(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 general scalar transport equation for any property **Φ** and explain the various terms and their significance

b) Explain the meaning and the significance of relaxation techniques used in a CFD solution

c) Explain the concept of meshing and mesh quality

d) Discuss the characteristics of free turbulent flows.

e) Derive the continuity equation in two dimensions

Q. No.2

a) A property ϕ is transported by means of convection and diffusion through a one dimensional domain. The governing equation to be used is **$d/dx (\rho u \phi) = d/dx (\Gamma d\phi /dx)$.** The boundary conditions to be used are at **$x = 0$, $\phi_0 = 1$ and at $x = L$, $\phi_L = 0$.** 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 = 0.15 m/s, L = 2.5 m, $\rho = 1.1$ kg/m^3, $\Gamma = 0.15$ kg/ms **16**

b) Give an account of the errors in CFD **04**

Q. No.3 **20**

Consider a large plate of thickness t = 3 cm with an internal heat generation of 1200 kW/m^3 and a constant thermal conductivity of 1.1 W/mK. The faces of the plate are maintained at 150 ^{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

Q.No.4

a) What is a SIMPLER algorithm used for? Explain the steps involved in the algorithm. How is it different from SIMPLE? **10**

b) Discuss the k - ε and k- omega models used in turbulence modeling **10**

Q.No.5 Write brief notes **20**

a) Explain the concept of Peclet no.

b) What is QUICK? Give the distribution of flux ϕ at the face values of a control volume.

c) What are the differences between FDM and FVM.

d) Application of CFD in automobile engineering.
