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18AE72

Seventh Semester B.E. Degree Examination, Dec.2024/Jan.2025

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. List the needs and applications of CFD in aerospace and non aerospace engineering. (06 Marks)
- b. Illustrate the Euler and Lagrangian approaches. (06 Marks)
- c. Derive the differential form of continuity equation using control volume approach, fixed in space for 3D flow. (08 Marks)

OR

- 2 a. Derive the differential form of momentum equation using infinitesimal small fluid element approach in conservation form. (10 Marks)
- b. Discuss the physical boundary conditions used in CFD. (04 Marks)
- c. Illustrate the shock capturing and shock fitting approaches. (06 Marks)

Module-2

- 3 a. Classify the quasi-linear partial differential equations and describe. (10 Marks)
- b. Apply the Eigen value method to determine the classification of PDE. (10 Marks)

OR

- 4 Discuss the following case studies with suitable sketches. (20 Marks)
 - i) Steady inviscid supersonic flow
 - ii) Steady boundary layer flow
 - iii) Unsteady thermal conduction

Module-3

- 5 a. Illustrate the essential features of structured and unstructured grids. (10 Marks)
- b. Discuss the elliptically generated boundary fitted grid for physical plane and computational plane. (10 Marks)

OR

- 6 a. Illustrate the mechanism of adaptive grids. (10 Marks)
- b. Describe the grid quality by mentioning the factor effecting it. (10 Marks)

Module-4

- 7 a. Illustrate the different finite difference modules (any 3). (10 Marks)
- b. Illustrate the explicit and implicit approaches. (10 Marks)

OR

- 8 a. With suitable expressions, deduce the metrics and Jacobian of a transformation. (10 Marks)
- b. Discuss the following : (10 Marks)
 - i) Time marching and space marching
 - ii) Relaxation technique

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8=50, will be treated as malpractice.

Module-5

- 9 a. Illustrate the cell centered and cell vertex techniques. (10 Marks)
b. List and describe the importance of FVM, also the difference between FVM and FDM. (10 Marks)

OR

- 10 a. Describe the numerical dissipation and dispersion. (10 Marks)
b. Discuss the flux vector splitting and approximate factorization with an example. (10 Marks)

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