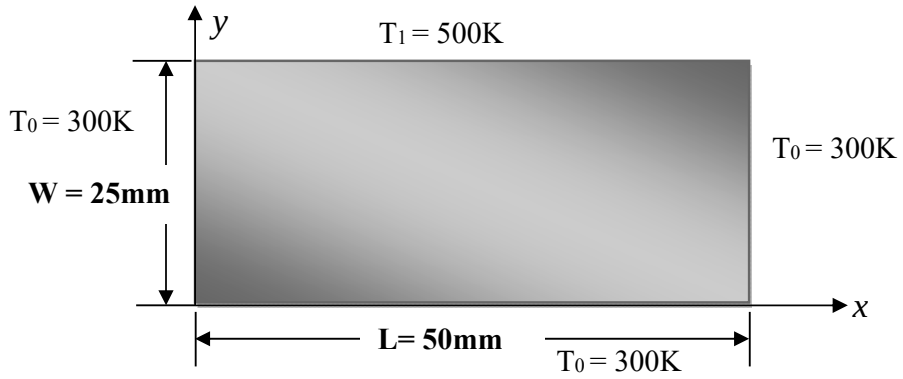
ME630A: Computational Fluid Dynamics and Heat Transfer
Computer Assignment II
Instructor: A. K. Saha

Submission DEADLINE: **February 13, 2019 (5:00pm)**

The general equation for 2-D steady state heat conduction in an isotropic material is given by $\frac{\partial^2 T}{\partial x^2}+\frac{\partial^2 T}{\partial y^2}=0$

Consider a rectangular slab one edge of which is at a temperature (T_1) of 500˚K and the remaining three edges are at ambient temperature (T_o) of 300˚K.



For such an arrangement (with all Dirichlet boundary conditions), the analytical solution is given by the following expression.

$$\frac{T(x,y)-T_o}{T_1-T_o}=\frac{2}{\pi}\sum_{n=1}^{\infty}\frac{1-(-1)^n}{n}\sin\left(\frac{n\pi x}{L}\right)\frac{\sinh\left(\frac{n\pi y}{L}\right)}{\sinh\left(\frac{n\pi W}{L}\right)}$$

Obtain the final FDE and matrix equations to be solved. Get the temperature distribution inside the slab (for the given boundary conditions) numerically by discretizing the governing equation using 2nd order accurate scheme (central). For the solution of set of simultaneous algebraic equations, use TDMA technique (Line SOR-GS). Consider a grid of 60×40 points for discretizing the domain.

Prepare a **report** which should contain the following:

1) Problem Definition.
2) Method of solution including governing differential equation (GDE) and boundary conditions (BCs).
3) Results and discussion (i.e. analysis of the problem) by giving the following results

(a) Isotherms or temperature contours.
(b) Contours of error between the numerical solution and analytical solution.
(c) Both analytical and numerically generated temperature variation (T versus *y*) along the central line of the slab (*x*=constant).
(d) Both analytical and numerically generated temperature variation (T versus *x*) along the central line of the slab (*y*=constant).

Marks distribution:

Total: 50 marks.
Presentation: 15 marks.
Solution technique and problem description: 10 marks.
Correctness of results and analysis: 25 marks.

It is suggested that you try converting your 1D program written for the computer assignment # 1.