Name: **Enrolment No:**	

UPES

End Semester Examination, December 2023

Course: Computational Fluid Dynamics **Semester: VII**

Program: B. Tech ME **Time 03 hrs.**

Course Code: ASEG 4005P **Max. Marks: 100**

SECTION A

S. No.		Marks	CO
Q 1	Discuss the importance of transformation in CFD.	**4**	**CO1**
Q 2	Discuss on various error sources in CFD.	**4**	**CO2**
Q 3	Analyze the factors and fundamental principles to be considered when making decisions about grid sizing in a CFD simulation.	**4**	**CO3**
Q 4	Elaborate on the strategies employed to optimize the stability of a CFD simulation	**4**	**CO4**
Q 5	Compare finite volume approach with finite difference approach for fluid flow simulations.	**4**	**CO5**
	SECTION B		
Q 6	Apply second law of motion to a control volume and hence derive the momentum equation in integral form. Use mathematical theorems to convert it into differential equation form.	**10**	**CO1**
Q 7	Derive the second order accurate discretized term for $\frac{\partial^2}{\partial x \partial y}$. **OR** Assume a function u(x) as given below: $u = 2x^2 - 10x$ Calculate the exact value of $\frac{du}{dx}$ at x = 2. Also calculate the approximate value of $\frac{du}{dx}$ at the same point (x = 2) on grid size of 0.1, using following methods: a) First order forward difference b) Second order central difference Based on your answers, comment on the accuracy of the above methods.	**10**	**CO2**

Q 8	The 2D inviscid incompressible flow is governed by Laplace equation as given below: $$\frac{\partial^2 \varphi}{\partial x^2} + \frac{\partial^2 \varphi}{\partial y^2} = 0$$ Transform the above equation from physical plane (x,y) to computational plane (ε,η).	**10**	**CO3**
Q 9	Emphasis on the formulation of cell centered approach for solving fluid flow problems.	**10**	**CO4**
	SECTION-C		
Q 10	Compare implicit approach with explicit approach of solving governing equation. Mention advantages and disadvantages of both the approaches. Formulate the set of mathematical equations using implicit approach for one-dimensional heat conduction equation and hence explain the concept of time marching.	**20 (10+10)**	**CO4**
Q 11	Formulate the mathematical equations of Lax-Wendroff method for solving fluid flow problems. **OR** Formulate the mathematical equations of Alternating-Direction-Implicit (ADI) technique for solving fluid flow problems.	**20**	**CO5**