

IV B.Tech I Semester Supplementary Examinations, April/May 2005
COMPUTATIONAL AERODYNAMICS
(Aeronautical Engineering)

Time: 3 hours**Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) What is the difference between the differential and integral form of continuity equation.
 (b) Compare the different type of continuity equations with their applications.
 (c) Write complete Navier-Stokes equations in non-conservative form.
 (d) What are the different forms of the general fluid flow problems and which form is best suited for CFD analysis.

2. (a) Show that Second order wave equation given below is hyperbolic in nature

$$\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$$
 (b) Explain finite differences method of discretization and derive the equations for forward finite differences.

3. (a) The temperature ratio for an isentropic flow is given by

$$\frac{T_o}{T} = 1 + \frac{\gamma-1}{2} M^2$$
 The value of T_o/T at $M=2.0$ is 1.8 find the value at $M=2.5$ using finite differences and find the error w.r.t exact value.
 (b) Derive the difference equation for the heat equation

$$\frac{\partial T}{\partial t} = \alpha \frac{\partial^2 T}{\partial x^2}$$

4. The equation for a 2D unsteady flow is given as

$$\frac{\partial U}{\partial t} + \frac{\partial F}{\partial x} + \frac{\partial G}{\partial y} = 0$$
 Write the equation in $\frac{\partial U1}{\partial t} + \frac{\partial F1}{\partial x} + \frac{\partial G1}{\partial y} = 0$
 Form and find the expressions of U1, F1, G1 using Jacobians.

5. (a) Form a grid over an airfoil and derive the expression for transformation in to computational plane.
 (b) With the help of a sketch show the grid generation on an airfoil.

6. (a) Derive a discretized form of generic integral form of momentum and energy equations.
 (b) Derive the expression for divergence of the velocity vector and state its physical significance.

7. Write short notes on the following:
 - (a) Round off error

- (b) Discretization error
 - (c) Left turning Characteristic
8. (a) Discuss the different panels used in panel method for finding the solutions of flow problems.
- (b) Discuss the numerical solution of shock in a convergent divergent nozzle.
