BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION SP2023)

CLASS: BTECH **SEMESTER : VI**
BRANCH: MECHANICAL **SESSION : SP2023**

SUBJECT: ME353 COMPUTATIONAL FLUID DYNAMICS

TIME: 02 Hours **FULL MARKS: 25**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 5 marks and total 25 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Tables/Data handbook/Graph paper etc., if applicable, will be supplied to the candidates**

			CO	BL
Q.1(a)	What are the basic physical principles associated with fluid flow and heat transfer, and what are the associated equations commonly known as?	[2]	1	1
Q.1(b)	State and prove the physical significance of the divergence of velocity vector in a flow field.	[3]	1	2
Q.2(a)	Derive the continuity equation for fluid flow in the conservation form for an infinitesimally small control volume.	[3]	1	3
Q.2(b)	Show the equivalence of the above equation to the conservation for a finite control volume.	[2]	1	3
Q.3(a)	Classify quasilinear Partial Differential Equations (PDEs) of 2nd order, stating their mathematical conditions for a simple linear 2-D equation of 2nd order.	[2]	2	1
Q.3(b)	Giving simple examples of physical equations of heat transfer, fluid flow, etc, illustrate the different categories of PDEs mentioned above, and briefly state the physical characteristics associated with them.	[3]	2	2
Q.4(a)	Prove the following relation for the first order derivative of a variable φ with respect to the x-dimension, where all the symbols carry usual meaning as discussed in the class. What is the order of accuracy? $$\frac{\partial \emptyset}{\partial x} = \frac{1}{2h}\left[\frac{\overline{\delta_x}\emptyset}{1+\frac{\delta_x{}^2}{6}}\right]$$	[5]	3	4
Q.5(a)	Define consistency of a numerical scheme. Show that central difference scheme applied to discretize the Laplace equation is consistent. What is the associated order of the truncation error?	[2]	3	2
Q.5(b)	What are the 4 types of iterative methods to solve any discretized algebraic equation over a space domain. Briefly discuss the application of Tri-Diagonal-Matrix Algorithm (TDMA), showing the sequential steps involved.	[3]	3	3

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