PROGRAMMING ASSIGNMENT – II

Solve the following unsteady second order partial differential equation arising from a transient diffusion problem.

$$\frac{\partial T}{\partial t} = \frac{\partial^2 T}{\partial x^2} \qquad 0 < x < 1;\ t > 0$$

$$t = 0^-,\ T(x,0) = 0$$

$$t > 0^+,\ T(0,t) = 1$$

$$t > 0^+,\ T(1,t) = 0$$

Write two programs – one for the analytical solution and one for the numerical. The numerical solution is to be obtained by developing the following matrix form:

$$[A]\{T\}^{n+1} = \{T\}^n$$

Show the required formulation separately in your report.

Use Gauss-Seidel method to solve the algebraic system of equations at each time step. Use a stopping criterion of 10^{-3}%.

On a 51 × 51 grid, plot RMS error as a function of time. Error can be defined as the RMS difference between analytical and numerical calculated over the entire grid. Show this result on a 101 × 101 grid as well.