Indian Maritime University

(A Central University, Govt of India)

End Semester Examinations – June 2023

Programme Name: M Tech (NAOE)

Semester: II

Subject Code: PG11T2202

Subject Name: Computational Fluid Dynamics

Date: 31.05.2023	Max Marks: 60
Duration: 03 Hrs	Pass Marks: 30

General Instructions

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

Section A:

10 MCQs of 01 Mark Each = 10 Marks

1. What does Fig.1 represent?

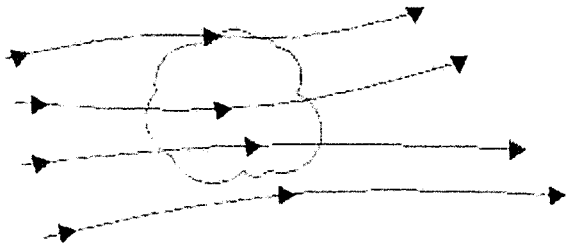

Fig.1

(a) Finite control volume moving with the flow
(b) Finite control volume fixed in space
(c) Infinitesimally small control volume moving with the flow
(d) Infinitesimally small control volume fixed in space

2. Choose the right equation for substantial derivative $\frac{D\rho}{Dt}$

(a) $\frac{D\rho}{Dt} = \frac{d\rho}{dt} + u.\frac{du}{dx} + v.\frac{dv}{dy} + w.\frac{dw}{dz}$

(b) $\frac{D\rho}{Dt} = \frac{\partial\rho}{\partial t} + u.\frac{du}{dx} + v.\frac{dv}{dy} + w.\frac{dw}{dz}$

(a) $\frac{D\rho}{Dt} = \frac{d\rho}{dt} + u.\frac{\partial u}{\partial x} + v.\frac{\partial v}{\partial y} + w.\frac{\partial w}{\partial z}$

(b) $\frac{D\rho}{Dt} = \frac{\partial\rho}{\partial t} + u.\frac{\partial u}{\partial x} + v.\frac{\partial v}{\partial y} + w.\frac{\partial w}{\partial z}$

3. The Navier-Stokes equations are _____ system of equations
(a) coupled
(b) uncoupled
(c) exponential
(d) logarithmic

4. The Laplace equation, $\nabla^2 \emptyset = 0$ represents _____ class of equations
(a) parabolic
(b) hyperbolic
(c) elliptic
(d) circular

5. The methods used to classify the PDEs are
(a) Lagrangian and Eulerian
(b) Eigen value and Lagrangian
(c) Cramer's and Lagrangian
(d) Cramer's and Eigen Value

6. The Neumann and Dirichlet boundary conditions are _____ and _____ respectively.
(a) value fixed; flux specified
(b) flux specified; value fixed
(c) flux specified; gradient specified
(d) gradient specified; time specified

7. Which is not a type of boundary condition in CFD?
(a) wall boundary conditions
(b) symmetry boundary conditions
(c) cyclic boundary conditions
(d) nodal boundary conditions

8. Discretization of the partial differential equation results in
(a) integral equations
(b) partial differential equations
(c) algebraic equations
(d) higher-order equations

9. Adaptive grids change automatically based on
(a) flow field gradients
(b) temporal change of flow properties
(c) grid gradients
(d) spatial change of flow properties

10. The advantage of implicit schemes is
(a) truncation errors
(b) stability
(c) convergence
(d) consistency

Section B:

5 out of 7 Questions of 8 Marks Each = 40 Marks

11.(a) Compare the merits of CFD over experimental methods

(4 marks)

(b) Write is Finite Volume Method

(4 marks)

12.Develop the conservative and non-conservative forms of continuity equation.

13. Explain Cramer's method in detail for classifying partial differential equations.

14.Explain the formulation of RANSE equations and the significance of turbulence modelling.

15.With the help of neat sketches describe the forward and backward difference techniques.

16.Differentiate between structured and unstructured grid.

17.Explain with a flow chart the PISO algorithm.

Section C:

1 out of 3 Questions of 10 Marks Each = 10 Marks

18. Describe the detailed CFD procedure in the calculation of ship resistance.

19. Find the first derivative of $y = e^x$ at $x=4.0$ using forward, backward and central difference schemes and compare the answers with that obtained analytically. Use a step size $\Delta x = 0.1$. Comment on your computations.

20.Discuss the class of PDEs used in incompressible fluid flow problems. Also comment on the various boundary conditions used in a CFD solver for solving a typical problem on sea-keeping.