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Question Paper Code : 91038

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2014.

Seventh Semester

Aeronautical Engineering

AE 2402/AE 72/10122 AE 703 — COMPUTATIONAL FLUID DYNAMICS

(Regulation 2008/2010)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What are the characteristics of a well–posed problem?

2. What is the nature of the equation if all eigen values are non–zero and all but one are of the same sign.

3. What is meant by a multiply–connected region? Give examples.

4. Give an application for C–grid.

5. Compare the stability aspect of explicit and implicit equation solving approaches.

6. Write the boundary layer equations for a two dimensional flow

7. What is the need for an isoparametric element?

8. What is meant by weighted–residual formulation?

9. Write the vorticity–stream function transport equations.

10. What are the typical grid types used in finite volume method.

PART B — (5 × 16 = 80 marks)

11. (a) Identify the mathematical properties and explain the behavior of the following types of flows:

(i) steady inviscid supersonic flow (8)

(ii) unsteady inviscid compressible flow. (8)

Or

(b) Explain the procedure to determine the Lift for an arbitrary two-dimensional body using source panel method. (16)

12. (a) Explain Delauny Triangulation and the algorithm involved in detail. (16)

Or

(b) Explain partial differential equation method of structured grid generation in detail with examples. (16)

13. (a) Explain the concept of numerical dissipation with a suitable example. Show that numerical dissipation is equivalent to artificial viscosity. (16)

Or

(b) Explain the conservative upwind discretiation of an Hyperbolic system using a suitable example. (16)

14. (a) Explain the strong and weak formulation of a boundary value problem using examples. (16)

Or

(b) Use two—term Galerkin's method of weighted residuals to obtain an approximate solution of the differential equation $\frac{d^2y}{dx^2} - 10x^2 = 5$ $0 \le x \le 1$. With boundary conditions $y(0) = y(1) = 0$. (16)

15. (a) Explain the PISO solver algorithm in detail. (16)

Or

(b) Explain Runge—Kutta Time stepping method in detail with emphasis on stability and accuracy of the method. (16)