

**B.Tech. AEROSPACE ENGINEERING
(BTAE)**

Term-End Examination

00045

December, 2014

**BASE-005 : INTRODUCTION TO COMPUTATIONAL
FLUID DYNAMICS**

Time : 3 hours

Maximum Marks : 70

Note : Answer any **seven** questions. Use of scientific calculator is permitted.

1. (a) What is CFD ? Explain the reasons for the present growth of CFD in aerospace applications. 5
- (b) Differentiate between finite control volume approach and infinitesimal fluid element approach of models of fluid flow. 5
2. (a) List the available structured grid generation techniques. 5
- (b) Explain the algebraic grid generation technique. 5
3. Describe Von Neumann stability analysis with suitable examples. 10

4. Write short notes on the following :
- (a) Strong and weak conservation forms of governing equations 5
- (b) Shock capturing method 5
5. Explain the two methods available to develop hyperbolic grid generator. 10
6. What are metrics ? Derive the relationship between the direct and inverse metrics i.e.

$$\frac{\partial \xi}{\partial x} = \frac{1}{J} \frac{\partial y}{\partial \eta} \quad \frac{\partial \eta}{\partial x} = -\frac{1}{J} \frac{\partial y}{\partial \xi}$$

$$\frac{\partial \xi}{\partial y} = -\frac{1}{J} \frac{\partial x}{\partial \eta} \quad \frac{\partial \eta}{\partial y} = \frac{1}{J} \frac{\partial x}{\partial \xi}$$

where symbols have their usual meaning. 10

7. Derive integral and differential forms of continuity equations on the basis of flow models of control volume moving with the fluid and infinitesimally small element moving with the fluid respectively. 10
8. Explain the mathematical and physical nature of flows governed by hyperbolic equations with an illustration of steady, inviscid, supersonic flow over a two-dimensional circular arc airfoil. 10

9. (a) How is the source term $S = (S_C + S_P T)$, where S_C and S_P are constants ? Explain the negative linearisation of source term with the help of suitable examples. 5
- (b) What is upwind scheme ? How is it applicable for solving the convection term ? 5
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