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

CLASS: M. Tech. **SEMESTER : II**
BRANCH: SE & R **SESSION : SP/22**

SUBJECT: SR 578 Computational Fluid Dynamics

TIME: 2.00 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.

Q.1(a) Briefly discuss on the importance of the classification of partial differential equations. [5]

Q.1(b) Classify the steady two-dimensional velocity potential equation, [5]

$(1 - M^2)\partial^2\varphi/\partial x^2 + \partial^2\varphi/\partial y^2 = 0$

where, M is Mach number.

Q.2(a) Compute the first derivative of the function $f(x) = \tan(\pi x/4)$ at $x = 1.5$, using first order forward and backward approximations. Use step size of 0.1. [5]

Q.2(b) Define and explain the terms (i) consistency, (ii) stability, and (iii) convergence. [5]

Q.3(a) Explain the alternating direction implicit (ADI) method to solve the equation $\partial u/\partial t = \alpha [\partial^2 u/\partial x^2 + \partial^2 u/\partial y^2]$, where α = constant. [5]

Q.3(b) What is upwind method? Explain this method to solve the linear convection equation $\partial u/\partial t + c\, \partial u/\partial x = 0$, where c is a constant. [5]

Q.4(a) Derive the Poisson equation for pressure in primitive variable formulation. [5]

Q.4(b) What is staggered grid? Why is it required for solving incompressible Navier-Stokes equations? [5]

Q.5(a) Explain the implementation of wall boundary condition for inviscid flows. [5]

Q.5(b) Discuss briefly on global and local time steps. [5]

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