



CBCS SCHEME

18AE72

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:
- Shock capturing method
 - 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
$$(1 - M_\infty^2) \frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} = 0$$
$$\frac{\partial u}{\partial y} - \frac{\partial v}{\partial x} = 0$$
 (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:
- Structured grids
 - 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 discretization. (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)
