DEPARTMENT OF CHEMICAL ENGINEERING
NATIONAL INSTITUTE OF TECHNOLOGY CALICUT

Name:_____
Reg. No._____

WINTER SEMESTER 2015

Test II

CH 4038 – Computational Fluid Dynamics

Duration: 1 hour | Date: 9.04.2015 | Maximum Marks: [20]

Answer all questions:

1. Finite volume discretization equation for scalar variable ϕ is obtained as: [1]
   $-5\phi_P = -3\phi_E - 2\phi_W + 5$
   Is the above discretization expected to yield a physically unrealistic solution. Justify with reasoning.

2. Consider a 1-D steady state convection – diffusion problem without any source term. Derive a profile assumption for variation of the dependent variable in the advection term, following the QUICK scheme. Based on that, derive the complete disctretization equation for the convection-diffusion problem. [5]

3. Explain false diffusion. [3]

4. What are the objectives of turbulence modeling? Explain k-ε model. [3]

5. Consider a square plate. The left face is maintained at 100°C and the top face at 500°C, while the other two faces are exposed to an environment at 100°C. h = 10 W/m^2·°C and k = 10 W/m·°C The block is 1 m square. Compute the temperature of the various nodes using finite volume method .(Use a uniform grid with $\Delta x=\Delta y=0.5$ m. Form the set of equations) [5]

6. For a 1-D convection – diffusion problem, fluid density = 1000kg/m^3, flow velocity = 1m/s, diffusion coefficient = 10^{-9} m^2/s, and domain length = 1m. Will a central difference scheme work, for a numerical solution of this problem. Which scheme would you prefer? Give reasons for your answer. [3]