15AE72

Seventh Semester B.E. Degree Examination, Dec.2019/Jan.2020
Computational Fluid Dynamics

Time: 3 hrs.   Max. Marks: 80

Note: *Answer any FIVE full questions, choosing ONE full question from each module.*

Module-1

1   a.   With the help of neat sketches, explain the different models of the flow.   **(06 Marks)**
    b.   Derive the momentum equation considering an infinitesimally small fluid element moving with the flow, for an unsteady. Three dimensional, compressible and various flow with usual notations.   **(10 Marks)**

OR

2   a.   Explain the importance of CFD in modern study and the different architectures used in CFD.   **(08 Marks)**
    b.   Derive an expression for divergence of velocity with usual notation and explain its physical meaning.   **(08 Marks)**

Module-2

3   a.   Explain the different mathematical behavior of CFD equation that reflects different physied behavior of flow. Given an example for each case.   **(08 Marks)**
    b.   Describe the external features of hyperbolic equation and explain its impact on physical behavior of CFD problems.   **(08 Marks)**

OR

4   a.   Consider the irrigational two dimensional, inviscid steady flow of a compressible gas. If the flow field is only slight perturbed from the freestream conditions such as the flow over as thin body as small angles of attack and if the freestream mach number is either subsonic or supersonic (but not transonic or hypersonic) the governing conformity, momentum and energy equation can be reduced to the systems. Find the roots of equations involved in such kind of flow problem using Cramer's rule.   **(08 Marks)**
    b.   Explain the following with relevant sketches :
         i)   Parabolised viscous flow
         ii) Unsteady in viscous flow.   **(08 Marks)**

Module-3

5   a.   With the help of relevant sketch explain the elliptic grid generation.   **(08 Marks)**
    b.   Define grid quality. List the measures of quality and explain in detail.   **(08 Marks)**

OR

6   a.   List the advantages and disadvantages of structured and unstructured grids. Explain in brief.   **(08 Marks)**
    b.   Write short notes on : i) Adaptive grids   ii) Meshless grids.   **(08 Marks)**

Module-4

7 a. Demonstrate the explicit and implicit approach of solving CFD problems. List their advantages and disadvantages. (08 Marks)

   b. For an inviscid, incompressible, two-dimensional irrotational flow in a Cartesian space explain the steps involving in numerical solving by relaxation technique with suitable expressions. (08 Marks)

OR

8 a. Explain numerical and artificial viscosity with suitable expressions. (08 Marks)

   b. With suitable expressions, demonstrate the transformation of governing partial differential equations from physical domain to computational domain. (08 Marks)

Module-5

9 a. Write short notes on :
   i) Cell-centered technique
   ii) Cell-vertex technique. (10 Marks)

   b. With suitable expression explain explicit time stepping scheme. (06 Marks)

OR

10 Describe the following finite volume techniques with their applications :
   i) Flux vector splitting
   ii) Spatial discritization. (16 Marks)

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