Code No: 07A72102 **R07** **Set No. 2**

IV B.Tech I Semester Examinations,December 2011
COMPUTATIONAL AERO DYNAMICS
Aeronautical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. Write a short notes on:
   (a) Elliptic grid
   (b) Parabolic grid
   (c) Hyperbolic grid. [5+5+6]

2. Let u=u(x,y)
   $x = x(\xi, \eta, t)$
   $y = y(\xi, \eta, t)$
   $t = t(\tau)$
   Show that
   $\frac{\partial u}{\partial y} = \frac{1}{J}\left[\left(\frac{\partial u}{\partial \eta}\right)\left(\frac{\partial x}{\partial \xi}\right)\left(\frac{\partial}{\partial \xi}\right)\left(\frac{\partial x}{\partial \eta}\right)\right]$. [16]

3. (a) Convert $\partial/\partial t[\int\limits_V \int\int \rho dV] + \int\limits_S \int \rho \nabla \bullet ds = 0$ *into* $\partial\rho/\partial t + \nabla \bullet (\rho V) = 0$
   (b) Convert D/Dt $[\int\limits_V \int\int \rho dV] = 0$ into $\partial/\partial t[\int\limits_S \int\int \rho dV] + \int\int \rho \nabla \bullet ds = 0$ [8+8]

4. What are the ways of handling shocks in computational fluid dynamics? Discuss their merits and demerits. [16]

5. (a) How Computational Fluid Dynamics is helpful as a research tool? Illustrate with an example?
   (b) How Computational Fluid Dynamics is useful as a design tool? Illustrate with an example? [8+8]

6. Explain O, H, C grid topology with their application. [16]

7. (a) What is stability and its importance in CFD?
   (b) What is converged solution? [8+8]

8. Explain the mathematical and physical nature of flows governed by parabolic equations with an illustration of a steady boundary layer flow. [16]

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Code No: 07A72102 **R07** **Set No. 4**

IV B.Tech I Semester Examinations,December 2011
COMPUTATIONAL AERO DYNAMICS
Aeronautical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) What is difference between computational plane and physical plane?
   (b) Write a short notes on transformations used in computational aerodynamics. [8+8]

2. (a) What are the factors considered in the grid generation?
   (b) Write the advantages and disadvantages of algebraic grids. [8+8]

3. (a) What is CFD? Explain the reasons for the present growth of CFD in aerospace applications.
   (b) Explain briefly finite control volume approach and infinitesimal fluid element approach of models of fluid flow. [8+8]

4. Discuss the mathematical and physical behavior of flows governed by hyperbolic equations with an example of steady, inviscid, supersonic flow over a two-dimensional circular-arc airfoil. [16]

5. Given the function f(x) = x^3-5x, calculate $\frac{\partial f}{\partial x}$ and $\frac{\partial^2 f}{\partial x^2}$ at x= 0.5 and 1.5 by second-order central, backward and forward differencing. Use step sizes 0.00001, 0.0001, 0.001, 0.01, 0.1, 0.2 and 0.3. Determine the numerical error for each computation. [16]

6. (a) Discuss about conservation form of governing flow equations and its importance in computational fluid dynamics.
   (b) Discuss why integral form of governing equations can be considered as more fundamental than differential form? Discuss with examples. [8+8]

7. Derive the energy equation in terms of internal energy for a viscous flow on the basis of flow model of infinitesimally small fluid element moving with the flow.[16]

8. Draw the suitable mesh required to carry out analysis over the aircraft wing and identify the regions of fine mesh on the grid. [16]

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Code No: 07A72102 **R07** **Set No. 1**

IV B.Tech I Semester Examinations,December 2011
COMPUTATIONAL AERO DYNAMICS
Aeronautical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) What are the errors enclosed in computational aero-dynamics?
   (b) Compare and contrast explicit and implicit formation methods. [8+8]
2. (a) What are the available structured grid generation techniques?
   (b) Explain the algebraic grid generation technique. [8+8]
3. Explain shock capturing and shock fitting methods for handling shocks in computational fluid dynamics along with their relative advantages and disadvantages. [16]
4. Write short notes on the following:
   (a) Physical Meaning of Substantial derivative
   (b) Vector processors. [8+8]
5. How does the transformation of equations helpful to solve complex fluid dynamics problems? [16]
6. How does the grid clustering helps in capturing shock waves? [16]
7. Discuss the mathematical and physical nature of flows governed by elliptic equations with an illustration of incompressible, inviscid flow. Explain Newmann and Dirichlet boundary conditions. [16]
8. Derive energy equation in integral form. [16]

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Code No: 07A72102 **R07** **Set No. 3**

IV B.Tech I Semester Examinations,December 2011
COMPUTATIONAL AERO DYNAMICS
Aeronautical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) What is the difference between structured grid and unstructured grid?
   (b) Write a short note on principle of structured mesh generation. [8+8]
2. What is Computational Fluid Dynamics? Illustrate any two applications of CFD in Automobile industry? [16]
3. Derive the two differential forms of continuity equation on the basis of flow models of infinitesimally small element fixed in space and infinitesimally small element moving with the fluid. [16]
4. Write short notes on the following:
   (a) Parabolized Navier-Stokes equations
   (b) Well-posed problems. [8+8]
5. How shock capturing and shock fitting techniques are helpful in handling shocks? Discuss their relative merits and demerits. [16]
6. Explain Von Newmann stability analysis with an example. [16]
7. Explain the significance of:
   (a) Aspect ratio.
   (b) Skewness factor.
   (c) Impact of parameters in (a) and (b) over the quality of mesh.
   (d) Grid point clustering. [4+4+4+4]
8. Let u=u(x,y)
   x=x(ξ, η)
   y=y(ξ, η)
   find $\frac{\partial u}{\partial x}, \frac{\partial u}{\partial y}$ and express Jacobian determination. [16]

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