DEPARTMENT OF MATHEMATICS, I.I.T. GUWAHATI

MA 322: Scientific Computing Lab - 8

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.

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

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

$$\begin{cases} y'' = -y - 1, \quad 0 < x < 1, \\ y'(0) = (1-\cos(1))/\sin(1), \quad y(1) = -(1-\cos(1))/\sin(1). \\ \text{Exact solution:} \quad y = \cos(x) + \dfrac{1-\cos(1)}{\sin(1)}\sin(x) - 1, \end{cases}$$

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

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

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

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.