

# Homework 4: AE601, Computational Fluid Mechanics

**Feb. 25 2009**

Due: March 9, 2009 (beginning of class)

Consider the convection-diffusion equation

$$\frac{\partial(\rho u \phi)}{\partial x} = \frac{\partial}{\partial x} \left[ \Gamma \frac{\partial \phi}{\partial x} \right]$$

on the interval  $[0,1]$  with  $\phi(0)=0$  and  $\phi(1)=1$ . Take  $u=\rho=1$  and  $\Gamma = 1/50$

- Approximate the diffusive term with a CDS.
- Approximate the convective term with three different methods, including BDS, FDS and CDS.
- Solve the resulting system of equations (use Matlab built in functions to solve the system represented in matrix-vector form as  $A * \phi = b$ ) on a grid with equidistant grid spacing 0.1. Explain the different results you get between the BDS, FDS and CDS scheme.
- Solve also on a grid with grid spacing of 0.005, and 0.001, and find the convergence rate of the solution. Explain your result.

This homework MUST be in the “Computer Homework” format.