B.Tech. AEROSPACE ENGINEERING (BTAE)

Term-End Examination

June, 2017

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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 important applications of CFD in engineering ?   5

   (b) List out the advantages and limitations of Panel method.   5

2. (a) Derive the continuity equation for an inviscid flow in partial differential non-conservation form.   5

   (b) Discuss in detail about shock capturing and shock fitting methods.   5

3. Solve the following equations by the Gauss-Seidel method : *10*

$$10x_1 - 2x_2 - x_3 - x_4 = 3$$
$$-2x_1 + 10x_2 - x_3 - x_4 = 15$$
$$-x_1 - x_2 + 10x_3 - 2x_4 = 27$$
$$-x_1 - x_2 - 2x_3 + 10x_4 = -9$$

4. (a) Explain the need for turbulence modeling in dealing with CFD problems. What are the various turbulence models used in CFD problems ? *5*

   (b) Explain the algebraic grid generation technique. *5*

5. Describe the Von Neumann stability analysis with suitable examples. *10*

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

   (b) How are the boundary conditions and initial conditions applied to the nozzle flow ? *5*

7. Using vortex panel method, obtain the lift generated by a plate considering N vortex panels. Make necessary assumptions. *10*

8. What is a Finite Element Method (FEM) ? Explain why should one use it. *10*

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

(a) Consistency

(b) Supersonic Flow

(c) Weighted Residual Formulation

(d) Round-off and Discrimination Errors

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