Exam.Code:0944
Sub. Code: 6753

2053

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 Section. All questions carry equal marks.

x-x-x

1. (a) What are the important applications of CFD in engineering?
   (b) Distinguish between conservation and non-conservation forms of fluid flow.
   (c) What are the different categories of boundary conditions? Give example of each category.
   (d) Compare implicit and explicit methods.
   (e) Discuss the need of upwind type discretization. (5×2)

SECTION-A

2. (a) Compare the merits and demerits of experimental fluid dynamics, theoretical fluid dynamics and computational fluid dynamics.
   (b) Derive the x-momentum equation for unsteady 3-dimensional flow. (5+5)
3. (a) Define and develop expression for substantial derivative. (3 + 7)
   (b) Explain the different models of fluid flow with derivation of continuity equation.
4. (a) Classify the following system of PDEs according to eigen value method:

   $\frac{\partial u}{\partial x}+\frac{\partial v}{\partial y}=0$; $\frac{\partial v}{\partial x}-\frac{\partial u}{\partial y}=0$, where u, v are dependent variables.

   (b) Prove that second order wave equation: $\frac{\partial^2 u}{\partial t^2}=\frac{\partial^2 u}{\partial x^2}$ is hyperbolic.
   (c) Write a note on well-posed and ill-posed problems. (5 + 2 + 3)

SECTION-B

5. (a) Derive the finite difference expressions for a first and second order derivatives with forward, backward and central difference approximations using Taylor series expansion with the leading error term. (3 + 3 + 4)
   (b) Distinguish between rounding off error, truncation error and discretization error.
   (c) Consider 1-dimensional wave equation $\frac{\partial u}{\partial t}+a\frac{\partial u}{\partial x}=0$. Discretize the equation and hence deduce dissipative term and dispersive term.
6. (a) Discuss finite volume method for 1-D and 2-D diffusion problems.
   (b) Compare upwind and central difference approximations for convection-diffusion problems. (5+5)
7. (a) Explain SIMPLE algorithm. Compare SIMPLE and SIMPLER algorithms.
   (b) What is Ti-diagonal matrix algorithm (TDMA)? Why it is used? Explain the algorithm in detail. (5+5)

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