www.firstranker.com

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

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

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

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. (a) Discuss with a neat diagram shock capturing method along with its merits and demerits.
   (b) Explain why conservation form of governing equations is important for calculations using shock capturing method. [8+8]

2. Derive the x-component of momentum equation $\rho Du/Dt = -\partial\rho/\partial x + \partial\tau_{xx}/\partial x + \partial\tau_{yx}/\partial y + \partial\tau_{zx}/\partial z + \rho f_x$ using appropriate flow model and write y-and z-components of momentum equation. [16]

3. (a) Explain any two applications of Computational Fluid Dynamics in automobile industry.
   (b) Describe the different steps involved in the process of Computational Fluid Dynamics. [8+8]

4. What are doubly connected and multiply connected domains? [16]

5. What are metrics and derive the relationship between the direct and inverse metrics. [16]

$$i.e.\quad \begin{array}{ll} \frac{\partial\xi}{\partial x} = \frac{1}{J}\ \frac{\partial y}{\partial \eta} & \frac{\partial\eta}{\partial x} = -\frac{1}{J}\ \frac{\partial y}{\partial \xi} \\ \frac{\partial\xi}{\partial y} = -\frac{1}{J}\ \frac{\partial x}{\partial \eta} & \frac{\partial\eta}{\partial y} = \frac{1}{J}\ \frac{\partial x}{\partial \xi} \end{array}$$

6. Write short notes on the following:
   (a) Parabolized Navier-Stokes equations
   (b) Well-posed problems. [8+8]

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

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]

⋆ ⋆ ⋆ ⋆ ⋆

www.firstranker.com

FIRSTRANKER

www.firstranker.com

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

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

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

Answer any FIVE Questions
All Questions carry equal marks
⋆⋆⋆⋆⋆

FIRSTRANKER

1. Classify the following partial differential equations according to their nature as elliptic/parabolic or hyperbolic
   (a) Unsteady Thermal Conduction Equation: $\partial T/\partial t = \alpha\partial^2 T/\partial t^2$
   (b) Laplace's Equation: $\partial^2\phi/\partial x^2 + \partial^2\phi/\partial y^2 = 0$
   (c) Second-order wave equation: $\partial^2 u/\partial t^2 = c^2\partial^2 u/\partial x^2$
   (d) First - order wave equation: $\partial u/\partial t + c\partial u/\partial x = 0$. [4+4+4+4]
2. Write short notes on
   (a) Conservation form
   (b) Non-conservation form of governing flow equations. [8+8]
3. Why Computational Fluid Dynamics is important in the modern practice of fluid dynamics? Illustrate with an example. [16]
4. Consider the diffusion equation given by $\frac{\partial u}{\partial t} = \alpha \frac{\partial^2 u}{\partial x^2}$. Write an implicit Crank Nicolson formulation. [16]
5. What are the available structured grid generation techniques and explain elliptic grid generation. [16]
6. Draw the suitable grid to capture the oblique shock wave generated by transonic flow on a simple cone. [16]
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. 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]

⋆⋆⋆⋆⋆

www.firstranker.com

www.firstranker.com

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

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

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

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. (a) What is curvilinear grid and uniform grid?
   (b) How to reduce curvilinear grid in to uniform grid? [8+8]
2. (a) Derive the continuity equation $D\rho$ /Dt + $\rho\nabla \bullet \nabla$ =0 assuming appropriate flow model. Convert this equation to conservation form.
   (b) What are the different types of temperature boundary conditions that are generally prescribed on the surface of a body in viscous flows? [10+6]
3. Explain grid point clustering with neat sketches. [16]
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. Write short notes on the following:
   (a) Strong and weak conservation forms of governing equations.
   (b) Shock capturing method. [8+8]
6. Explain the use of partial differential equations mapping methods. [16]
7. (a) What are the limitations of finite difference method?
   (b) Write a short notes on finite volume method. [8+8]
8. (a) What are vector processors and parallel processors? Explain their role in Computational Fluid Dynamics.
   (b) Explain with an example the importance of Computational Fluid Dynamics in modern study of fluid Dynamics. [8+8]

⋆ ⋆ ⋆ ⋆ ⋆

FIRSTRANKER

www.firstranker.com

www.firstranker.com

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

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

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

Answer any FIVE Questions
All Questions carry equal marks

⋆⋆⋆⋆⋆

1. How does transformations are helpful to reduce non uniform mesh in to uniform mesh such that the finite difference schemes can be applied for computation. [16]

2. (a) Explain the relevance of conservation and non-conservation forms for handling shocks in computational fluid dynamics.
   (b) Discuss why integral form of governing equations is more fundamental than differential form. [8+8]

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

4. Write short notes on the following:
   (a) Physical Meaning of Substantial derivative
   (b) Vector processors. [8+8]

5. Discuss the mathematical and physical behavior of flows governed by parabolic equations with an example of unsteady thermal conduction in two and three dimensions. [16]

6. Explain conservation and non-conservation forms of governing flow equations with illustrations from continuity equation. Comment on Integral versus differential form of the governing flow equations. [16]

7. Compare algebric and partial differential equation methods for grid generation.[16]

8. Explain Von Newmann stability analysis with an example. [16]

⋆⋆⋆⋆⋆

FIRSTRANKER

www.firstranker.com