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Seventh Semester B.E. Degree Examination, June/July 2024
Computational Fluid Dynamics

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Derive momentum equation in non-conservative form and deduce it to conservative form. **(12 Marks)**

  b. Write a short note on:
    i) Shock capturing method
    ii) Shock fitting method. **(08 Marks)**

OR

2 a. Derive substantial derivative equation and arrive at an expression in the following form:
$$\rho.\frac{Du}{Dt} = \frac{\partial(\rho u)}{\partial t} + \nabla(\rho u V).$$
(10 Marks)

  b. Define boundary conditions and write a note on physical boundary conditions used in CFD. **(10 Marks)**

Module-2

3 a. How does a quasi-linear partial differential equation get classified and explain using Cramer's rule. **(10 Marks)**

  b. Describe the external features of elliptic equation and explain its impact on physical behaviour of flow field. **(10 Marks)**

OR

4 a. Explain the mathematical behaviour of parabolic equation along with one case-study. **(10 Marks)**

  b. Consider an irrotational, 2-D, inviscid, steady compressible flow, classify the characteristic lines using Eigen-value method for
$$\left(1-M_\infty^2\right)\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} = 0$$
$$\frac{\partial u}{\partial y} - \frac{\partial v}{\partial x} = 0$$
(10 Marks)

Module-3

5 a. With the help of relevant sketch, explain the elliptic grid generation. **(10 Marks)**

  b. Write a note on the following:
    i) Structured grids
    ii) Unstructured grids. **(10 Marks)**

OR

6 a. What are adaptive grids? Describe 2 types of grid adaptive methods. **(10 Marks)**

  b. Describe Hermite polynomial interpolation. **(10 Marks)**

Module-4

7   a. Briefly explain about time marching and space marching. **(10 Marks)**
    b. Summarize stability analysis of explicit, implicit and multistep method. **(10 Marks)**

OR

8   a. Illustrate on Lax-Wendroff marching method. **(10 Marks)**
    b. Write a note on the following:
       i)   Numerical viscosity
       ii) Upwind scheme
       iii) Alternating direction implicit. **(10 Marks)**

Module-5

9   a. Briefly explain about cell-centered scheme. **(10 Marks)**
    b. Summarize about spatial discritization. **(10 Marks)**

OR

10 a. Briefly explain cell-vertex scheme overlapping control volume. **(10 Marks)**
    b. Explain high resolution scheme and upwind biasing. **(10 Marks)**

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