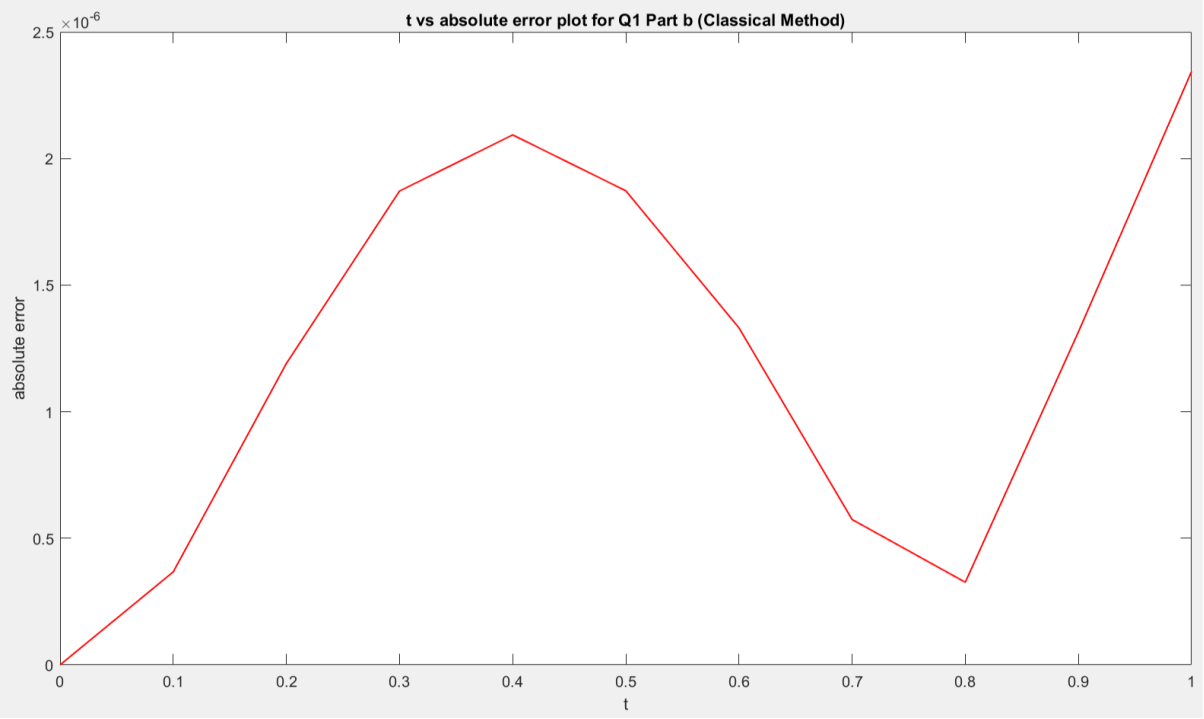

N vs Order of Convergence for Q1 Part b with c2 = 1 (Euler-Cauchy Method)
Order of Convergence
N
3.4
3.2
3
2.8
2.6
2.4
2.2
2
1.8
0
10
20
30
40
50
60
70
80
90
100

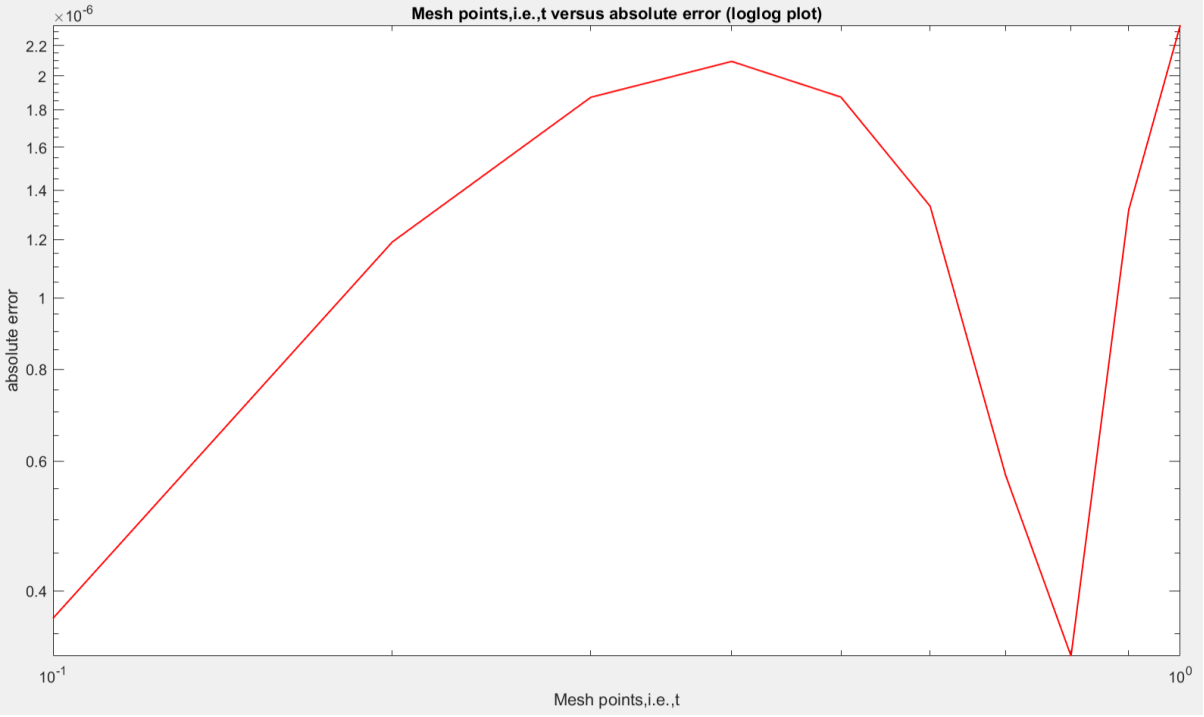

Plot of log(E_N) vs log(N) for Q1 Part b with c2 = 1 (Euler-Cauchy Method)
log(E_N)
log(N)
0
-2
-4
-6
-8
-10
-12
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

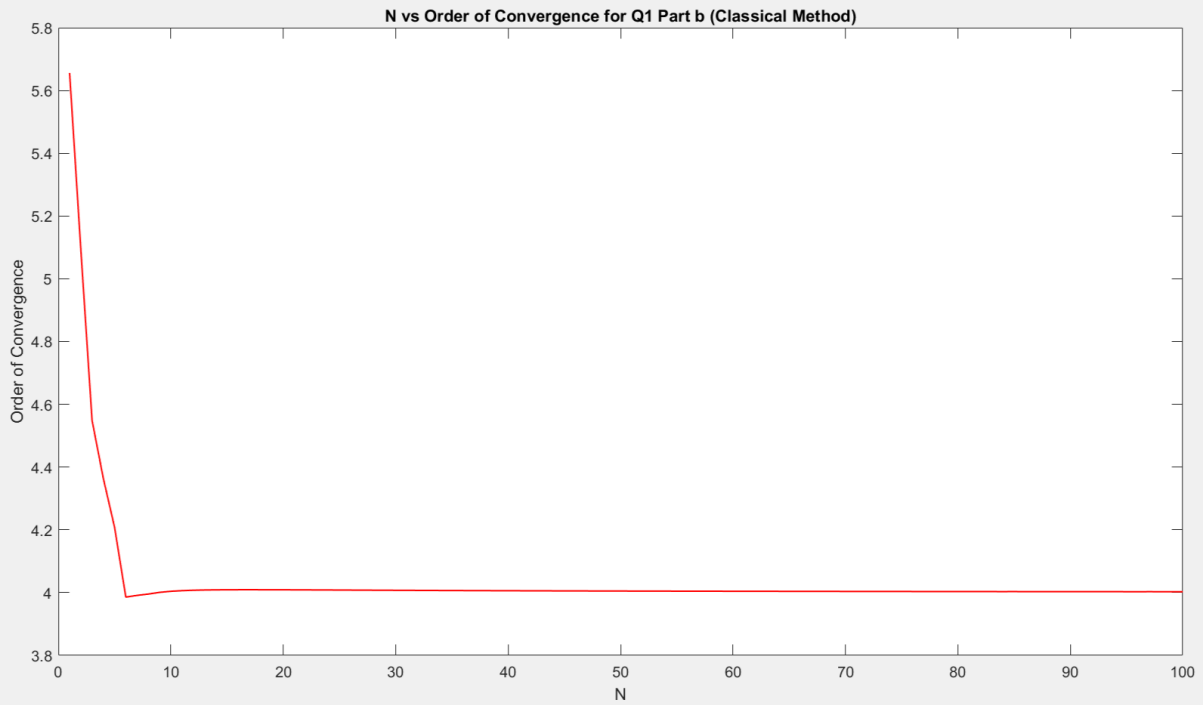
Using Fourth-order Runge-Kutta Method for Q1 Part b (Classical Method)

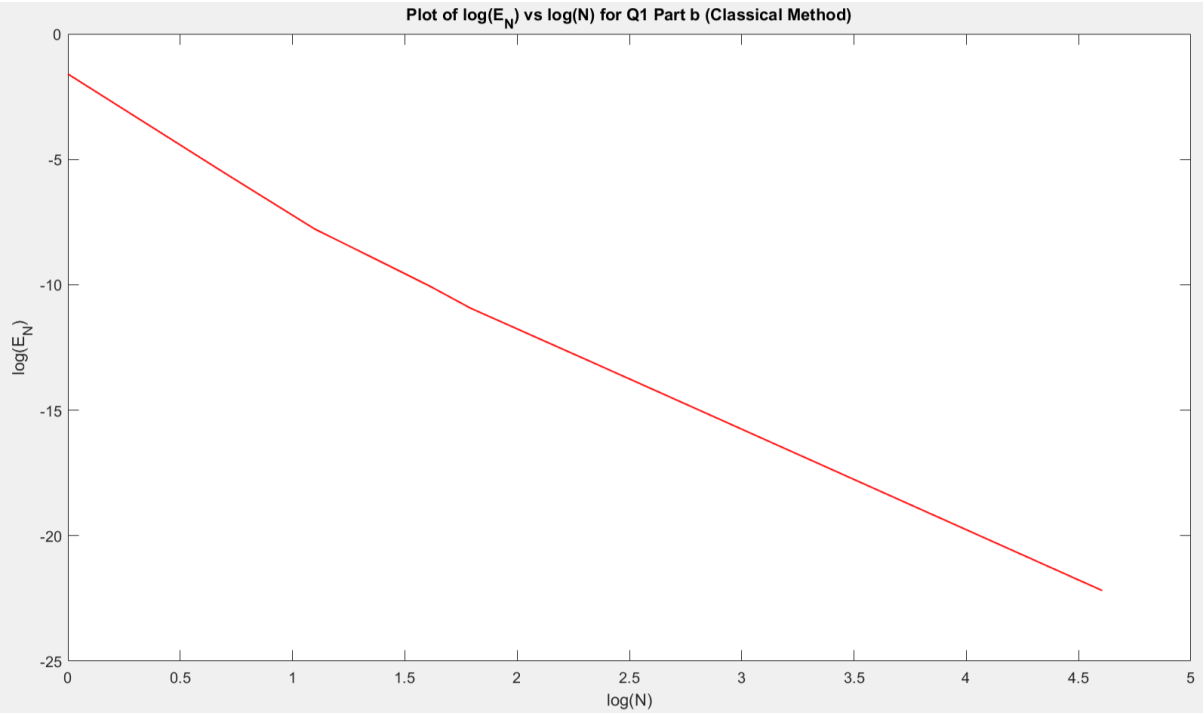
t	Approximate Solution	Exact Solution	Absolute Error
0.000000	1.000000	1.000000	0.000000
0.100000	1.014816	1.014815	0.000000
0.200000	1.057182	1.057181	0.000001
0.300000	1.121700	1.121698	0.000002
0.400000	1.201488	1.201486	0.000002
0.500000	1.289807	1.289805	0.000002
0.600000	1.380933	1.380931	0.000001
0.700000	1.470416	1.470415	0.000001
0.800000	1.555031	1.555031	0.000000
0.900000	1.632612	1.632613	0.000001
1.000000	1.701868	1.701870	0.000002




t vs absolute error plot for Q1 Part b (Classical Method)
×10^-6
2.5
2
1.5
1
0.5
0
absolute error
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
t

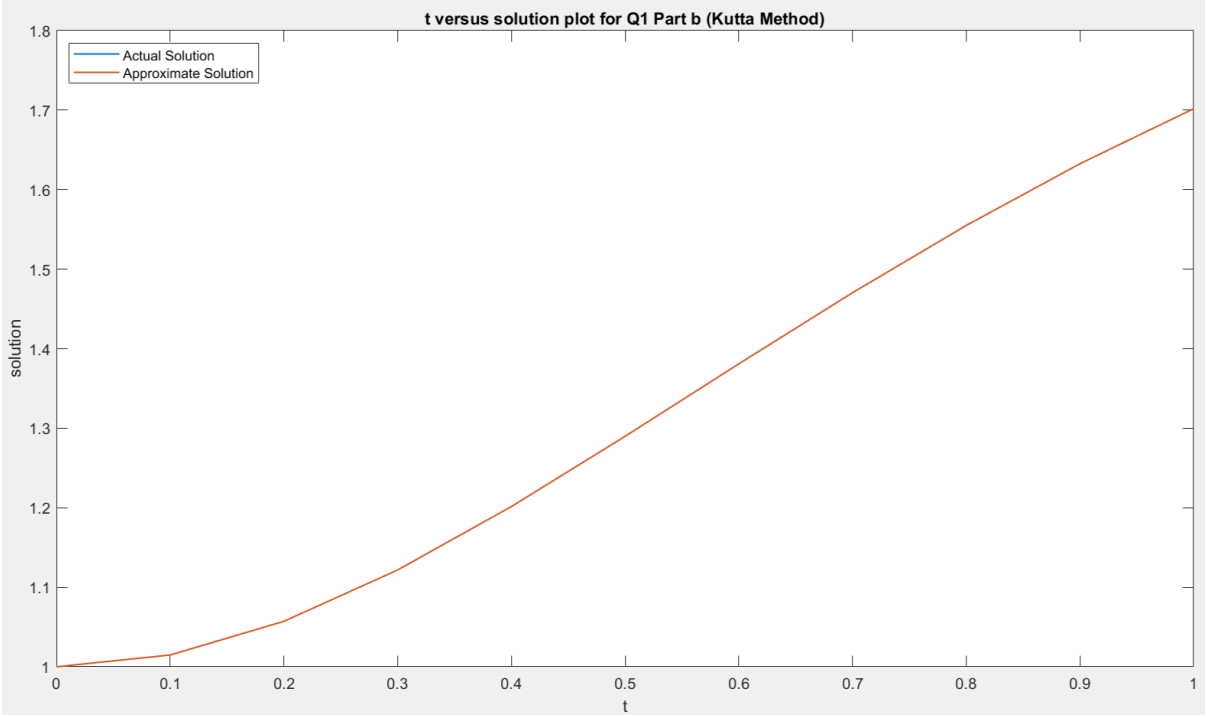

Mesh points,i.e.,t versus absolute error (loglog plot)
×10^-6
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
absolute error
10^-1
10^0
Mesh points,i.e.,t

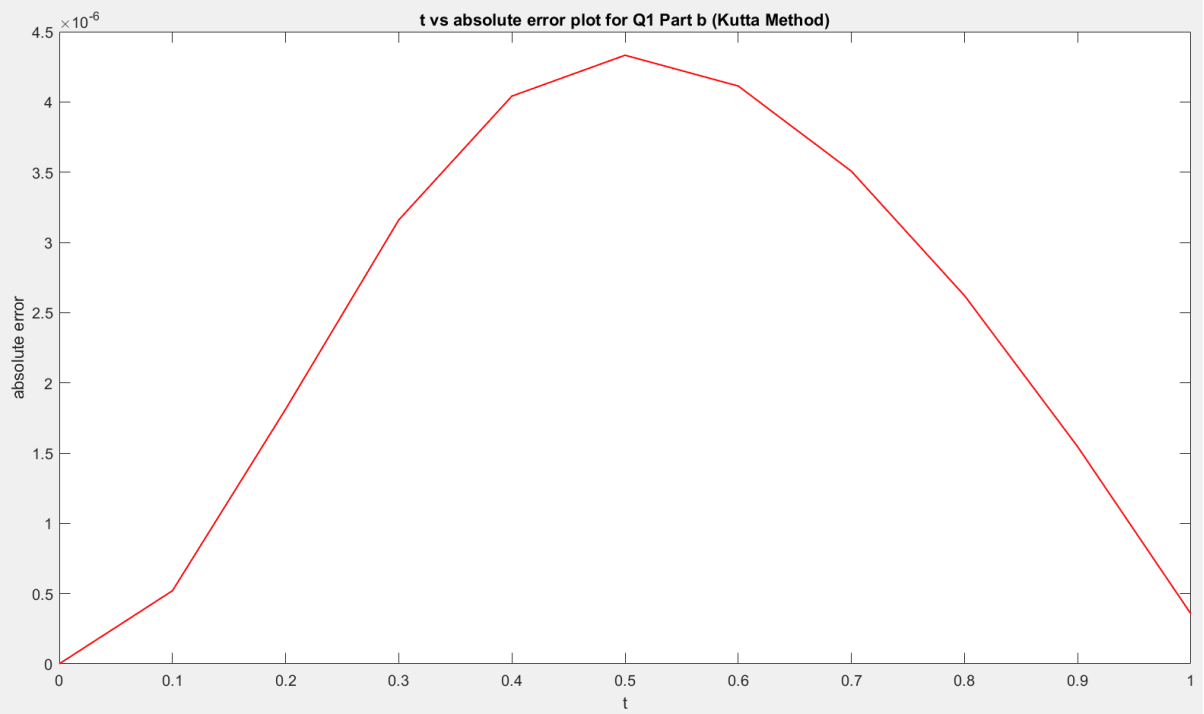

N vs Order of Convergence for Q1 Part b (Classical Method)
Order of Convergence
N
5.8
5.6
5.4
5.2
5
4.8
4.6
4.4
4.2
4
3.8
0
10
20
30
40
50
60
70
80
90
100

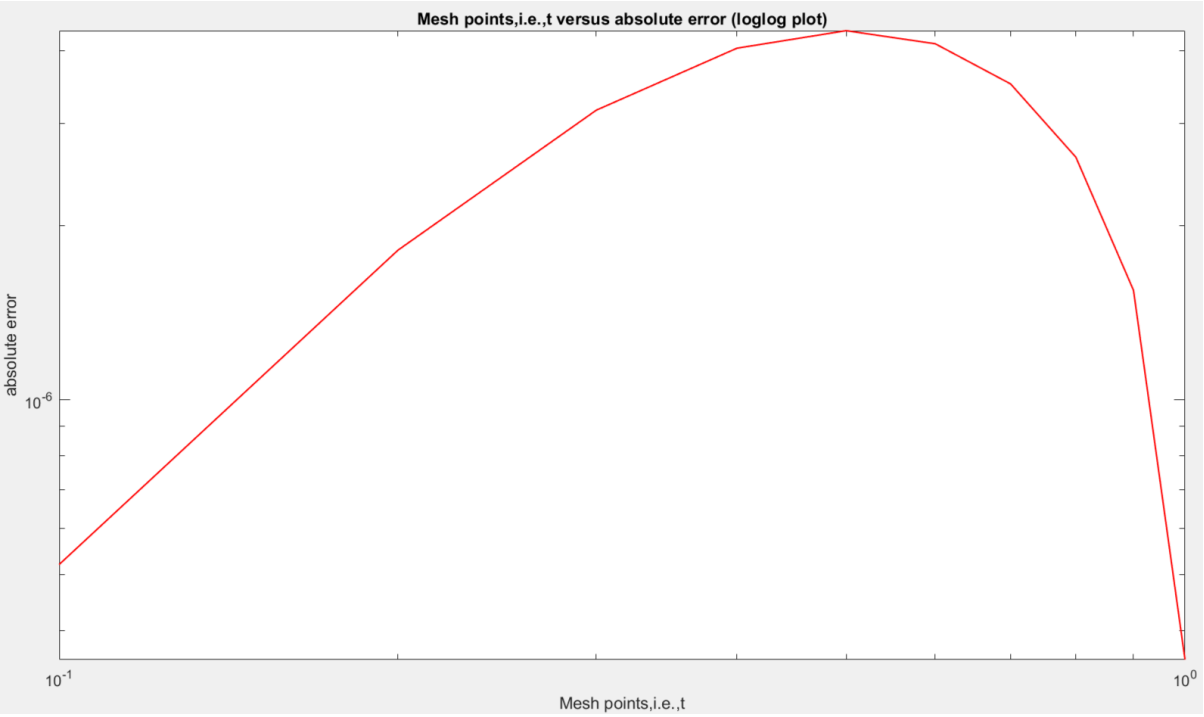

Plot of log(E_N) vs log(N) for Q1 Part b (Classical Method)
log(E_N)
log(N)
0
-5
-10
-15
-20
-25
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

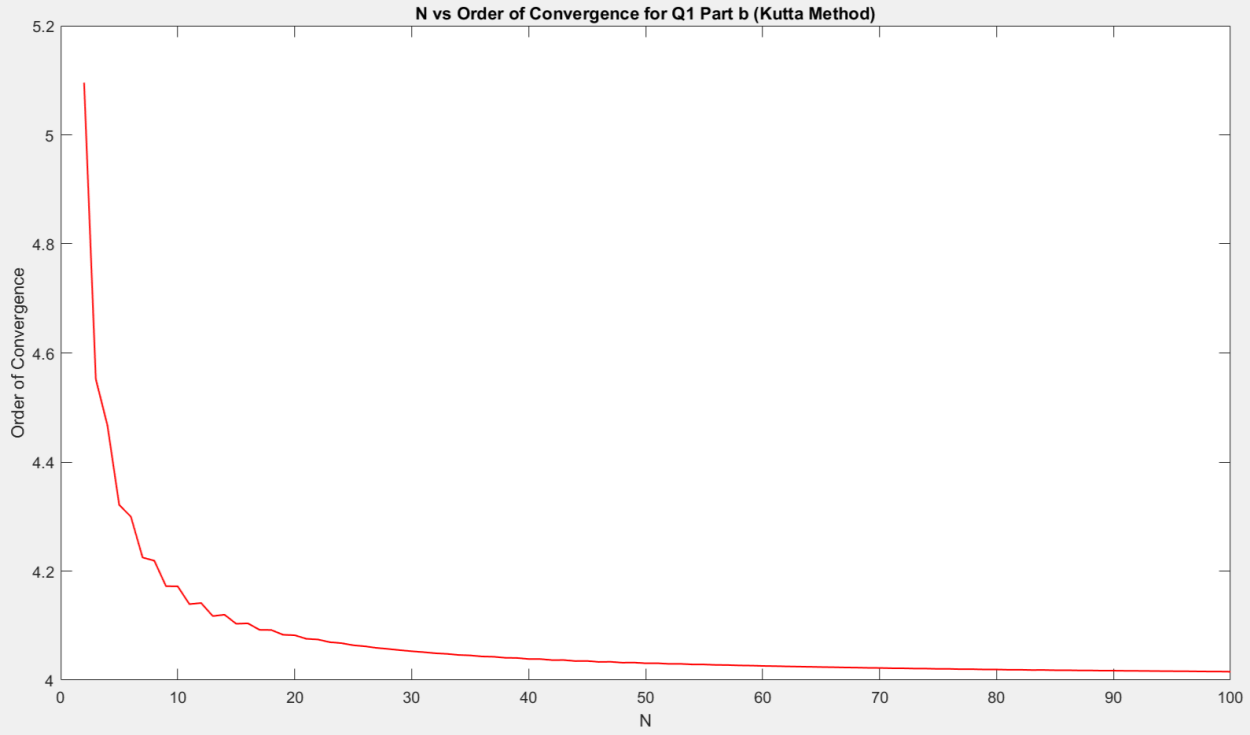
Using Fourth-order Runge-Kutta Method for Q1 Part b (Kutta Method)

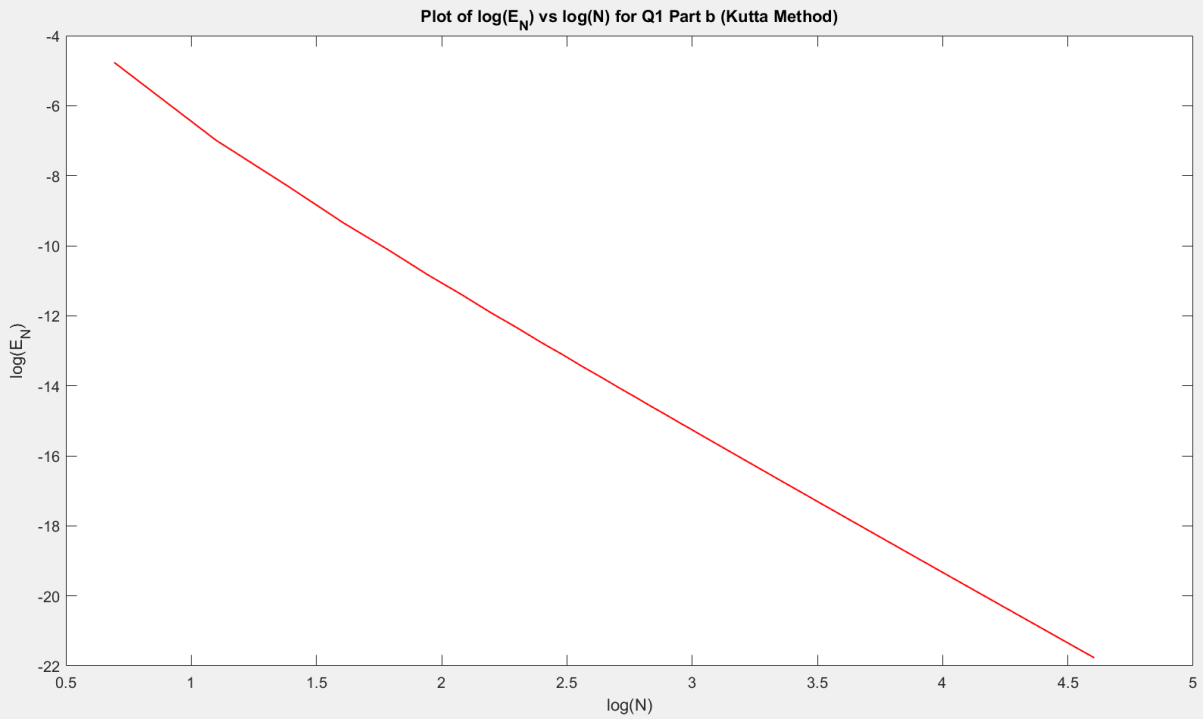
t	Approximate Solution	Exact Solution	Absolute Error
0.000000	1.000000	1.000000	0.000000
0.100000	1.014816	1.014815	0.000001
0.200000	1.057183	1.057181	0.000002
0.300000	1.121701	1.121698	0.000003
0.400000	1.201490	1.201486	0.000004
0.500000	1.289810	1.289805	0.000004
0.600000	1.380935	1.380931	0.000004
0.700000	1.470419	1.470415	0.000004
0.800000	1.555034	1.555031	0.000003
0.900000	1.632615	1.632613	0.000002
1.000000	1.701870	1.701870	0.000000




t vs absolute error plot for Q1 Part b (Kutta Method)
×10^-6
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
absolute error
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
t


Mesh points,i.e.,t versus absolute error (loglog plot)
absolute error
10^-6
10^-1
10^0
Mesh points,i.e.,t





The graphs for actual and approximate solutions are almost coinciding in the case of Fourth Order Runge-Kutta methods. For the given initial-value problems, performance of: Implicit-Euler Method < Second-order Runge-Kutta Methods < Fourth-order Runge-Kutta Methods, which is as expected.

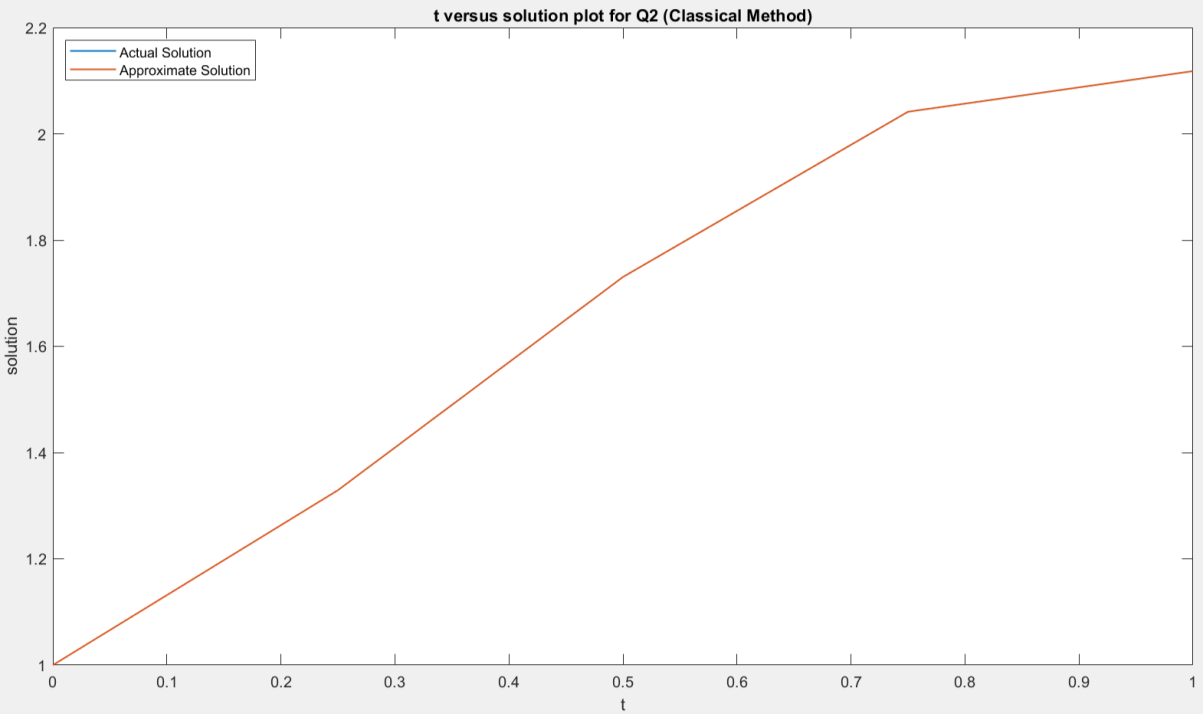
2)

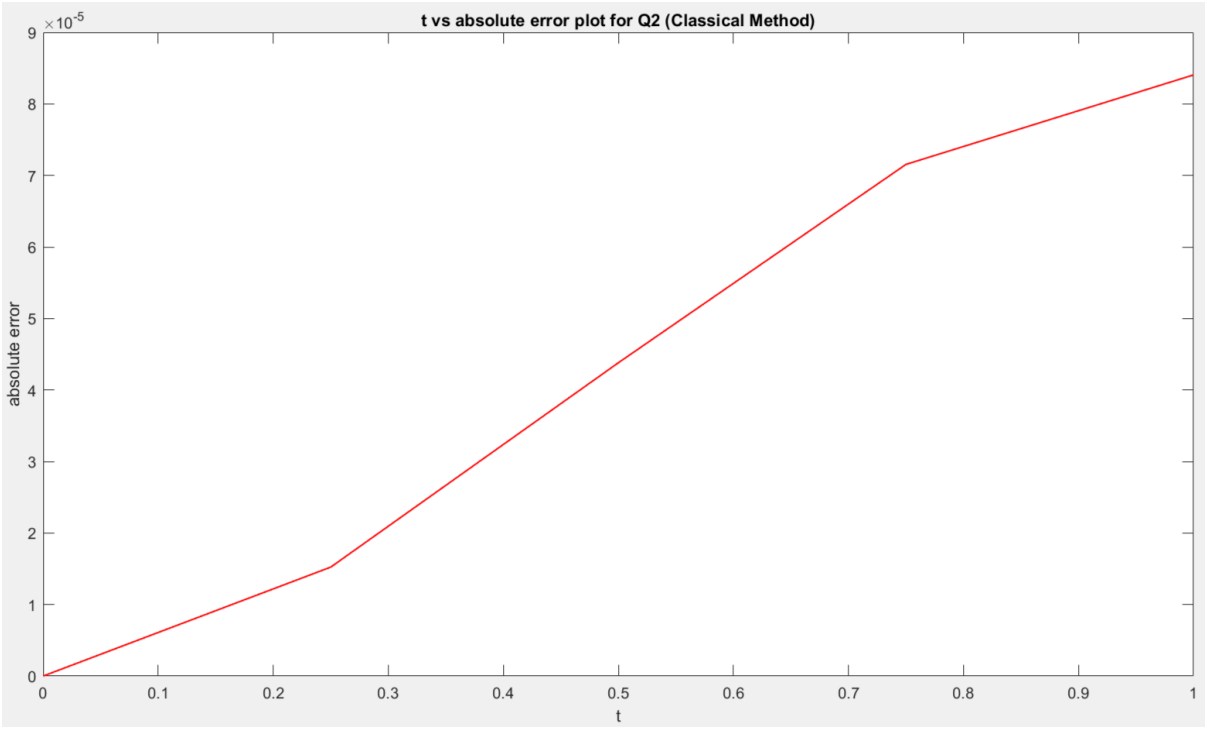
The following methods are implemented:

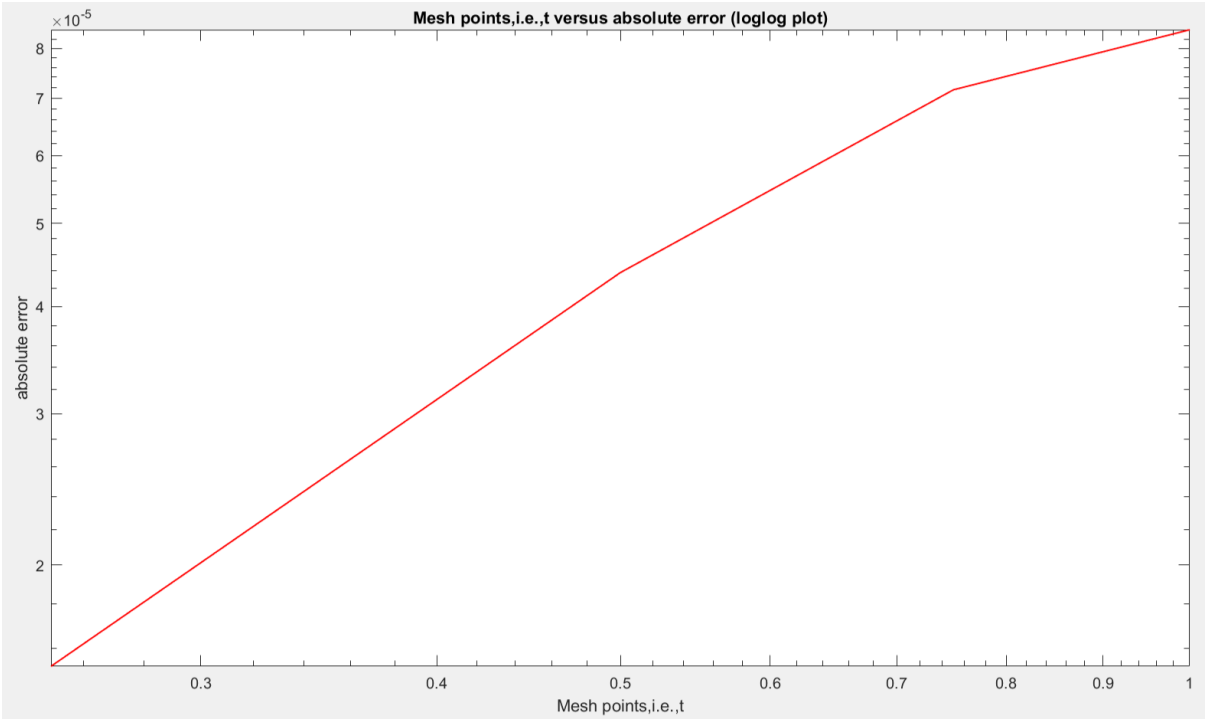
(i) Fourth-order Runge-Kutta method with:

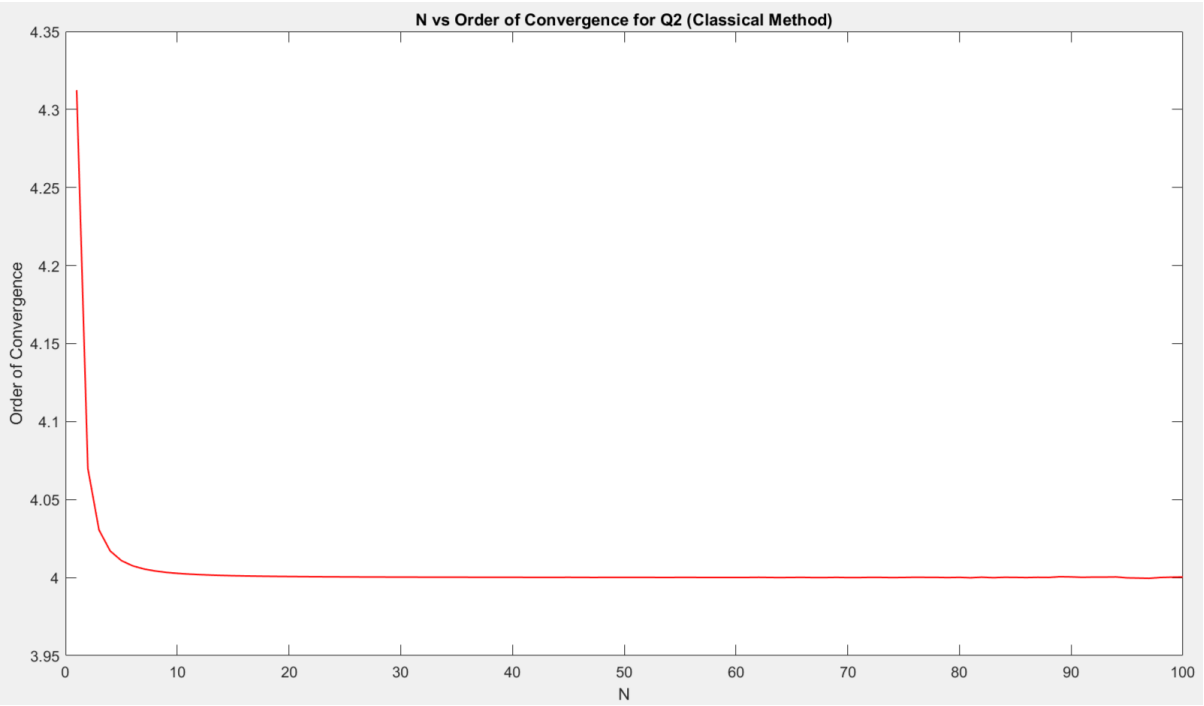
- $c_2 = 1/2$, $c_3 = 1/2$, $c_4 = 1$ (Classical Method)
- $c_2 = 1/3$, $c_3 = 2/3$, $c_4 = 1$ (Kutta Method)

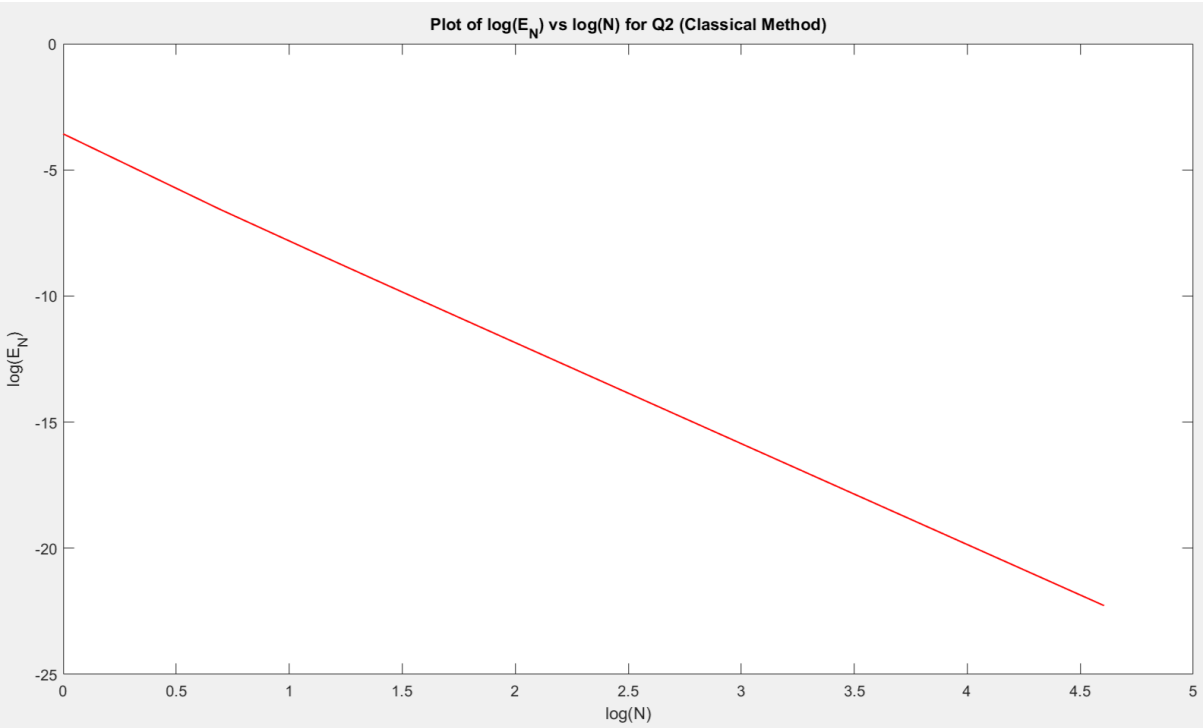
```
Question 2
Using Fourth-order Runge-Kutta Method for Q2 (Classical Method)
    t          Approximate Solution     Exact Solution   Absolute Error
0.000000           1.000000              1.000000          0.000000
0.250000           1.329165              1.329150          0.000015
0.500000           1.730534              1.730490          0.000044
0.750000           2.041544              2.041472          0.000072
1.000000           2.118064              2.117980          0.000084
```




t vs absolute error plot for Q2 (Classical Method)
×10^-5
absolute error
t
0
1
2
3
4
5
6
7
8
9
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9

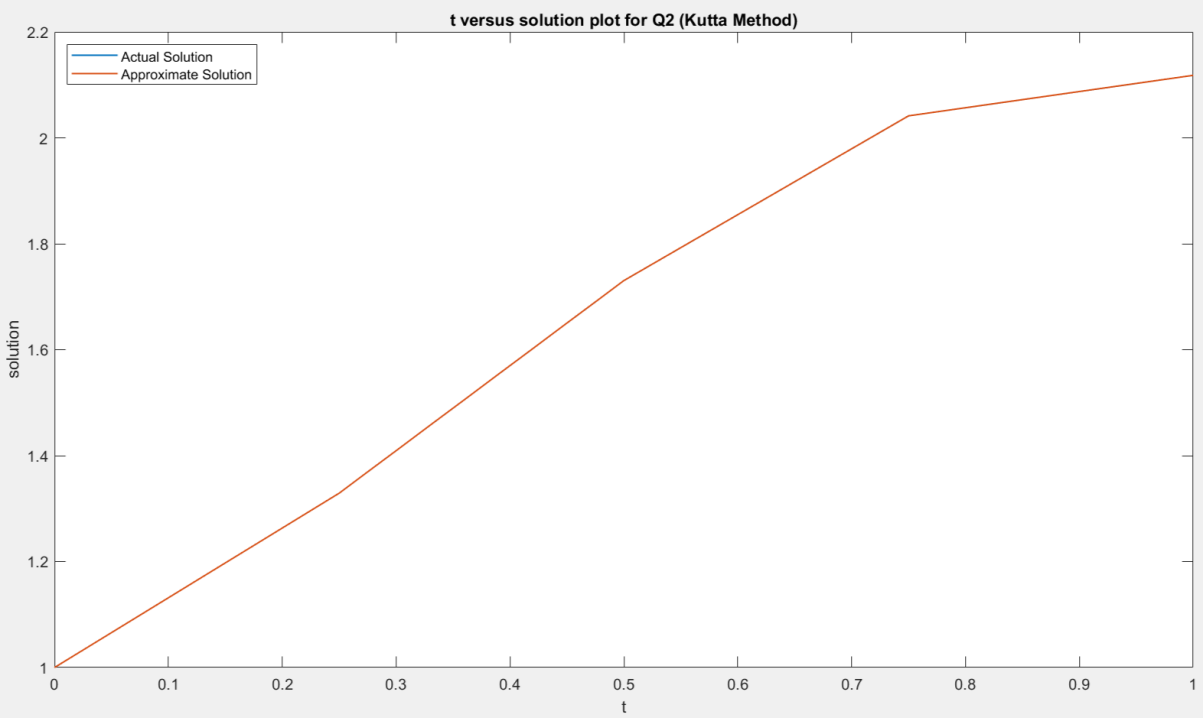

Mesh points,i.e.,t versus absolute error (loglog plot)
×10^-5
absolute error
Mesh points,i.e.,t
2
3
4
5
6
7
8
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

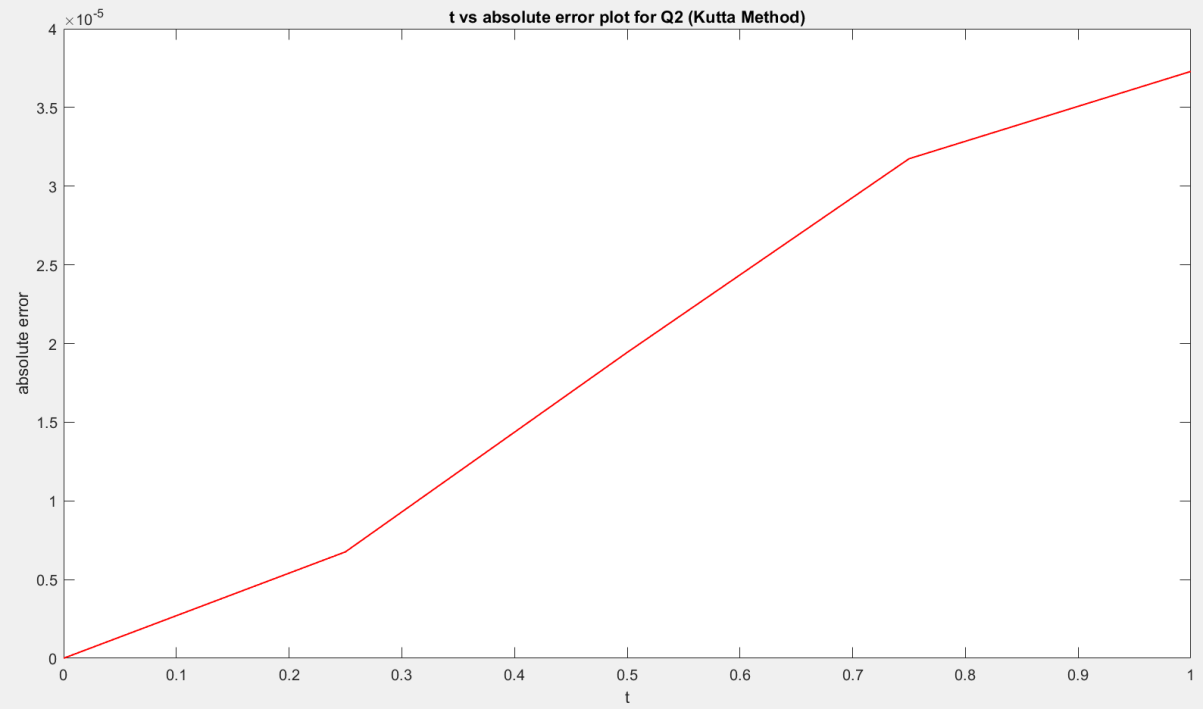


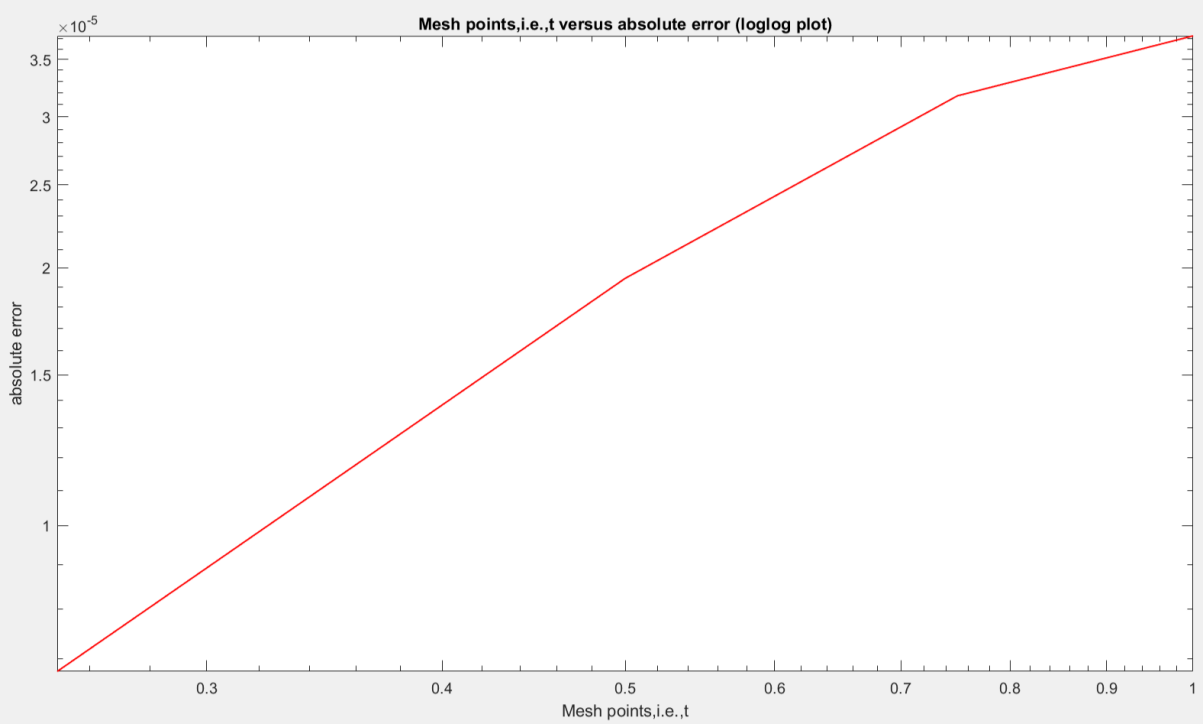


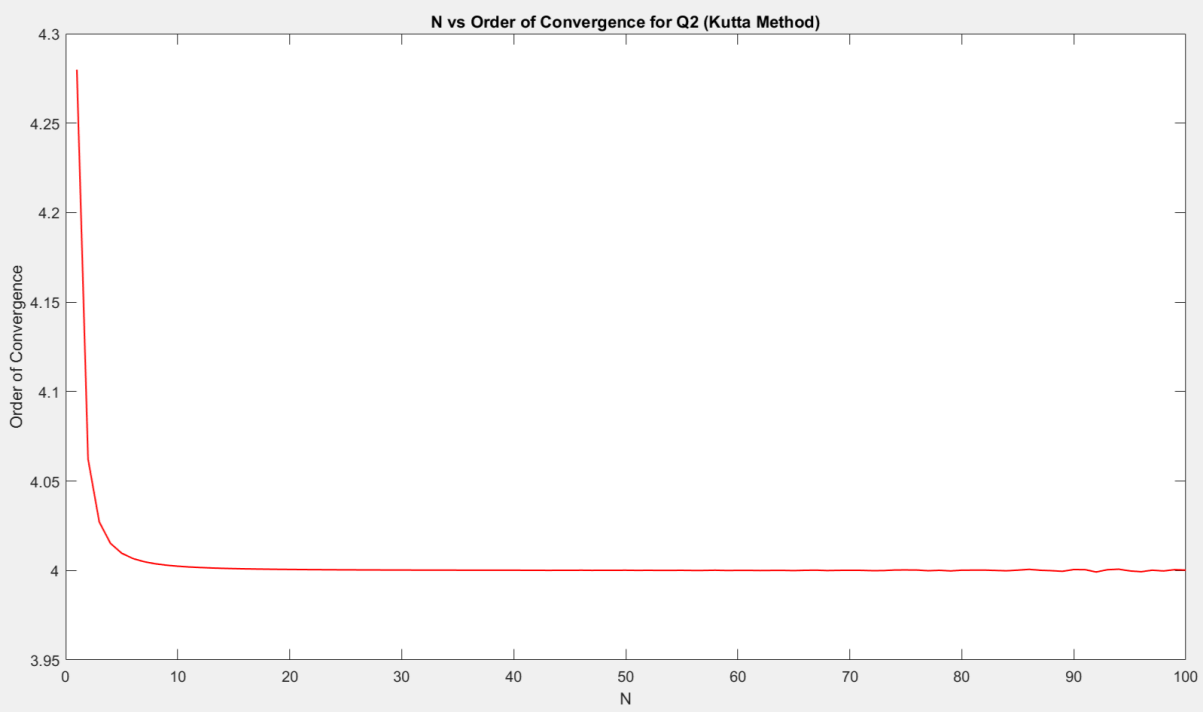
Using Fourth-order Runge-Kutta Method for Q2 (Kutta Method)

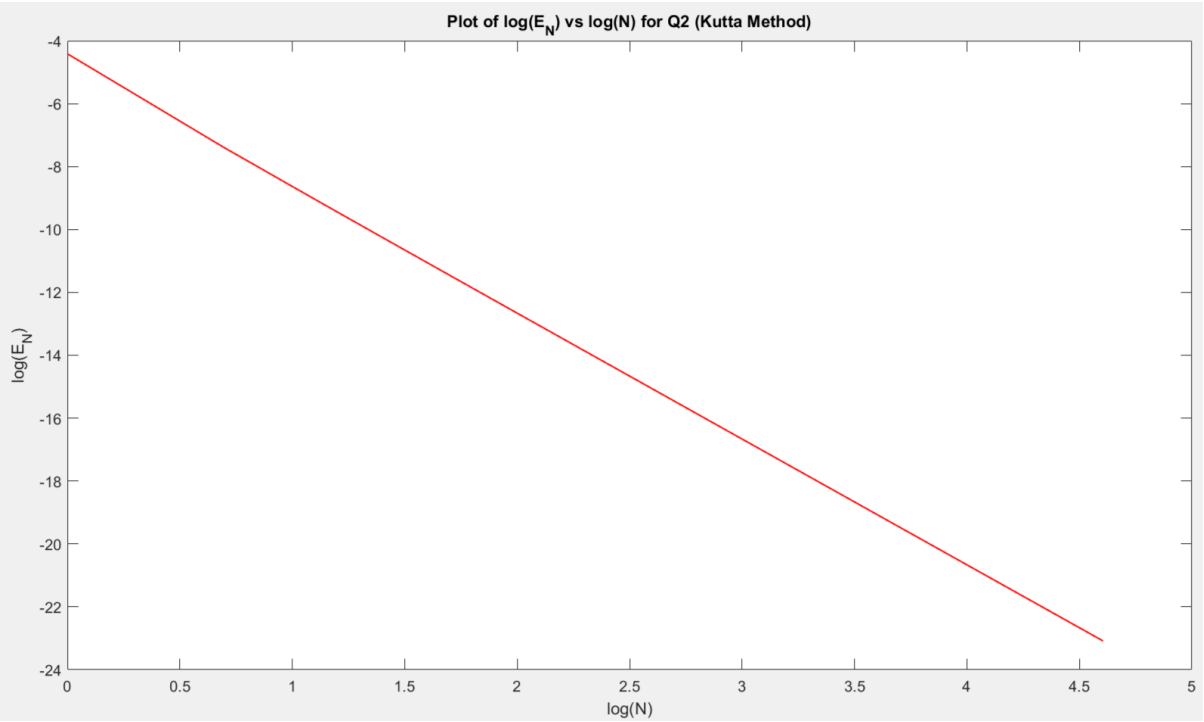
t	Approximate Solution	Exact Solution	Absolute Error
0.000000	1.000000	1.000000	0.000000
0.250000	1.329157	1.329150	0.000007
0.500000	1.730509	1.730490	0.000019
0.750000	2.041504	2.041472	0.000032
1.000000	2.118017	2.117980	0.000037


t versus solution plot for Q2 (Kutta Method)
Actual Solution
Approximate Solution
solution
t
2.2
2
1.8
1.6
1.4
1.2
1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1


t vs absolute error plot for Q2 (Kutta Method)
×10^-5
absolute error
t
4
3.5
3
2.5
2
1.5
1
0.5
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1


Mesh points,i.e.,t versus absolute error (loglog plot)
×10^-5
absolute error
Mesh points,i.e.,t
3.5
3
2.5
2
1.5
1
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1


N vs Order of Convergence for Q2 (Kutta Method)
Order of Convergence
N
4.3
4.25
4.2
4.15
4.1
4.05
4
3.95
0
10
20
30
40
50
60
70
80
90
100



Both Classical and Kutta methods exhibit similar performance, with little discernible difference between them. Kutta method is giving slightly better estimates.