[4859] - 59
B.E. (Mechanical/Sandwich)
COMPUTATIONAL FLUID DYNAMICS
(2008 Pattern) (Elective - II)

Time : 3 Hours]   *[Max. Marks :100*

Instructions to the candidates:

1)   Answer any three questions from each section.

2)   Answers to the two sections should be written in separate answer books.

3)   Figures to the right indicate full marks.

4)   Neat diagrams must be drawn wherever necessary.

5)   Use of logarithmic tables, Mollier charts, electronic calculator is allowed.

6)   Your answer will be valued as a whole.

7)   Assume suitable data, if necessary.

SECTION - I

Q1) a)   Why is it important to correctly define the computational domain for the fluid flow problem? Explain with suitable examples.   **[10]**

   b)   Explain significance of substantial derivative to describe the physics of flow, mathematically.   **[6]**

OR

Q2) a)   How is CFD being used in the Civil and environmental industry? **[8]**

   b)   Write a force balance equation for all the forces acting on a differential control volume.   **[8]**

Q3) a)   Name the sources of energy that contribute to the energy equation.**[9]**

   b)   Given the function $f(x) = 0.25x^2$ find the first derivative off (x) at x = 3; using forward, backward and central differencing of order ($\triangle$x). Use a step size of $\triangle$x = 0.1.   **[9]**

OR

Q4) a) Apply Fourier's law of heat conduction to obtain the heat flux in the X-direction. **[10]**

b) Obtain the general analytical solution for Laplace's equation for a one dimension case. **[8]**

Q5) a) What is the difference between using a direct method and an iterative method to solve the discretized equations? **[6]**

b) Is finite difference more suitable for structured or unstructured mesh geometries? Why? **[12]**

OR

Q6) a) What is the technique associated with the successive over-relaxation and why is it used? **[8]**

b) Derive an expression for the equation of a boundary node subjected to a constant heat Flux from the environment. Use Fig.6(B) shown below for nomenclature. **[10]**

Fig.6(B)
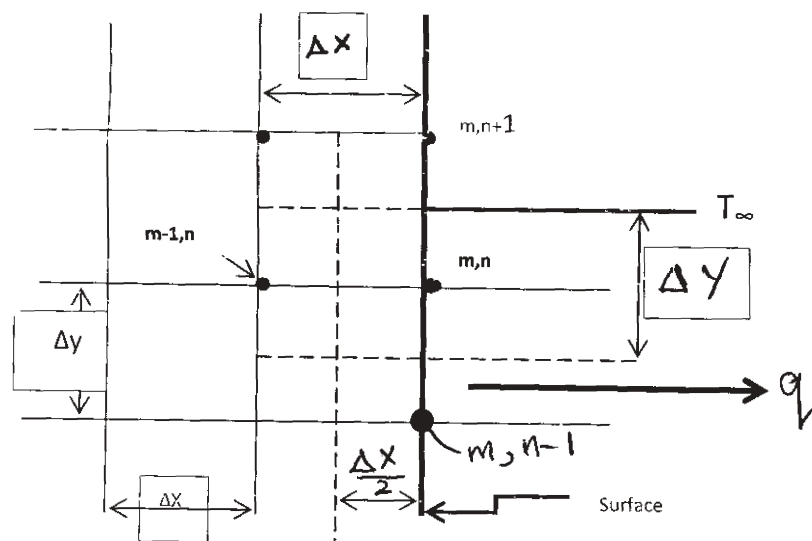
SECTION - II

Q7) A plane wall of thickness δ has its surfaces maintained at temperature T1 and T2. The wall is made of a material whose thermal conductivity varies with temperature according to the relation $k = k_0 T^2$. Derive an equation to determine the temperature distribution by steady state heat conduction through the wall. **[16]**

OR

Q8) a) Discuss various aspects of the explicit and implicit finite difference approach. **[8]**

b) How does time step affect stability, explain with suitable example. **[8]**

Q9) a) Describe the following types of grids : **[16]**
   i) Boundary fitted grid.
   ii) Staggered grid.
   iii) Structured grid.
   iv) Unstructured grid.

OR

*Q10)*a) Considering the steps of SIMPLEC algorithm, justify the need for this algorithm. **[8]**

b) Describe the pressure correction approach incompressible viscous flow. **[8]**

*Q11)*a) Explain temporalmarching two dimensional method for inviscid flow. **[8]**

b) Justify the need of artificial viscosity to solve Navier Stoke equation. **[8]**

OR

*Q12)*Write short notes on any two : **[16]**
   a) Finite Difference method.
   b) Finite Volume method.
   c) Errors resulting in numerical solution.
   d) CFL criteria of stability.

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