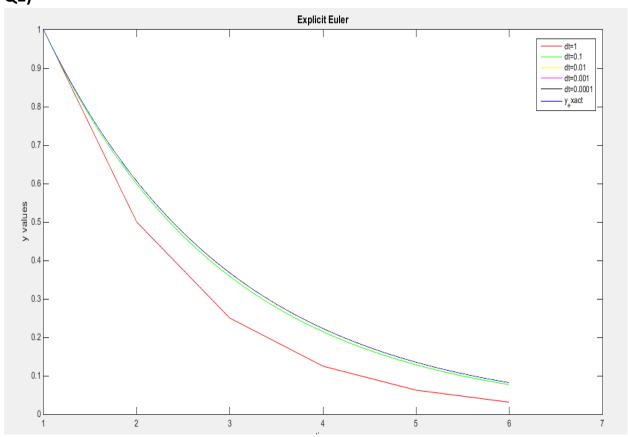
## Assignment 1 Prabhakar Pal 12010093

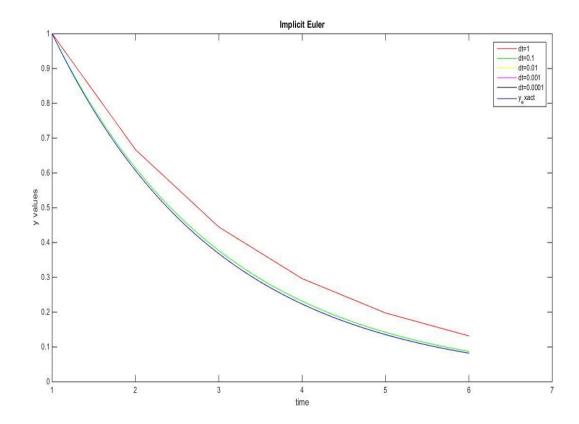




**Explicit Euler Method** 

The accuracy of the method is increasing as dt is decreasing.

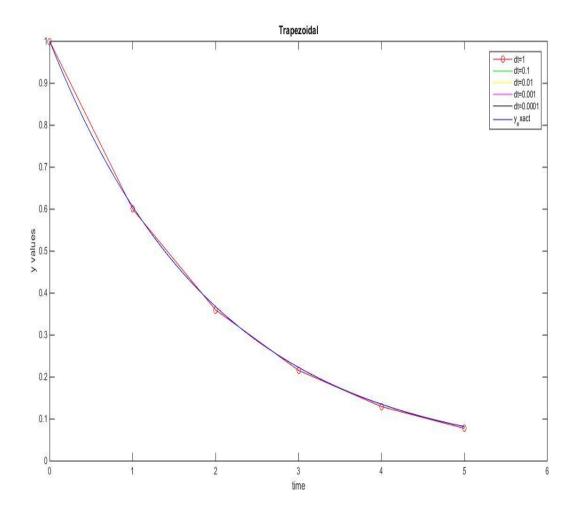
For dt=1 explicit Euler method underestimates the value of y i.e. y -  $y_exact<0$ 



## Implicit Euler method

Implicit Euler method is more accurate as compared to explicit Euler method.

The accuracy of the method is increasing as dt is decreasing.

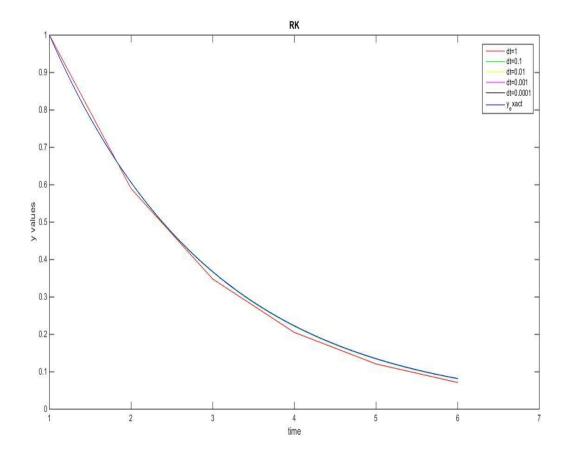


## Trapezoidal Method

The Trapezoidal method is the most accurate among explicit and implicit Euler.

In case of dt=1 also trapezoidal method gives very accurate results

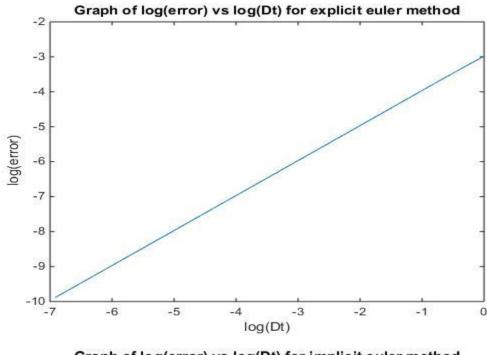
Trapezoidal method is more accurate because more no. of data points are considered in any interval for the interpolation purpose.

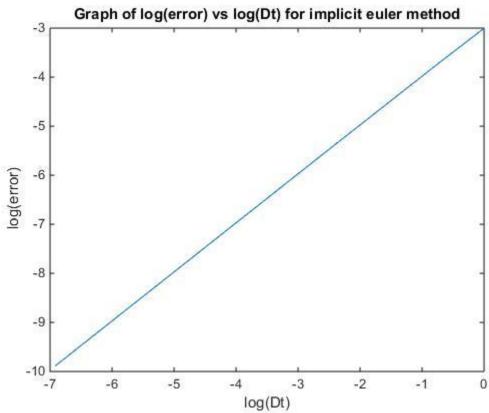


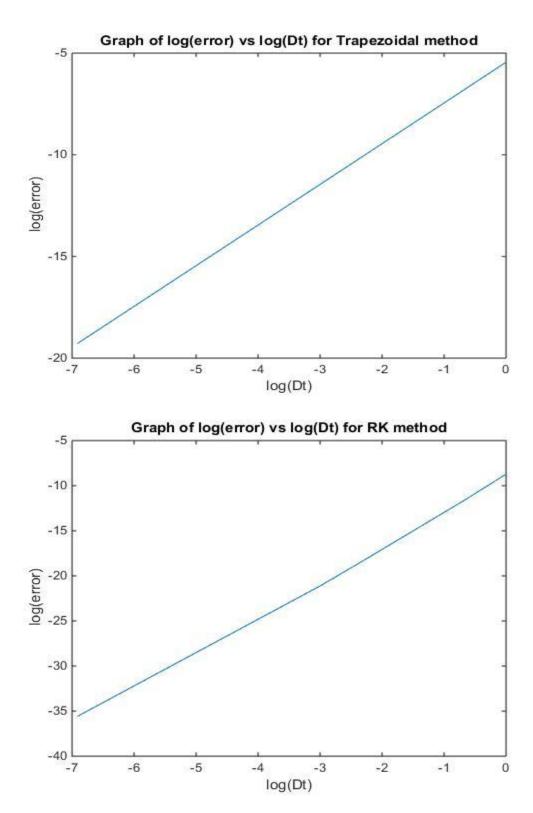
**RK Method** 

RK method is the most accurate method among all the methods.

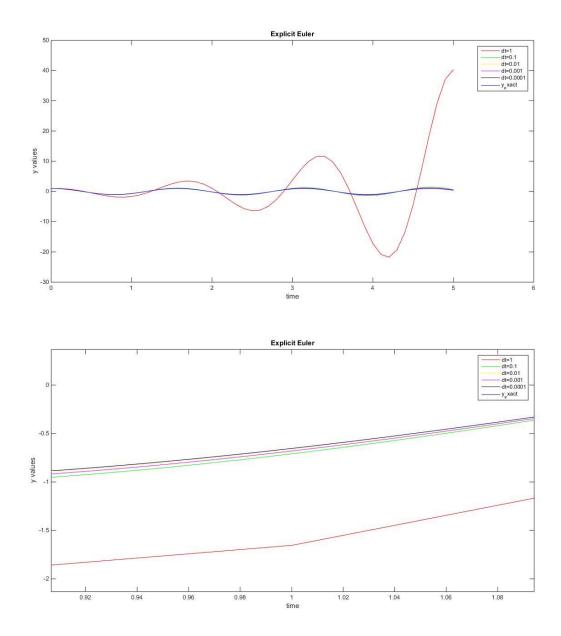
For all the values of dt RK method approximates the exact solution very well.





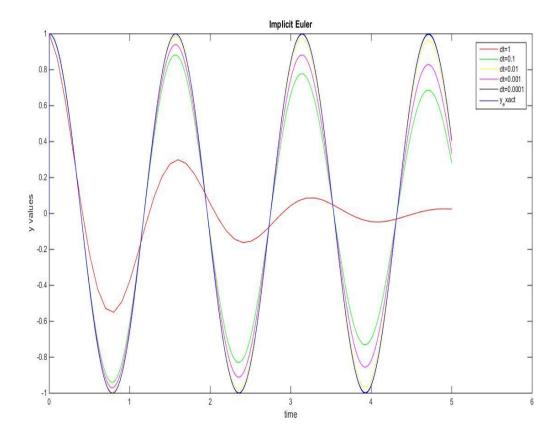


The log-log error plot for all the four method is linear and it can be seen that the error is minimum in the cases of RK method followed by trapezoidal method, implicit Euler and then forward Euler method.



Explicit Euler method except of dt=1 follows the exact solution very well. There is no phase difference. The difference in amplitude is very less and keeps on decreasing as the dt is decreasing.

For dt=1 the amplitude is growing with time and also phase difference is also present in y and exact solution.

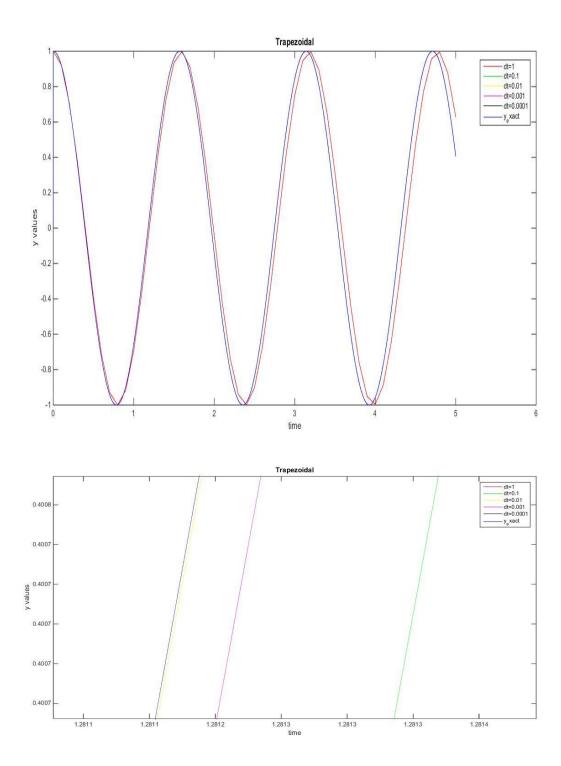


## Implicit Euler

There is no phase difference for any value of dt

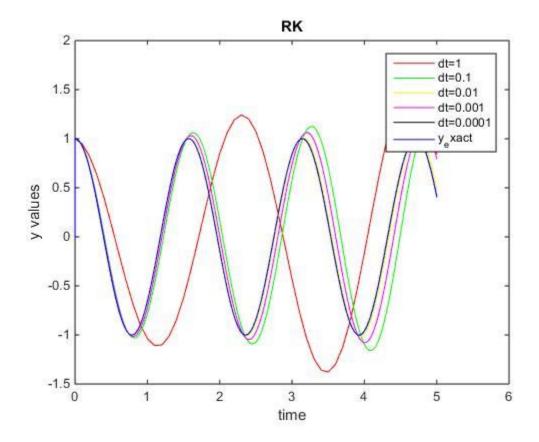
Amplitude difference is present for all the case. Except of dt=1, the amplitude difference remains constant with time, and is decreasing as dt is decreasing.

For dt=1 the amplitude is decreasing with time



For dt=1 phase difference is present but no amplitude difference in there

For all other case there is no phase difference and amplitude difference is also very small as can be seen in the second photo .



There is phase difference and amplitude difference for all values of dt.

For dt=1 the amplitude is growing with time

The phase and amplitude difference is decreasing as dt is decreasing.

