

**DEPARTMENT OF MATHEMATICS
IIT GUWAHATI**

MA 332

Scientific Computing

Lab - IX

1. Solve the following two-point boundary-value problems with Dirichlet boundary condition by using forward, backward and central difference for the first-order derivative and central difference for the second-order derivative.

$$\begin{cases} y'' = e^x + y \cos x - (x+1)y', \\ y(0) = 1, \quad y(1) = 3, \end{cases} \quad \begin{cases} y'' + 2y' + y = x, \\ y(0) = 0, \quad y(1) = 0. \end{cases}$$

2. Solve the following boundary-value problems with Neumann boundary condition by a second-order method.

$$\begin{cases} y'' + xy' - 2y = 2 + (2+x^2)e^x, & -1 < x < 0. \\ y'(-1) = -2, \quad y'(0) = 1. \\ \text{Exact solution: } y(x) = x^2 + xe^x. \end{cases}$$
$$\begin{cases} y'' = -xy + (3 - x - x^2 + x^3) \sin(x) + 4x \cos(x), & 0 < x < 1, \\ y'(0) = -1, \quad y'(1) = 2 \sin(1). \\ \text{Exact solution: } y = \sin^2(\pi x). \end{cases}$$

3. Use a second-order method to solve the following boundary-value problems with mixed boundary condition.

$$\begin{cases} y'' = xy + 1, & 0 < x < 1, \\ y'(0) + y(0) = 1, \quad y(1) = 1, \end{cases} \quad \begin{cases} y'' - 3y' + 2y = 2, & 0 < x < 1, \\ y'(0) - y(0) = 1, \quad y'(1) + y(1) = 1. \end{cases}$$

The output folder should contains the following things:

1. It should include the MATLAB code of each program.
2. The outputs for each question should be given in one or all of the followings forms:
 - (i) The final answers are to be copied in a word document in terms of the numerical values and plots.
 - (ii) The final answers and errors (if possible to calculate) are to be given in plots (line plot, surface plot, etc.)
 - (iii) The order of convergence has to be calculated and the final answers have to be given in Tables, and log-log plots.