MA322 – Scientific Computing Laboratory

Lab – 11

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For each part of both the questions, 4 plots are formed, namely: -

* Y(t) vs t plot for actual and approximated solutions.
* Absolute error vs t plot.
* N vs error. (Loglog plot)
* N vs order of convergence.

Where, N is number of intervals, i.e., N = (b - a)/h.

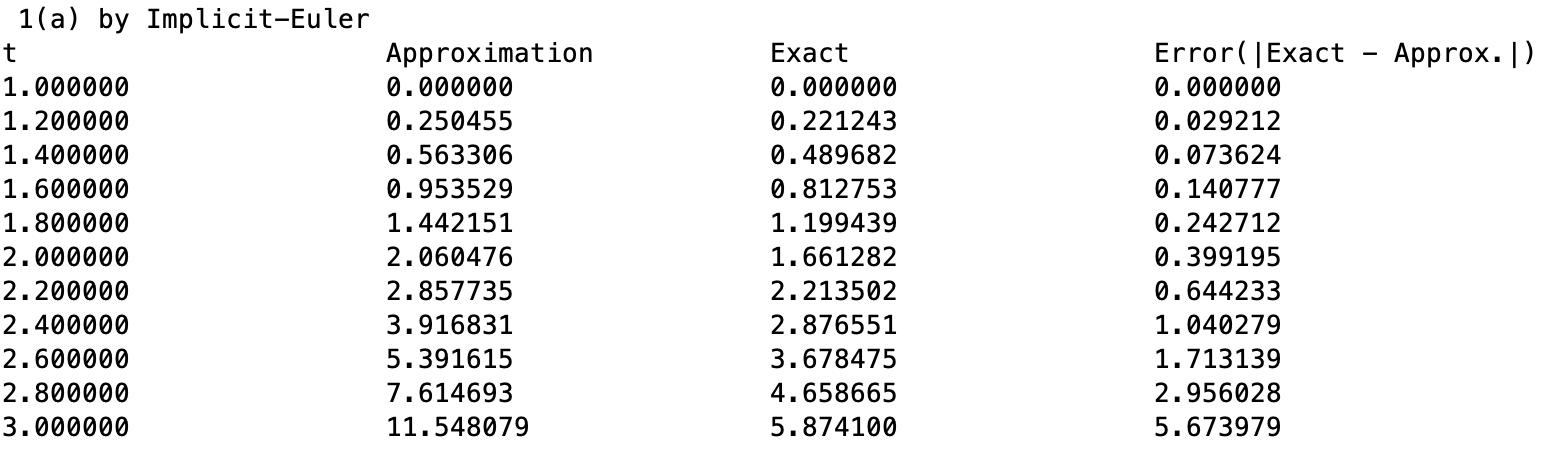
To get the last two plots, N is varied from 1 to 100, and maximum errors are taken for N and 2N. The order is calculated by log2(EN/E2N), EN and E2N being maximum errors while computing the mentioned method for that particular value of N.

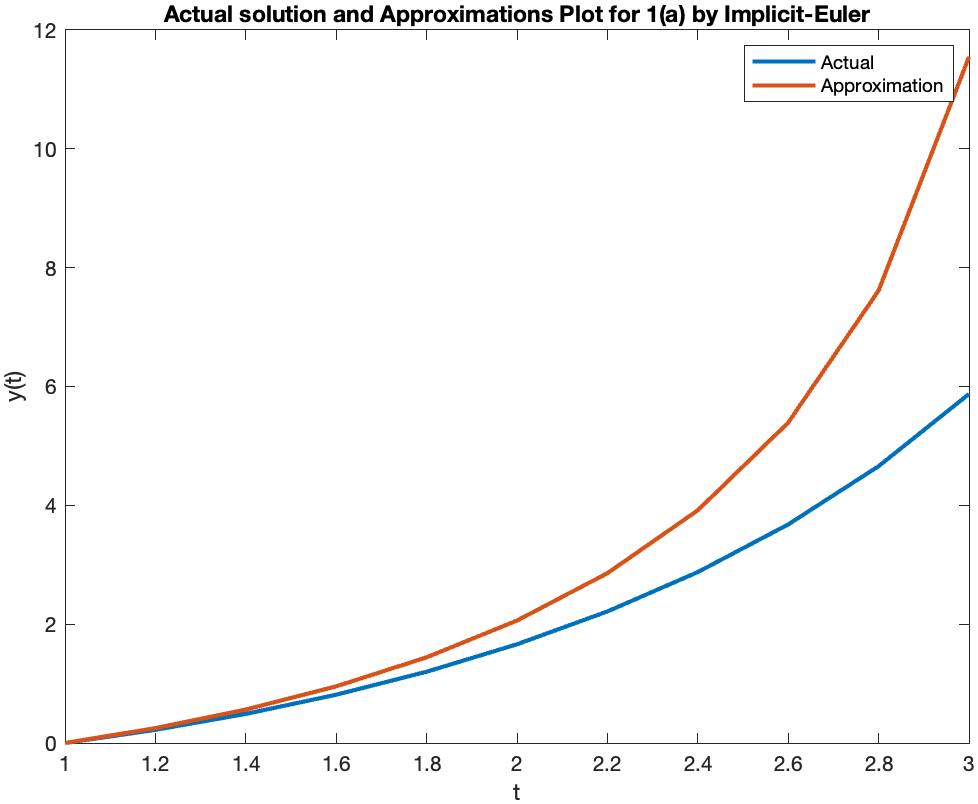
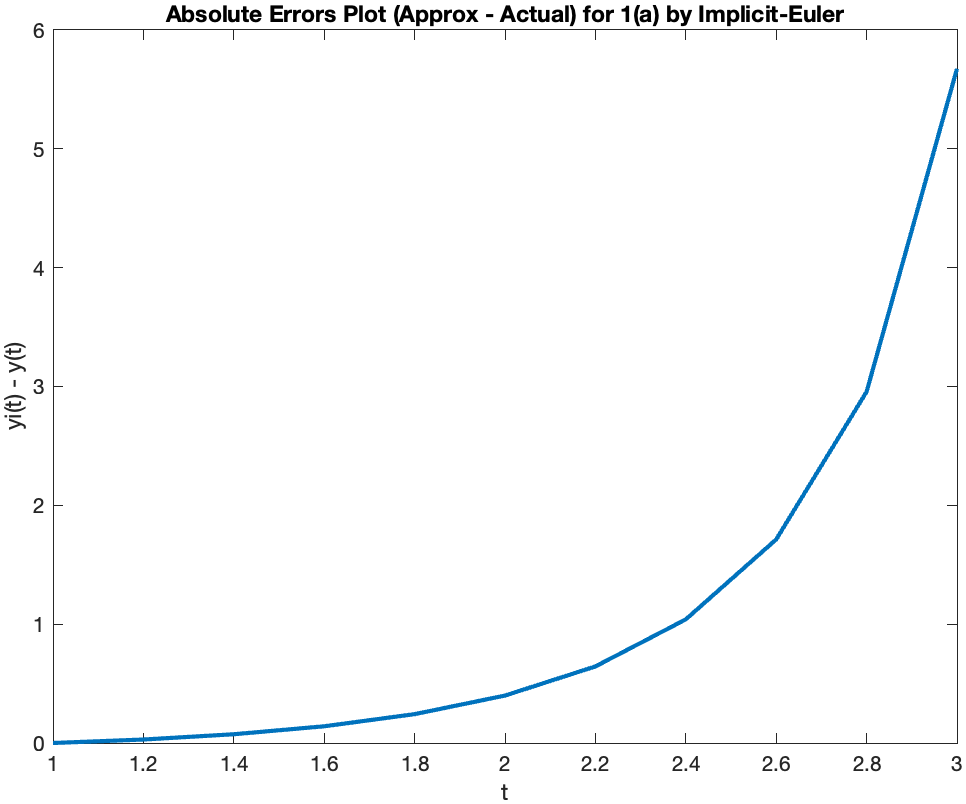
# Ques – 1

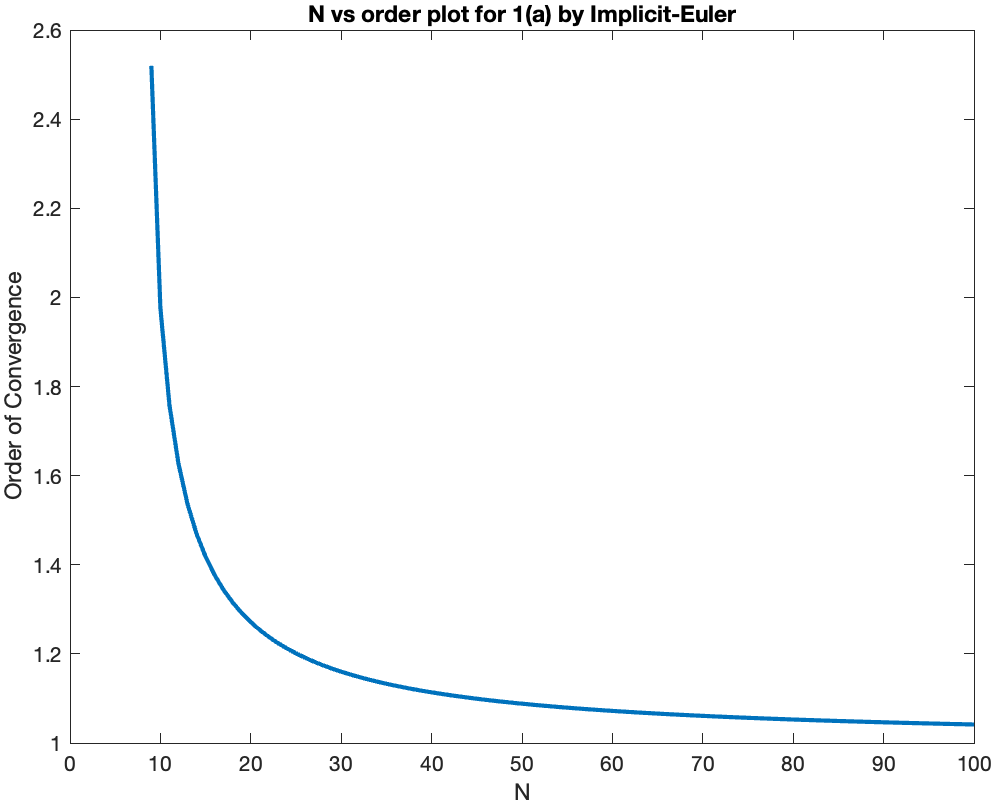
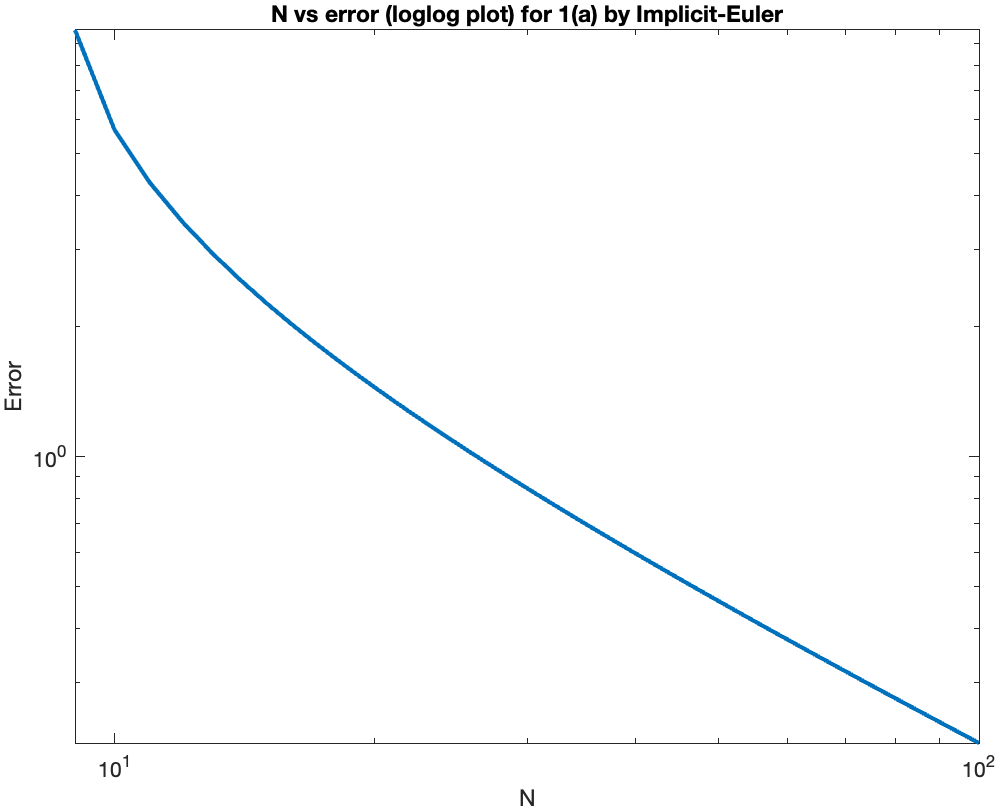
Here, the following methods are implemented for given two parts: -

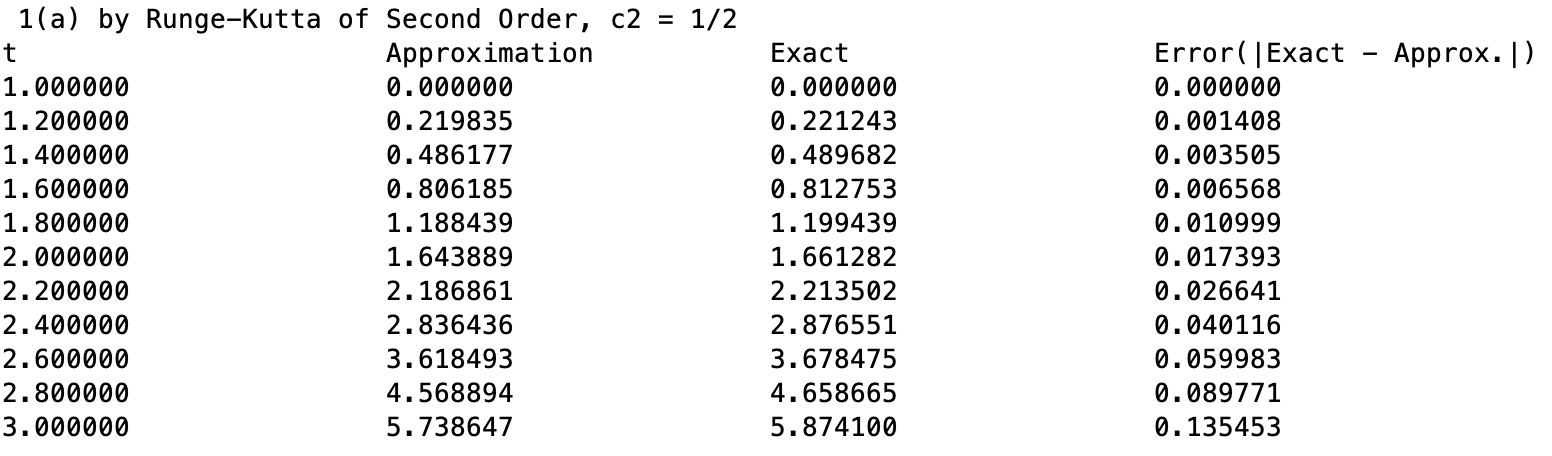
* Implicit-Euler’s Method.
* 2nd Order Runge-Kutta Method for c2 = ½, 2/3 and 1.
* 4th Order Runge-Kutta Method (classical and Kutta Method).

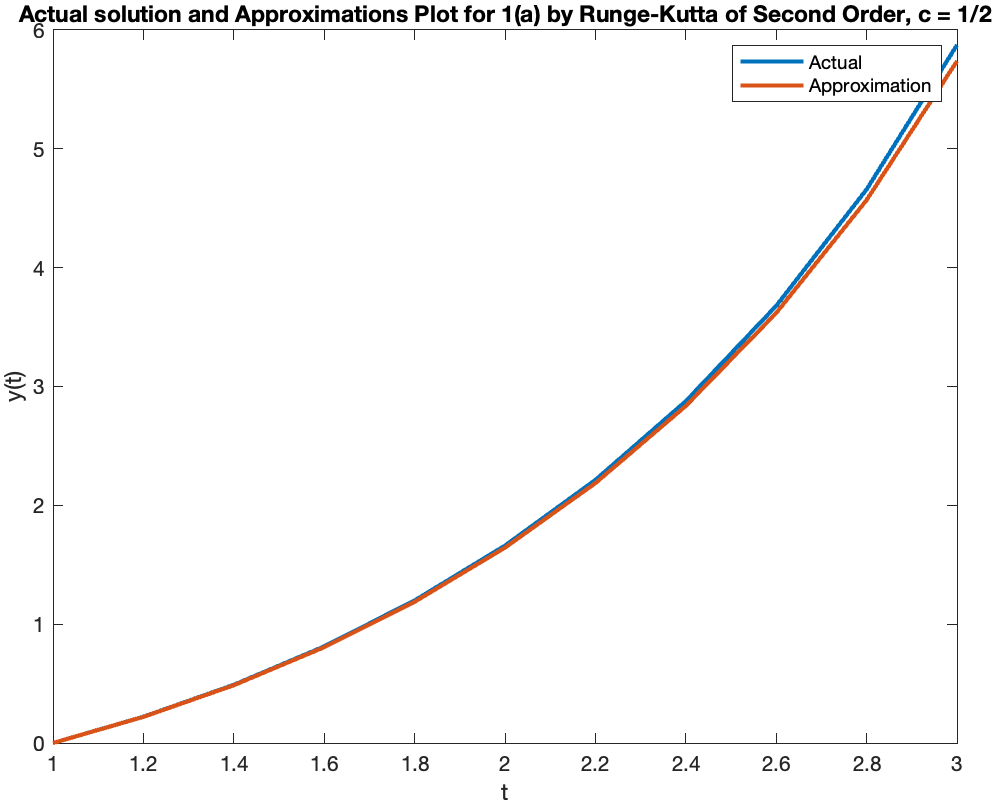
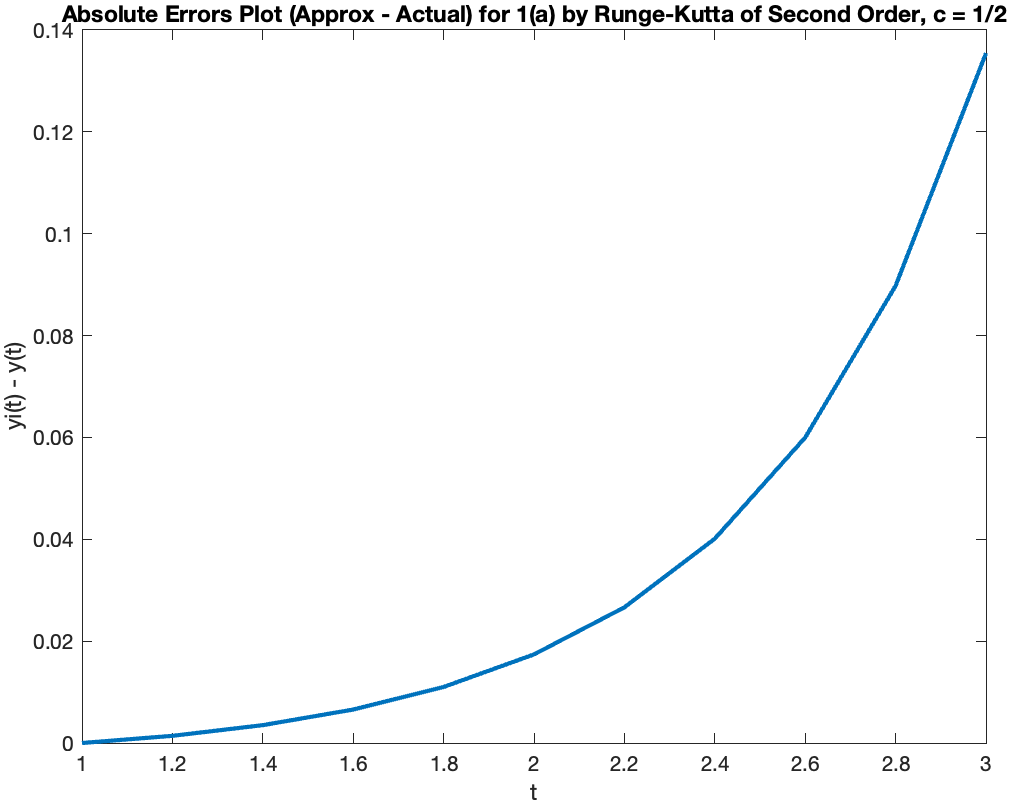
Following are the results thus obtained: -

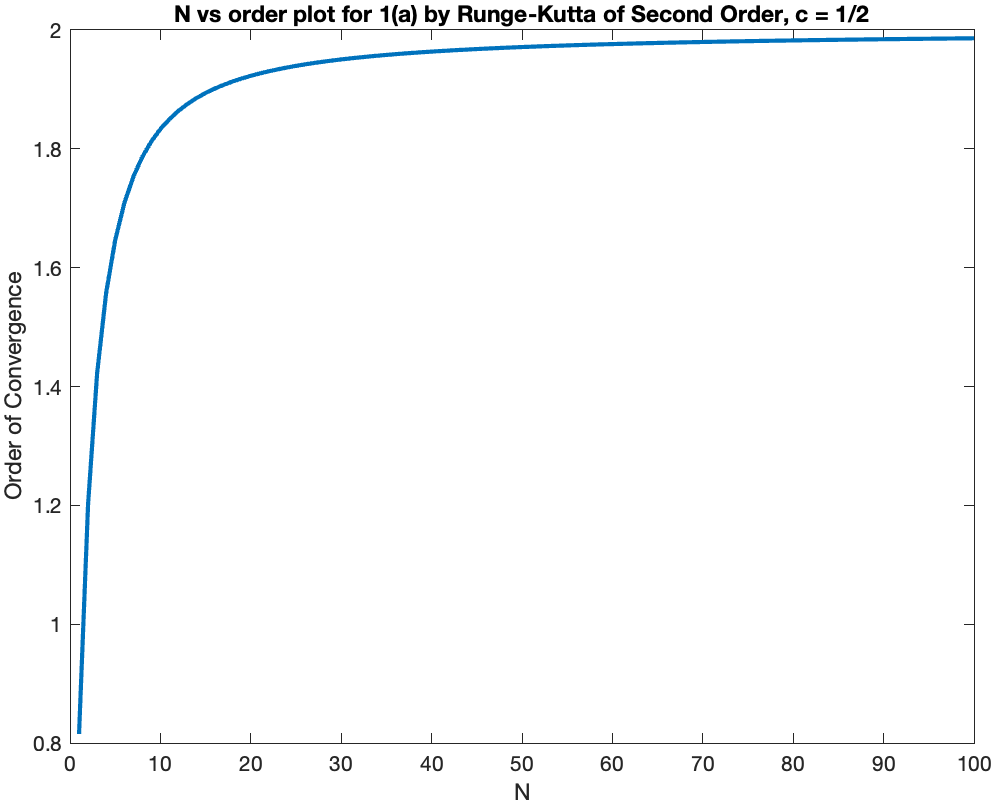
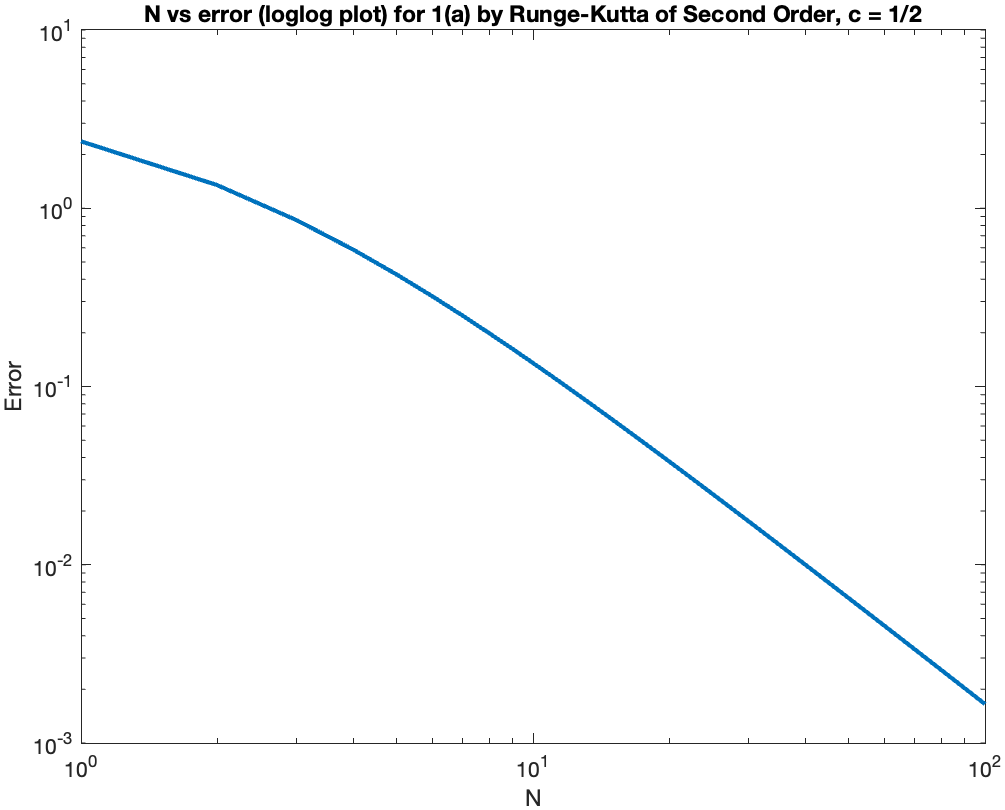


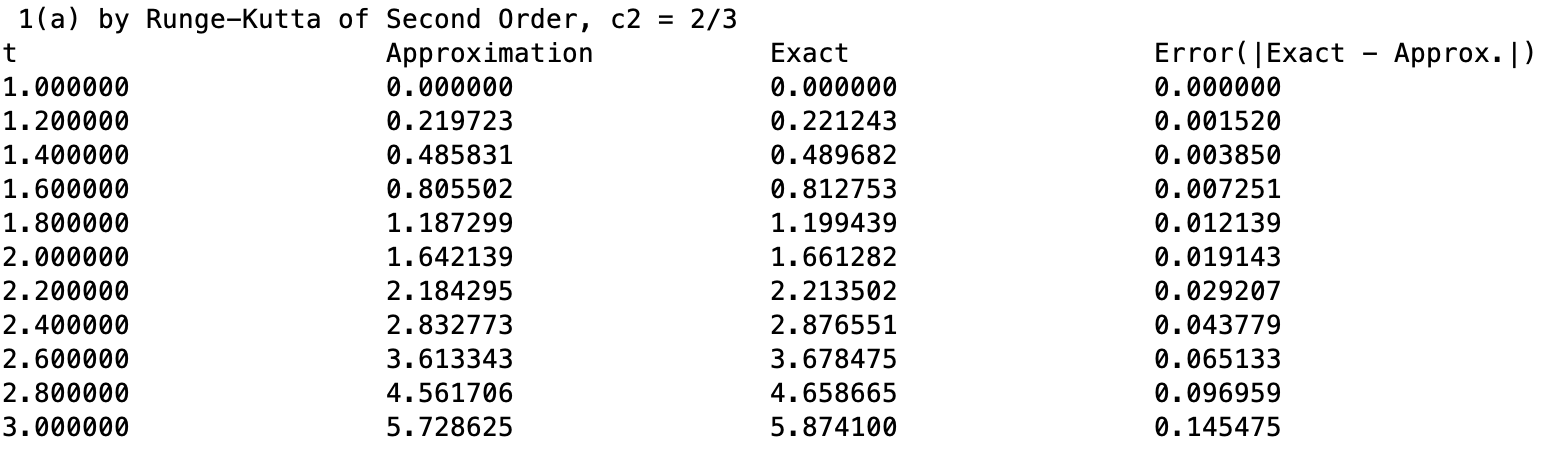
 

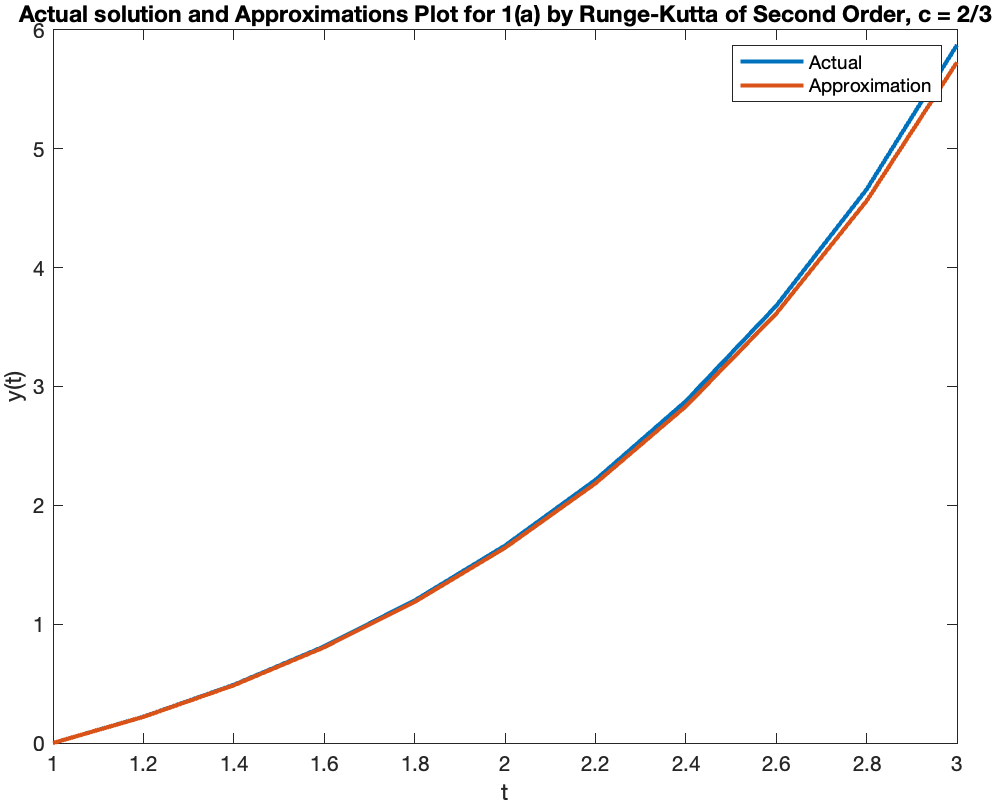
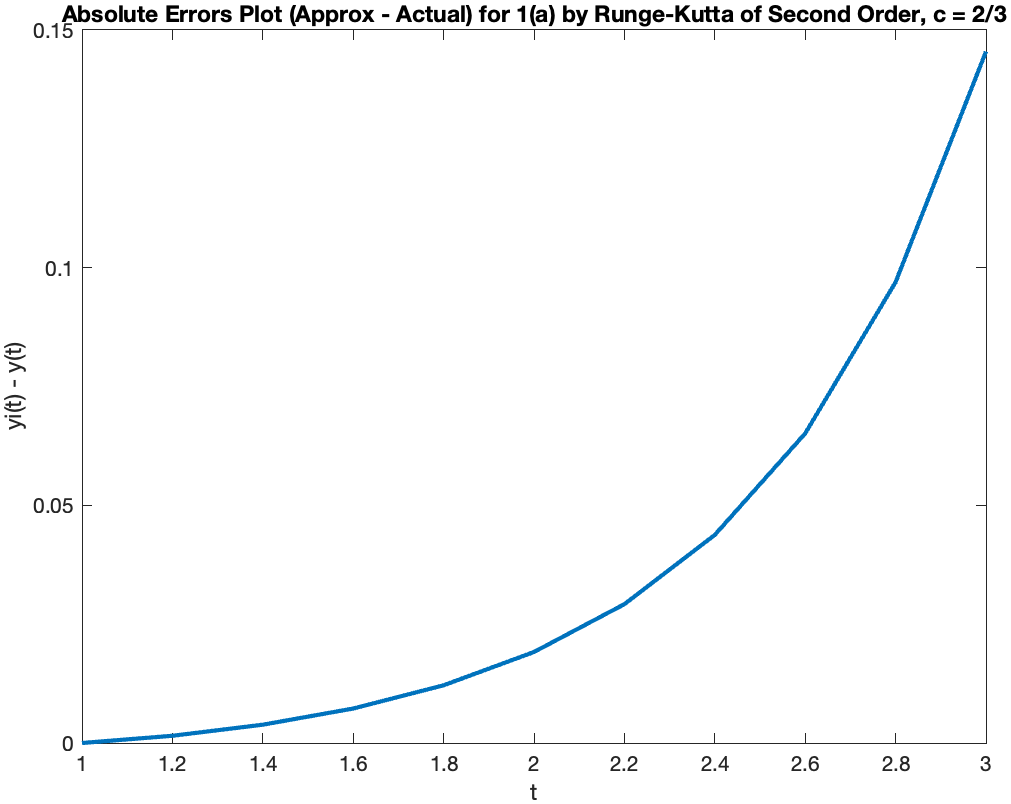
 

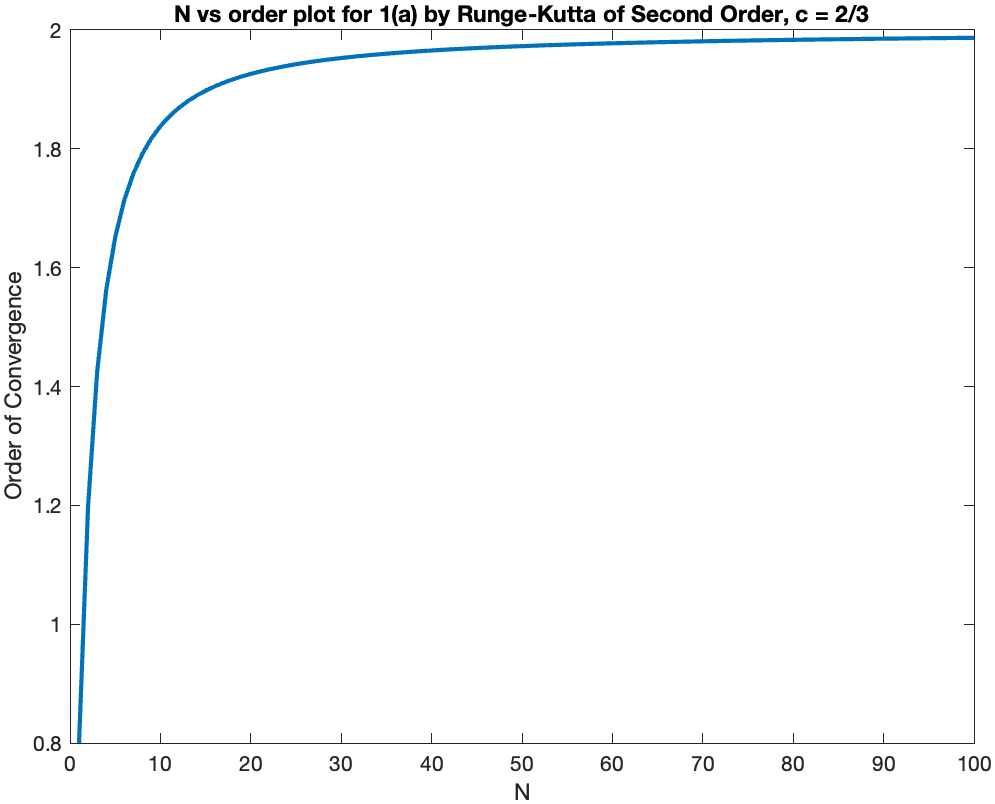
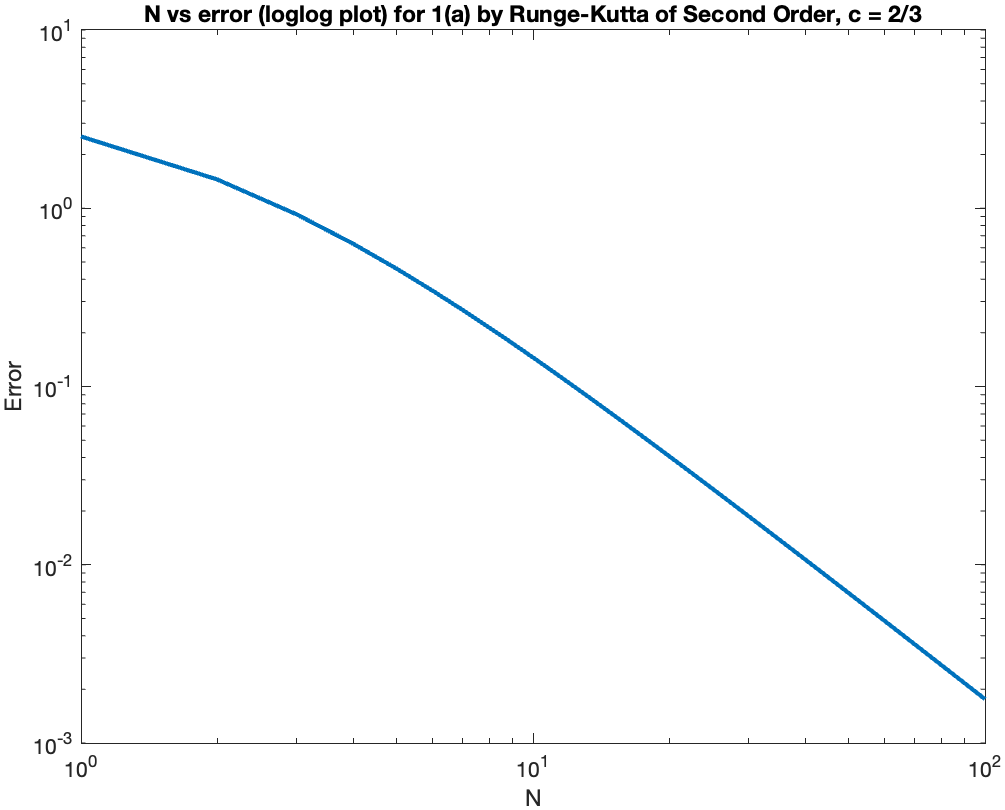


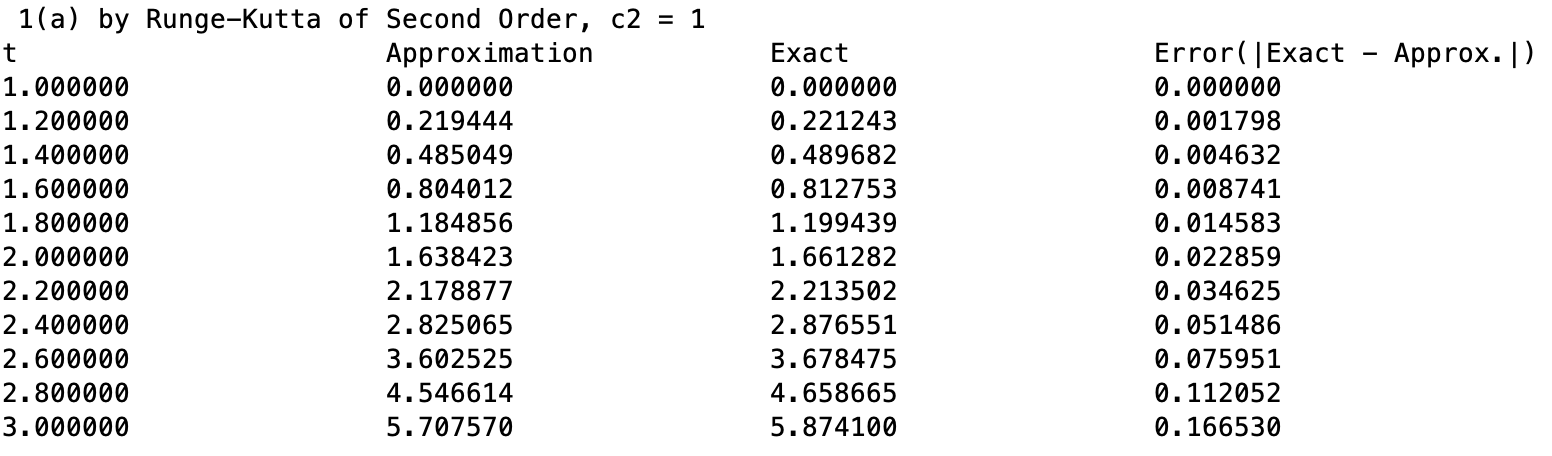
 

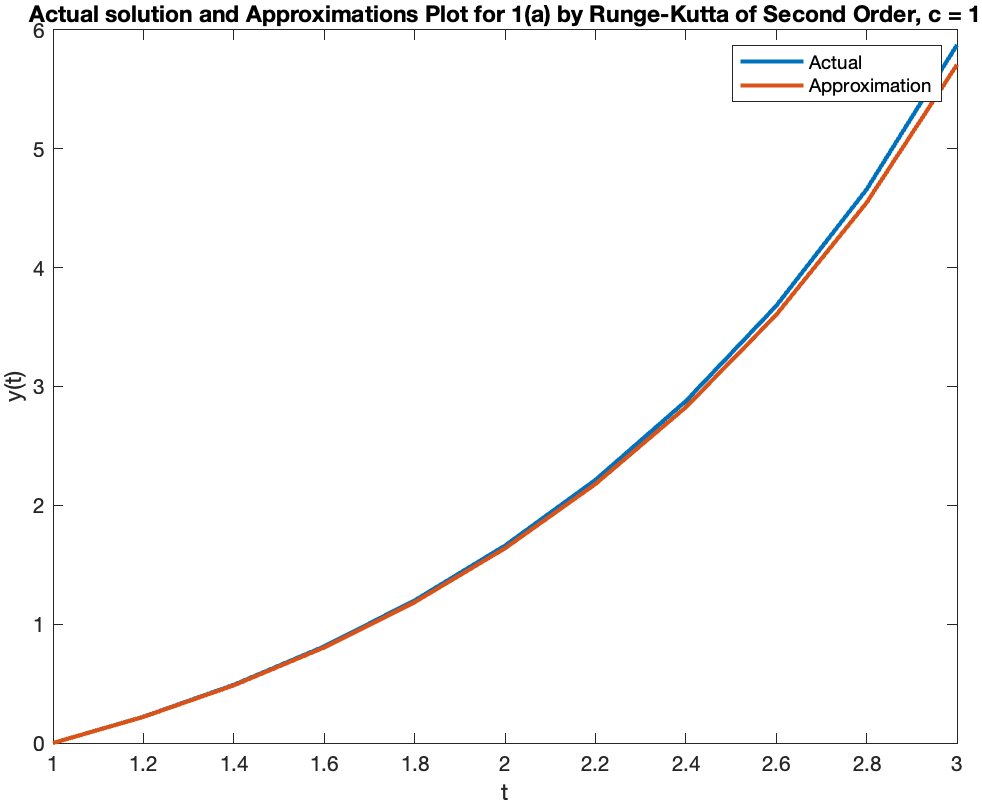
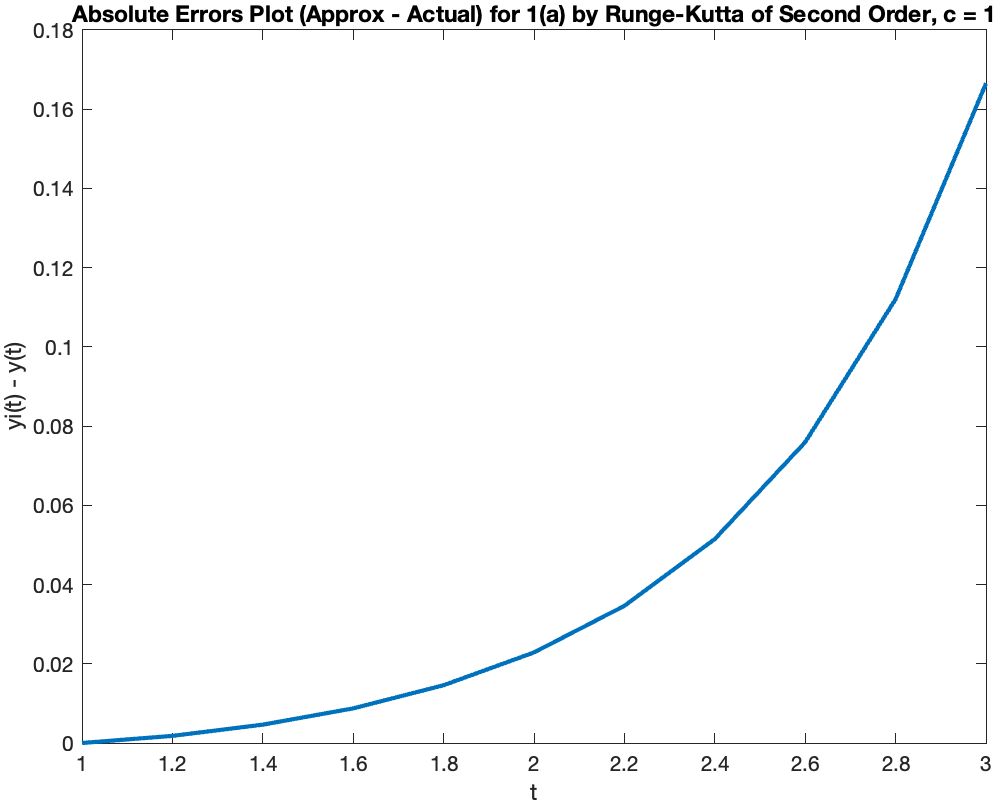
 

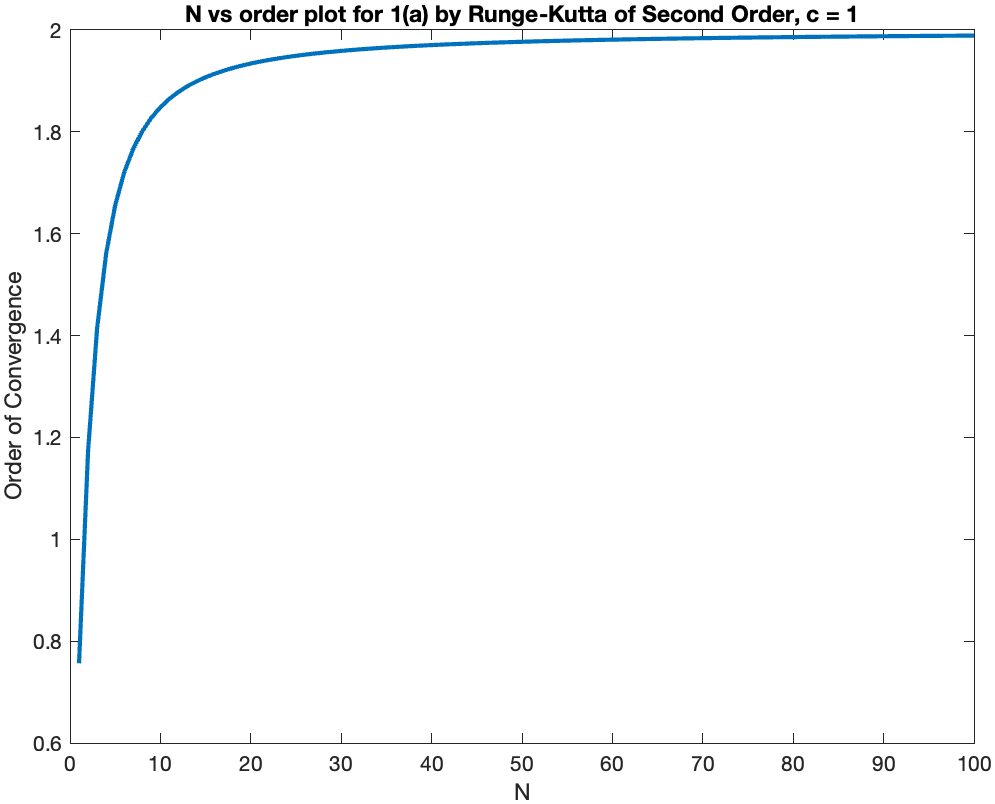
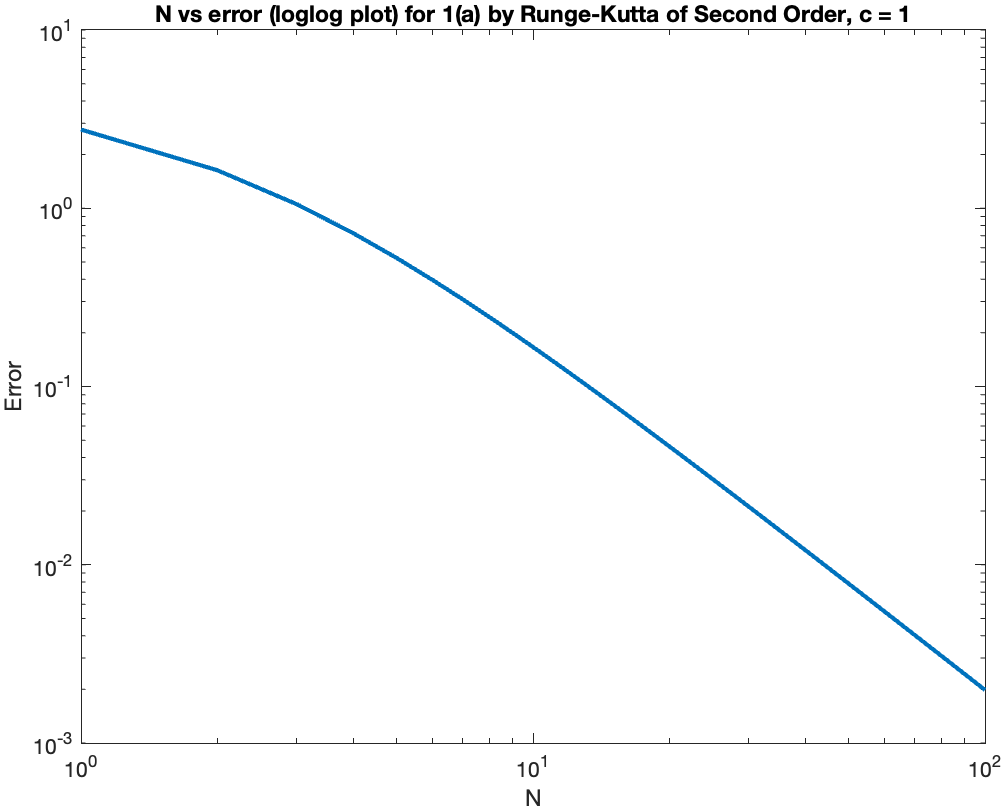


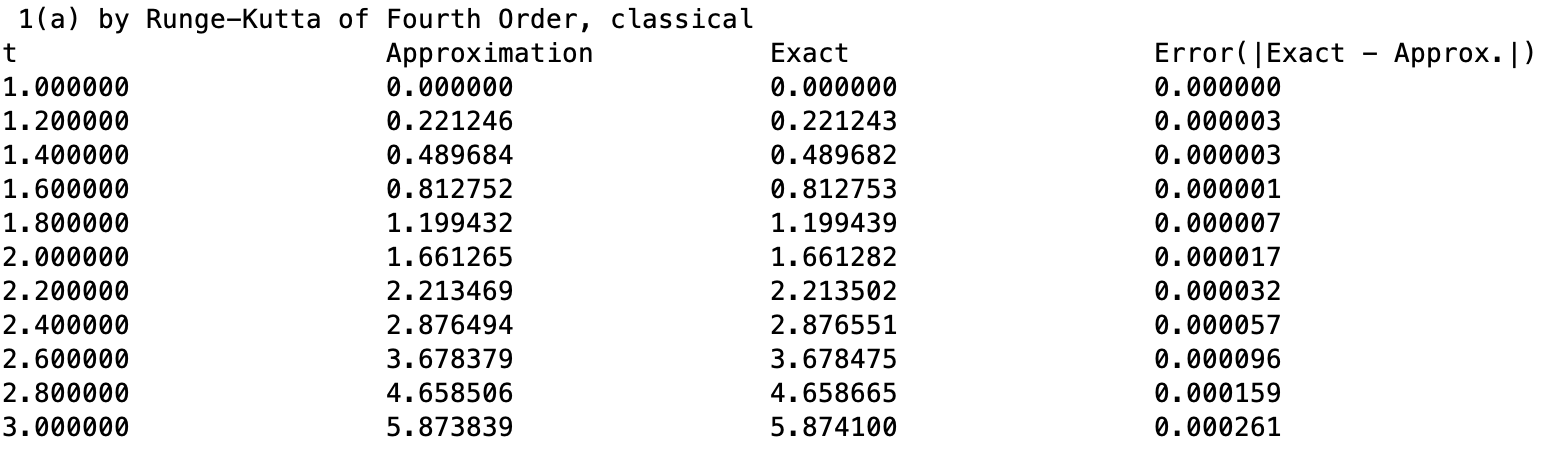
 

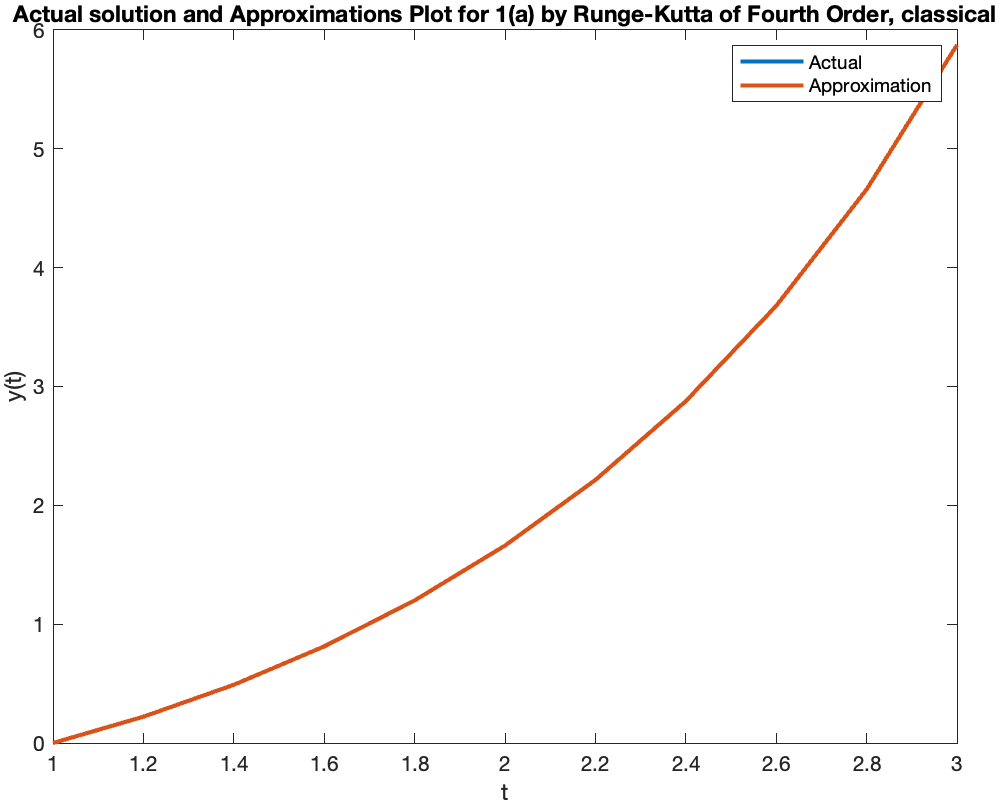
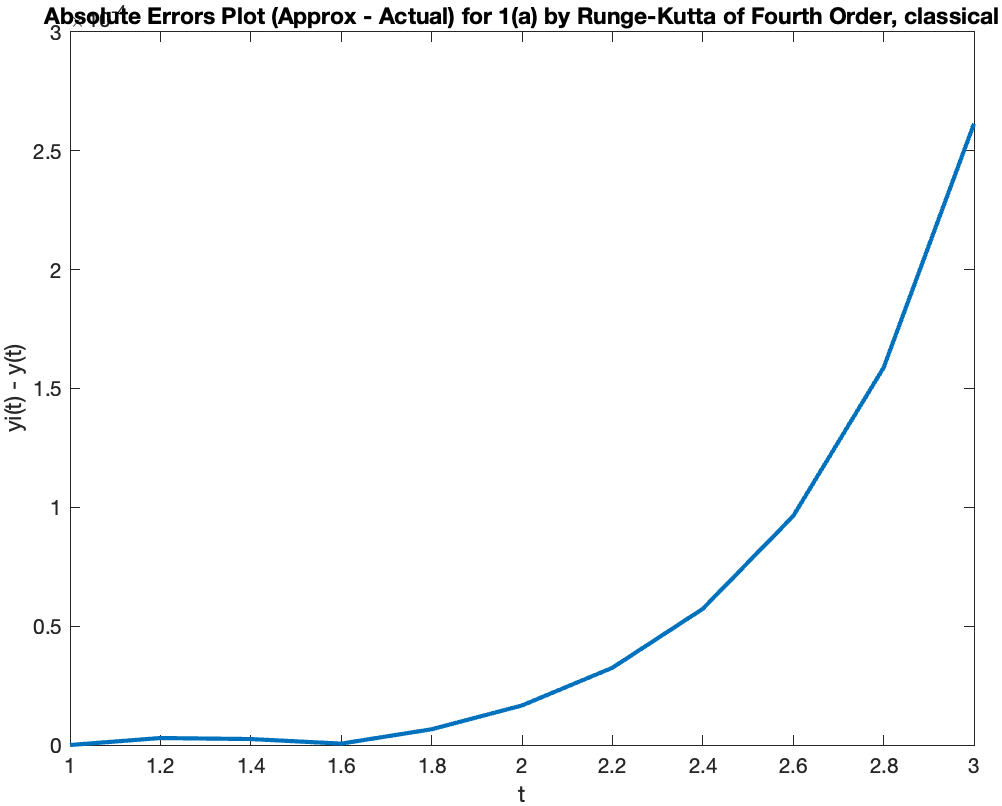
 

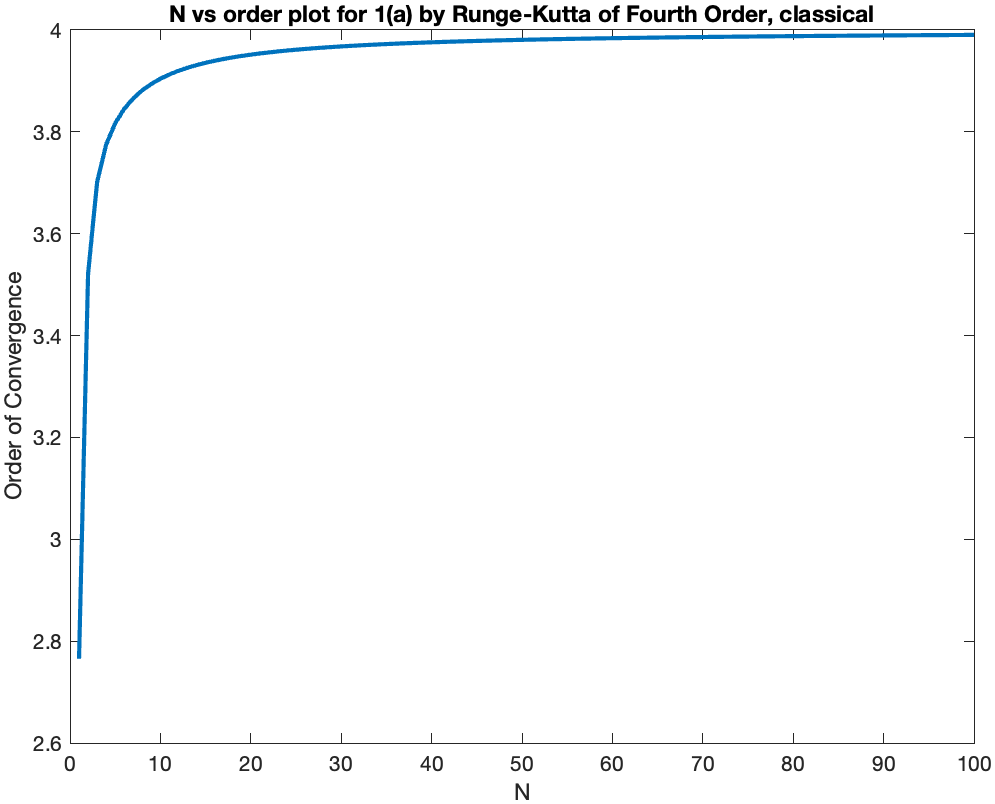
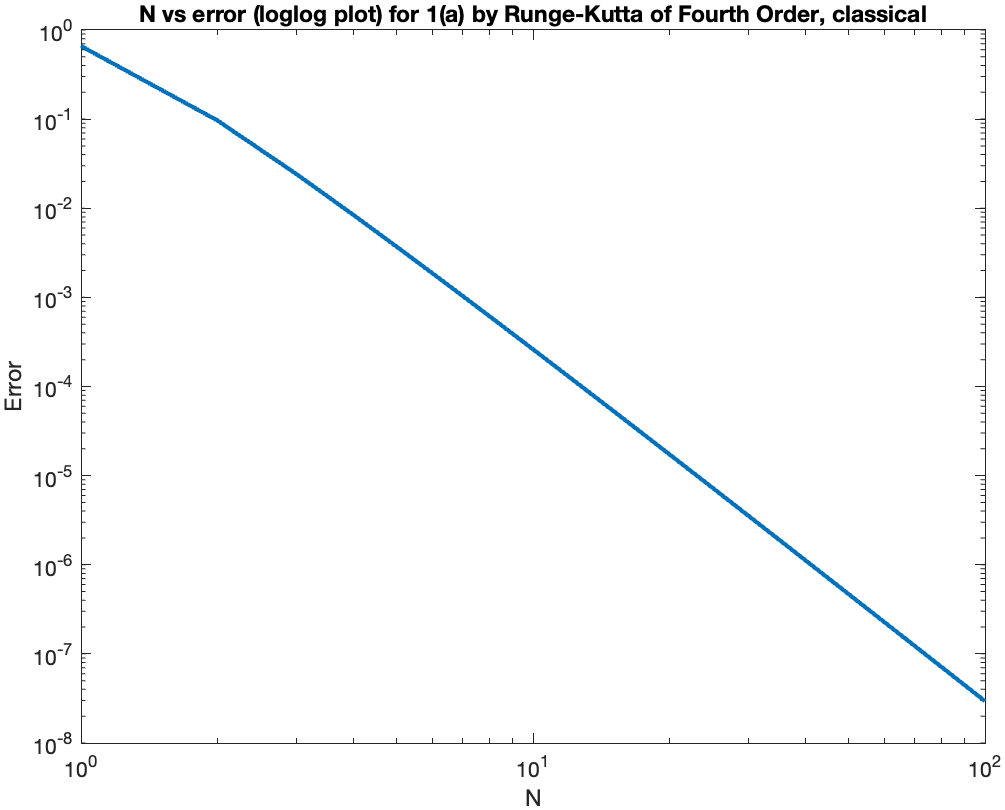


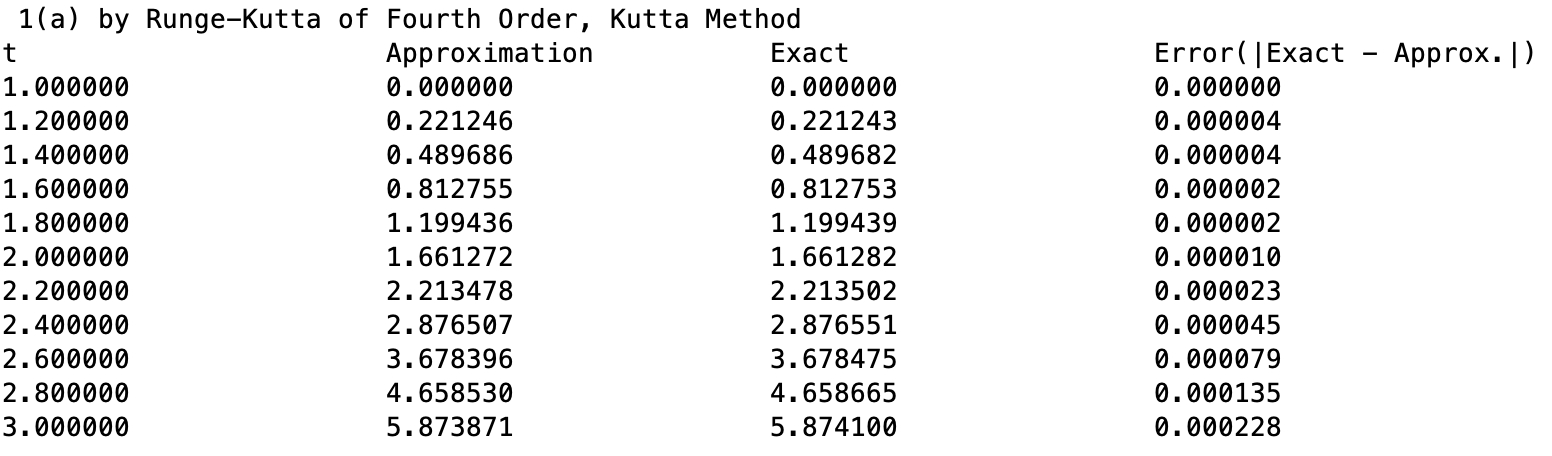
 

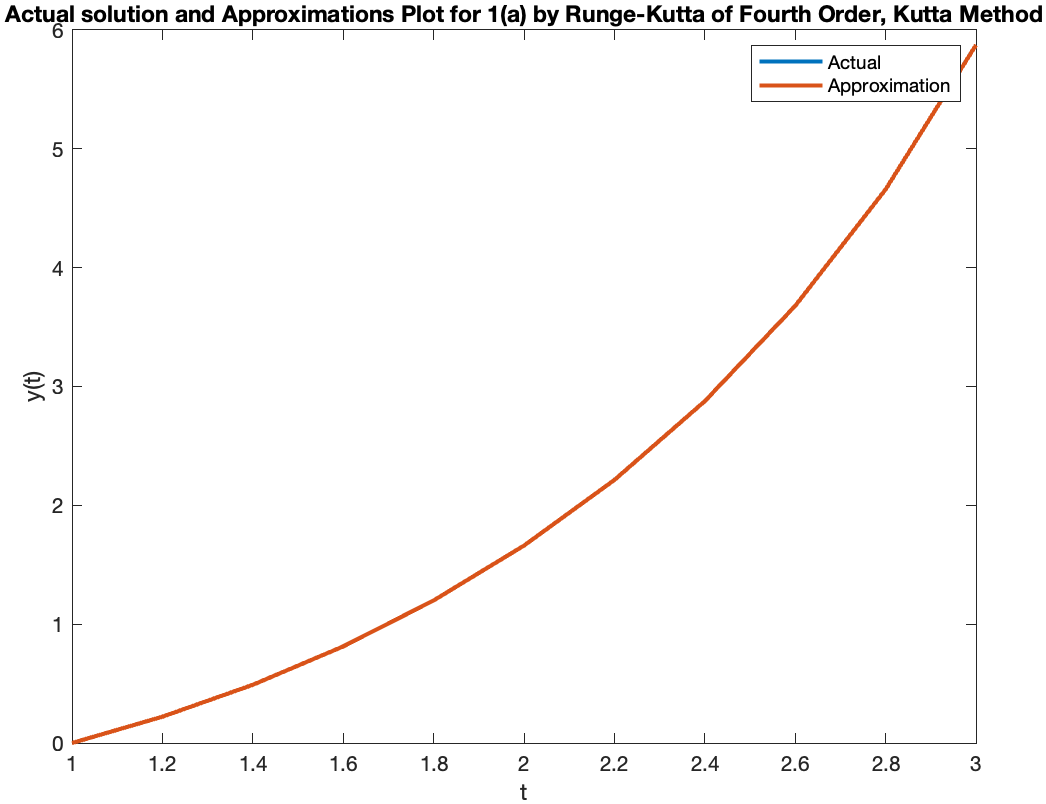
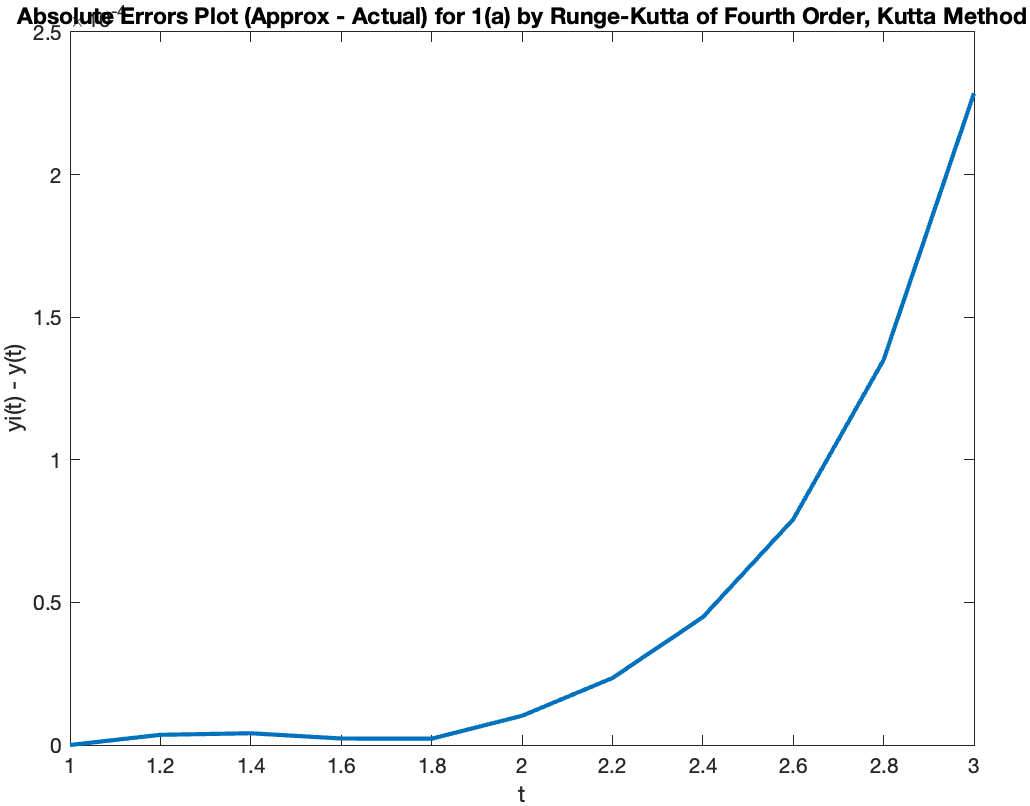
 

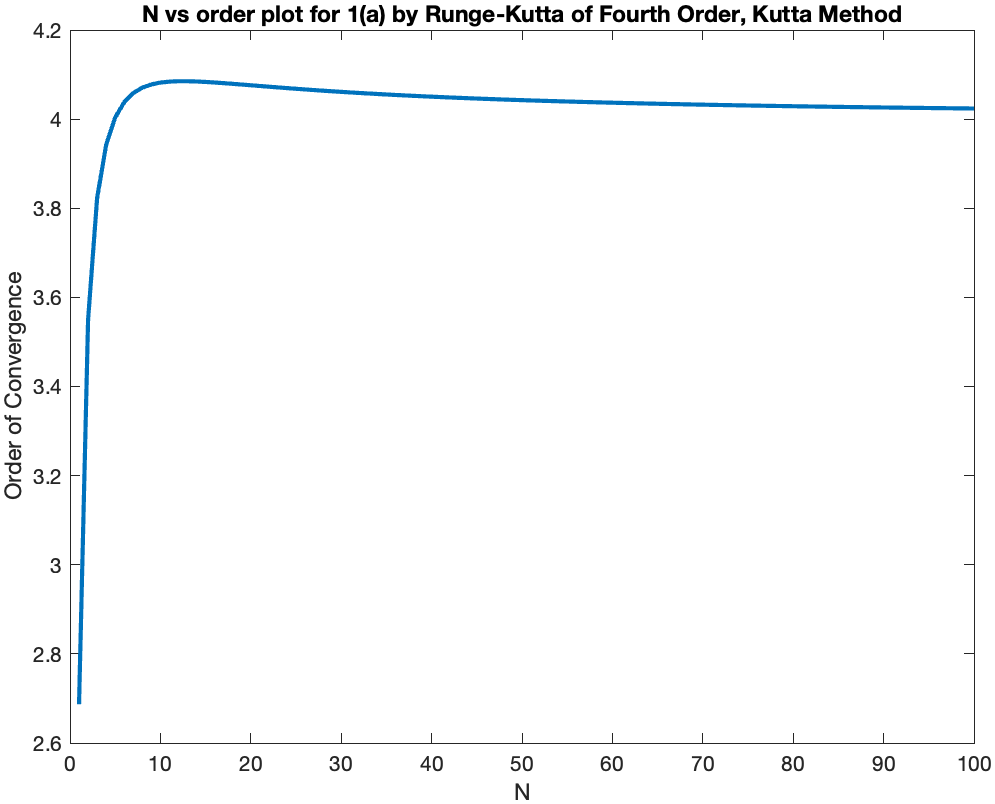
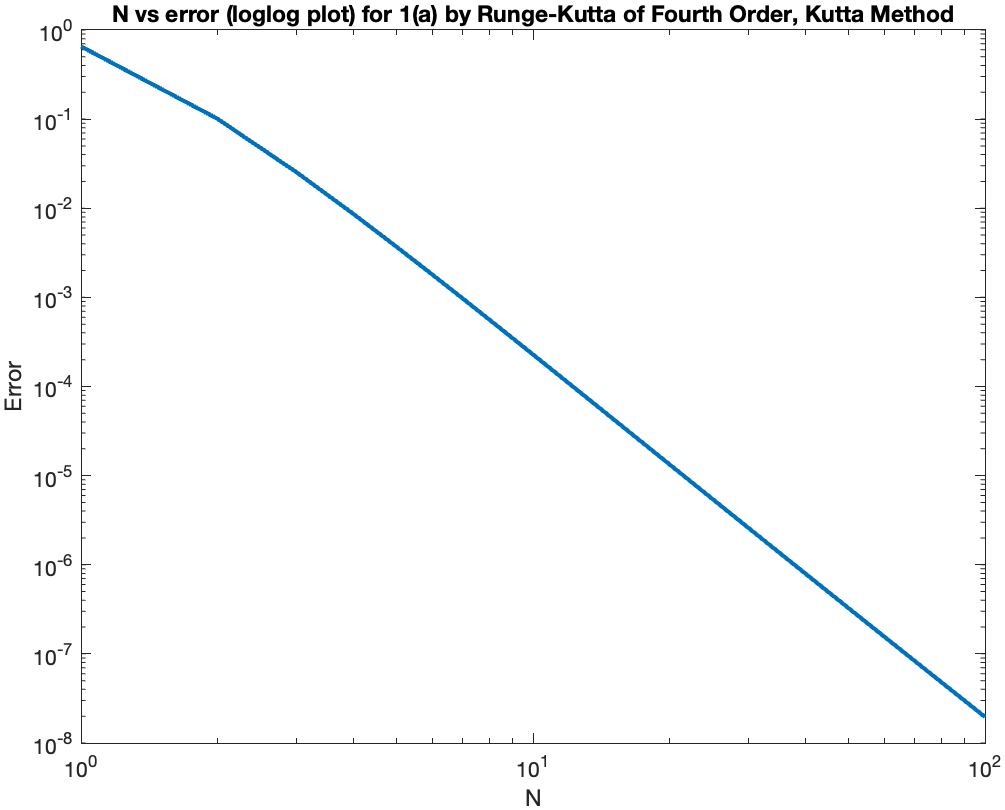


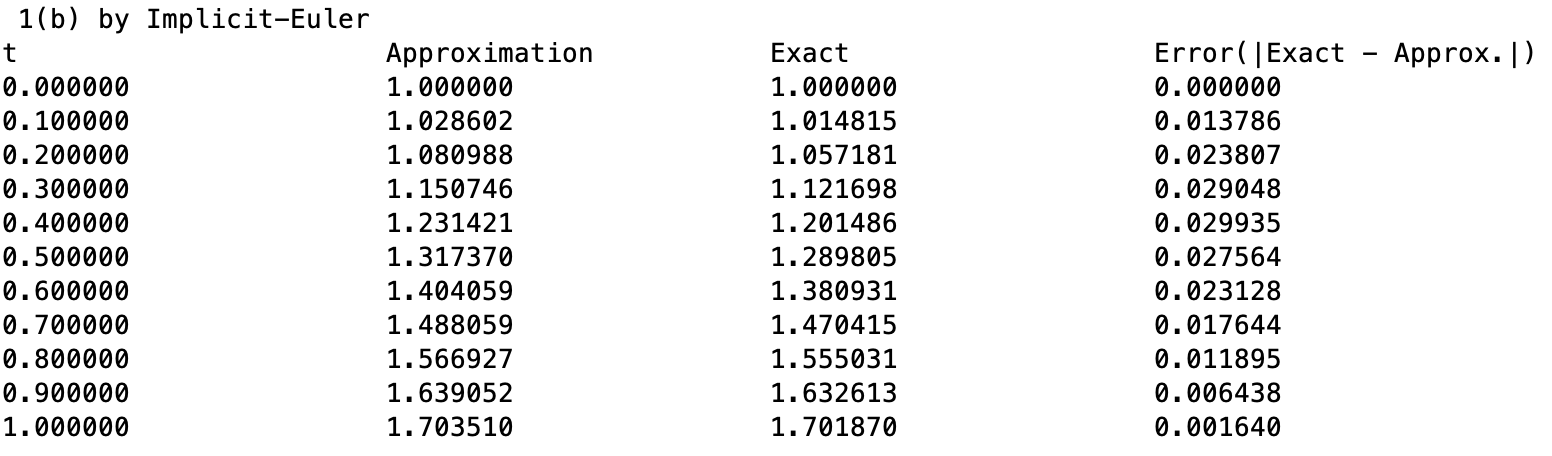
 

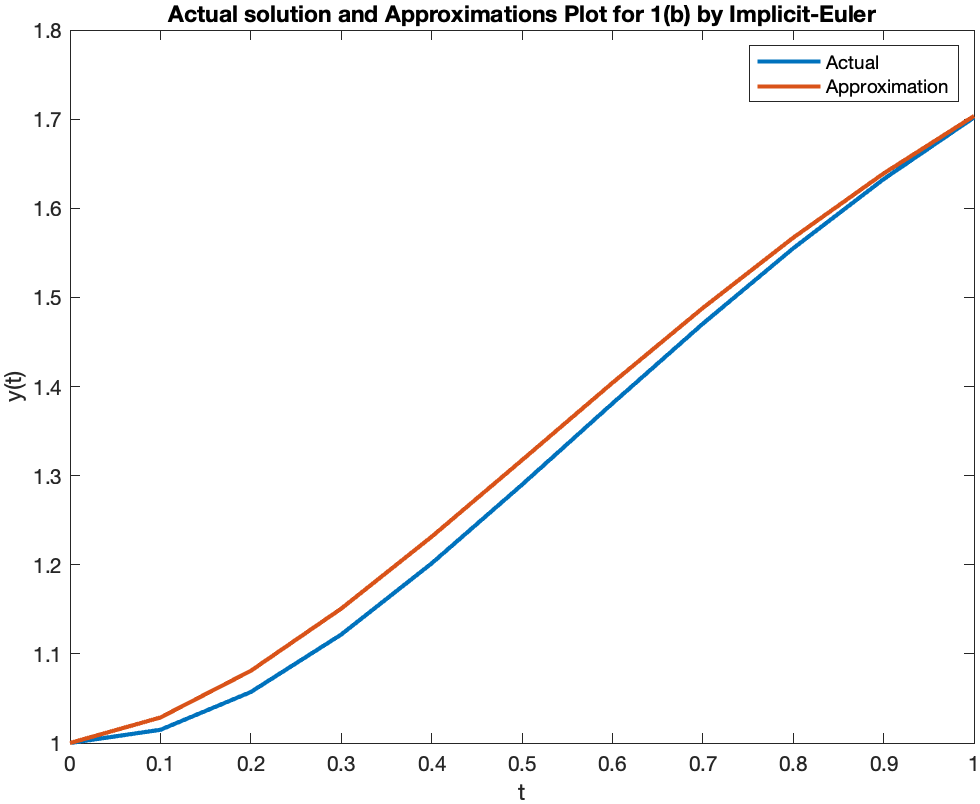
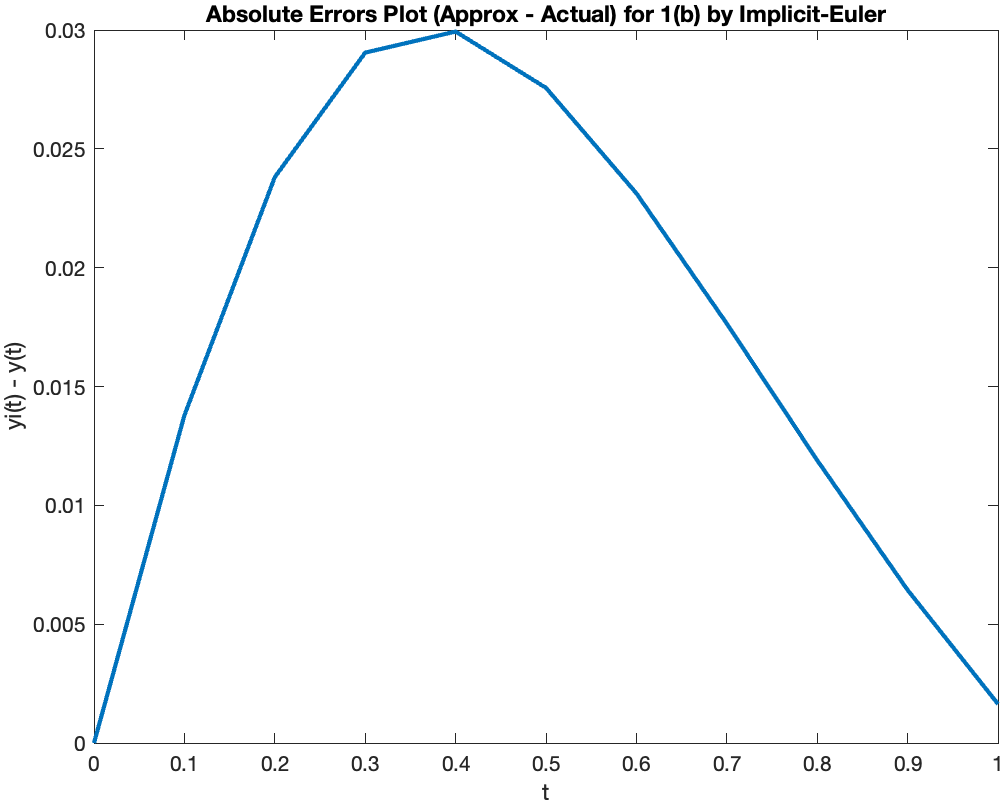
 

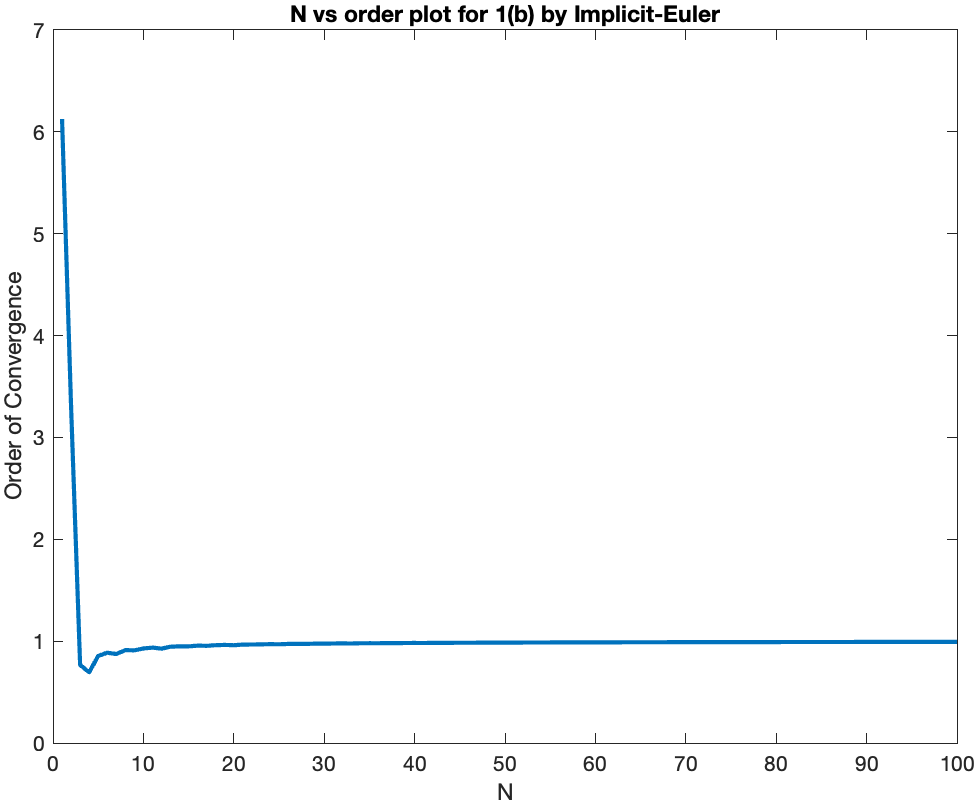
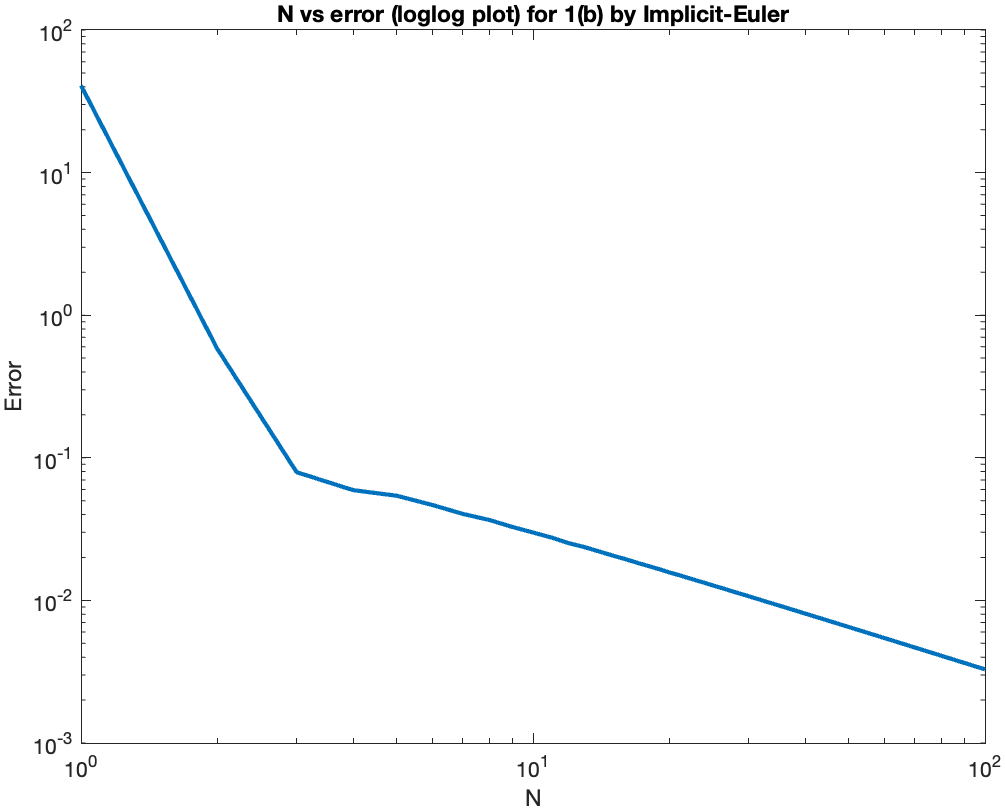


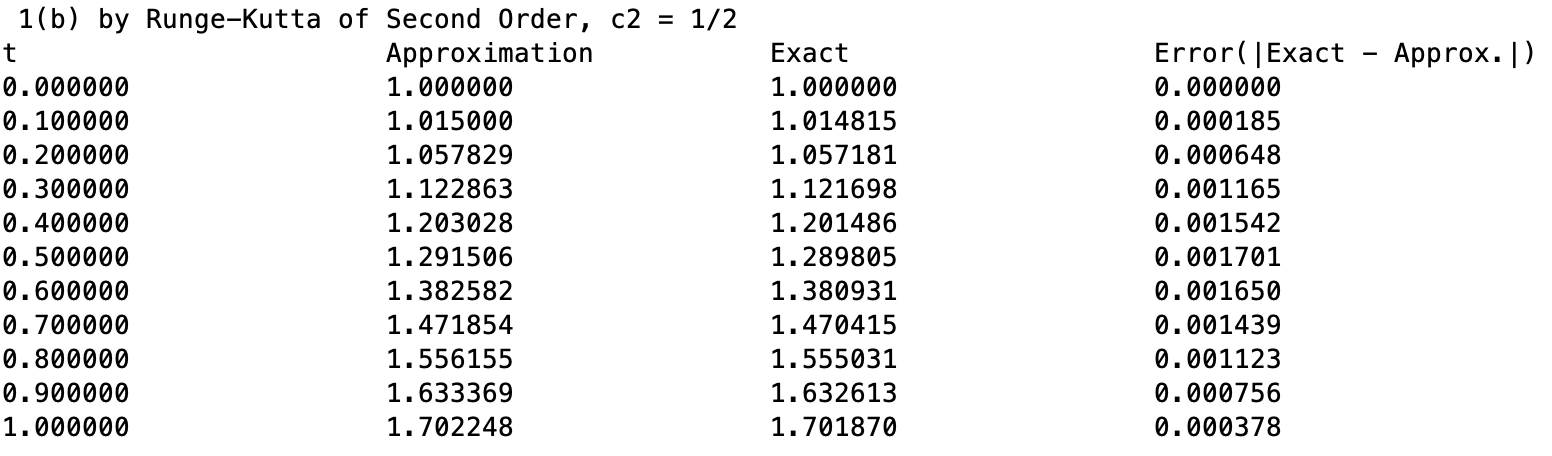
 

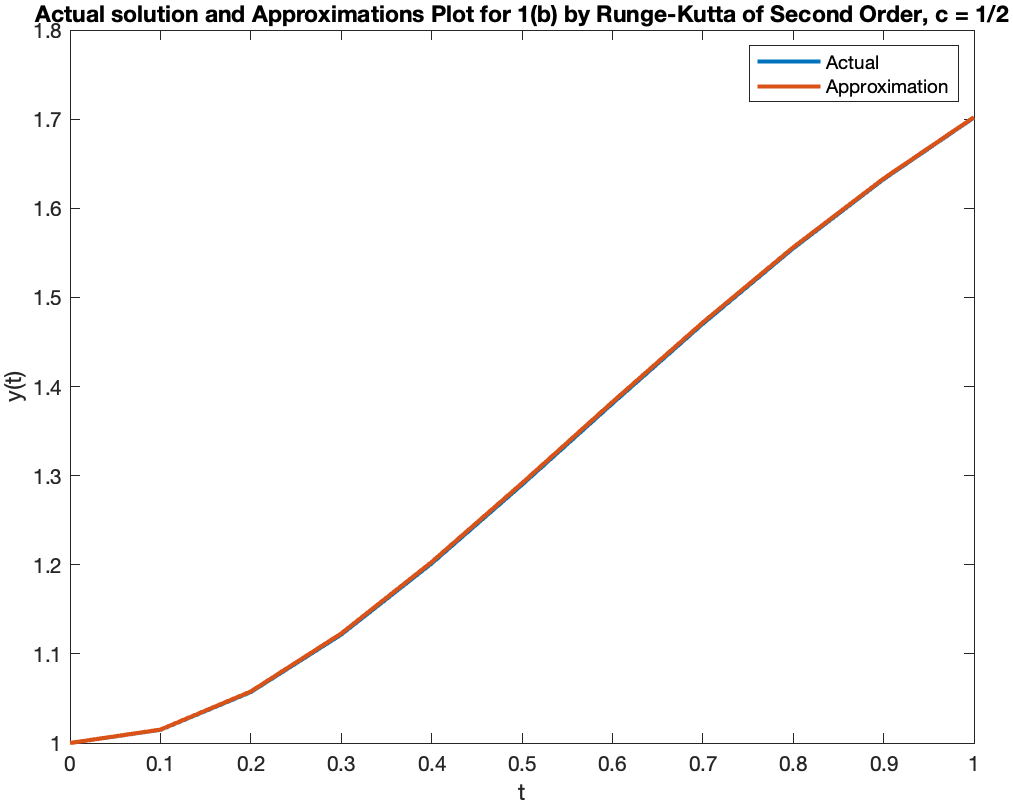
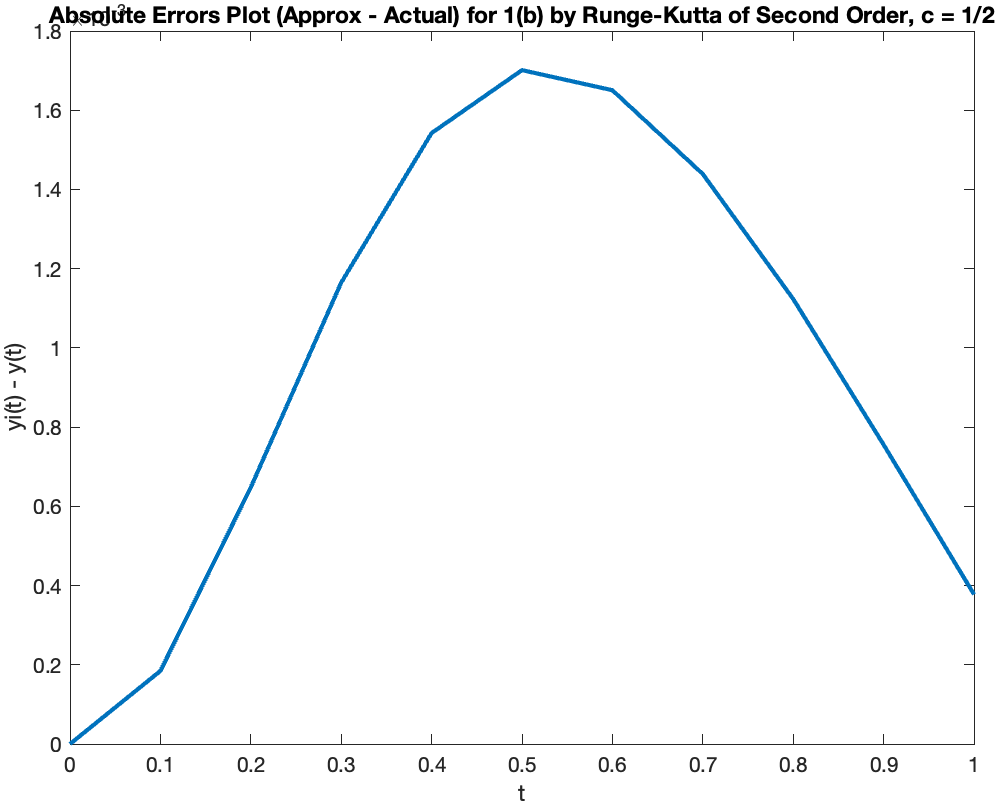
 

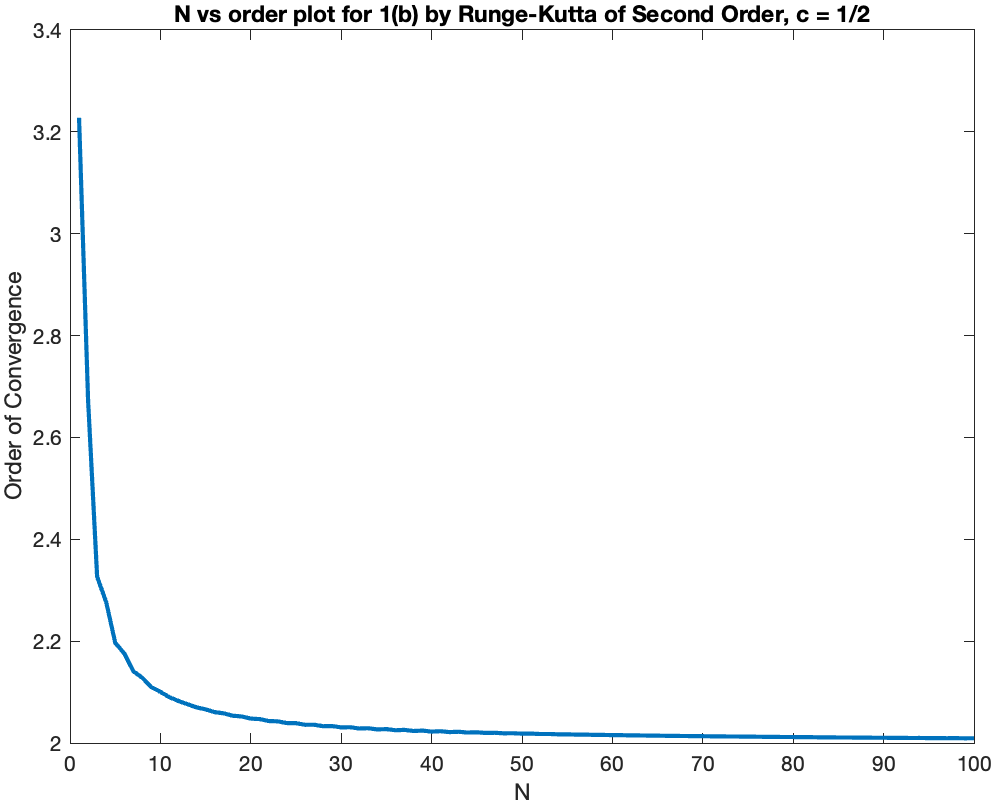
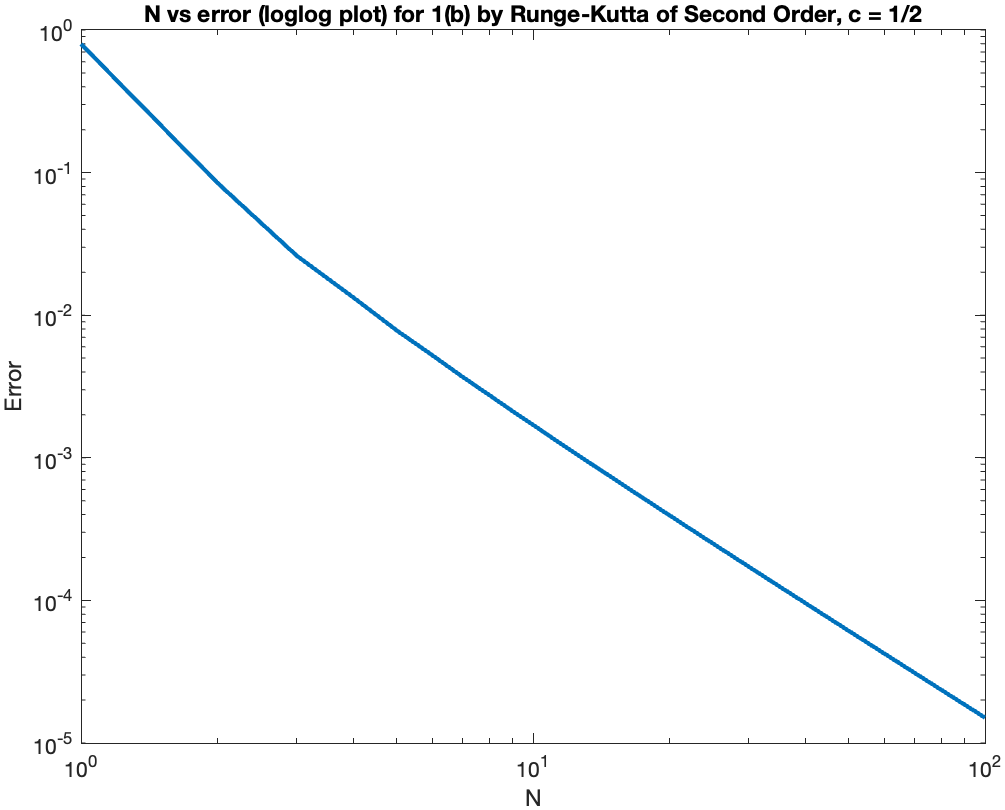


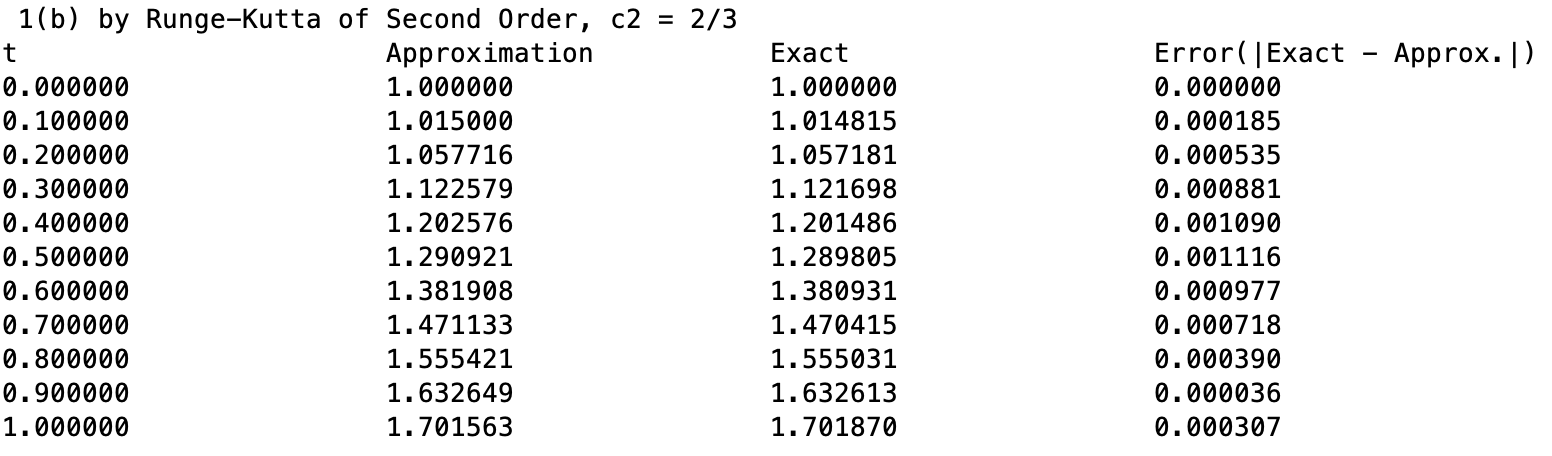
 

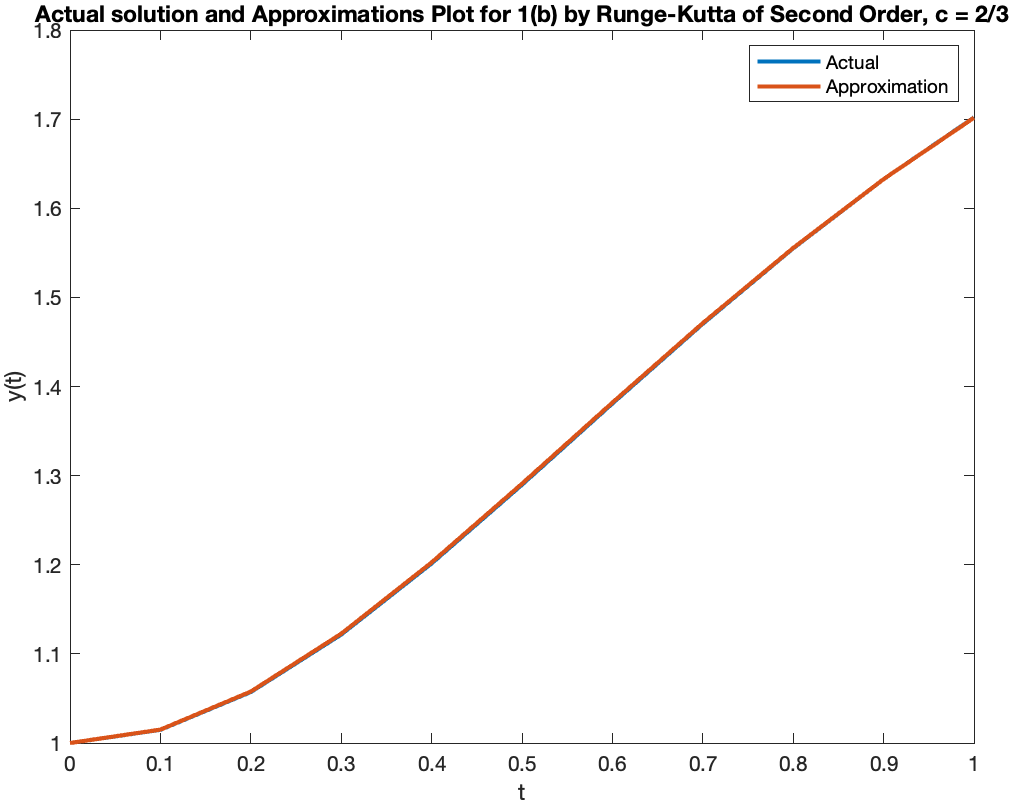
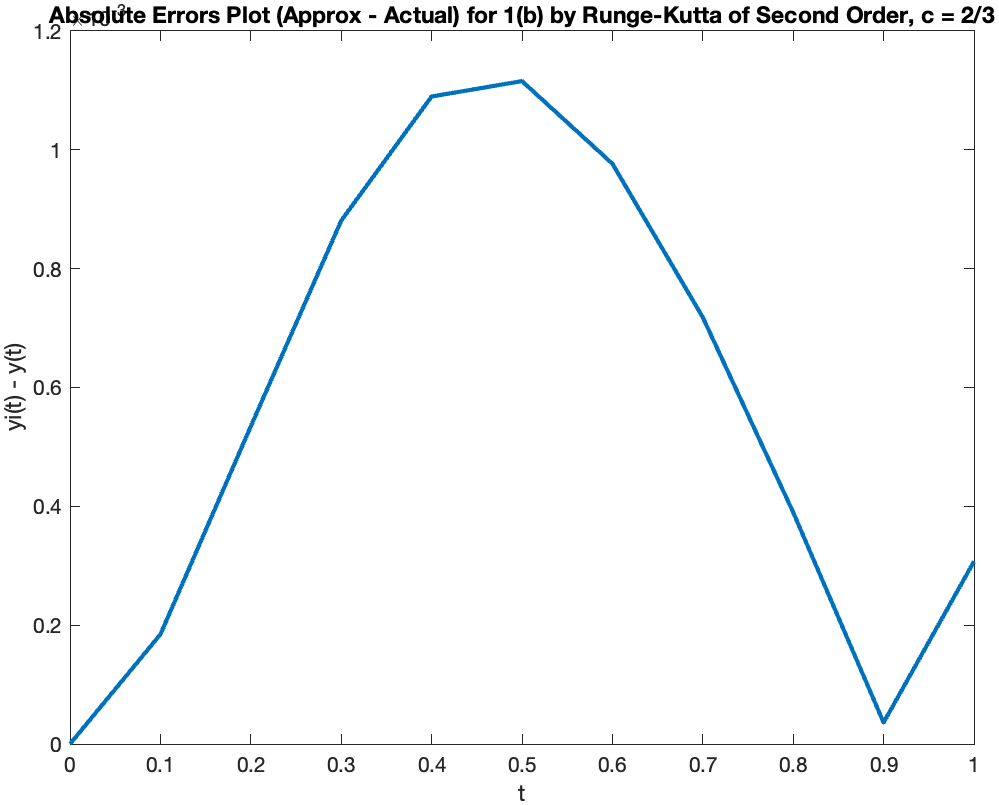
 

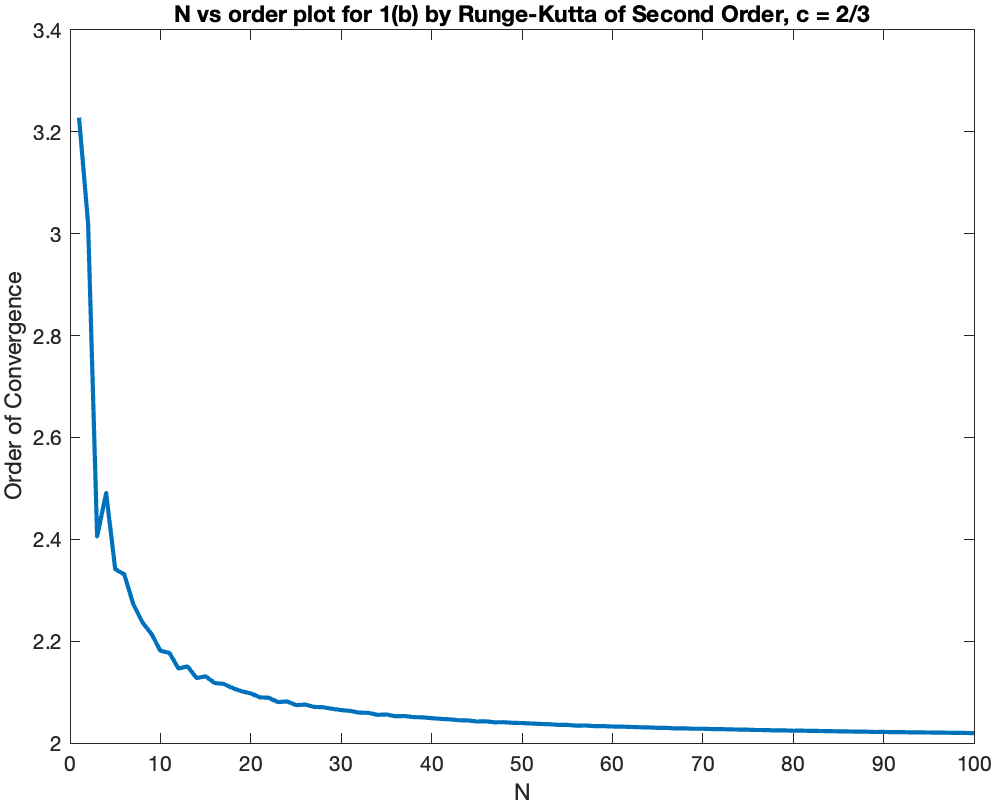
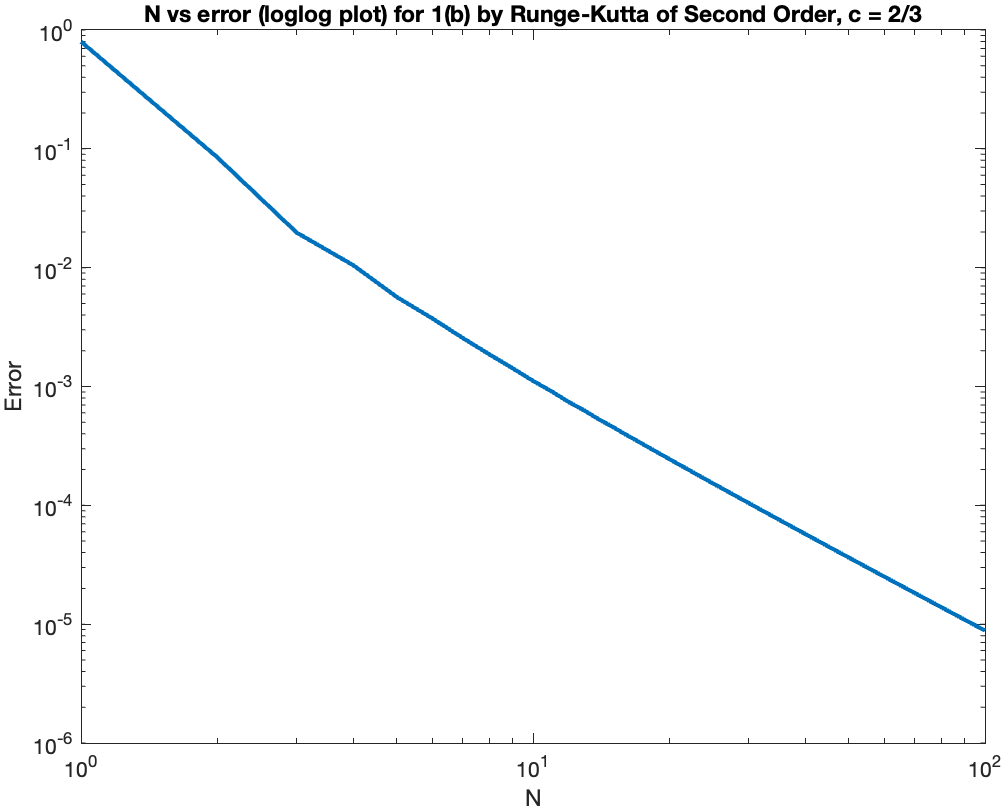


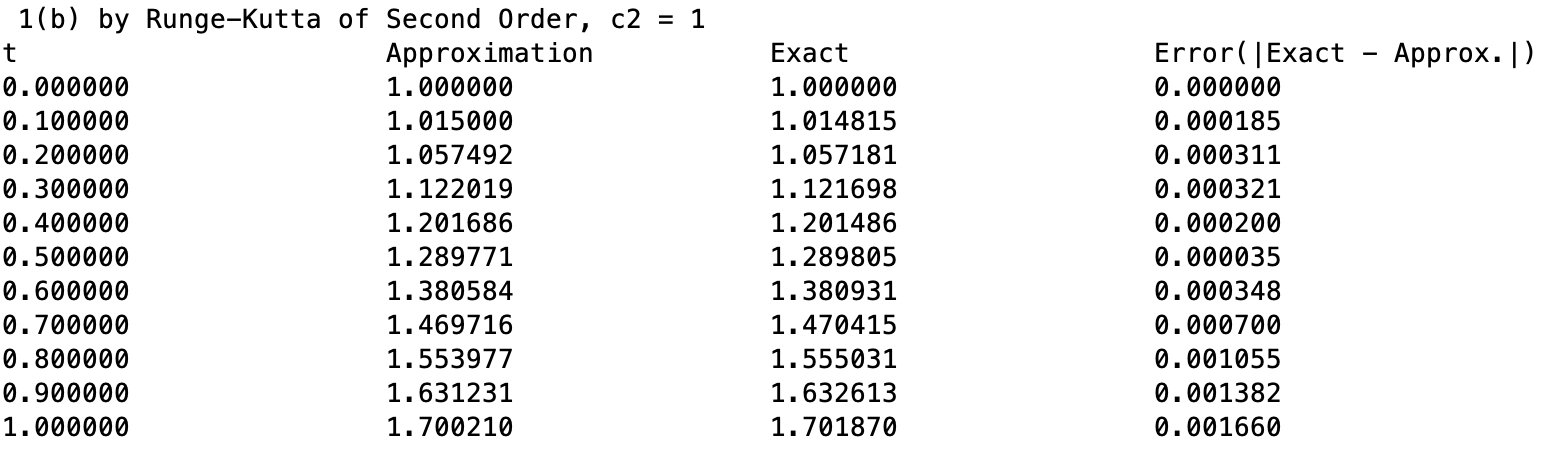
 

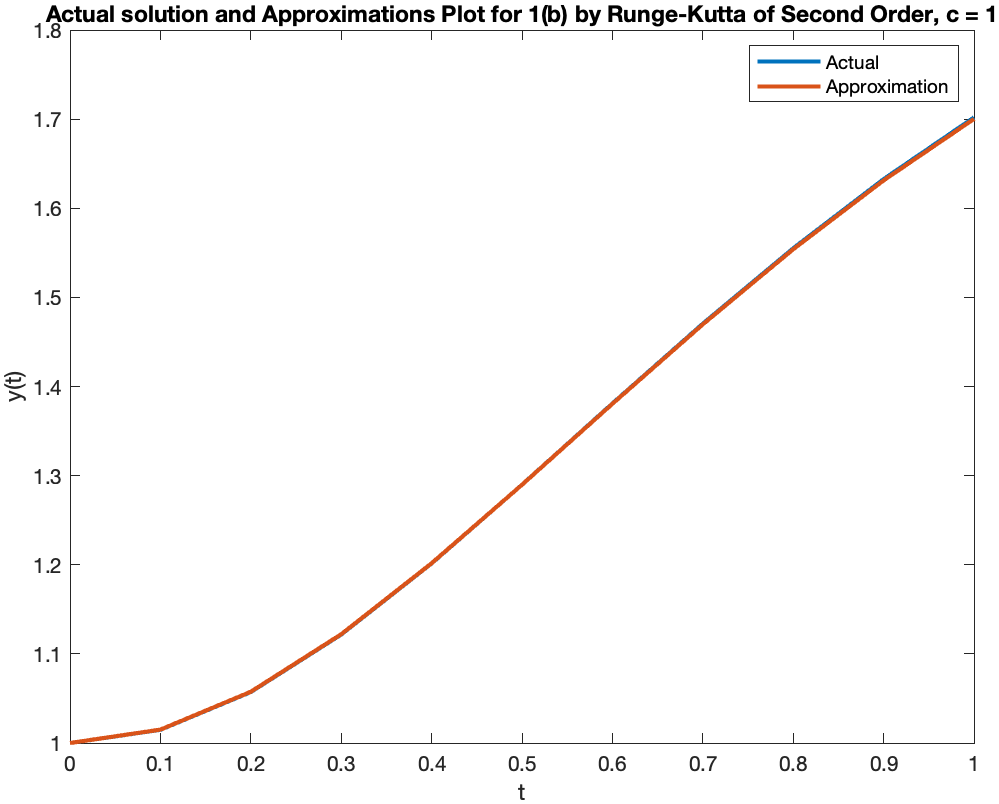
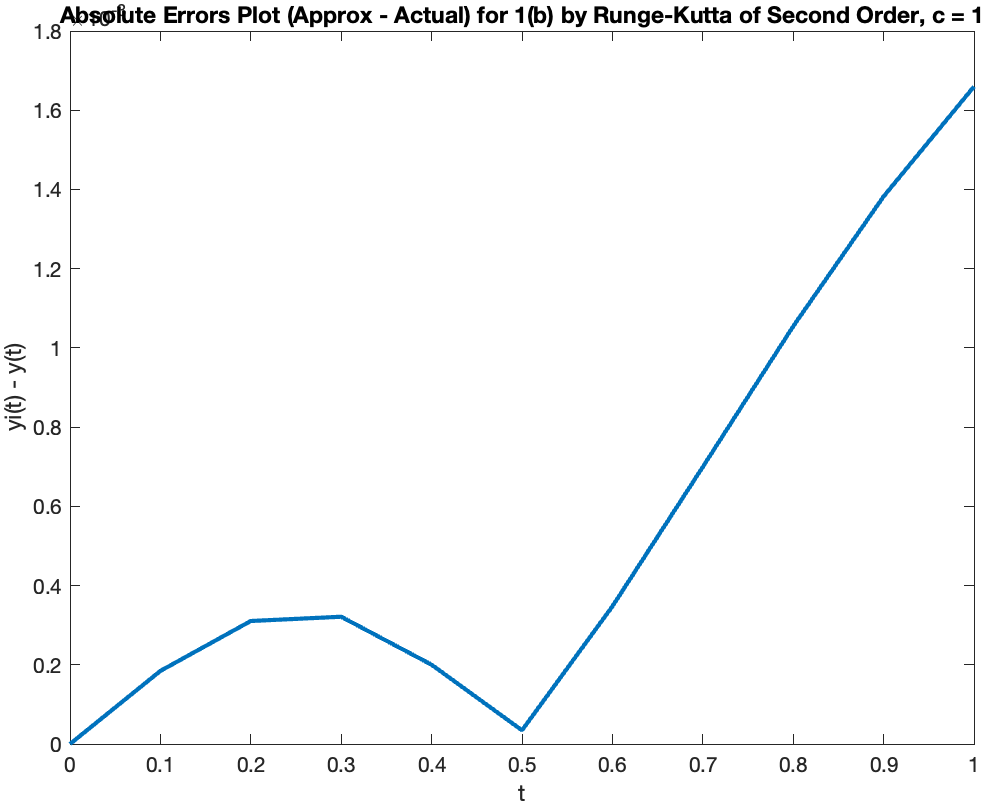
 

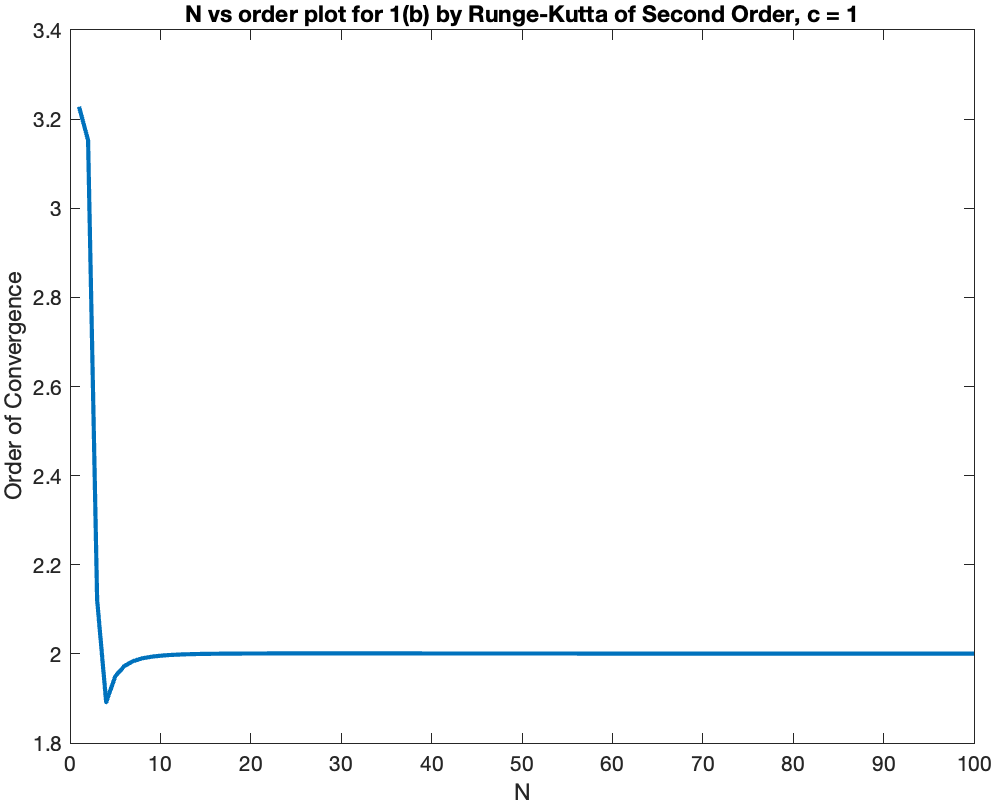
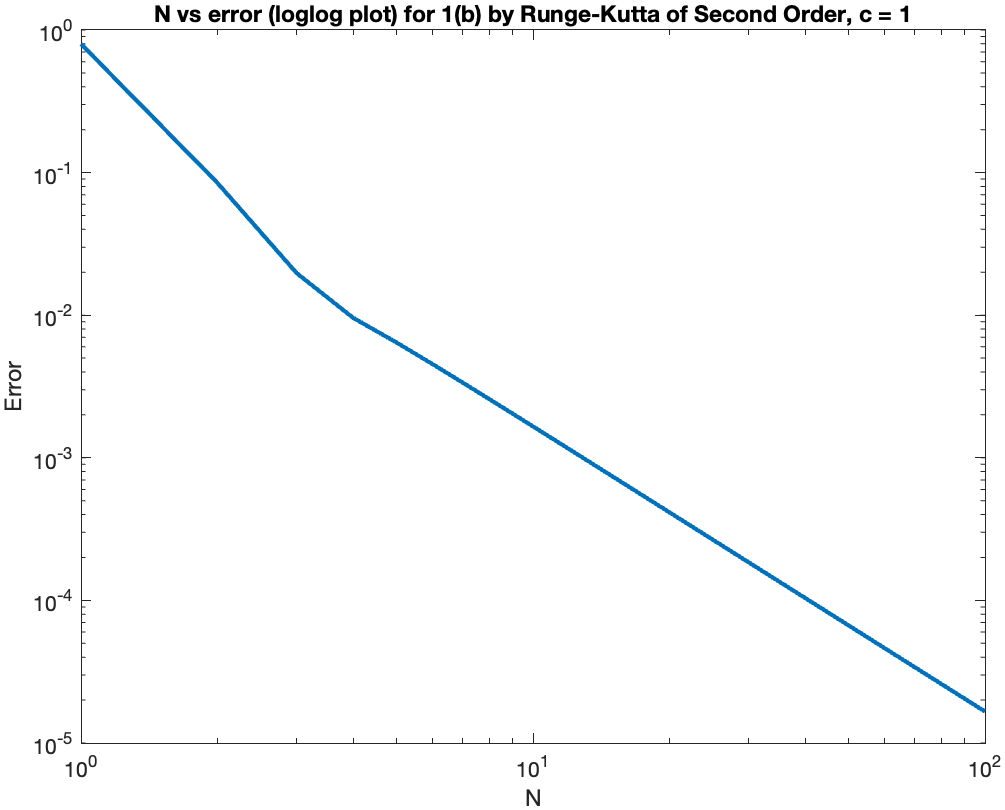


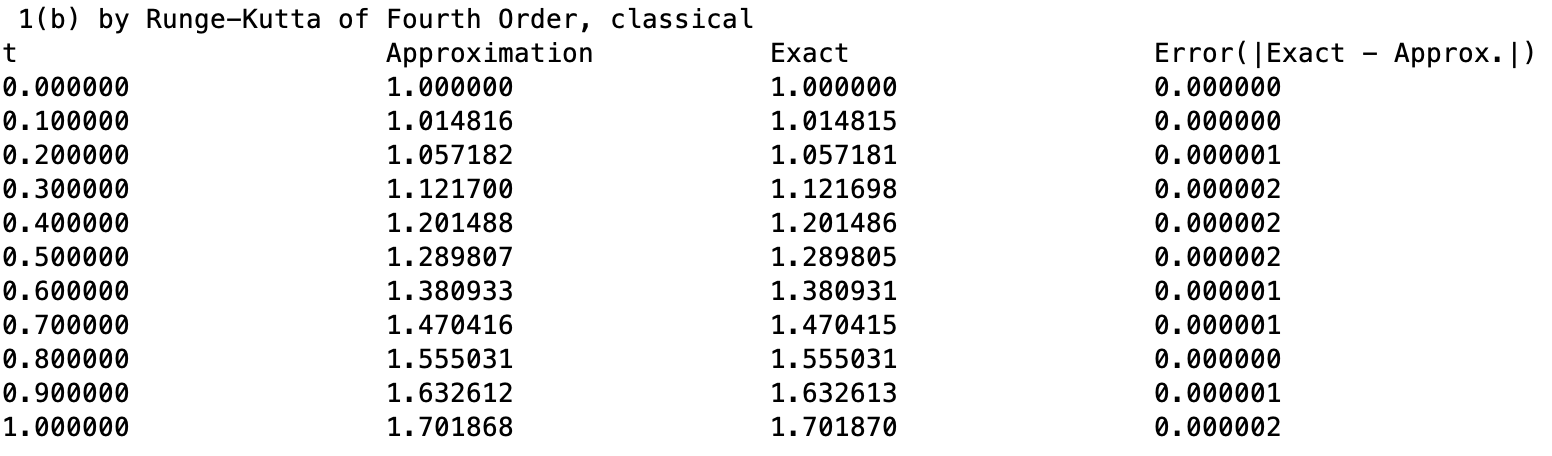
 

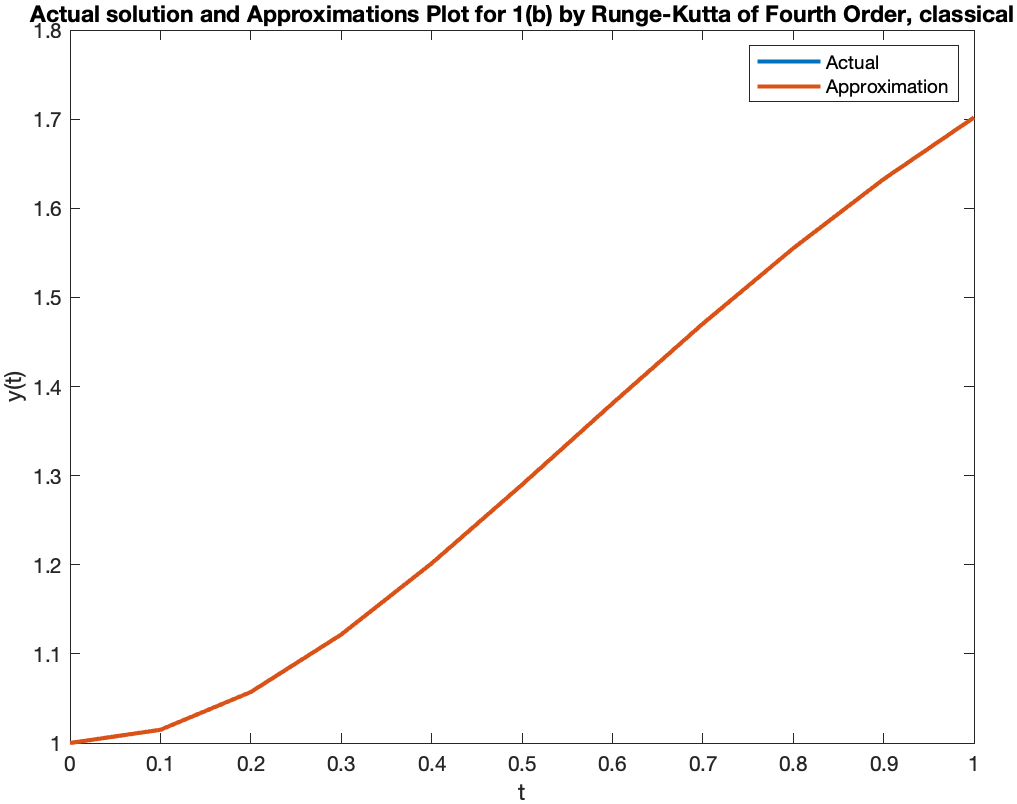
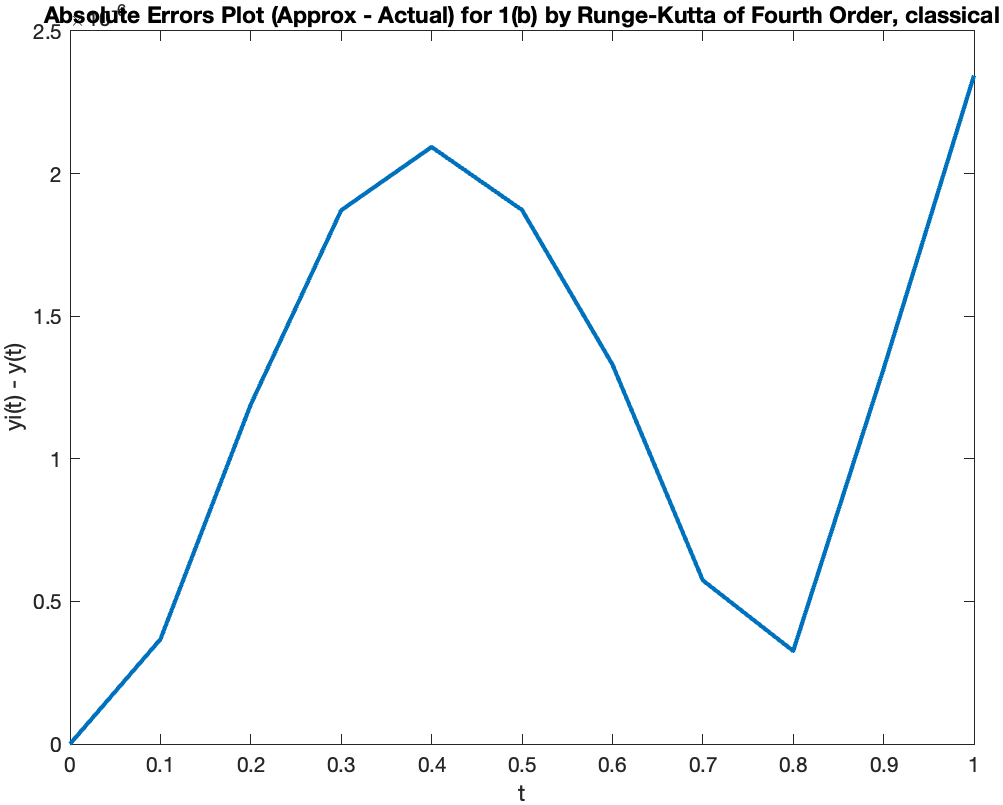
 

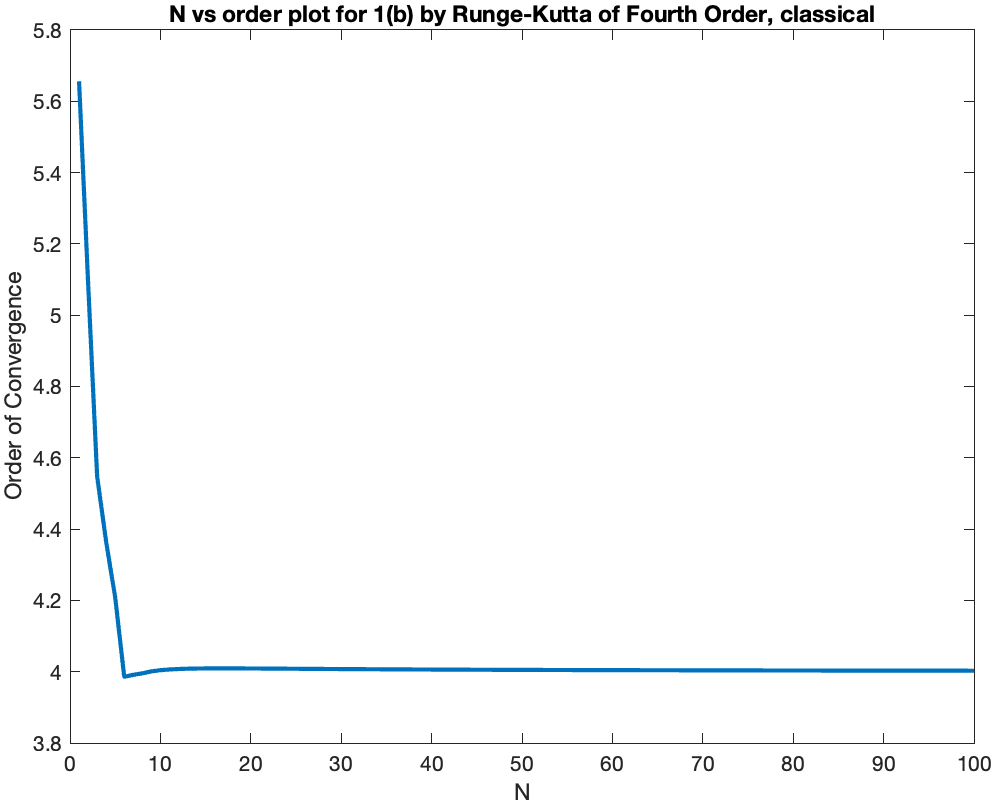
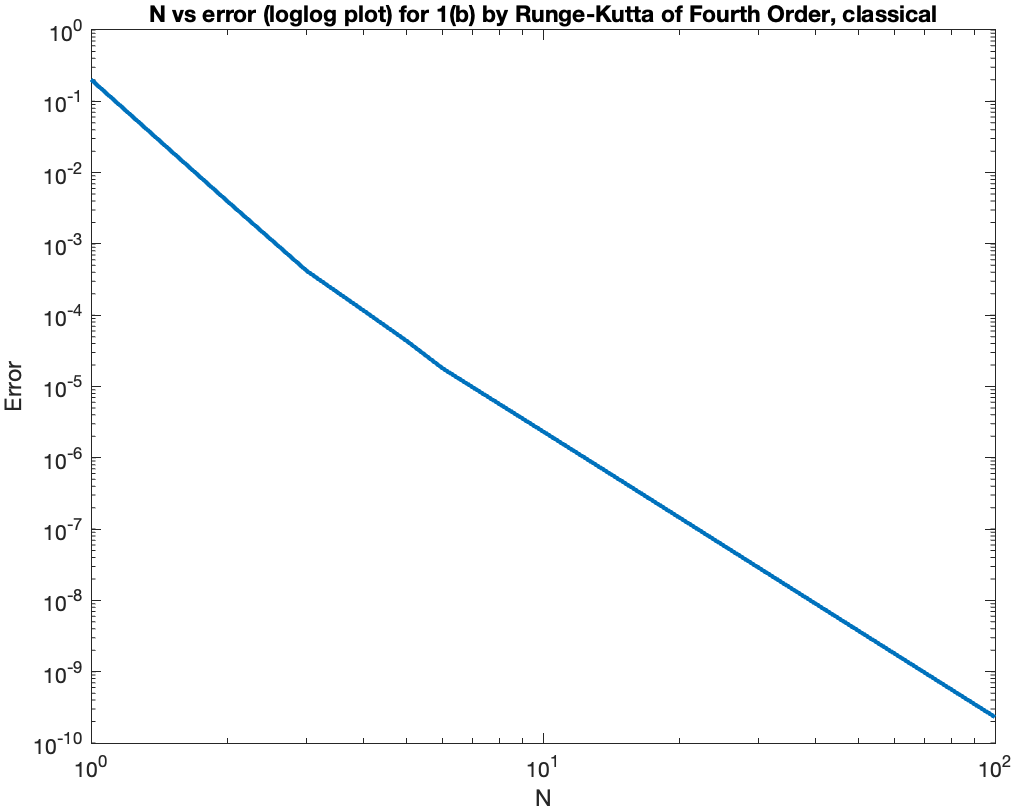


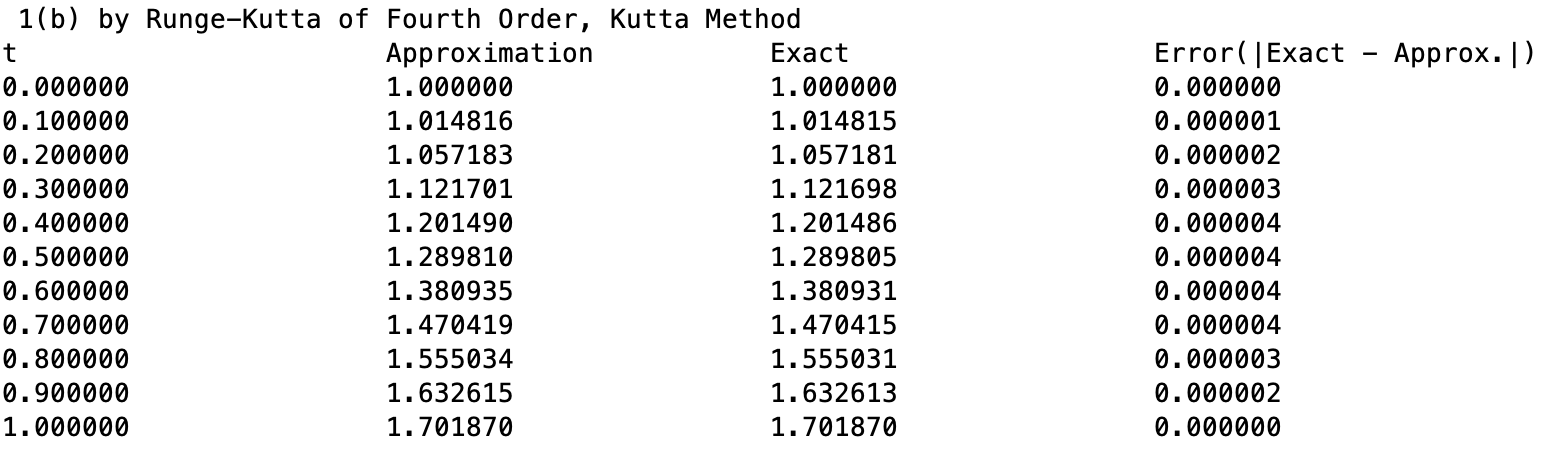
 

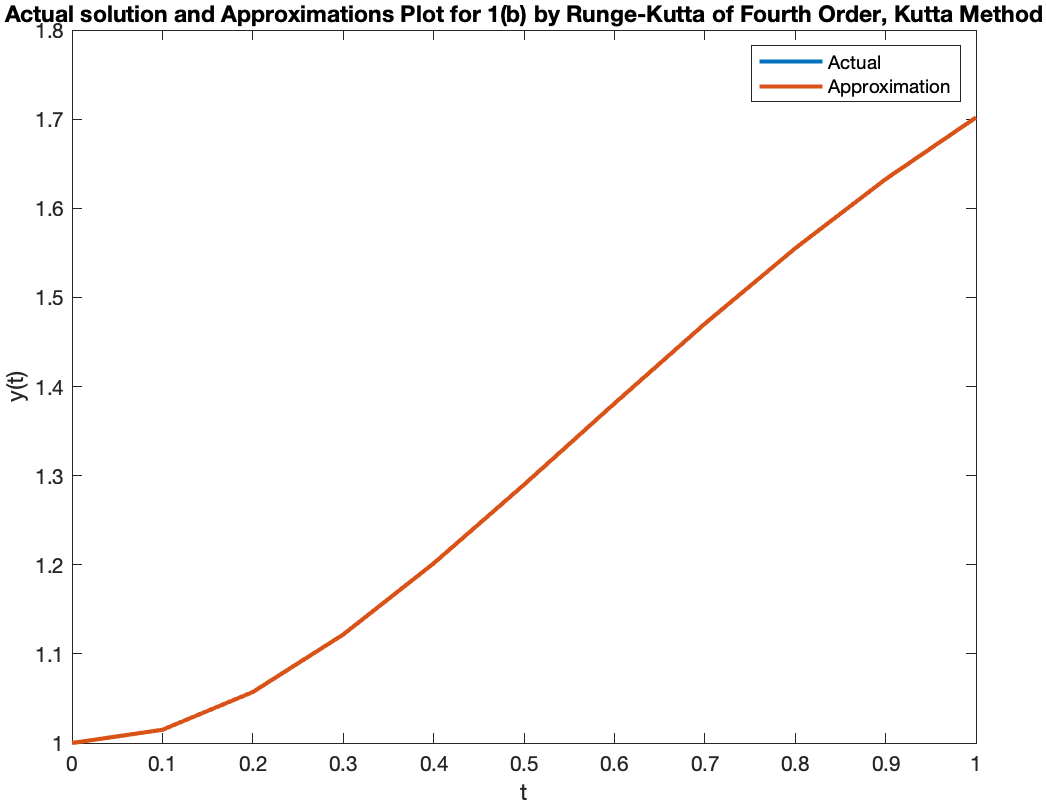
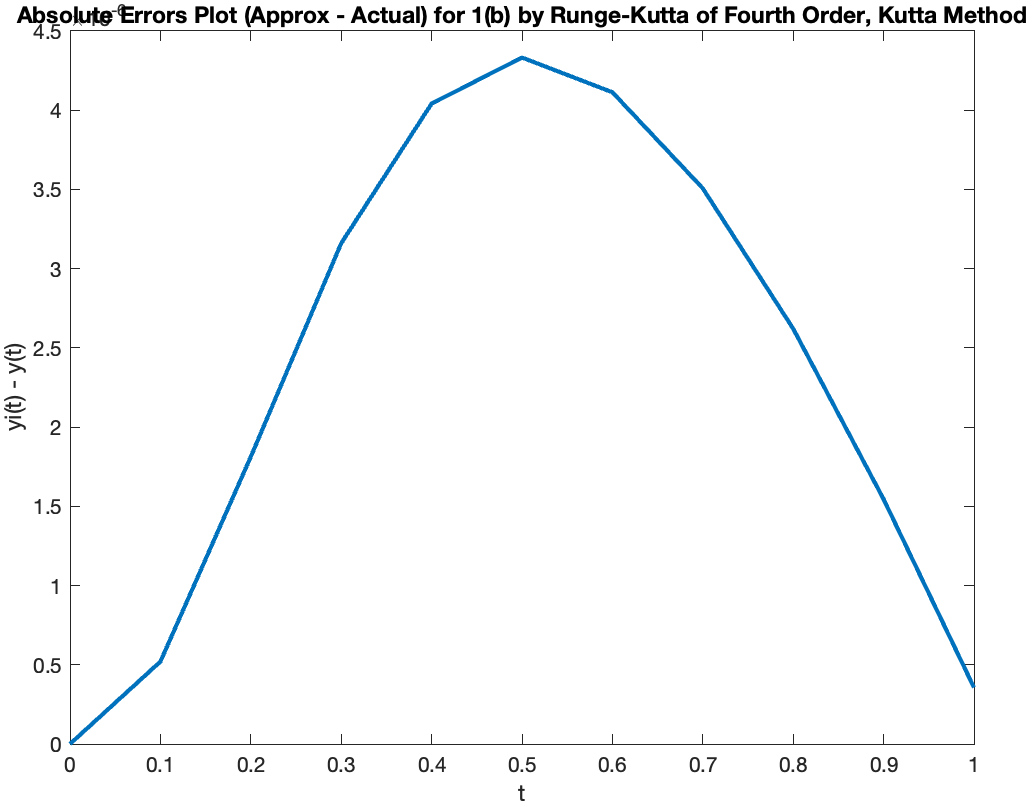
 

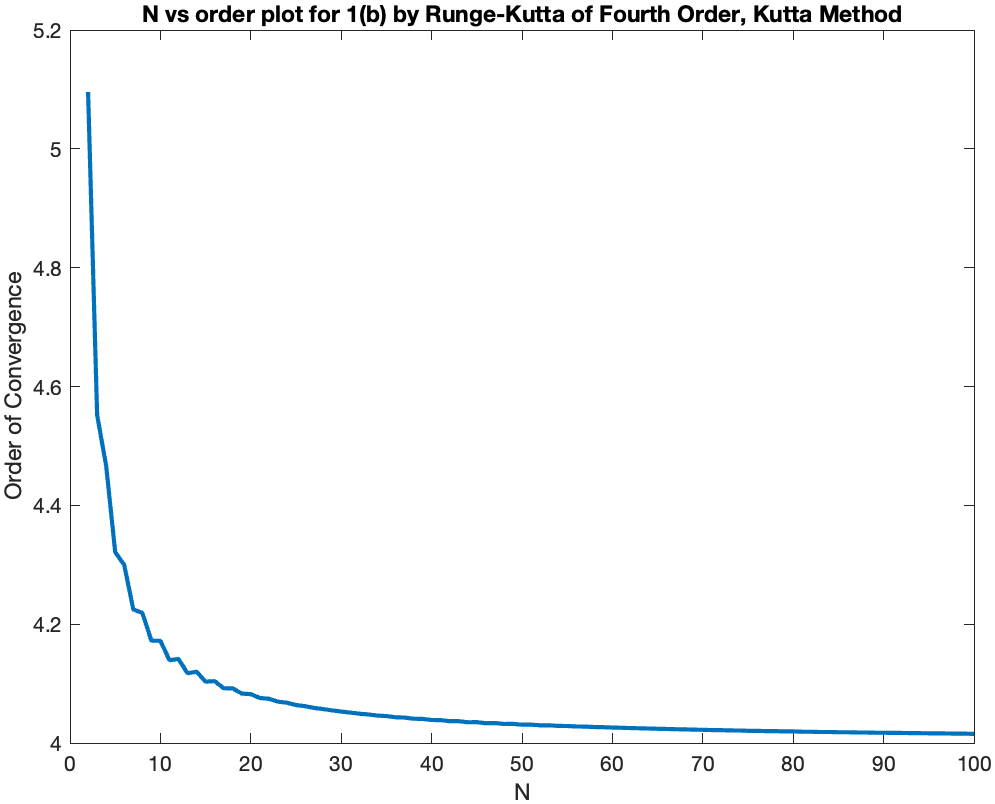
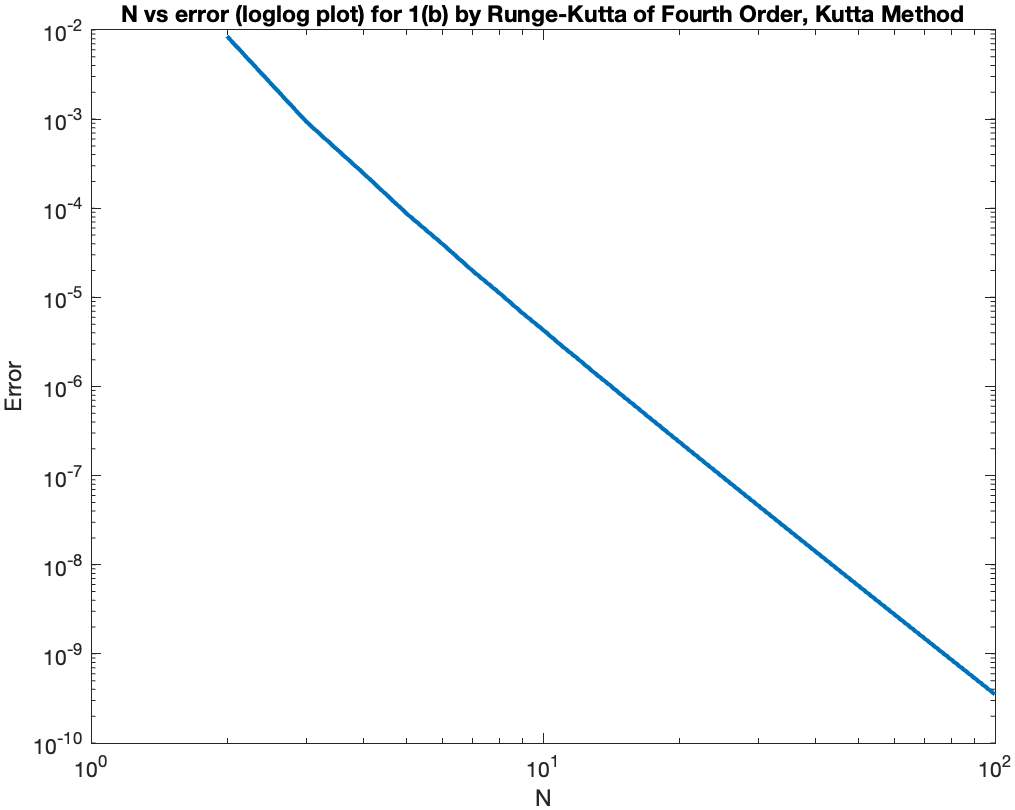




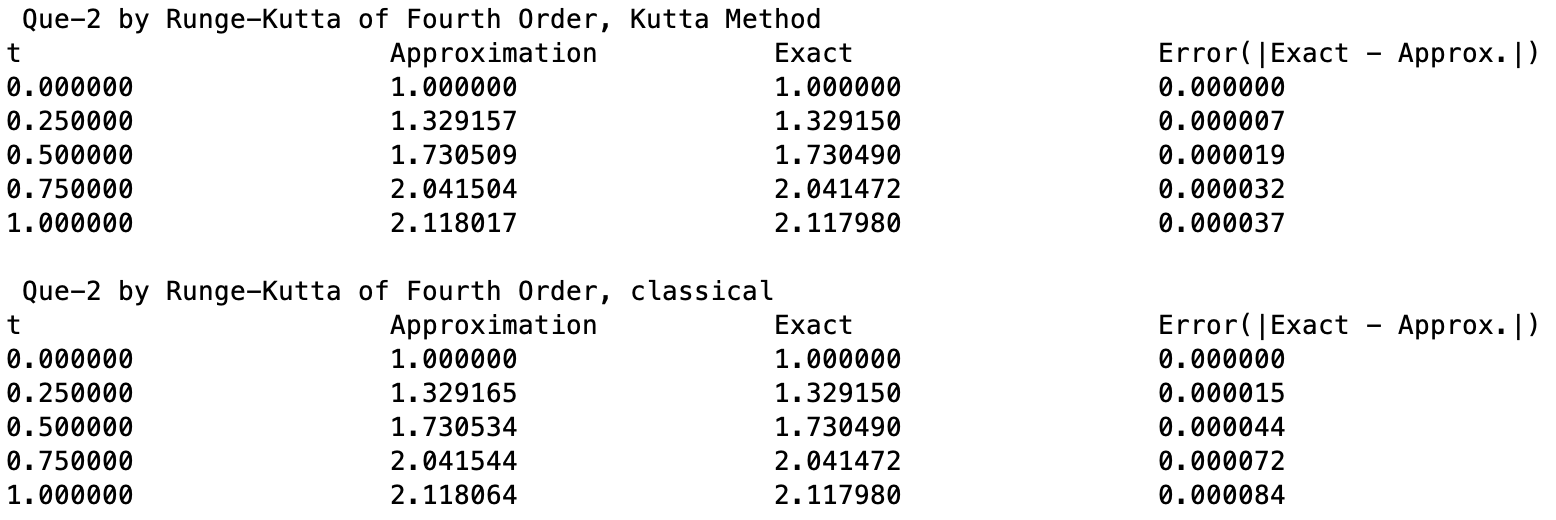
 

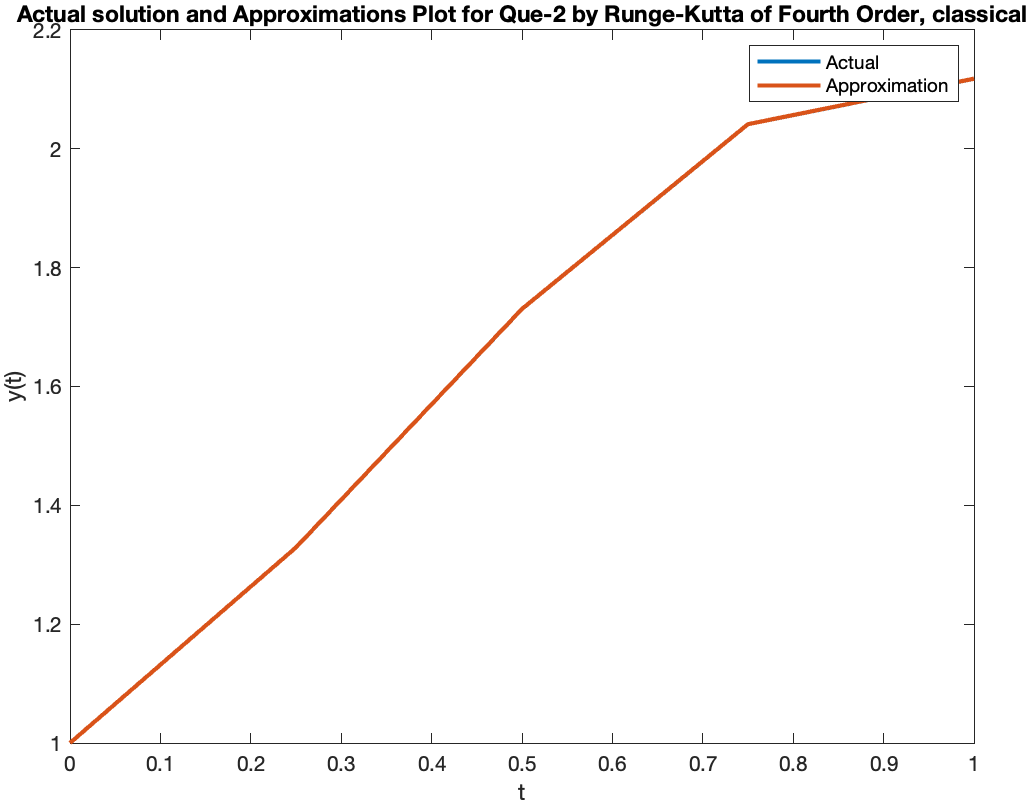
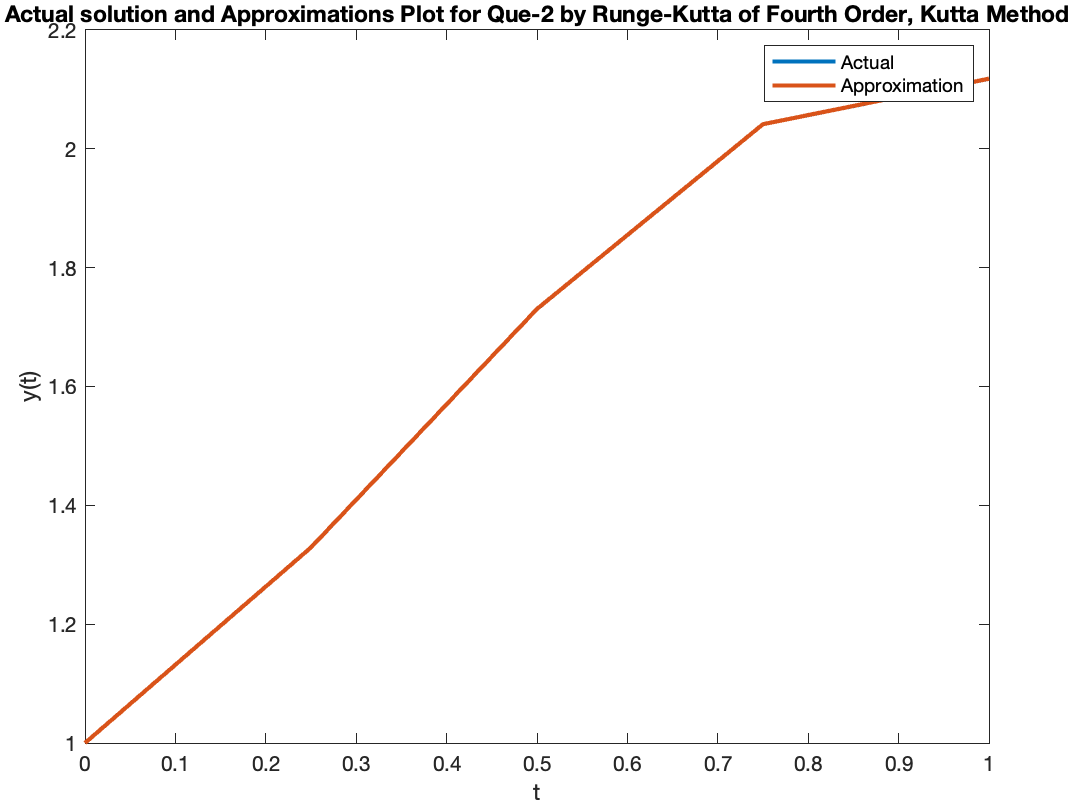
It is observed that the Implicit-Euler is performing the worst in these methods and Fourth Order Runge Kutta is giving a very good approximation of the given IVP. The graph for actual and approximated solution is almost coinciding in case me Fourth Order Runge-Kutta methods.

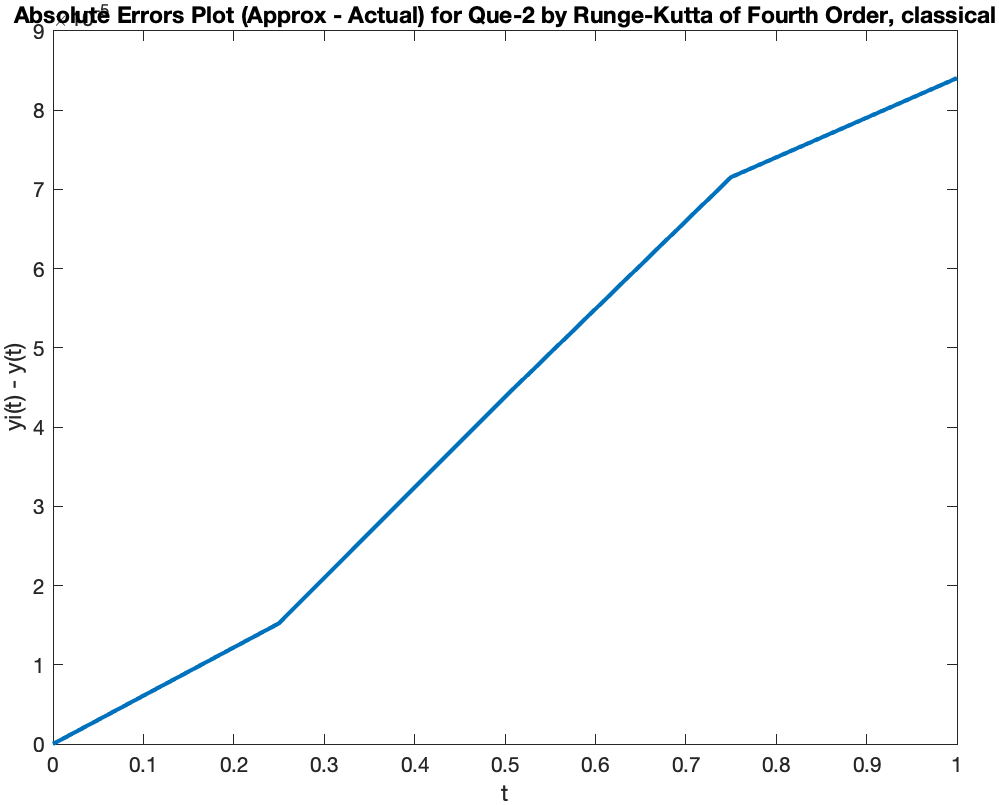
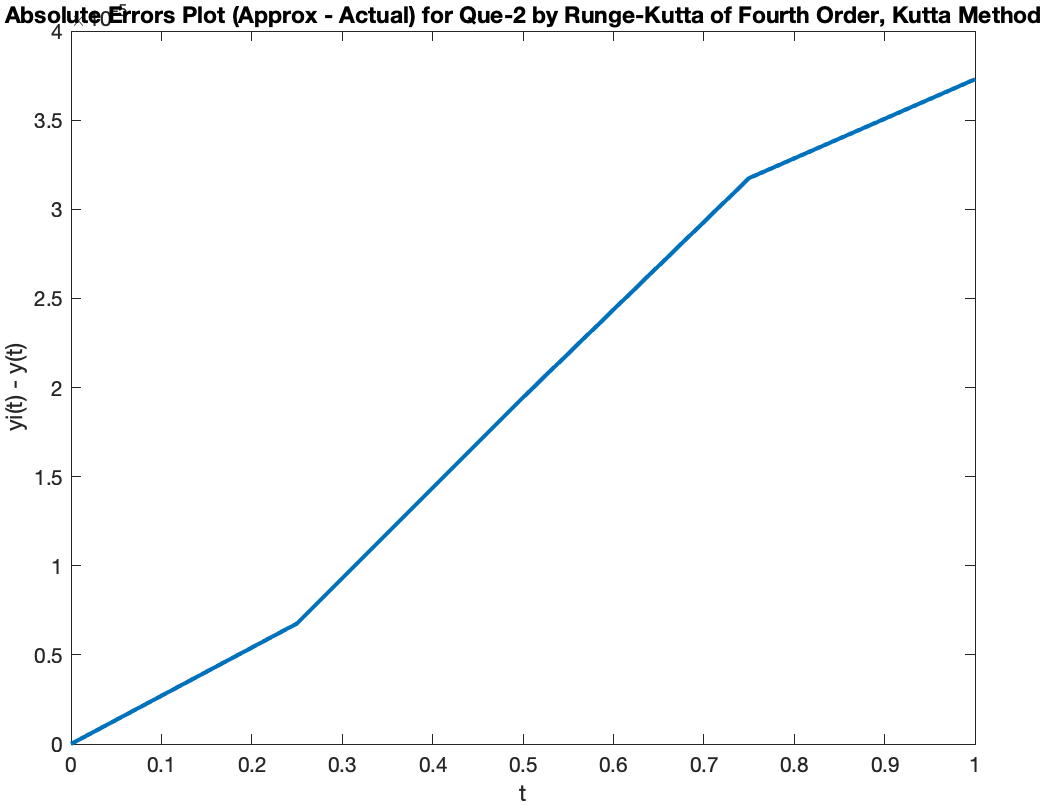
Second Order Runge-Kutta methods are performing better than the Implicit-Euler’s method while worse than Fourth Order Runge-Kutta method, which is as expected.

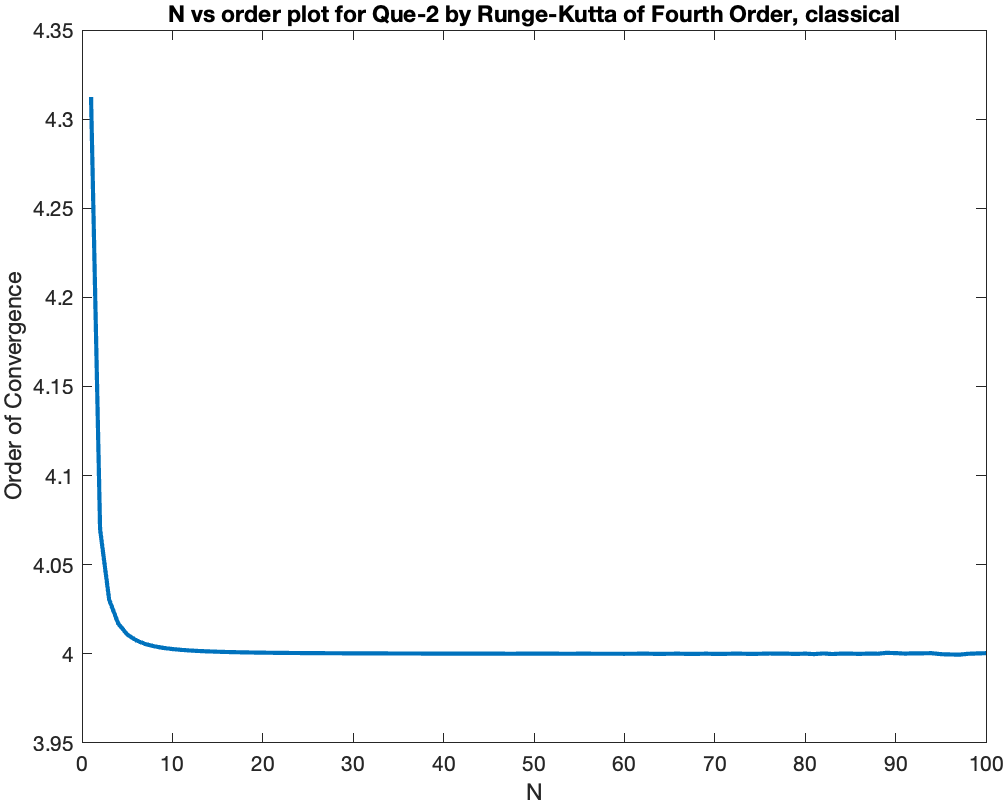
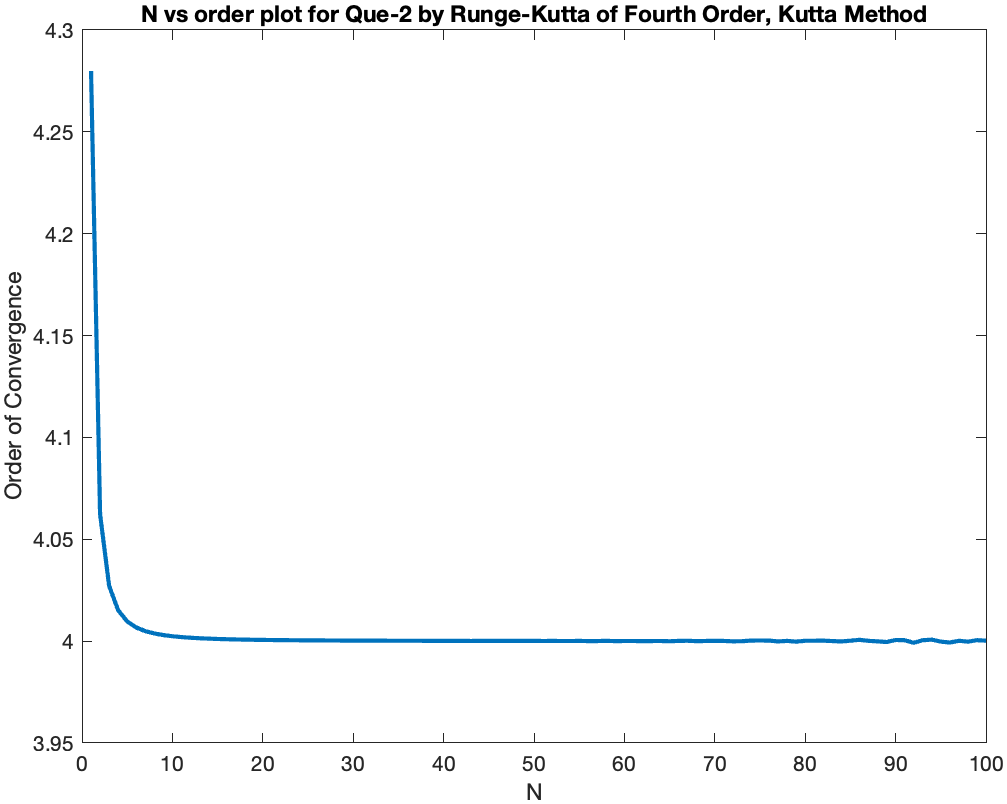
# Ques – 2

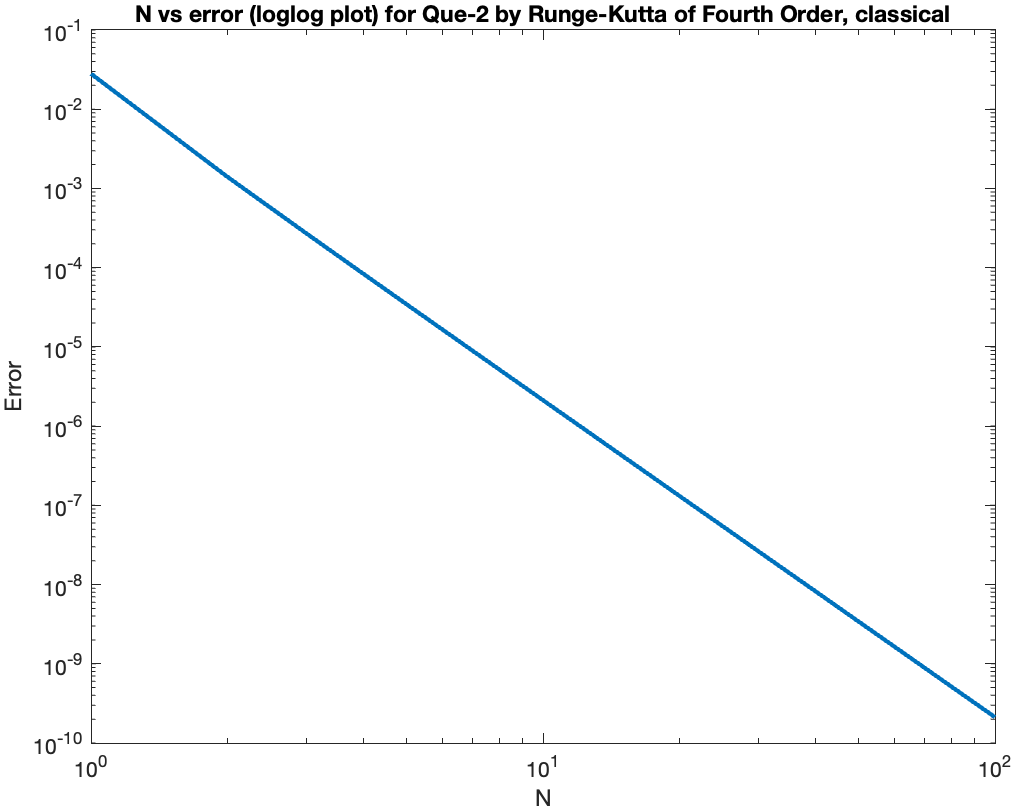
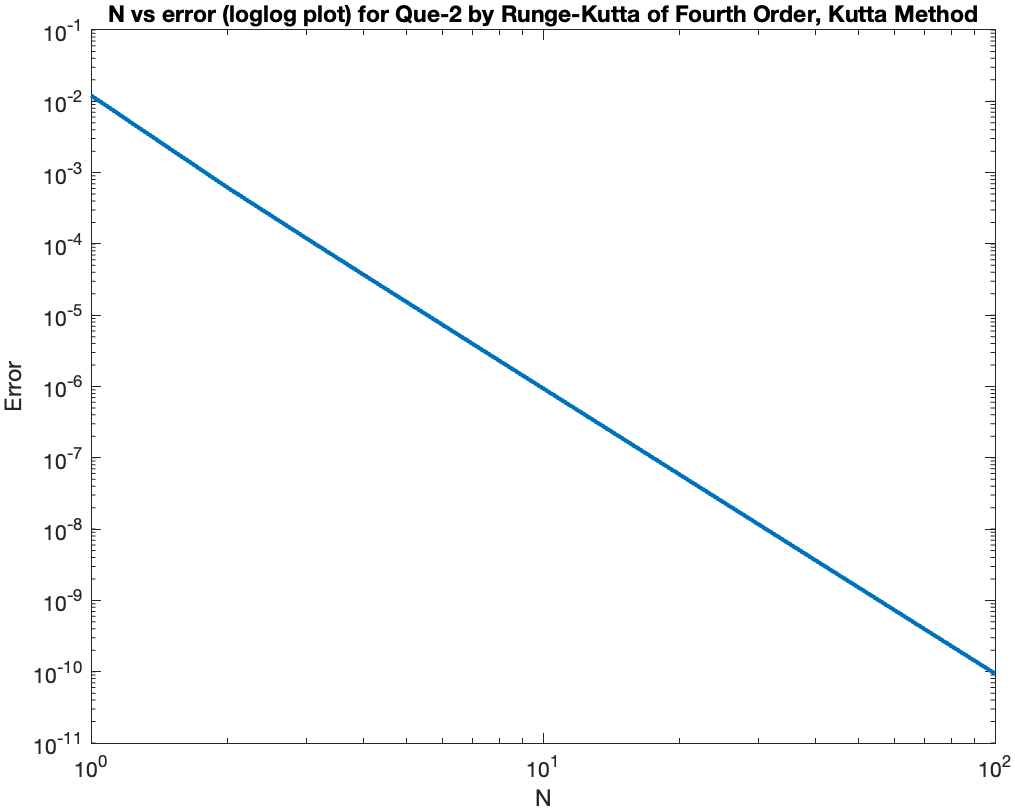
Here the Fourth Order Runge-Kutta methods are implemented for the given IVP and those 4 plots same is question-1 are formed. The results obtained are as follows: -



Both classical and Kutta method are performing nearly the same as each other. Kutta method is giving better final estimate in this case.