MTP290 Tutorial Sheet - 5

1. Write a MATLAB function for implementing the Euler method to solve the first order ODE,

$$y' = f(x, y), \;\; y(x_0) = y_0.$$

Find solution after 10 steps with specified step-size h for the following problems:

(a) $y' + 0.2y = 0,\ y(0) = 5,\ h = 0.2.$

(b) $y' = \frac{1}{2}\pi\sqrt{1-y^2},\ y(0) = 0,\ h = 0.1.$

(c) $y' = -20y + 20x^2 + 2x,\ y(0) = 1,\ h = 0.1.$ Plot the solution with the exact solution $y = \exp(-20x) + x^2$.

2. Write a MATLAB function for implementing the improved (also called modified) Euler method to solve the first order ODE,

$$y' = f(x, y), \;\; y(x_0) = y_0.$$

Find solution after 10 steps with specified step-size h for the following problems:

(a) $y' - xy^2 = 0,\ y(0) = 1,\ h = 0.1.$

(b) $y' = y - y^2,\ y(0) = 0.2,\ h = 0.1.$

(c) Solve Problem 1b using improved Euler method and compare the results with the Euler method.

3. Write a MATLAB function for implementing the classical Runge-Kutta method of fourth order to solve the first order ODE,

$$y' = f(x, y), \;\; y(x_0) = y_0.$$

Find solution after 10 steps with specified step-size h for the following problems:

(a) $y' + y\tan x = \sin 2x,\ y(0) = 1,\ h = 0.1.$

(b) Redo Problem 2b using classical Runge-Kutta method of fourth order and compare the results.

4. Use finite difference method to solve the following boundary value problems with $n = 4,\ 8$:

(a) $y'' = 6x,\ y(0) = 0,\ y(2) = 8.$

(b) $y'' = 24x^2,\ y(0) = 0,\ y(2) = 32.$

(c) $y'' + y = 1,\ y(0) = 1,\ y(\pi/2) = 0.$

Also, plot the discrete solution.