SCHOOL OF BASIC SCIENCES
INDIAN INSTITUTE OF TECHNOLOGY BHUBANESWAR
Numerical Techniques (MA2L007) Spring 2020

Problem Sheet-6

1. Convert the Wave equation for a vibrating string $u_{tt} = 4u_{xx}$ over $[0,1] \times [0,0.5]$ with boundary conditions $u(0,t) = 0 = u(1,t)$ and $u(x,0) = \sin(\pi x) + \sin(2\pi x)$, $u_t(x,0) = 0$ into a linear system using finite difference method. Take $\Delta x = 0.1$.

2. What difficulty might occur when trying to use finite difference method to solve $u_{tt} = 4u_{xx}$ with the choice $\Delta t = 0.02, \Delta x = 0.03$?

3. Write the linear system for the problem $u_t = 4u_{xx}$ over $[0,1] \times [0,1]$ with boundary conditions $u(0,t) = 1, u_x(1,t) = 2$ and $u(x,0) = \sin(2\pi x)+2x+1$ using Crank-Nicholson scheme.

4. Convert the Wave equation $u_{tt} = u_{xx}$ over $[0,4] \times [0,1]$ with boundary conditions $u(0,t) = 0, u_x(4,t) = 1$ and $u(x,0) = x(4-x)$, $u_t(x,0) = 0$ into a linear system using finite difference method. Take $\Delta t = 0.5$.

5. Write the system for $u_{xx} + u_{yy} = 0$ over $[0,1] \times [0,1]$ with boundary conditions $u_x(0,y) = 0 = u_x(1,y)$ and $u(x,0) = x$, $u_y(x,1) = 0$ into a linear system using finite difference method. Take 5 nodes along x and y directions.