MANIPAL INSTITUTE OF TECHNOLOGY
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VI SEMESTER B.TECH. (AERONAUTICAL ENGINEERING)

END SEMESTER MAKEUP EXAMINATION JUNE 2018

SUBJECT: COMPUTATIONAL FLUID DYNAMICS [AAE 4002]

REVISED CREDIT SYSTEM
(22/06/2018)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitable assumed.

1A. Use the explicit finite difference approximation to solve for the temperature distribution of a long thin rod with a length of 10cm after t = 0.3s and the following values: $\Delta x = 2cm, \Delta t = 0.1s$ At t=0 the temperature of the rod is zero and the boundary conditions are fixed for all the times at T(0)=100°C and T(10)= 50°C.value of k = 0.835cm^2/s. Use the governing equation is given as, **07**

$$k\frac{\partial^2 T}{\partial x^2} = \frac{\partial T}{\partial t}$$

1B. With an example explain the phenomenon of divergence of velocity field. **03**

2. A property ϕ is transported by means of convection and diffusion through the one dimensional domain sketched below. The governing equation is **10**

$$\frac{d}{dx}(\rho u \phi) = \frac{d}{dx}\left(\Gamma \frac{d\phi}{dx}\right)$$

The boundary conditions are $\phi_0 = 1.2$ at x = 0 and $\phi_L = 0$ at x = L. Using five equally spaced cells and the CDS calculate the distribution of ϕ when u = 0.2 m/s. Consider $\rho = 1.5$, L = 0.5m, Γ = 0.1

3A. Explain the solution capsule for simple – implicit method (FDM) and also write the discritized form 1D parabolic equation using the same. **02**

3B. With suitable examples explain the importance of Peclet number with reference to various solution schemes for convection – diffusion flows . **04**

3C. Derive the conservative form of Continuity Equation for an infinitely small fluid element. **04**

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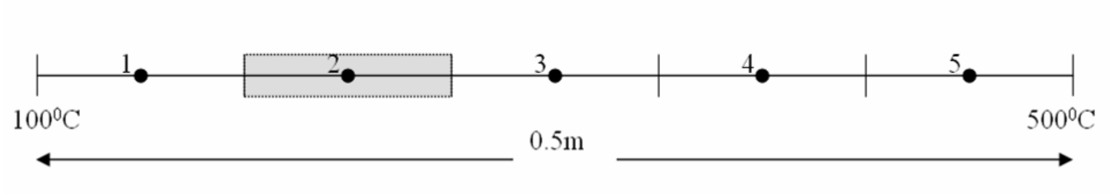
4A. With suitable example explain Numerical False Diffusion **03**

4B. Using control volume approach solve for temperature distribution with the following value: Conductivity k = 800W/m/K, A = 5X 10^{-3}m^2. **05**



Governing equation $\frac{d}{dx}\left(k\frac{dT}{dx}\right)=0$

4C. Explain the **FOUR RULES** of control volume formulation **02**

5 Solve the temperature distribution in a 1D domain with internal heat source S (= 10 K/m^2). The governing equation is $\frac{d^2T}{dx^2}+S=0$ .The domain range is, with the boundary conditions, *T (x = 0)* = 100 º C and *T (x =1)* = 60 º C. **10**

Use Δx = 0.2m. Use **control volume approach**.