KUMARAGURU
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Register Number:……..

B.E DEGREE EXAMINATIONS: MAY 2015

(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. _____ is the base principle in continuity equation.
   a) Mass is conserved b) Momentum is conserved
   c) Energy is conserved d) Force is conserved
2. The second order 1-D wave equation is classified as.
   a) Elliptic b) Parabolic
   c) Hyperbolic d) Supersonic
3. Inviscid, irrotational, incompressible flow is governed by _____
   a) Euler's equation b) Laplace's equation
   c) Bernoulli's equation d) Reynolds's equation
4. Vortex flow is _____
   a) Rotational b) Bi-directional
   c) Irrotational d) Axial
5. Governing equation of Subsonic problem will be_____
   a) Parabolic b) Hyperbolic
   c) Elliptic d) Linear
6. _____ condition will alert the unstable behavior of the solution.
   a) $|\varepsilon_i^{n+1}/\varepsilon_i^n| \leq 1$ b) $|\varepsilon_i^{n+1}/\varepsilon_i^n| > 1$
   c) $|\varepsilon_i^{n+1}/\varepsilon_i^n| = 0$ d) $|\varepsilon_i^{n+1}/\varepsilon_i^n| \neq 1$
7. In FEM, domain is subdivided into cells, called _____
   a) Volume b) Element
   c) Face d) Surface

8. Standard finite element method is based on a_____

a) Weak Formulation b) Strong Formulation

c) Normal Formulation d) Regular Formulation

9. Piecewise constant interpolation in FVM is denoted by

a) cell-centered method b) cell-vertex method

c) cell-line method d) cell-curve method

10. FVM is having one of the main advantages of FEM, which is_____

a) Domain Flexibility b) Geometric flexibility

c) Volume flexibility d) Structural flexibility

PART B (10 x 2 = 20 Marks)

11. What is substantial derivative? and give its components.
12. Write down the different modeling approaches used in CFD to derive the governing equations?
13. Define Doublet.
14. Write down two Panel methods and it's applications.
15. Write about 'Absolute Stability'.
16. What is Courant number and give its significance in CFD?
17. List out differences between finite volume and finite difference methods.
18. Give two types of Shape functions definition used in FEM.
19. What is cell-centered formulation in Finite Volume Method (FVM)
20. Define FEM-Like FVM.

PART C (5 x 14 = 70 Marks)

21. a) What is the need of transformation of curvilinear, non uniform grid in physical plane to rectangular grid in computational plane? And also explain why the governing equations must be transformed from (x, y) to (ξ, η) as the new independent variables, with suitable derivations for first and second derivatives.

(OR)

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

22. a) Discuss the vortex panel method applied to lifting flow over a flat plate.

(OR)

b) Write down the procedure for the calculation of pressure coefficient distribution around a circular cylinder using the source panel technique.

23. a) Describe the concept of ‘numerical dissipation’ using an example.

(OR)

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

24. a) Explain the basic observations and features of ‘Discretization using FEM’.

(OR)

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

25. a) Explain in detail about the Runge-Kutta multi-stage time stepping.

(OR)

b) Explain cell-vertex scheme for solving non-overlapping and overlapping control volumes.

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