BLG 202E Homework - 4

Due 30.05.2016 23:00

• An e-report should be prepared individually. The written MATLAB codes should be included in the submitted report.

• **Plagiarized assignments will be given a negative mark.**

• No late submissions will be accepted.

Submissions: Please submit your report and your MATLAB codes through Ninova e-Learning System.

QUESTIONS

1. Use Matlab to find approximation to the integral of the function $f(x) = e^{-x}\sin(x)$ on the interval [0, 3] with $N = 10$ and $\varepsilon_{step} = 0.001$ using Composite-Trapezoidal Rule.

2. Implement Composite Simpon's Rule on MATLAB to evaluate the integral of function $f(x) = \int_0^4 xe^{2x}dx$ with $N = 4$ and find the absolute error of the approximation according to the exact integration.

3. Let $f(x) = 1 + e^{-x}sin\left(8x^{2/3}\right)$ over [0,2]. Use the Midpoint Rule with different m sample points ($m = 2, 4, 8, 16, 32, 60, 70, 100$) to approximate the values of the integral. Plot the approximation results according to the number of sample values.

4. In a closed eco-system (i.e. no migration is allowed into or out of the system) there are only 2 types of animals: the predator and the prey. They form a simple food-chain where the predator species hunts the prey species, while the prey grazes vegetation. There is one prey species whose number at any given time is $y_1(t)$. The number of prey grows unboundedly in time if unhunted by the predator. There is only one predator species whose number at any given time is $y_2(t)$. The size of the 2 populations can be described by a simple system of 2 first order differential equations:

$$y_1' = .25y_1 - .01y_1y_2, \;\; y_1(0) = 80$$
$$y_2' = -y_2 + .01y_1y_2, \;\;\; y_2(0) = 30$$

Use Matlab to solve the above ODE's using Runge Kutta 2 stage, Euler Forward and Backward methods integrating from a = 0 to b = 100 with step size h = 0.01. Visualize y functions according to t and plot y_1 vs y_2 figure. (You can examine the Example 16.8 in [1])

5. You have the initial value ODE problem as:

$$y = -1000\big(y - cos(t)\big) - sin(t), \qquad y(0) = 80$$

The exact solution of the ODE is $y(t) = cos(t)$ and it vanishes at $t = \pi/2$. Use Euler Forward ve Backward methods to find the solutions for the different step sizes (h values) (h=.00005π, .0001π, .0005π, .001π) and compare the error recoded in each step size value. Also, consider the numerical stability of Euler's Forward and Backward method for the different h values.

[1] A First Course in Numerical Methods by Uri M. Ascher, Chen Greif