Indian Maritime University

(A Central University, Govt of India)

Supplementary Examinations – September/October 2024

Programme Name: B Tech (Marine Engineering)

Semester: V

Subject Code: UG11T4501

Subject Name: INTRODUCTION TO CFD

Date: 14.10.2024	Max Marks: 70
Duration: 03 Hrs	Pass Marks: 35

General Instructions

(i) All Sections (A,B & C) are to be attempted.
(ii) Options, if any, are specified in respective section.

Section A

Answer All Questions **10X1=10 Marks**

1. The first step in the finite volume method is to divide the domain into _____ control volumes.

2. Which of these will not come under the three main elements of CFD packages?

a) Pre-processor b) Post-processor c) Code creator d) Solver

3. Structured adaptive mesh is constructed by _____ function approach.

4. Computational stability, convergence, and accuracy may be improved using multistep intermediate step between _____ schemes.

5. The Navier-Stokes equations are _____ system of equations.

a) coupled b) uncoupled c) exponential d) radical

6. Which among these is used to specify a particular problem which we consider for solving in CFD?

a) Boundary conditions b) Governing equations

c) Governing laws d) Solution method

7. What is the method used in CFD to solve partial differential equations?

a) Variable separation
b) Method of characteristics
c) Change of variables
d) Discretization

8. Which of these apply to parabolic equations?

a) They have one real characteristic line

b) They have two real characteristic lines

c) They have two imaginary characteristic lines

d) They do not have characteristic lines

9. Which type of grids is the best for flow over an airfoil?

a) Stretched grids

b) Adaptive grids

c) Boundary-fitted grids

d) Elliptic grids

10. What is the main disadvantage of explicit schemes in a time-dependent problem?

a) Marching solution

b) Simultaneous equations

c) Small time-step size

d) Small grid size

Section B

Answer All Questions **5X2=10 Marks**

11. What are the three stages of a CFD software?

12. Write down the advantages of adaptive grid?

13. What is point Gauss-Seidel iteration method?

14. Runge – Kutta fourth order method is used to solve the differential equation $\frac{dy}{dx} = y - x$. If the initial value y (0) = 2 and step-size is 0.1, then determine the value of k_1, k_2, k_3 and k_4.

15. Write short notes on finite volume and finite element methods.

Section – C

Answer Any FIVE Questions **5X10=50 Marks**

16. (a) Explain the steps involved in the process of computational fluid dynamics (CFD).

(b) How CFD can be used as a design tool?

(c) Discuss some of the applications of CFD in engineering. (3+3+4)

17. Derive Navier-stokes equation in conservation form based on conservation of momentum. (10)

18. (a) What are the different types of partial differential equations? Classify and describe their solution methods.

(b) Discuss briefly about the rules for discretization. (5+5)

19. (a) Describe explicit FTCS method for solving partial differential equations.

(b) Explain the features of Crank-Nicolson scheme. (5+5)

20. Write down the governing equations of fluid flow, stating the assumptions in deriving the equation and then explain the significance of each term? (10)

21. Explain total variation diminishing (TVD) property with its applications in CFD. (10)

22. Derive the unsteady, three-dimensional mass conservation or continuity equation at a point in a compressible fluid. (10)