A

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. Truncation error becomes zero as mesh spacing tends to   CO1- U

    (a) maximum   (b) minimum   (c) zero   (d) equal

2. Region of flow trailing a body where effect of that body is felt on velocity   CO1- U
    field is called

    (a) flow region   (b) wake   (c) trailing region   (d) velocity region

3. For compressible, two-dimensional flows, the minimum number of partial   CO1- U
    differential equations (PDE) to be solved is

    (a) 3   (b) 4   (c) 5   (d) 6

4. For partial differential equation, if $b^2 - 4ac < 0$ then equation is called   CO1- U

    (a) hyperbolic   (b) parabolic

    (c) elliptic   (d) cyclic

5. What is the characteristic feature of the central differencing scheme in 1D   CO1- U
    steady convection-diffusion problems?

    (a) first-order accurate   (b) always stable

    (c) second-order accurate   (d) introduces numerical diffusion

6. Which of the following discretization schemes is generally more stable for   CO1- U
    high Peclet number flows?

    (a) central differencing   (b) upwind differencing

    (c) quick scheme   (d) backward differencing

7. Vorticity is mathematically defined as   CO1- U

(a) $\nabla \cdot \vec{V}$ (b) $\nabla \times \vec{V}$ (c) $\frac{\partial p}{\partial x}$ (d) $\Delta \psi$

8. The purpose of staggered grids is to   CO1- U

(a) Reduce CPU time   (b) Avoid pressure–velocity decoupling

(c) Improve convergence rate   (d) Reduce storage

9. The mixing length model of turbulence was proposed by   CO1- U

(a) Kolmogorov   (b) Prandtl

(c) Smagorinsky   (d) Reynolds

10. In Large Eddy Simulation (LES), which part of turbulence is modeled?   CO1- U

(a) Large eddies   (b) Small scales

(c) Both large and small scales   (d) None

<div align="center">PART – B (5 x 2= 10 Marks)</div>

11. What are the fundamental governing equations of fluid dynamics?   CO1 - U

12. Write the Equation of unsteady one dimensional heat conduction.   CO1 - U

13. What is meant by steady one-dimensional convection-diffusion?   CO1 - U

14. Outline the main advantage of using a staggered grid arrangement in CFD   CO1 - U

15. Differentiate between High-Reynolds number and Low-Reynolds number k-ε CO1 - U
    models.

<div align="center">PART – C (5 x 16= 80Marks)</div>

16. (a) Derive the momentum equation for a 3D compressible flow   CO2-Ap (16)
<div align="center">Or</div>
    (b) Derive the Accuracy of Finite Difference Solutions   CO2-Ap (16)

17. (a) Derive Implicit Schemes for parabolic equations.   CO2-Ap (16)
<div align="center">Or</div>
    (b) Identify finite difference methods in steady flow and derive FVM for   CO2-Ap (16)
         3D Steady State Diffusion.

18. (a) Discuss the numerical implementation of central differencing and   CO3- Ap (16)
         upwind differencing schemes
<div align="center">Or</div>

<div align="center">2</div>

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(b) Derive the finite difference discretized form of the steady 1D   CO3- Ap (16)
convection-diffusion equation using the Central Differencing
Scheme (CDS)

19. (a) Interpret the relation between stream function and velocity   CO4- Ap (16)
components for 2D incompressible flow.

<div align="center">Or</div>

(b) Solve SIMPLE algorithm step by step and explain with a flow chart.   CO4- Ap (16)

20. (a) Apply the k-ε turbulence model by deriving and using its governing   CO5- Ap (16)
equations to solve for turbulent kinetic energy and dissipation.

<div align="center">Or</div>

(b) Solve sub-grid scale modeling equation and also explain the   CO5- Ap (16)
principles of LES.

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