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BASE-005

B.Tech. AEROSPACE ENGINEERING (BTAE)

Term-End Examination

December, 2016

00113

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) What is CFD ? How can it be applied in aerodynamics ? *5*

(b) Differentiate between finite control volume approach and infinitesimal fluid element approach of models of fluid flow. *5*

2. What are the different types of panels used in the analysis of flow using Panel method ? Explain any one method with neat diagram. *10*

3. Solve the following system of equations : *10*

$2x + y + z = 10$

$3x + 2y + 3z = 18$

$x + 4y + 9z = 16$

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

(b) What are the sources of errors in CFD Analysis ? How can they be minimized ? 5

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

(b) Explain the various computer graphic techniques used in CFD. 5

6. Derive the Navier-Stokes equation in conservation form. 10

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

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

(b) Explain vortex lattice along a wing, with a neat sketch. 5

9. (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) What is the importance of CFL (Courant-Friedrichs-Lewy) condition ? Explain. 5

10. (a) What is upwind scheme ? How is it applicable for solving the convection term ? 5

(b) What are the different categories of boundary conditions ? Give examples of each category. 5

11. Write short notes on the following : $4 \times 2\frac{1}{2} = 10$

(a) Degree of Freedom

(b) Convergence

(c) Galerkin Formulation

(d) Lax Equivalence Theorem