CODE NO: 07A7EC08 | R07 | SET - 1

IV B.TECH - I SEMESTER EXAMINATIONS - MAY, 2011
COMPUTATIONAL FLUID DYNAMICS
(COMMON TO ME, MCT, AME)

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

Answer any FIVE questions
All Questions Carry Equal Marks

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1. Explain the direct method for matrix inverse? Briefly explain partial pivoting and LU decomposition used in direct method. [16]

2. A steel rod of length, 50 cm, diameter, 2 cm and thermal conductivity, 55 W/m-K is kept at a temperature of 150^0C at its base. The fin is exposed to fluid of heat transfer coefficient, 15 W/m^2K and temperature, 20^0C. The tip of the rod is kept at 50^0C. Obtain the temperature distribution for the fin using finite difference method and also calculate what amount of heat is lost from the surface maintained at 50^0C. [16]

3. Explain the term consistency in numerical schemes and in detail explain the behavior of errors and analyze them. [16]

4. Explain incompressible Reynolds Averaging Navier Stokes equation and write a note on averaging of property. [16]

5. Using Von Neumann Stability Analysis, obtain the criterion for stability of Explicit scheme for discretization of 1D parabolic equation. [16]

6. Derive the 2-D momentum equation to obtain the dimensionless form of it. [16]

7. Define Vorticity? How the pressure gradient term is eliminated from the momentum equations using Vorticity – Stream Function method? What are the disadvantages of this method in determination flow field? [16]

8. Write short notes on:

   a) Upwind scheme in 1D convection – diffusion problem.
   b) Implicit scheme in transient heat conduction.
   c) Staggered grid in modeling of 1D convection – diffusion problem. [16]

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CODE NO: 07A7EC08 | R07 | SET - 2

IV B.TECH - I SEMESTER EXAMINATIONS - MAY, 2011
COMPUTATIONAL FLUID DYNAMICS
(COMMON TO ME, MCT, AME)

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

Answer any FIVE questions
All Questions Carry Equal Marks
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1. Give the classification of linear PDEs. What are the different discretization schemes that are used to solve parabolic equations? Compare them. [16]

2. A steel rod of length, 50 cm, diameter, 2 cm and thermal conductivity, 55 W/m-K is kept at a temperature of 150^0C at its base. The fin is exposed to fluid of heat transfer coefficient, 15 W/m^2K and temperature, 20^0C. The tip of the rod is kept at 50^0C. Obtain the temperature distribution for the fin using finite difference method and also calculate what amount of heat is lost from the surface maintained at 50^0C. [16]

3. Consider a square slab of side, L. The right, left and bottom surfaces of the slab are kept at 100^0C, while the top surface is kept at 500^0C. The thermal conductivity of the slab is 2 W/mK. Taking the mesh size as L/3, obtain the finite difference temperature distribution of slab. [16]

4. What are different types of errors that occur during the discretization of PDEs? Using the Von Neumann Stability analysis, obtain the stability criterion for the explicit formulation of parabolic equations. [16]

5. Define Vorticity? How the pressure gradient term is eliminated from the momentum equations using Vorticity – Stream Function method? What are the disadvantages of this method in determination flow field? [16]

6. What are the basic parameters used to assess interpolation schemes in finite volume formulation of Convection – Diffusion problems? [16]

7. What are different schemes of interpolation used in the discretization of 1D Convection – Diffusion problem? Write about Central Difference Scheme in detail and compare them. [16]

8. Write short notes on any *two* of the following:
   a) What are the four basic rules for discretization using Finite Volume Method?
   b) What are different methods to evaluate matrix inverse for the solution of simultaneous algebraic equations? Compare them.
   c) ADI scheme. [16]

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CODE NO: 07A7EC08 | R07 | SET - 3

IV B.TECH - I SEMESTER EXAMINATIONS - MAY, 2011
COMPUTATIONAL FLUID DYNAMICS
(COMMON TO ME, MCT, AME)

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

Answer any FIVE questions
All Questions Carry Equal Marks
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1. Obtain the finite difference formulation for 2-D steady state heat conduction of solid cylinder in r-θ plane subjected to a temperature of T_S at its outer surface. Discuss the peculiarities in the discretization of curvilinear grid compared to the Cartesian grid and how the singularities are handled in the present case. [16]

2. A square slab of side, L is subjected to 50^0C on its right side, 0^0C on its top side, 150^0C on its left side and 250^0C on its bottom. Considering the mesh size in x and y directions as L/3, obtain the steady state temperature distribution for the square slab using Guass Seidel Method. What is the temperature distribution at the end of 5 iterations? [16]

3. What is meant by banded matrices? Explain the algorithm to solve tridiagonal matrices. [16]

4. Using the Von Neumann Stability analysis, obtain the stability criterion for the explicit formulation of Parabolic equations. [16]

5. Define Vorticity? How the pressure gradient term is eliminated from the momentum equations using Vorticity – Stream Function method? What are the disadvantages of this method in determination flow field? [16]

6. Explain how pressure and velocity are linked using SIMPLE algorithm for 2D momentum equations? [16]

7. What are different schemes of interpolation used in the discretization of 1D Convection – Diffusion problem? Write about Upwind Schemes in detail and compare them. [16]

8. Write short notes on any *two* of the following:
   a) Explain ADI scheme for the discretization of 2D parabolic equations.
   b) What are different methods to evaluate matrix inverse for the solution of simultaneous algebraic equations? Compare them.
   c) What are the basic parameters used to assess interpolation schemes in finite volume formulation of Convection – Diffusion problems? [16]

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CODE NO: 07A7EC08 | R07 | SET - 4

IV B.TECH - I SEMESTER EXAMINATIONS - MAY, 2011
COMPUTATIONAL FLUID DYNAMICS
(COMMON TO ME, MCT, AME)

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

Answer any FIVE questions
All Questions Carry Equal Marks
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1. List out the properties of Numerical solution methods in detail. [16]

2. Two ends of a fin of cross sectional area 2 cm^2, perimeter 2 cm, 100 cm long are maintained at 127^0C and 227^0C respectively. It losses heat from the surface due to natural convection to the surroundings at 27^0C with the heat transfer coefficient of 5W/m^2K. The thermal conductivity of fin material is 45 W/m K. Find the temperature distribution in the fin taking the mesh size as 20 cm. Compare the finite difference solution with analytical solution and tabulate both the values. [16]

3. a) What are the different types of Numerical grids? Illustrate them by figures.
   b) What are the relative advantages and disadvantages of Explicit and Implicit methods applied to linear parabolic equations? [16]

4. a) What are the sources of error in the numerical solution of given partial difference equation?
   b) Derive the expression for the stability criterion for the finite difference solution of the ID unsteady heat conduction using Von Neumann Analysis. [16]

5. A stainless steel rod of 20mm diameter is carrying an electric current of 1000A. The thermal and electrical conductivities are 20 W/mK and 1.25 X 10^4 $(\Omega\ cm)^{-1}$. What is the temperature distribution from centre to surface if the outer surface is kept at 400^0C taking the mesh size as 2mm. [16]

6. A marble slab (k = 2 W/mK, α = 1 X 10^{-6} m^2/s) that is 2 cm thick is initially at a uniform temperature of 200^0C. Suddenly, one of its surfaces is lowered to 0^0C and is maintained at that temperature, while the other surface is kept insulated. Develop an explicit finite difference scheme for the determination of the temperature distribution in the slab at the end of nearly 50 seconds. [16]

7. Define Vorticity? Using Vorticity / Stream function method, derive the expression for momentum equation without pressure term? What are its advantages and disadvantages compared with other methods? [16]

8. Write short notes on any *two* of the following:
   a) Convergence techniques in Gauss Seidel method.
   b) Crank Nickolson Scheme.
   c) Turbulence models. [16]

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