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**BASE-005**

# B.Tech. AEROSPACE ENGINEERING (BTAE)

## Term-End Examination

00463 **June, 2018**

## BASE-005 : INTRODUCTION TO COMPUTATIONAL FLUID DYNAMICS

*Time : 3 hours* *Maximum Marks : 70*

***Note :*** *Answer any* ***seven*** *questions. All questions carry equal marks. Use of scientific calculator is permitted.*

**1.** (a) What are the sources of errors in CFD analysis ? How can it be minimized ? *5*

(b) Differentiate between conservative and non-conservative forms of fluid flow. *5*

**2.** (a) Explain the principle of panel methods used in CFD. *5*

(b) List out the advantages and limitations of panel methods. *5*

3. (a) Explain the algebraic grid generation technique with suitable example. 5

(b) Describe the shock capturing method. 5

4. Describe Von Neumann stability analysis with suitable examples. 10

5. (a) Explain the physical behaviour of Hyperbolic PDE in CFD, with suitable examples. 5

(b) List out the differences between finite volume and finite difference method. 5

6. (a) What are the theoretical aspects of transonic flow ? 5

(b) Show that the Laplace's equation is as given below : 5

$$\frac{\partial^2 \phi}{\partial x^2} + c^2 \frac{\partial^2 \phi}{\partial y^2} = 0$$

7. Define Isentropic flow. What do you mean by quasi-one dimensional flow ? Derive the expression for governing equations of quasi-one dimensional steady, isentropic flow by considering equation of state. 10

8. (a) Using Taylor's series, derive the backward difference expression for $\frac{\partial u}{\partial y}$. 5

(b) Discuss about the Dirichlet and Neumann boundary conditions with suitable examples. 5

9. Explain the shock fitting and shock capturing techniques using neat appropriate sketches. 10

10. Write short notes on any ***two*** of the following : $2 \times 5 = 10$

(a) Consistency

(b) Convergence

(c) Finite Volume Method

(d) Weighted Residual Formulation