U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

June 2025 Semester End Main Examinations

Programme: B.E. **Semester: VI**

Branch: Aerospace Engineering **Duration: 3 hrs.**

Course Code: 20AE6DECFD **Max Marks: 100**

Course: COMPUTATIONAL FLUID DYNAMICS

Instructions: 1.Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

			UNIT - I	*CO*	*PO*	Marks
1	a)		What is the physical meaning of divergence of velocity? What is its relation with the continuity equation?	*CO1*	*PO1*	**5**
	b)		What are the physical boundary conditions for an inviscid and viscous flow when there is a flow over a wall?	*CO1*	*PO1*	**10**
	c)		List five applications of CFD in aerospace engineering.	*CO1*	*PO1*	**5**
			OR			
2	a)		Transform non-conservation form of differential continuity equation into differential conservation form.	*CO1*	*PO1*	**5**
	b)		Derive the continuity equation for the infinitesimally small element fixed in space.	*CO1*	*PO1*	**10**
	c)		Define substantial derivative, local derivative and convective derivative and explain with suitable examples.	*CO1*	*PO2*	**5**
			UNIT - II			
3	a)		Apply Cramer's rule to a quasi-linear PDE for the mathematical classification as elliptic, parabolic and hyperbolic by deriving the discriminant.	*CO1*	*PO1*	**20**
			OR			
4	a)		Explain about the Domain and boundaries for the solution of hyperbolic equations in a 2D steady flow.	*CO1*	*PO1*	**5**
	b)		What type PDE is used in boundary layers? What happens when the boundary layer is not thin when the entire flow of interest is fully viscous?	*CO1*	*PO1*	**5**
	c)		Explain briefly on the behavior of elliptic equations and also the propagation of disturbances in a subsonic inviscid flow.	*CO1*	*PO1*	**10**

			UNIT - III			
	5	a)	What is Boundary-fitted co-ordinate system? Explain.	*CO2*	*PO1*	**10**
		b)	Explain the disadvantages of rectangular grid. Also, how it is disadvantageous for a profile like an airfoil and how this disadvantage can be overcome?	*CO2*	*PO1*	**10**
			OR			
	6	a)	Define (i) Aspect ratio, (ii) Skewness, (iii) Grid Independence, (iv) Hybrid grid.	*CO2*	*PO1*	**10**
		b)	Explain the algebraic grid generation with an example. Explain briefly what quantities are necessary to solve using finite differences if numerical methods are used?	*CO2*	*PO1*	**10**
			UNIT - IV			
	7	a)	Derive the equation for Temperature distribution for a 1D steady state heat conduction starting from Taylor's series.	*CO3*	*PO2*	**15**
		b)	Write the advantages and disadvantages of explicit and implicit methods.	*CO3*	*PO1*	**5**
			OR			
	8	a)	Write the significance of first three terms in Taylor's series expansion.	*CO3*	*PO1*	**5**
		b)	Explain the methodology of Crank-Nicholson implicit differencing scheme for the governing parabolic partial differential equation with respect to space and time.	*CO3*	*PO2*	**15**
			UNIT - V			
	9	a)	Write briefly about the cell-centered and cell-vertex techniques.	*CO3*	*PO1*	**08**
		b)	Derive an expression for calculating the average value of u for the successive nodes using the Governing Equation for 1D finite volume method.	*CO3*	*PO2*	**12**
			OR			
	10	a)	Enumerate the differences between the finite difference method and the finite volume method.	*CO3*	*PO2*	**10**
		b)	Write the similarities and differences between cell-centered and cell-vertex techniques.	*CO3*	*PO2*	**10**

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