BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: MTech./Pre-PhD **SEMESTER : II/NA**
BRANCH: Mech. **SESSION : SP/2023**

SUBJECT: ME504 COMPUTATIONAL FLUID DYNAMICS

TIME: 3 Hours **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
4. Before attempting the question paper, be sure that you have got the correct question paper.
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

			CO	BL
Q.1(a)	Define and explain Dirichlet and Neumann boundary conditions with a suitable physical problem.	[5]	1	2
Q.1(b)	Classify the stationary potential flow equation $(1 - u^2/c_0^2)\partial^2\varphi/\partial x^2 - (2uv/c_0^2)\,\partial^2\varphi/\partial x\partial y + (1 - v^2/c_0^2)\partial^2\varphi/\partial y^2 = 0$, where c_0 = speed of sound, u and v are components of velocity in x and y directions respectively.	[5]	1	3
Q.2(a)	Use the second-order accurate central difference approximation and the first order forward difference approximation to evaluate ∂f/∂x at x=2 for the function f(x) = e^x. Step size Δx=0.1 is to be employed. Compare the numerical results with exact value.	[5]	2	3
Q.2(b)	Describe the Thomas' algorithm to solve a tridiagonal system of equations.	[5]	2	2
Q.3(a)	Write down the basic rules that the discretization equation of 1-D steady heat conduction problem should obey to obtain physically realistic solution.	[5]	3	2
Q.3(b)	Derive the discretization equation of 1-D unsteady heat conduction equation using finite volume method.	[5]	3	2
Q.4(a)	Explain line Gauss-Seidel iteration method for the solution of 2-D Laplace's equation $\partial^2u/\partial x^2 + \partial^2u/\partial y^2 = 0$.	[5]	4	2
Q.4(b)	Describe the upwind scheme for solving 1-D steady convection and diffusion problem.	[5]	4	2
Q.5(a)	Derive the Poisson equation for pressure in primitive variable formulation.	[5]	5	2
Q.5(b)	Explain Marker and Cell (MAC) method for solving incompressible Navier-Stokes equations.	[5]	5	2

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