19ASB304 - COMPUTATIONAL FLUID DYNAMICS FOR AEROSPACE APPLICATION

Question Bank

UNIT II – DISCRETIZATION

Part A – 2 Mark Questions

(Remembering, Understanding, and Applying Levels)

1. Define the **boundary layer equation** in fluid dynamics. *(Remembering)*
2. What are the key **assumptions** made in boundary layer theory? *(Understanding)*
3. List different **methods for solving boundary layer equations**. *(Remembering)*
4. Define **implicit time-dependent methods**. *(Understanding)*
5. How do **implicit methods** differ from **explicit methods**? *(Analyzing)*
6. What is the significance of **numerical dissipation** in CFD? *(Understanding)*
7. Explain the concept of **stability in numerical methods**. *(Understanding)*
8. What is meant by the **stability property of an explicit method**? *(Understanding)*
9. How does **numerical dissipation affect the accuracy** of a numerical scheme? *(Applying)*
10. What are the advantages of **implicit time-dependent methods** for compressible flows? *(Understanding)*
11. Define a **conservative upwind discretization scheme**. *(Understanding)*
12. Why are **upwind schemes preferred for hyperbolic systems**? *(Understanding)*
13. Differentiate between **upwind and central differencing schemes**. *(Analyzing)*
14. What is a **hyperbolic system in fluid dynamics**? *(Understanding)*
15. Explain the term **conservative discretization**. *(Understanding)*
16. How does **upwind differencing help in reducing numerical oscillations**? *(Analyzing)*
17. What are the key **advantages of upwind differencing** over other discretization schemes? *(Analyzing)*
18. Define **viscous and inviscid compressible flow**. *(Understanding)*
19. What are the main **challenges in solving boundary layer equations numerically**? *(Analyzing)*

20. What is **artificial viscosity**, and how does it relate to numerical dissipation? *(Understanding)*

Part B – 16 Mark Questions

(Applying, Analyzing, Evaluating, and Creating Levels)

1. Derive the boundary layer equations and discuss different methods for solving them. ***(Applying)***
2. Compare explicit and implicit time-dependent methods for solving inviscid and viscous compressible flows. ***(Analyzing)***
3. Explain the role of numerical dissipation in computational fluid dynamics and its effect on solution accuracy. ***(Applying)***
4. Discuss the stability properties of explicit and implicit numerical methods, highlighting their advantages and limitations. ***(Analyzing)***
5. Explain conservative upwind discretization for hyperbolic systems and derive its governing equations. ***(Applying)***
6. Evaluate the importance of upwind differencing in solving hyperbolic PDEs. How does it improve numerical stability? ***(Evaluating)***
7. Analyze the advantages of implicit schemes over explicit schemes in terms of numerical stability and convergence. ***(Analyzing)***
8. Illustrate the impact of numerical dissipation in computational schemes with suitable examples. ***(Applying)***
9. Explain the challenges in solving viscous compressible flow equations and propose numerical strategies to overcome them. ***(Evaluating)***
10. Compare different upwind schemes, such as first-order and higher-order methods, in terms of accuracy and computational cost. ***(Analyzing)***
11. Develop a numerical algorithm using an upwind differencing scheme for solving hyperbolic systems. ***(Creating)***
12. Critically assess the role of artificial viscosity in numerical simulations and propose techniques to optimize its effects. ***(Evaluating)***
13. Design an implicit numerical method for solving boundary layer equations in high-speed flows. ***(Creating)***
14. Propose a hybrid numerical scheme that combines explicit and implicit methods for improved stability and accuracy. ***(Creating)***

15. Discuss the real-world applications of upwind differencing in aerospace and computational fluid dynamics. ***(Evaluating)***

16. Evaluate the impact of numerical errors in boundary layer solutions and suggest approaches to minimize them. ***(Evaluating)***