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BASE-005

B.Tech. AEROSPACE ENGINEERING (BTAE)

Term-End Examination

00298

June, 2016

BASE-005 : INTRODUCTION TO COMPUTATIONAL FLUID DYNAMICS

Time : 3 hours *Maximum Marks : 70*

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

1. (a) Derive the energy equation for a viscous flow in conservative form. 5

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

2. (a) Explain the difficulties of evaluating the influences of a panel at its own control point. 5

(b) Discuss the application of CFD in Aerospace Engineering. 5

3. (a) Classify the following system of equations : 5

(i) $\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} = 0$

(ii) $\frac{\partial v}{\partial x} - \frac{\partial u}{\partial y} = 0$

(b) Draw the propagation of disturbance in subsonic, supersonic and sonic speeds. 5

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

(b) Discuss the need of upwind type discretization. Explain. 5

5. (a) State and explain the difference between explicit and implicit methods with suitable examples. 5

(b) Differentiate between structured and unstructured grids. 5

6. Derive the continuity equation in differential form for incompressible flow. 10

7. (a) Show that the Laplace's equation given below is elliptical in nature : 5

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

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

8. (a) Compare the generation of grids in physical and computational planes. *5*

(b) Draw a neat sketch and show vortex lattice along a wing. *5*

9. Derive the first order accurate forward difference and backward finite difference approximation for the second derivative of 'f' with respect to 'x', using Taylor series expansion. *10*

10. Explain the need for turbulence modeling in dealing with CFD problems. What are the various turbulence models used in CFD problems ? *10*