B.E. (Mechanical) (Sem-VII) (CBSGS) (R-2012)

Paper / Subject Code: 42809 / 5)Computational Fluid Dynamics Date-26/11/19

(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 momentum equations and explain the terms involved in momentum equation

b) Discuss the disadvantages of a Numerical Scheme over experimental method for solving a problem

c) Explain the types of grids used in CFD

d) Explain any one turbulent model

e) Differentiate between Upwind and Quick scheme used for discretization

Q.2 **20**

Consider a large plate of thickness t = 10 cm with an internal heat generation of 400 kW/m^3 and a constant thermal conductivity of 10 W/mK. The faces of the plate are maintained at 100 ^{0} C and 450 ^{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

Q.3 **16**

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

b) Give an account of applications of CFD **04**

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Q.4 **14**

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 ρc = 10 X 10^6 J / m^3K . The governing equation of the phenomena is $\rho c\,(\partial T/\partial t) = \partial/\partial x\,(k\,\partial T/\partial x)$.

b) Discuss the steps involved in using a CFD software **06**

Q.5

a) Discuss the properties of a discretization scheme **10**

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

Q.6

Write brief notes on any three **20**

a) Explain RANS

b) Derive the continuity equation in three dimesion

c) Discuss the TDMA method used in CFD

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