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

Autonomous Institute Affiliated to VTU

July 2023 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 **Date: 19.07.2023**

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)	Define CFD and list its applications.	CO2	PO1	**5**
	b)	What is divergence of velocity? Explain its physical meaning.	CO2	PO1	**5**
	c)	Derive an integral and conservative form of continuity equation for a finite control volume, fixed in space with fluid flowing through it.	CO2	PO2	**10**
		OR			
2	a)	List the physical boundary conditions used in fluid flow and heat transfer problems. Explain any two types with the help of sketch.	CO2	PO1	**5**
	b)	What are the different flow models used in CFD for a continuum fluid? Explain the flow model with finite control volume moving with the fluid.	CO2	PO1	**5**
	c)	Derive the energy in a partial differential and non-conservative form for an infinitesimally small fluid element moving with flow.	CO2	PO2	**10**
		UNIT - II			
3	a)	Explain the general behavior of elliptical equation and List the types of flow governed by elliptical equation.	CO2	PO1	**5**
	b)	Classify the mathematical behavior of the equation $\frac{\partial^2\Phi}{\partial x^2} - \frac{\partial^2\Phi}{\partial y^2} = 0$ using Cramer's Rule:	CO2	PO2	**5**
	c)	Derive the general conditions for classifying the partial differential equations using Cramer's rule.	CO2	PO1	**10**

			UNIT - III			
	4	a)	What is mesh quality? How the assessment of mesh quality is made?	*CO3*	*PO1*	**5**
		b)	Write the difference between structured and unstructured grids.	*CO3*	*PO1*	**5**
		c)	Define the following: (i) Hybrid grid (ii) Grid independence (iii) Aspect ratio (iv) Skewness	*CO3*	*PO1*	**10**
			UNIT - IV			
	5	a)	Explain the forward and backward finite difference methods with the help of suitable grids.	*CO1*	*PO1*	**5**
		b)	Compare explicit and implicit approaches.	*CO1*	*PO1*	**5**
		c)	Using Taylor's series, derive the finite difference expressions for the following partial differential equations: (i) First-order central second difference for $\frac{\partial u}{\partial x}$ (ii) Second-order central second difference for $\frac{\partial^2 u}{\partial x^2}$	*CO1*	*PO2*	**10**
			OR			
	6	a)	What is time marching and space marching in discretization process? Explain with an example.	*CO1*	*PO1*	**5**
		b)	List types of errors in the solution methods and explain briefly any two types.	*CO1*	*PO1*	**5**
		c)	Derive the finite difference solution for a transient equation $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$ using following schemes: (i) Explicit scheme, (ii) Implicit scheme and (iii) Crank-Nicolson scheme	*CO1*	*PO2*	**10**
			UNIT - V			
	7	a)	What is final volume method? What are its advantages?	*CO1*	*PO1*	**5**
		b)	Explain briefly Cell-Centered spatial discretization technique used in finite volume method.	*CO1*	*PO1*	**5**
		c)	Derive an expression for calculating the average value of u for the successive nodes for governing equation $\frac{\partial u}{\partial t} + \frac{\partial f}{\partial x} = 0$ using the 1-D finite volume method.	*CO1*	*PO2*	**10**

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