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B.E./B.Tech (Full-Time) DEGREE END SEMESTER EXAMINATION, MAR/APR 2011
Mechanical Engineering BRANCH
SEVENTH Semester- REGULATIONS 2004

ME 516 – COMPUTATIONAL FLUID DYNAMICS

Time : Three hours Maximum : 100 marks

Answer ALL questions

Part A – (10 × 2 = 20 marks)

1. Give an example for parabolic type of equation?
2. Define truncation error.
3. Define Neumann boundary conditions.
4. Write the discretisation equation for solving I.D. unsteady heat transfer problem using a semi-implicit scheme.
5. Discuss the advantages of explicit, semi-implicit and pure implicit schemes.
6. When do you make use of image-point technique for discretisation?
7. What is conservativeness of a discretisation scheme?
8. Write the advantages and disadvantages of a staggered grid.
9. What is Prandtl's Mixing length model?
10. Define by turbulence?

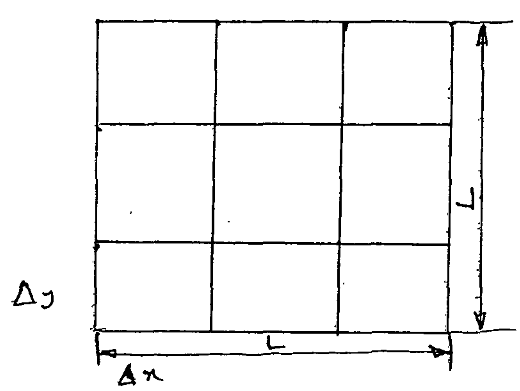
PART – B (5 X 16 = 80 Marks)

11. An iron rod l = 6 cm long d = 2.5 cm with thermal conductivity k = 60 W / m^0C protrudes from a wall and exposed to air to an ambient at T_∞ = 30^0C and h = 100 W/m^2C. The base of the rod is at $T_0 = 300^0C$ and tip is insulated. Assuming 1D steady state heat flow, calculate the temperature distribution along the rod using the finite difference scheme.

12. (a) Derive the continuity , X-momentum equations in Cartesian co – ordinate system.

(Or)

(b) Write the finite – difference formulation of the heat conduction equation. $\partial^2T / \partial x^2 + \partial^2T / \partial y^2 = 0$ for the square region of side L by using a mesh size $\Delta x = \Delta y = L / 3$ for the boundary conditions shown in Fig. 12.b. Express the resulting equations in matrix form for the unknown node temperature T_m , m = 1 to 4.



13. (a) Derive the finite – difference equation for a ID transient heat conduction in a slab using explicit scheme.

(Or)

(b) Consider a rod of length 1 m. The ends are maintained at 200^0C and 20^0C respectively. The surface of the rod is insulated. Set up the matrix to obtain the temperature distribution in the rod using finite volume method. Given k = 1.5 W/mk, A = $1m^2$

14. (a) Discuss the SIMPLE algorithm in detail.

(Or)

(b) A property ϕ is transported by means of convection and diffusion through the one-dimensional domain. The governing equation is d/ dx (ρu ϕ) = d / dx (Γ dϕ/dx/) : the boundary conditions are $\phi_0 = 1$ at x = 0 and $\phi_L = 0$ at x = L. Using five equally space cells and the central difference scheme for convection and diffusion calculate the distribution of ϕ as a function of x for u = 2.5 m/s. The following data apply L = 1.0m: ρ = 1.0 kg/m^3 : Γ = 0.1 kg/m.s.

15. (a) Consider a 1 D convection diffusion problem. Descritize the governing equation using hybrid scheme.

(Or)

(b) Discuss in detail the k-.ε model.
