Code No: 5421AP

R17

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech II Semester Examinations, June/July - 2018
COMPUTATIONAL FLUID DYNAMICS
(Thermal Engineering)

Time: 3hrs **Max.Marks:75**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

PART - A

5 × 5 Marks = 25

1.a) Discuss the importance of stability criteria for usage of Explicit scheme with example. [5]

b) What are the steps involved in solving the PDE using finite volume method? Explain. [5]

c) Differentiate among Elliptic, Parabolic and Hyperbolic equations applied to fluid flow. [5]

d) Explain the importance of the pressure correction in solving the fluid flow equations. [5]

e) How does the turbulence have the influence on the flow fields? Explain. [5]

PART - B

5 × 10 Marks = 50

2.a) Solve the following algebraic equations using Gauss elimination method.
$X_1 + 4X_2 + 8X_3 = 12$; $2X_1 + 6X_2 + X_3 = 10$; $3X_1 + 8X_2 + 4X_3 = 22$

b) What are different iterative methods used for solving for the simultaneous equations? Explain. [5+5]

OR

3.a) Formulate the finite difference equations for 1-D steady state heat conduction problems in spherical coordinate system and describe the solution.

b) A sphere of radius 5.0 cm in which heat is generated at a constant rate of 240 kW/m^3 with the boundary surface at outside is maintained at uniform temperature 42^0C. The thermal conductivity of a rod is 287 W/mK. Formulate the finite differences equation and calculate the temperature at nodes by dividing at least four divisions. [5+5]

4.a) What are the basic rules to be considered for solving the finite volume method for solving the generalized partial differential equations? Explain with the suitable example.

b) How do you determine the accuracy of the discretization process? What are the uses and difficulties of approximating the derivatives with finite volume methods? How do you overcome these difficulties? Explain. [5+5]

OR

5. How to formulate the solution for 1 D steady state heat conduction with internal heat generation using finite volume method? Discuss the difficulties associated with the finite volume method. [10]

6. What are different methods to solve the convection and diffusion coupled terms of the generalized differential equation given below:
$\partial(\rho u\phi)/\partial x = \partial(\tau\, \partial\phi/\partial x)/\partial x$
And also explain the limitations of upwind scheme over the other schemes. [10]

OR

7. How to consider the boundary conditions while solving the equations of convection and diffusion terms? Explain. [10]

8.a) Draw a flow chart and describe SIMPLE algorithm for two-dimensional laminar steady flow equations in Cartesian co-ordinates.

b) Compare SIMPLE with the SIMPLER algorithm and discuss the limitations of each. [5+5]

OR

9.a) Derive the vorticity equation for 2-D problems from the Navier Stokes equations and explain its limitations.

b) How does the staggered grid can help to overcome the difficulties in solving the pressure term of Navier Stokes equations? Explain. [5+5]

10.a) Explain large eddy simulation model for formulation of the turbulence velocity component into the CFD equations.

b) Describe the importance of pressure, velocity and density coupling for the compressible flows. [5+5]

OR

11.a) Explain the significance of High Reynolds number turbulence model used in CFD analysis with a suitable example.

b) Discuss the method to consider the normal shock in solving the equations for the compressible fluids. [5+5]

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