30

B.E./B.Tech (Full-Time) DEGREE END SEMESTER EXAMINATION, APR/MAY 2012

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 example of a parabolic equation.
2. Write down the Neumann boundary condition.
3. Write down the first order forward difference equation for temperature.
4. List down some direct methods of solving equations.
5. State any two merits of finite volume method over finite difference method.
6. What is ADI method?
7. What is conservativeness of a discretisation scheme?
8. What do you mean by structured grid?
9. What is Prandtl's mixing length.
10. Define turbulence.

Part B – (5 × 16 = 80 marks)

11. An iron rod length = 6 cm and d=1.5 cm with thermal conductivity k=50 W/m.K protrudes from a wall and exposed to air at an ambient T_∞ = 23 °C and h= 100 W/m²K. The base of the rod is at T_0=350°C and the tip is insulated. Assuming 1D steady state flow, calculate the temperature distribution along the length of the rod using finite difference scheme.

12.a) Explain the various iterative methods of solving algebraic equations with example.

(Or)

12b) Derive the finite difference formulation for 1D & 2D heat conduction equations using forward, backward and central difference schemes.

13. a) Derive the continuity equation is Cartesian co-ordinates.

(Or)

b) Write down the Navier-Stokes equation in 2D and in X & Y direction. Derive the same in Cartesian co-ordinates.

14.a) Derive the finite difference equation for a 1D transient heat conduction in a slab using explicit scheme (16)

(Or)

b) A property Φ is transported by means of convection and diffusion through the 1D domain. The governing equation is $\frac{d}{dx}(\rho u \phi) = \frac{d}{dx}\left(\Gamma \frac{d\phi}{dx}\right)$. The boundary conditions are Φ_0=1 at x=0 and Φ_0=0 at x=L. Using 5 equally spaced cells and the central difference scheme calculate the distribution of Φ as a function x for u= 3 m/s using finite volume method. Assume L= 1 m, ρ=1.2 kg/m^3 and Γ=0.1 kg/ms

15.a) Discuss the characteristics of turbulent flow. What is the use of turbulence? models. Explain the k-ε turbulence model in detail (4+2+10)

(Or)

b) What is the necessity of SIMPLE algorithm? Derive the SIMPLE algorithm and deduce its variants.