B.E. (Mechanical) (Sem-VII) (CC B) Date- 22/11/19

Time : 3 hrs **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 the following **20**

a) What is turbulence? Explain the characteristics of s simple turbulent flow.

b) Explain the errors involved in CFD Modelling

c) Give the advantages and disadvantages of experimental method for a physical problem

d) Discuss the types of grids used in discretization.

Q.2

a) Derive Momentum equation in three dimensions and discuss the terms involved in it. **10**

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

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 $\frac{d}{dx}(\rho u \phi) = \frac{d}{dx}\left(\Gamma \frac{d\emptyset}{dx}\right)$. The boundary conditions to be used are at **x = 0, ϕ_0 = 1 and at x = L, ϕ_L = 0.** Assume that the property is transported from x = 0 to x = L. Using five equally spaced nodes and an Central Differencing scheme, calculate the distribution of ϕ as a function of x for u = 0.1 m/s, L = 1 m, ρ = 1.5 kg/m^3, Γ = 0.1 kg/ms. **15**

b) What is QUICK? Give the distribution of flux ϕ at the face values of a control volume **05**

Q.4

Consider a large plate of thickness L = 10 cm with an internal heat generation of 1000 kW/m^3 and a constant thermal conductivity of 1.1 W/mK. The faces of the plate are maintained at 100 ^{0} C and 400^0 C. Assume 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**

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Q.5

a) A thin plate is initially at a uniform temperature of 500^0C. At a certain time t = 0 the temperature of the east side of the plate is suddenly reduced to 100^0C. The other surface is insulated. Use the fully implicit technique and a time step of 2s; 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 = 15 W/mK and $\rho c = 10 \times 10^6$ J / m^3K . The governing equation of the phenomena is $\rho c\frac{\partial T}{\partial t} = \frac{\partial}{\partial x}\left(k\frac{\partial T}{\partial x}\right)$. **15**

b) Write the conservative form of energy equation and explain the terms involved in it. **05**

Q.6

a) What is CFD? Give its application. Also describe the working of a commercial CFD software. **10**

b) Discuss the properties of discretization scheme. **10**

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