INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
DEPARTMENT OF MECHANICAL ENGINEERING
Guwahati – 781 039, Assam, India

ME 543 Computational Fluid Dynamics
Computer Assignment – 2
Due Date for Submission: 07.09.15 (Monday), <u>No Late Submission</u>

Solve the following partial differential equation using finite difference method with specified boundary conditions for **60×60** grid size as shown in the figure. Use **pseudo-transient** solution approach for two materials (**copper and stainless steel**) with initial condition of temperature as 10°C.

$$\frac{\partial T}{\partial t} = \alpha\left(\frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2}\right) \qquad \epsilon = \sqrt{\frac{\sum_{\substack{i=2,M-1\\ j=2,N-1}}\left(T_{i,j}^{n+1} - T_{i,j}^{n}\right)^2}{(M-2)\times(N-2)}}$$

1. Explicit method: **FTCS**
2. Implicit method
   a) **BTCS**: Point Gauss-Seidel iterative method
   b) **ADI**: Line Gauss-Seidel iterative method (TriDiagonal Matrix Algorithm)
   c) **Optional**: You may try (a) and (b) with over relaxation.

Discretize the PDE using above discretization schemes with uniform grid $M \times N$. Write the code such a way so that you can input the values of $\propto_s, N, M, H, L$. $\Delta x, \Delta y$ may be different, so use $\beta = \frac{\Delta x}{\Delta y}$.

Submit the results in terms of temperature contours and conclusions, **convergence history** (**ε vs *t***), (Optional: ***ω* vs *t***) and report on discretized algebraic equation of each discretization scheme, comparison study of number of time iterations and physical time taken to converge up to $\epsilon < 10^{-4}$. Email only the soft copy of the code.