

# ANT\_LAB ASSIGNMENT-05-Set-2

10 February 2022 14:30



ANT\_LAB  
ASSIGNME...

INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR

DEPARTMENT OF MATHEMATICS

MA39110 - Advanced Numerical Techniques Lab

1. Use second order FDM (finite difference scheme) and Newton linearization technique, write a MATLAB Code to solve the following BVP (Boundary Value Problem) with step size  $h=0.1$ . Also compare the solution with exact solution and plot the resulting solutions.

$$yy'' + y' = 2 \quad x \in [0, 1]$$

$$y(0) = 0, \quad y(1) = 2$$

2. Use second order FDM (finite difference scheme) and Quasi linearization technique to solve the following BVP with step size  $h=0.1$ . Also compare the solution with exact solution of the given BVP and plot the resulting solution.

$$(y')^2 = 2yy'' \quad x \in [1, 2]$$

$$y(1) = 1, \quad y(2) = 4$$

(2)

$$y = 2x$$

$$\begin{aligned} & \boxed{yy'' + y' = 2} \\ & y(0) = 0 \\ & y(1) = 2 \end{aligned}$$

$$\boxed{yy'' + y' - 2 = 0}$$

On discretization.

$$y_i \left( \frac{y_{i+1} - 2y_i + y_{i-1}}{h^2} \right) + \left( \frac{y_{i+1} - y_{i-1}}{2h} \right) - 2 = 0$$

$$F(y_{i-1}, y_i, y_{i+1}) = y_i \left( \frac{y_{i+1} - 2y_i + y_{i-1}}{h^2} \right) + \left( \frac{y_{i+1} - y_{i-1}}{2h} \right) - 2$$

$$F(y_{i-1}, y_i, y_{i+1}) + \frac{\partial F}{\partial y_{i-1}} (\Delta y_{i-1}) + \frac{\partial F}{\partial y_i} (\Delta y_i) + \frac{\partial F}{\partial y_{i+1}} (\Delta y_{i+1}) = 0$$

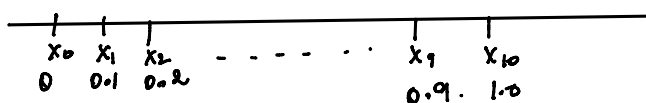
$$\frac{\partial F}{\partial y_{i-1}} = \left( \frac{y_i}{h^2} - \frac{1}{2h} \right) \quad \frac{\partial F}{\partial y_i} = \left( \frac{y_i}{h^2} + \frac{1}{2h} \right) \quad \frac{\partial F}{\partial y_{i+1}} = \left( \frac{y_{i+1} - 4y_i + y_{i-1}}{h^2} \right)$$

$$\left( \frac{y_i}{h^2} - \frac{1}{2h} \right) \Delta y_{i-1} + \left( \frac{y_{i+1} - 4y_i + y_{i-1}}{h^2} \right) \Delta y_i + \left( \frac{y_i}{h^2} + \frac{1}{2h} \right) \Delta y_{i+1} = \left\{ 2 - \left( \frac{y_{i+1} - y_{i-1}}{2h} \right) - y_i \left( \frac{y_{i+1} - 2y_i + y_{i-1}}{h^2} \right) \right\}$$

$$\boxed{h = 0.1}$$

$$\begin{aligned} & \boxed{y_0 = 0} \\ & \boxed{y_{10} = 2} \end{aligned}$$

$$i = 1, 2, \dots, 9$$



0.01. 1.0

0.01. 1.0