Full Marks: 70   **Time: 3 hrs**

*Answer any five (5) from Part A and **any four (4)** questions from Part B*

Part A (2 Marks each) any five (5)

1. What is upwinding?
2. What is turbulence modeling? Classify it.
3. Write down the basic ideas behind splitting of convective flux?
4. Define interpolation and extrapolation.
5. What are errors influence numerical solutions the PDE? Define them.
6. Define flux Jacobian considering 1-d Euler equation.

Part B (15 Marks each) any four (4)

7. a) Define and explain consistency in finite difference representation of partial differential equation. (5)

   b) Consider the equation

   $$\frac{\partial T}{\partial t} + u\frac{\partial T}{\partial x} + v\frac{\partial T}{\partial y} = \alpha\left[\frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2}\right]$$

   Where T is the dependent variable which is convected and diffused. The independent variables, x and y, are in space while t is the time (evolution) coordinate. The coefficient u, v and α can be treated as constant. Employing forward difference for the first order derivatives and central second difference for the second order derivatives, obtain the finite difference equation. What is the physical significance of the difference between the above equation and the equation actually being solved? Suggest a method to overcome this difference. (10)

8. a) Explain the conservative property in CFD considering inviscid Burger's equation. (7)

   b) Examine the stability characteristics of the first order wave equation. (8)

9. Define semi explicit finite volume method for the incompressible Navier-Stokes (NS) equations. Solve the NS equations by considering the so called predictor and corrector steps.

10. a) Explain the different boundary conditions like no-slip, free slip, inlet, outlet using equations and proper diagram. (10)

    b) Explain farfield Riemann boundary conditions with mathematical expressions. (5)

11. a) Write the advantages and disadvantages of structured and unstructured grid. (3)

    b) Write short notes over C-, H- and O-structured grid topology with applications. (7)

    c) Write overviews of unstructured grid generation. (5)

12. a) From two dimensional Navier-Stokes equations in conservative differential form, obtain an integral equation and express it in a semi-discretized form. (6)

    b) Describe the convective flux splitting by Advection Upstream Splitting Method (AUSM+). (9)