CO2020
Assignment 1

Aaryan, CO21BTECH11001

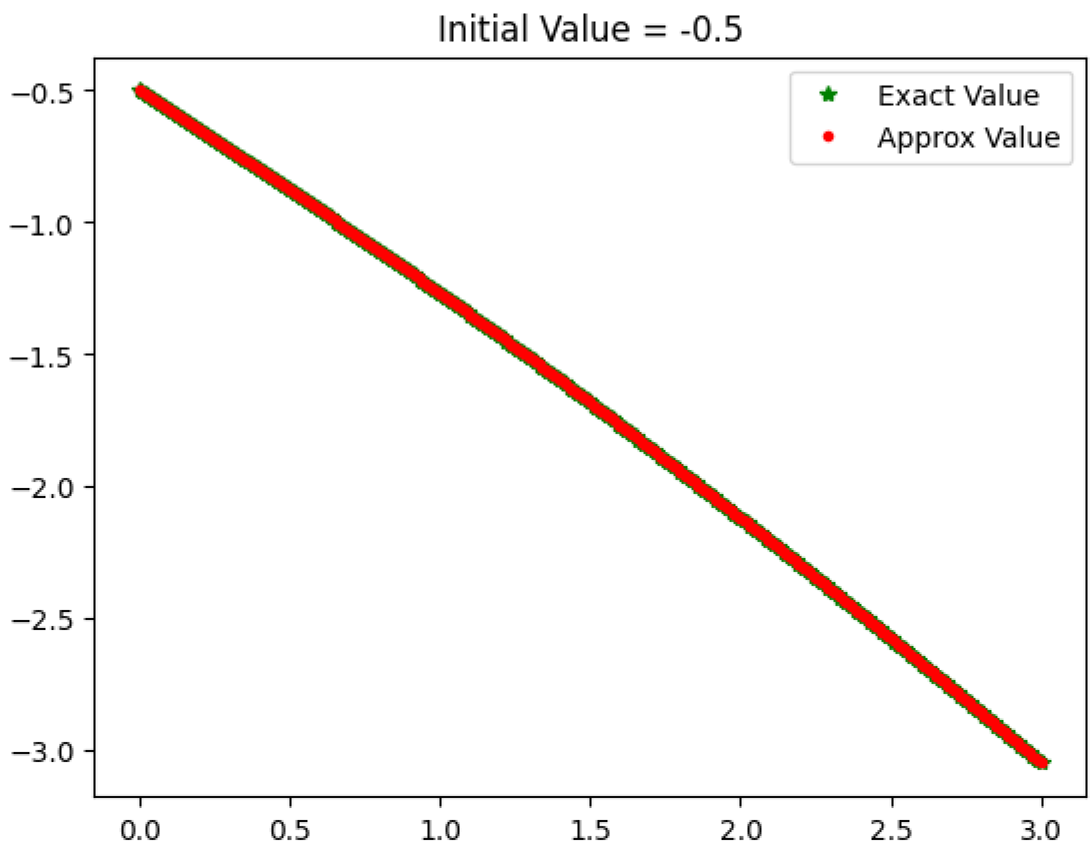
Q. 1

Solution:

File: Que1.cpp

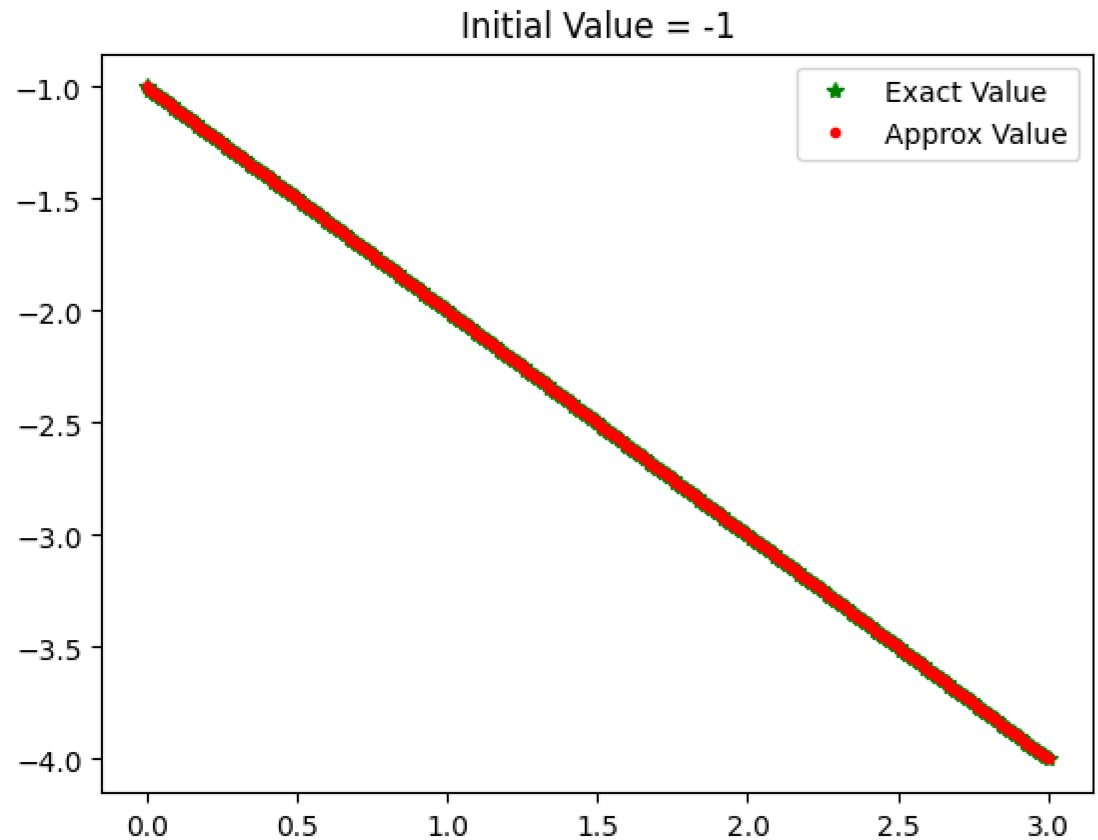
Step size = 0.01

a. When initial value is -0.5, the plot of exact value and approximated value by Euler's method is following:



Percentage error = 0.012693334

b. When initial value is -1, the plot of exact value and approximated value by Euler's method is following:



Percentage error = 0.000000000. Because the exact solution is a straight line. And Euler's method predicts the next value by assuming that the curve is a straight line from the current value.

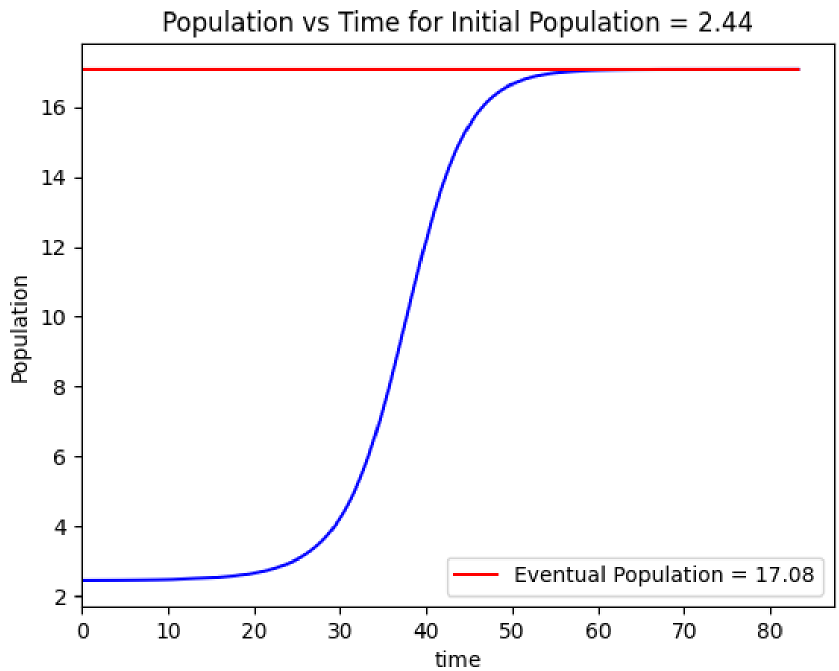
Q.2

Solution:

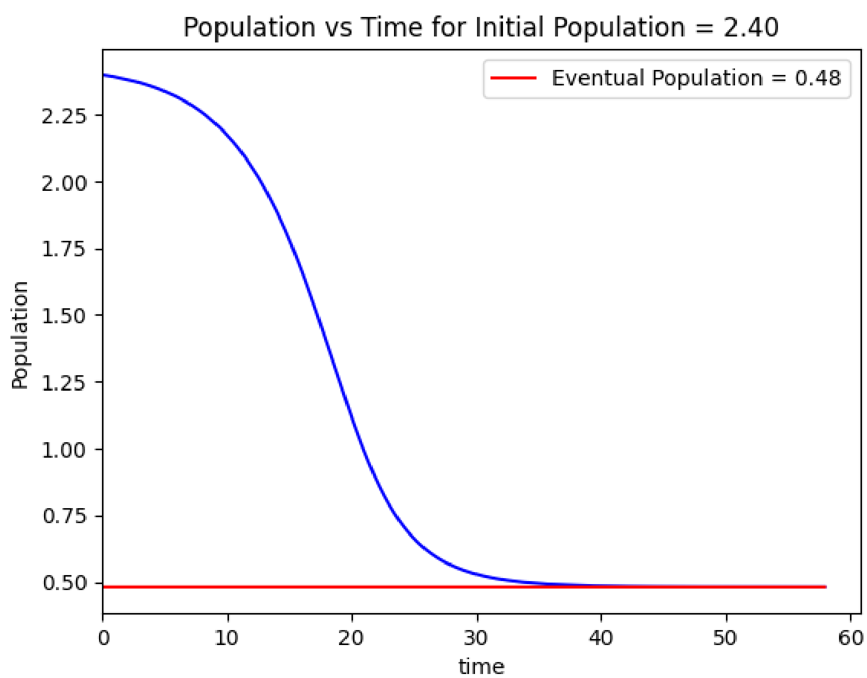
File: Que2.cpp

Step size = 0.001

a. When initial population is 2.44, eventual population = 17.08
The plot for the same is following:



b. When initial population is 2.40, eventual population = 17.08
The plot for the same is following:



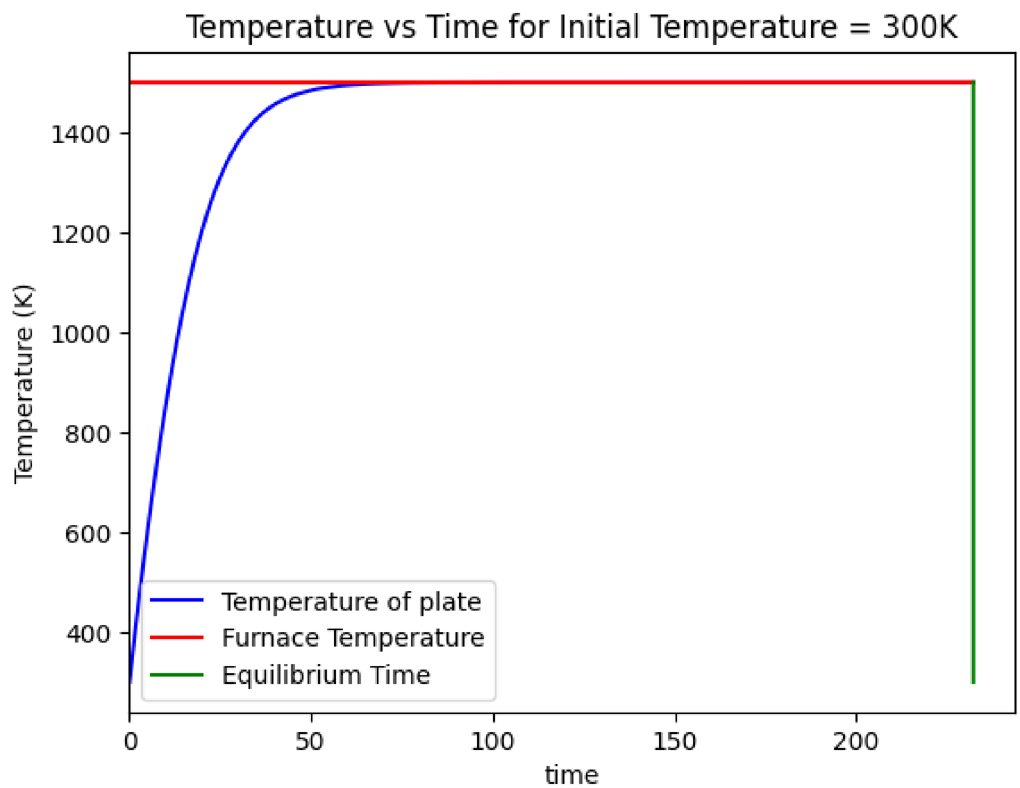
Q. 3

Solution:

File: Que3.cpp

Step size = 0.01

Using a tolerance of 10^{-8}, equilibrium is reached at time $t = 232.10$
The plot for the same is following:



Q. 4

Solution:

File: Que4.cpp

Step size = 0.001

Using RK2 method:

Approximated value : 215.8928

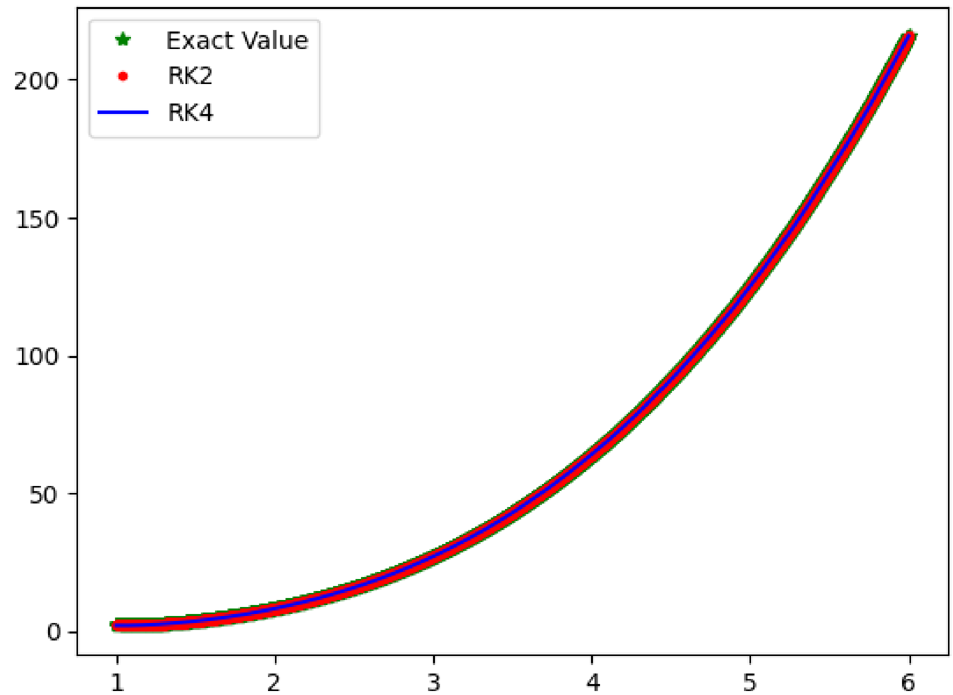
Percentage error : 0.049987637

Using RK4 method:

Approximated value : 215.8928

Percentage error : 0.049991250

The plot for same is:



Q.5

Solution:

File: Que5.cpp

Step size = 0.001

Using RK2 method:

Approximated value : $-\ 0.0869$

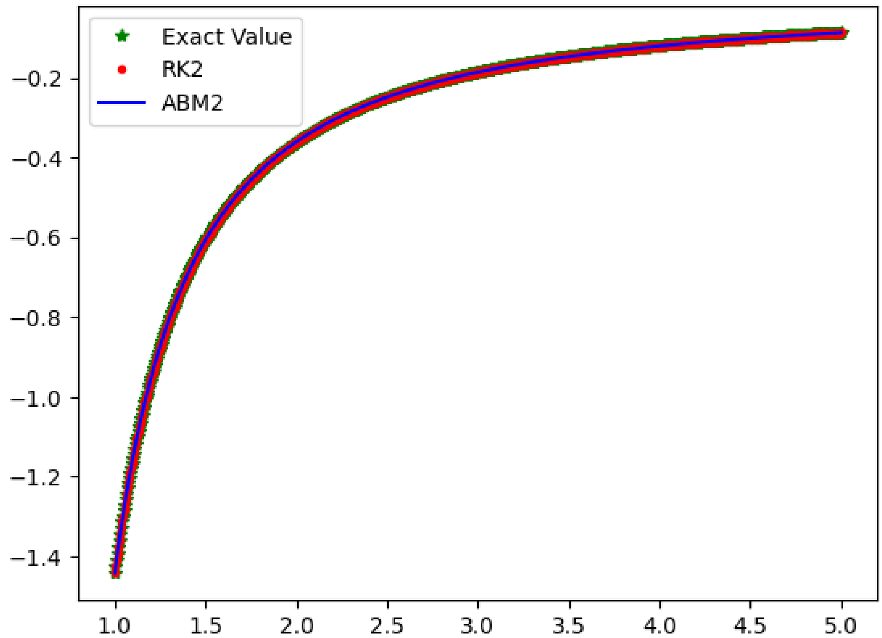
Percentage error : 0.0012

Using ABM2 method:

Approximated value : $-\ 0.0869$

Percentage error : 0.0056

The plot for both of them is following:



Q. 6

Solution:

File: Que6.cpp

Step size = 0.001

Using RK4 method:

Approximated value : 74.7324

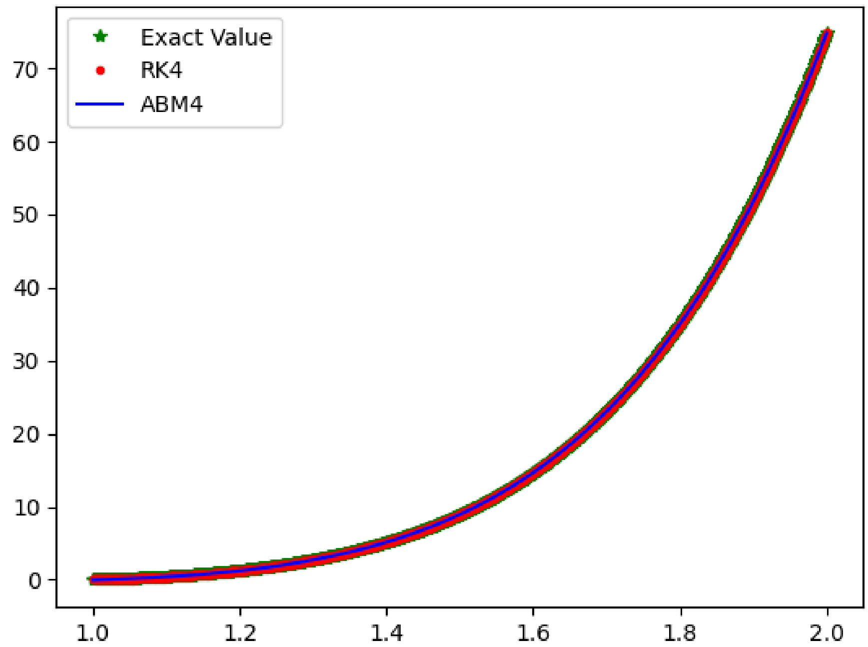
Percentage error : 0.0000

Using ABM4 method:

Approximated value : 74.7318

Percentage error : 0.0008

The plot for both of them is following:



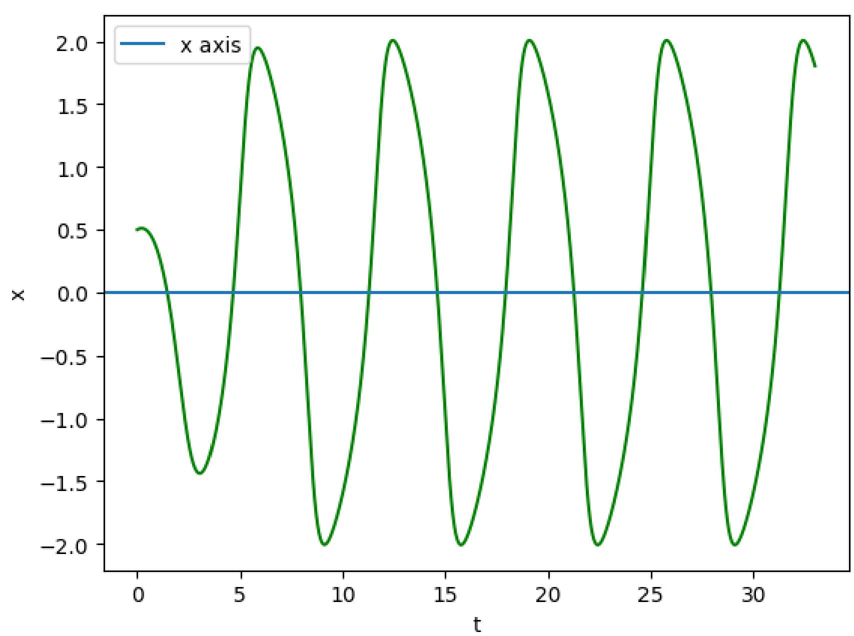
Q.7

Solution:

File: Que7.cpp

Step size = 0.1

First four cycles of this function can be drawn as follows:



As we can see, the function $x(t)$ is periodic with a time period of $5.5s$. Amplitude of the function is $2\ units$.