Department of Mechanical Engineering, BUET.

ME 6189: Computational Fluid Dynamics

Assignment-3

(**Due date: 23 February 2013**, **Saturday**. *Submit hard-copy, at class*)

Note: *(i) Symbols have their usual meanings.*

(ii) Clearly sketch the C.V. (control volume), show the nodal points, and C.V. faces.

(iii) Consider uniform grid.

(iv) Show details of the discretization process.

(v) Submit your code with necessary results plotted.

(vi) ***Make sure that your results are grid independent, and compare the results with the analytical solutions.***

1. A number of simple fully developed flows are governed by conduction-like equations. For example, the fully developed flow between parallel plates obeys the equation

$$\frac{d}{dy}\left(\mu\frac{du}{dy}\right)-\frac{dp}{dx}=0$$

where u is the velocity, μ is the viscosity, and dp/dx is the constant pressure gradient.

(a) Compute the velocity distribution in the fully developed flow between stationary parallel plates.

(b) Let the lower plate is stationary, and the upper plate is moving with velocity U. Calculate the fully developed flow between the plates for various values of the parameter $L^2(dp/dx)/(\mu U)$, where L is the distance between the two plates.

2. Obtain the one-dimensional temperature distribution in a square bar of mild steel as shown in Figure 1.

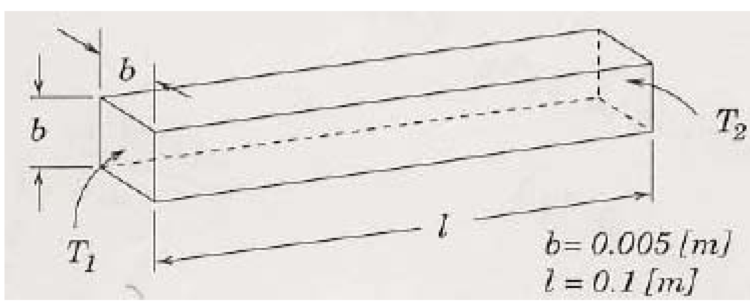

Figure 1

The properties of mild steel are k = 60 W/m.K, ρ = 7800 kg/m^3 and C_p = 430 J/kg.K.

Assume the convection coefficient h = 0 W/m^{2}K on the exposed surfaces, and

fixed end temperatures of T_1 =100 ^{o}C and T_2 = 0 ^{o}C. Explain your results.

3. Consider the same geometry and properties as in question 2 and use h= 12 W/m^{2}K for the exposed surfaces of the bar, and end temperatures of $T_1 = T_2$ = 100 ^{o}C.

Assume the surrounding air to be at T_∞ = 25 ^{o}C. Obtain the solution for this problem and compare your solution to the analytical solution. Explain your results.