Reg. No. | | | | | | | | | | |

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

Mechanical Engineering BRANCH

36

EIGHTH Semester

REGULATIONS 2008

ME 9032 – COMPUTATIONAL FLUID DYNAMICS

Time : Three hours Maximum : 100 marks

Answer ALL questions

Part A – (10 × 2 = 20 marks)

1. Give example of an elliptic equation.
2. Write down the Dirichlet boundary condition.
3. Derive 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 Crank Nicholson method?
7. What is transportiveness of a discretisation scheme?
8. What do you mean by unstructured grid?
9. What is Prandtl's mixing length.
10. Define turbulence.

Part B – (5 × 16 = 80 marks)

11. An iron rod length = 5 cm and d=1 cm with thermal conductivity k=50 W/m.K protrudes from a wall and exposed to air at an ambient T_∞ = 25 °C and h= 100 W/m^{2}K. The base of the rod is at T_o=300°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 generalised form of Navier-Stokes equation. Derive the same in Cartesian co-ordinates.

14.a) Explain about the power law, QUICK and upwind differencing schemes with example. (5+6+5)

(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_5=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= 2 m/s using finite volume method. Assume L= 1 m, ρ=1.1 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 Prandtl's mixing length in detail (4+2+10)

(Or)

b) What is SIMPLE algorithm? Explain briefly about pressure correction equations. State their necessity. (5+6+4)