Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

VI SEMESTER B.TECH. (AERONAUTICAL ENGINEERING)

END SEMESTER EXAMINATIONS, APRIL 2018

SUBJECT: COMPUTATIONAL FLUID DYNAMICS [AAE 4002]

REVISED CREDIT SYSTEM
(24/04/2018)

Time: 3 Hours | MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitable assumed.
- (Kindly specify any chart, tables and any other information permitted to use. Else delete the current line)

1A.	Using finite difference numerical scheme and TDMA to solve for the temperature distribution with the data given below. Consider T_a = 20ºC Governing equation: $\frac{d^2T}{dx^2} + h'(T_a - T) = 0$, $\Delta x = 2.0,\ h' = 0.01$ boundary conditions: $T\big|_{x=0} = 200\ ^{o}C\ \ and\ \ \frac{dT}{dx}\Big|_{x=10} = 0$	**07**
1B.	What is ADI method? Explain the computational capsule of this scheme for the solution of a 2D heat transfer problem governed by a parabolic equation	**03**
2.	Kerosene is flowing in a square duct of side 15 mm. It enters the duct with a temperature of 50ºC. The velocity at inlet is 6 m/s which can be assumed to remain constant along the duct. The diffusive flux (Γ) and the density through the duct can also be assumed to be constant at 700 kg/m/s, density 800 kg/m^3 respectively. The length of the pipe is 1000 mm. Kerosene leaves the duct at a temperature of 20ºC.Obtain the temperature distribution along the duct. Use five equally spaced grids to descritize the domain and Upwind Differencing Scheme (UDS) for the solution.	**10**
3A.	Explain the advantages of staggered grid over collocated grid.	**02**
3B.	With suitable examples explain Conservativeness, Boundedness and Transportiveness with reference to descritization schemes.	**03**
3C.	Derive the non-conservative form of Navier Stokes Equation for an infinitely small fluid element.	**05**
4A.	With suitable examples, classify PDE's and also define the initial and boundary conditions required to solve the same.	**03**

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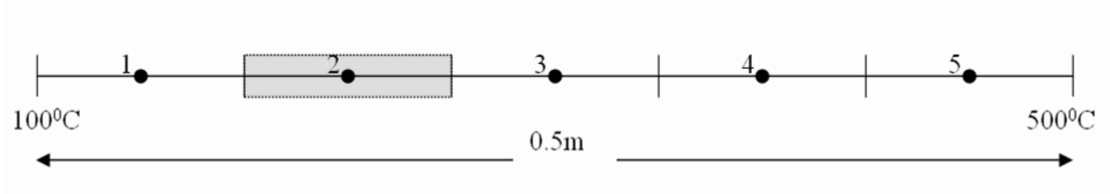
Using control volume approach solve for temperature distribution with the following value: Conductivity k = 1000W/m/K, A = 10X $10^{-3}m^2$.

4B. 

05

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

4C. With a neat sketch explain the **four basic models** of flow. **02**

5 Two plates are 10 cm apart as shown in the sketch, Initially, both plates and the fluid is still. The top plate is moved at constant velocity of 7 cm/s. The equation governing the motion of fluid is $\frac{\partial v}{\partial t}=\mu\frac{\partial^2 v}{\partial x^2}$. What is the velocity of the fluid at distances x= 2, 4, 6 and 8 from the bottom plate at t = 1.5. Note: Use semi implicit method with Δt = 0.5s, $\mu = 3\text{cp}$. **10**