ME – 733 CFD

Programming Assignment 1

Consider a fluid bounded by two parallel plates extended to infinity such that no end effects are encountered. The walls and the fluid are initially at rest. Now, the lower wall is suddenly accelerated in the x-direction. The Navier-Stokes equations for this problem may be expressed as:

$$\frac{\partial u}{\partial t} = \upsilon \frac{\partial^2 u}{\partial y^2}$$

It is required to compute $u(t, y)$.

Assume initial conditions of

$$u = u_o \ @ \ y = 0$$

$$u = 0 \ @ \ 0 < y \leq h$$

Where h is the distance between the two plates

Assume Boundary conditions

$$u = u_o \ @ \ y = 0$$

$$u = 0 \ @ \ y = h$$

Take υ=0.000217 m^2/s, u_o =40 m/s, max time of 1.08 sec. Assume 40 nodes in y direction

Apply the following schemes:

- ❑ FTCS - Explicit
- ❑ FT Implicit
- ❑ Dufort Frankel
- ❑ Crank-Nicolson schemes.

Calculate and plot the velocity distribution by using Matlab by using the following time steps:

- ❑ dt = 0.002 sec
- ❑ dt = 0.00232 sec
- ❑ dt = 0.003 sec

Bonus points will be given to the student who

- **Creates a video of the development of the flow speed with time.**
- **Shows the demonstration of the results.**