BE / Mechanical / CBSGS / Sem VII

14 DEC 2018

(3 Hours)

Marks :80

N.B: 1) Question No.1is compulsory
2) Attempt any three questions of the remaining five questions
3) Assume suitable data wherever necessary
4) Figures to the right indicate maximum marks

Q.1 Answer any four 20

a) Write the conservative form of the governing equations and explain the terms involved in momentum equation

b) Discuss the advantages of a Numerical Scheme over conventional method for solving a problem

c) Explain the types of grids used in CFD

d) Discuss the characteristics of free turbulent flows.

e) Differentiate between FDM and FVM

Q.2

Consider a large plate of thickness t = 8 cm with an internal heat generation of 500 kW/m^3 and a constant thermal conductivity of 10 W/mK. The faces of the plate are maintained at 100 ^{0} C and 300 ^{0} C. Assume that the dimensions in the directions perpendicular to the thickness are so large that the temperature gradients due to conduction are significant in the direction of thickness only

- Write the one dimensional governing equation for the above phenomena
- Obtain the discretized equation for each node
- Arrange the equations in the matrix form and solve it to find the steady state temperature at five equally spaced nodes using TDMA 20

Q.3

a) A property ϕ is transported by means of convection and diffusion through a one dimensional domain. The governing equation to be used is $\mathbf{d/dx\ (\rho\ u\ \phi) = d/dx\ (\Gamma\ d\phi\ /dx)}$. The boundary conditions to be used are at $\mathbf{x = 0,\ \phi_0 = 1}$ and at $\mathbf{x = L,\ \phi_L = 0}$. Assume that the property is transported from x= 0 to x = L. Using five equally spaced nodes and an Upwind scheme, calculate the distribution of ϕ as a function of x for u = 0.1 m/s, L = 2 m, ρ = 1.0 kg/m^3, Γ = 0.15 kg/ms 16

b) Give an account of applications of CFD. 04

Q.4

a) A thin plate is initially at a uniform temperature of 300^0C. At a certain time t = 0 the temperature of the east side of the plate is suddenly reduced to 0^0C. The other surface is insulated. Use the explicit technique and a time step of 2 seconds; calculate the transient temperature distribution of the plate at the end of the first time step. The plate thickness is 30 mm, thermal conductivity is k = 20 W/mK and $\rho c = 10 \times 10^6$ J / m^3K . The governing equation of the phenomena is $\rho c\ (\partial T/\partial t) = \partial/\partial x\ (k\ \partial T/\partial x)$. 14

b) Discuss the LES model used in turbulence modeling 06

Q.5

a) What is CFD? Also describe the working of a commercial CFD software. Name some of the software's used in CFD. 10

b) What is a SIMPLE algorithm used for? Explain the steps involved in the algorithm. 10

Q.6

Write brief notes on **any three** 20

a). Explain any two properties of a discretization scheme

b) Discuss the QUICK scheme for discretization

c) Discuss the TDMA method used in CFD

d) Explain RANS
