Department of Mechanical Engineering, BUET.

ME 6189: Computational Fluid Dynamics

Assignment-2

(**Due date: 30 January 2013**, **Wednesday**. *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.

1. (a) Discretize the following equation using finite volume method,

$$k\frac{d^2T}{dx^2}+\frac{dk}{dx}\frac{dT}{dx}+S=0$$

Use the following approximations,

$$k\frac{d^2T}{dx^2}=\frac{k_P\left(T_E+T_W-2T_P\right)}{\left(\Delta x\right)^2}; \qquad \frac{dT}{dx}=\frac{T_E-T_W}{2\left(\Delta x\right)}.$$

Consider $\frac{dk}{dx}$ is a given quantity, and S is a source term.

(b) Noting that $\frac{dk}{dx}$ can be negative or positive, find the conditions for which the coefficient a_E or a_W become negative, thus violating the basic rule 2.

2. In an axisymmetrical situation, a steady one-dimensional conduction problem is governed by

$$\frac{1}{r}\frac{d}{dr}\left(kr\frac{dT}{dr}\right)+S=0$$

where r is the radial coordinate.

Derive a discretization equation for the above equation using finite volume method.

Interpret the coefficients in the discretization equation.