

**2008 JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY****III B.TECH SEMESTER SUPPLEMENTARY EXAMINATIONS  
COMPUTATIONAL AERO DYNAMICS  
(AERONAUTICAL ENGINEERING)**

AUG/SEP 2008

TIME : 3 HR  
MARK : 80**Answer any FIVE Questions  
All Questions carry equal marks**

1. Why Computational Fluid Dynamics is important in the modern practice of fluid dynamics? Illustrate with an example.
2. Derive the energy equation in terms of total energy for a viscous flow on the basis of flow model of infinitesimally small fluid element moving with the flow.
3. How shock capturing and shock fitting methods handle shock waves in computational fluid dynamics? What are the merits and demerits of these methods?
4. Discuss the mathematical and physical behavior of flows governed by parabolic equations with an example of unsteady thermal conduction in two and three dimensions.
5. Consider the function  $f(x,y) = ex+ey$ . Consider the point  $(x,y) = (1,1)$ 
  - (a) Calculate exact values of  $\frac{\partial f}{\partial x}$  and  $\frac{\partial f}{\partial y}$  at this point
  - (b) Use first-order forward differences, with  $\Delta x = \Delta y = 0.1$ , to calculate approximate values of  $\frac{\partial f}{\partial x}$  and  $\frac{\partial f}{\partial y}$  at point(1,1). Calculate the percentage difference when compared with the exact values.
  - (c) Use second-order central difference, with  $\Delta x = \Delta y = 0.1$ , to calculate approximate values for  $\frac{\partial f}{\partial x}$  and  $\frac{\partial f}{\partial y}$  at point (1, 1). Calculate the percentage difference when compared with the exact value.
6. What are metrics and derive the relationship between the direct and inverse metrics.
7. Explain the elliptic grid generation with simply connected domain and doubly connected domain.
8. Write a short notes on:
  - (a) Elliptic grid
  - (b) Parabolic grid
  - (c) Hyperbolic grid.