

Register Number:

B.E DEGREE EXAMINATIONS: APRIL/MAY 2014

(Regulation 2009)

Fifth Semester

AERONAUTICAL ENGINEERING

AER111: Computational Fluid Dynamics

Time: Three Hours

Maximum Marks: 100

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. In computational techniques the systems with partial differential equations are transformed into.
 - a) algebraic equations
 - b) ordinary differential equations
 - c) energy equations
 - d) continuity equations
2. If the equation is elliptic then it should satisfy one of the following.
 - a) $B^2-4AC < 0$
 - b) $B^2-4AC > 0$
 - c) $B^2-4AC=0$
 - d) $B^2+4AC < 0$
3. Panel methods are also known as
 - a) boundary element method
 - b) point method
 - c) Kraus method
 - d) element method
4. _____ method is best suited to compute flow over lifting bodies
 - a) Source panel
 - b) Lift panel
 - c) Uniform panel
 - d) Vortex panel
5. Round off error is associated with
 - a) computer
 - b) experiment
 - c) transformation
 - d) human error
6. _____ condition will alert the unstable behavior of the solution
 - a) $|\epsilon_i^{n+1} / \epsilon_i^n| \leq 1$
 - b) $|\epsilon_i^{n+1} / \epsilon_i^n| > 1$
 - c) $|\epsilon_i^{n+1} / \epsilon_i^n| = 0$
 - d) $|\epsilon_i^{n+1} / \epsilon_i^n| \neq 1$
7. The shape of sub domains of FEM for two-dimensional application is
 - a) tetrahedral
 - b) pentahedral
 - c) quadrilateral
 - d) hexahedral
8. Collocation method is a type of
 - a) Galerkin scheme
 - b) Weighted residual scheme
 - c) Stability analysis
 - d) cell vertex Formulation

9. Range- Kutta schemes are expressed in
 - a) implicit schemes
 - b) explicit schemes
 - c) variational schemes
 - d) residual schemes
10. One of the following is finite volume scheme
 - a) vector point formulation
 - b) node point formulation
 - c) scalar point formulation
 - d) line point formulation

PART B (10 x 2 = 20 Marks)

11. Distinguish between conservation and non-conservation forms of fluid flow.
12. What is discretization in CFD? Write down some of the methods available.
13. List out two panel methods and its flow applications.
14. Define vortex and frozen flow.
15. Define discretization error and round off error.
16. What is Courant number and give its significance in CFD?
17. Give two types of Shape functions definition used in FEM.
18. What is a boundary value problem?
19. What is cell-centered method?
20. Write about the advantages and disadvantages of Finite Volume Method.

PART C (5 x 14 = 70 Marks)

21. a) Derive the first and second order, mixed partial derivatives in x and y direction for FDM discretization using Taylor series.

(OR)

- b) What are the explicit and implicit methods used to solve elliptic equations? Explain the Explicit methods in detail using one example.
22. a) Write down the procedure for the calculation of pressure coefficient distribution around a circular cylinder using the source panel technique.

(OR)

- b) (i) Derive a source- dipole panel distribution for a stream line flow over a flat element with constant and linear density distribution (7)
- (ii) Discuss the vortex panel method applied to lifting flow over a flat plate. (7)

23. a) Explain in detail about the solution strategy followed for 'simple flow problems' like Subsonic and Supersonic flow problems.

(OR)

b) Explain about the various stability regions and its significance in CFD

24. a) Write in detail about strong formulation with the help of one dimensional boundary value problem.

(OR)

b) Write in detail about any two of the formulations available in FEM.

25. a) (i) Explain about the concept of Up-wind Type Discretization applicable to FVM. (7)

(ii) Solve inviscid Burger's equation using Lax – Wendroff method. (7)

(OR)

b) Explain in detail about the Range-Kutta multi-stage time stepping available for cell-centered method.
