

Roll No. -----

Total No. of Pages: 2

Total No. of Questions: 11

M. Tech (ME) (Semester: 2nd)
COMPUTATIONAL FLUID DYNAMICS
Subject Code: MMEE-2206
Paper ID: [191008]

Time: 3 Hrs.

Max. Marks: 60

Instruction for candidates:

1. Section A is compulsory. It carries 16 marks. It consists of 4 questions of 4 marks each.
2. Section B consist of 4 questions of 8 marks each. The student has to attempt any 3 questions out of it.
3. Section C consist of 3 questions of 10 marks each. The student has to attempt any 2 questions.

SECTION - A

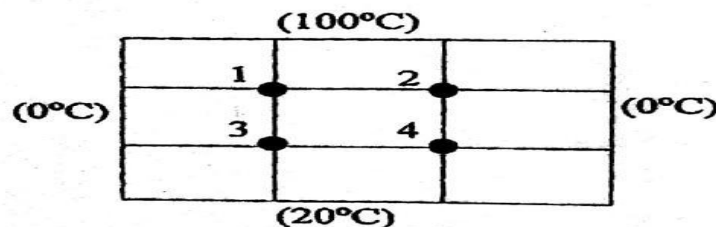
(4 marks each)

- Q1. What do you mean by CFD? How does CFD code work? What are different schemes of interpolation used in the discretization of 1D Convection – Diffusion problem?
- Q2. Write short note on any two of the following:
 - a. Mesh refinement and grid independence study.
 - b. Recent advances in computational techniques.
- Q3. Distinguish between finite element method and spectral method. Compare them with suitable examples.
- Q4. What are the relative advantages and disadvantages of Explicit and Implicit methods applied to linear parabolic equations?

SECTION - B

(8 marks each)

- Q5. What are the different types of boundary conditions encountered in solving fluid flow problems?
- Q6. Derive the compressible potential equation from 2D Navier Stokes equations. For what types of flows are compressible potential equation is generally used?
- Q7. Consider steady state heat conduction in square region subjected to the boundary conditions as shown in figure. Use mesh size $\Delta x = \Delta y$ and determine the node temperatures indicated below:



- Q8. Derive the expression for the stability criterion for the finite difference solution of the 1D unsteady heat conduction using Von Neumann Analysis.

SECTION-C

(10 marks each)

- Q9. Using the finite implicit method solve the temperature distribution of a long rod with a length of 10 cm. Obtain the temperature distribution after 0.3 seconds. Following data may be used. Initial condition: when $t = 0$, $T = 0^\circ\text{C}$
Boundary condition: when $T(0) = 100^\circ\text{C}$, $T(10) = 50^\circ\text{C}$
 $\alpha = 0.835 \text{ cm}^2/\text{sec}$ and $\Lambda = \frac{\Delta t}{(\Delta x)^2}$
- Q10. What are the different governing equations used for solving the fluid mechanics and heat transfer problems? Write these equations in Cartesian co-ordinates. Also write different boundary conditions used for solving these governing equations.
- Q11. Derive the finite difference expressions for a first order derivative with forward, backward and central difference approximations using Taylor series expansion.