CBCS SCHEME

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15AE72

Seventh Semester B.E. Degree Examination, Jan./Feb. 2023
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. Apply Cramer's rule to a quarilinear partial differential equation for the mathematical classification as elliptic, hyperbolic and parabolic. **(08 Marks)**

b. Explain the impact of partial differential equation classifications on unsteady thermal conduction phenomenon. **(08 Marks)**

OR

4 Describe the general behaviour of the different classes of partial differential equation. **(16 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. Differentiate between explicit and implicit approach of finite difference equations. **(08 Marks)**

b. Write short notes on :
i) Time and space marching in CFD
ii) Upwind schemes in CFD. **(08 Marks)**

OR

8 a. For the 2D steady flow, continuity equation in Cartesian co-ordinates obtain the transformation from physical plane to computational plane, using direct and inverse transformations. **(08 Marks)**

b. Derive the generic form of the governing flow equation with strong conservative form in the transformed space for 2D unsteady flow with no source term. **(08 Marks)**

Module-5

9 a. Derive an expression for flux vector splitting. **(10 Marks)**

b. Explain Upwind scheme. **(06 Marks)**

OR

10 a. Explain finite volume Discretization for a steady conduction equation :

$$\frac{\partial}{\partial x}\left(K\frac{\partial T}{\partial x}\right)+S=0$$

in 1 –d, where K is thermal conductivity and S is source term. **(08 Marks)**

b. Explain cell centered technique for spatial Discertization process. **(08 Marks)**

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