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15AE72

Seventh Semester B.E. Degree Examination, Feb./Mar. 2022  
**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 an example explain the role of computational Fluid dynamics as research tool in recent time. (08 Marks)  
b. Derive governing equation for the physical principle i.e.  $F = ma$  (Newton's Second law). (08 Marks)

**OR**

- 2 a. Differentiate between shock fitting and shock capturing method. (03 Marks)  
b. Derive an expression for divergence of velocity only its physical meaning. (05 Marks)  
c. Derive governing equation for conservation of energy. (08 Marks)

**Module-2**

- 3 a. Using Cramer's rule and eigen value method. Illustrate the procedure for actual set of equations

$$(1 - M_\infty^2) \frac{\partial u'}{\partial x} + \frac{\partial v'}{\partial y} = 0, \\ \frac{\partial u'}{\partial y} - \frac{\partial v'}{\partial x} = 0$$

(10 Marks)

- b. Classify Quasi-Linear PDE using Cramer Rule. (06 Marks)

**OR**

- 4 a. Describe the general behavior of PDE in the form of Hyperbolic, parabolic and elliptic forms of equation. (10 Marks)  
b. Comment on the Supersonic Blunt Body problem with the help of CFD. (06 Marks)

**Module-3**

- 5 a. Briefly explain the importance of adaptive grids. (08 Marks)  
b. Explain the features of Structured grids and Unstructured grids. (08 Marks)

**OR**

- 6 a. Explain : (i) Multiblock grid generation  
(ii) Advancing front method  
(iii) Delaunay-Voronoi diagram. (08 Marks)  
b. Explain structured and unstructured grids adaptive methods. (08 Marks)

**Module-4**

- 7 a. Explain Finite difference method and difference equations. (10 Marks)  
b. Explain second order Lax-Wendroff method. (06 Marks)

OR

- 8 a. Explain Boundary-fitted coordinate system for elliptic grid generation. (10 Marks)  
b. Differentiate between Explicit and Implicit approach of finite difference equation (06 Marks)

Module-5

- 9 a. Explain Cell Centered and Cell Vertex techniques. (08 Marks)  
b. Explain explicit and implicit time stepping techniques. (05 Marks)  
c. Explain the need of Finite Volume method. (03 Marks)

OR

- 10 a. Explain upwinding and high resolution scheme. (10 Marks)  
b. Explain Artificial dissipation and Flux limiters. (06 Marks)

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