2055
B.E. (Mechanical Engineering)
Eighth Semester
MEC-803: Computational Fluid Dynamics

Time allowed: 3 Hours   Max. Marks: 50

NOTE: *Attempt five questions in all, including Question No. I which is compulsory*
and selecting two questions from each Part.   All questions carry 10 marks.

x-x-x

1. (a) How does the conservation form of equations differ from the non-conservation

    form? Explain with an example.

   (b) Explain the differences and similarities between explicit and implicit methods in

    CFD.

   (c) Why is the finite volume method preferred over finite difference method for

    fluid flow problems?

   (d) Explain the first-order upwind scheme. What is its main drawback?

   (e) When is the Thomas algorithm used in CFD solvers?

PART-A

2. (a) Discuss the trade-offs between accuracy, time and cost in analytical,

    experimental and computational fluid dynamics.

   (b) Derive the continuity equation for a compressible fluid in conservation form and

    convert it into non-conservation form.

3. (a) Explain the physical meaning of each term in the Naiver-Stokes equations. How

    do they simplify for in-compressible flows?

   (b) Explain the classification of partial differential equations using Cramer's rule.

    Give examples of fluid governed by each type.

4. (a) Find the finite difference equation for Laplace equation using central difference

    approximation. Discuss the factors which contribute to errors in finite

    difference formulation.

   (b) Explain explicit and implicit approaches for solving partial differential

    equations with suitable examples. Also discuss their advantages and

    disadvantages.

PART-B

5. (a) Derive the finite volume discretization of the 1D steady diffusion equation. Discuss boundary condition implementation.

   (b) Explain the discretization of the convection-diffusion equation using the upwind scheme. Analyze its truncation error.

6. (a) Discuss in detail the advantages and disadvantages of finite volume method (FVM).

   (b) Write a note on different difference schemes. Why are higher order upwind schemes are more favourable than the first-order upwind scheme?

7. (a) What is meant by staggered grid? Explain the importance of staggered grids for the incompressible flow computations. $(5 + 10)$

   (b) Explain the concept of SIMPLE algorithm with pressure correction and velocity correction equations. What is the difference between SIMPLE and SIMPLER algorithms?

x-x-x