Name: **Enrolment No:**	UPES UNIVERSITY OF TOMORROW

UPES

End Semester Examination, Dec, 2024

Course: Computational Fluid Dynamics **Semester: VII**
Program: B.Tech ASE **Time 03 hrs.**
Course Code: ASEG 4005 **Max. Marks: 100**

SECTION A

S. No.		Marks	CO
Q1.	Identify four different key applications of CFD in aerospace engineering.	**4**	**CO1**
Q2.	Evaluate the impact of discretization on the accuracy of CFD simulations.	**4**	**CO2**
Q3.	Emphasize the need of numerical stability in CFD.	**4**	**CO3**
Q4.	Describe the concept of artificial viscosity in CFD, discussing its application in CFD simulations.	**4**	**CO4**
Q5.	Compare cell-centered and cell-vertex formulations.	**4**	**CO5**

SECTION B

Q6.	Discuss the steps involved in CFD analysis, emphasizing each step's significance in obtaining accurate results.	**10**	**CO1**
Q7	Perform mathematical manipulations to prove that all four forms of continuity equation i.e conservational integral form, non-conservational integral form, conservational differential form, and non-conservational differential form are euivalent to each other.	**10**	**CO2**
Q8	Explain the process of transforming governing PDEs from the physical domain to the computational domain, and evaluate its significance in modeling complex flow domains.	**10**	**CO3**
Q9	Formulate an implicit scheme for solving the one-dimensional heat conduction equation: $$\frac{\partial T}{\partial t} = \alpha \frac{\partial^2 T}{\partial x^2}$$ **OR** Compare explicit and implicit finite difference methods, analysing their stability, convergence, and computational efficiency.	**10**	**CO4**

SECTION-C			
Q 10	Consider a rod of length 1 m, initially at 25°C with both boundary temperatures held at 100°C, using the one-dimensional unsteady heat conduction equation: $$\frac{\partial T}{\partial t} = \alpha \frac{\partial^2 T}{\partial x^2}$$ Discretize the computational domain with $\Delta x = 0.2$ m and $\Delta t = 0.01$ s, and consider $\alpha = 0.01\ m^2/s$. Use FTCS scheme to discretize the governing equation. Calculate the temperature distribution over the rod for the first five time steps.	**20**	**CO5**
Q 11	Formulate the MacCormack technique to solve the fluid flow equations, provide practical examples of its application, and discuss its advantages and limitations. **OR** Formulate the relaxation techniques and illustrate the utilization of successive over and under relaxation for achieving faster convergence.	**20**	**CO4**