



Register Number: .....

**B.E DEGREE EXAMINATIONS: NOV/DEC 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. Choose the following one which satisfies the parabolic condition of PDE
  - a)  $B^2 - 4AC > 0$
  - b)  $B^2 - 4AC = 0$
  - c)  $B^2 - 4AC < 0$
  - d)  $B^2 - 4AC \geq 0$
2. Find the Laplace equation( $\phi$ ), If the flow is uniform and ir-rotational and moves with velocity  $V_\infty$  in X direction
  - a)  $\phi = V_\infty \cdot X$
  - b)  $\phi = V_\infty^2 \cdot X$
  - c)  $\phi = V_\infty \cdot (2X)$
  - d)  $\phi = 0$
3. Determine the type of system, If the system having “n” equations and “n+1” unknowns
  - a) Stable
  - b) Over determined
  - c) Under determined
  - d) Stable and over determined
4. Select any following option which one requires for Elliptical equation
  - a) Only boundary condition
  - b) Only initial condition
  - c) One boundary and one initial condition
  - d) One boundary and two initial condition
5. Which type of grid network automatically clusters at high flow field gradients
  - a) Mixed element grid
  - b) Uniform grid
  - c) Adaptive grid
  - d) Compressed grid
6. Choose the following one which gives the stability criterion for hyperbolic equation (C is courant number)
  - a)  $C = 1$
  - b)  $C < 1$



b) (i) Construct the expression for the transformation of equation from physical space  $(x, y, t)$  to transformed space  $(\xi, \eta, \tau)$ . (10)

(ii) Explain the nature of equation  $(\partial^2 u / \partial x^2) - (2 \partial^2 u / \partial x \partial y) + (\partial^2 u / \partial y^2) = 0$  (4)

22. a) Write down the procedure for lifting flow over arbitrary 2D bodies using vortex panel method and Prove the lift produced by the rotating body is proportional to circulation.

**(OR)**

b) Write down the procedure for the calculation of pressure coefficient distribution around a circular cylinder using the Source Panel method.

23. a) (i) Illustrate the description of Prandtl boundary layer equation. (8)

(ii) What are the differencing schemes used in numerical analysis and explain the methods used in explicit formulation of hyperbolic equation. (6)

**(OR)**

b) (i) Construct the forward, backward and central difference approximation to the first derivative, along with the leading error term. (8)

(ii) Explain the Upwind differencing scheme and Advantages of upwind differencing scheme. (6)

24. a) (i) Explain the weight residual and Galerkin formulation used in Finite Element Method using boundary value problems. (10)

(ii) Explain the essential characteristics of Finite Element Method in CFD. (4)

**(OR)**

b) (i) Show the expression for strong formulation in Finite Element Method using boundary value problems. (7)

(ii) Explain the Piecewise Defined Shape Functions using Finite Element Interpolation method. (7)

25. a) (i) Show the Lax Vendroff time step method used in Finite Volume Method. (5)

(ii) Show Multistage Time stepping method used in Finite Volume Methods. (5)

(iii) Summarize the Runge kutta method used in cell centered formulation. (4)

**(OR)**

b) (i) What are the types of pressure correction solvers used in numerical analysis and (8)  
Illustrate the SIMPLE algorithm for pressure corrections.

(ii) Summarize the Cell Vertices, Cell Centres and Staggered grid approach used in (6)  
FVM.

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