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

CLASS: M. TECH. **SEMESTER : II**
BRANCH: SER **SESSION : SP/2023**

SUBJECT: SR578 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)	Explain the domain of dependence and zone of influence of elliptic, parabolic and hyperbolic partial differential equations.	[5]	1	2
Q.1(b)	Classify the following system of partial differential equations: $a\ \partial u/\partial x + c\ \partial v/\partial y = f1$ $b\ \partial v/\partial x + d\ \partial u/\partial y = f2$ Consider two cases where (i) a=b=c=d=1, f1=f2=0 and (ii) a=1, b=0, c = -d = -1, f1=0, f2=v.	[5]	1	3
Q.2(a)	Given the following data, compute f'(3) and f'(6). Use finite differencing of order (Δx). Compare the results to the values obtained by finite differencing of order $(\Delta x)^2$.	[5]	2	3

x	2	3	4	5	6
f(x)	4	9	16	25	36

Q.2(b)	The finite difference scheme of the linear convection equation $\partial u/\partial t + c\ \partial u/\partial x = 0$ ($c < 0$) is given by, $$\frac{u_j^{n+1} - u_j^n}{\Delta t} = \frac{-c}{\Delta x}\left(u_{j+1}^n - u_j^n\right)$$ Obtain the modified partial differential equation (MPDE) of the above scheme.	[5]	2	3
Q.3(a)	Write the modified Runge-Kutta scheme of fourth-order to solve inviscid Burgers equation $\partial u/\partial t + u\ \partial u/\partial x = 0$.	[5]	3	2
Q.3(b)	Explain point Gauss-Seidel iteration method for the solution of 2-D Laplace's equation $\partial^2 u/\partial x^2 + \partial^2 u/\partial y^2 = 0$.	[5]	3	2
Q.4(a)	Write down the step-by-step procedure in SIMPLE algorithm to solve incompressible Navier-Stokes equations.	[5]	4	2
Q.4(b)	Discuss the pseudo-compressibility method for solving incompressible flows.	[5]	4	2
Q.5(a)	Explain the Flux Vector Splitting (FVS) and Flux Difference Splitting (FDS) approaches to find out the interfacial flux.	[5]	5	2
Q.5(b)	Discuss briefly on cell-centered and vertex-centered finite volume methods.	[5]	5	2

::::::27/04/2023::::::E