

2023

**B.E. (Mechanical Engineering)**  
**Eighth Semester**  
**MEC-803: Computational Fluid Dynamics**

Time allowed: 3 Hours

Max. Marks: 50

**NOTE:** Attempt five questions in all, including Question No. 1 which is compulsory and selecting two questions from each Section. All questions carry equal marks.

x-x-x

1. (a) What are the three stages of a CFD software?
- (b) What is conservation and non-conservation forms of governing equations?
- (c) Show that the second order wave equation is hyperbolic:

$$\frac{\partial^2 u}{\partial t^2} = c \frac{\partial^2 u}{\partial x^2}.$$

- (d) Explain the need to discretize the domain.
- (e) Explain the features of TDMA method?

### SECTION-A

2. (a) Explain three different approaches of CFD. State the advantages of CFD over experimental fluid dynamics.
- (b) Explain the steps for CFD Preprocessing and Post Processing.
3. (a) Derive the continuity equation in differential form for in-compressible flow.
- (b) Derive an energy equation in non-conservation form.
4. (a) Prove that the classification of the PDE:  $(1 - 2 M^2) \frac{\partial^2 \rho}{\partial x^2} + \frac{\partial^2 \rho}{\partial y^2} = 0$  is different for different values of the parameter M.
- (b) Explain the different boundary conditions used in CFD. State their importance in solving fluid flow problem.

### SECTION-B

5. (a) How do you determine the accuracy of the discretization process? What are the uses and difficulties of approximating the derivatives with higher order finite difference schemes? How do you overcome these difficulties?

(2)

- (b) State and explain the difference between explicit and implicit methods with suitable examples.
6. (a) Discuss the finite volume method for the solution of 2D steady state diffusion problem. What are its advantages over the finite difference method?
- (b) Discuss the instability issues related to QUICK scheme and its reformulation.
7. Explain the concept of SIMPLE algorithm with pressure correction and velocity correction equations for incompressible fluid and give the importance of SIMPLER algorithm.

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