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

CLASS: BTECH **SEMESTER: IV**
BRANCH: MECHANICAL **SESSION: SP/2023**

SUBJECT: ME213 THERMO-FLUID ENGINEERING

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)	Describe with an example, the Eulerian and Lagrangian description in fluid flow.	[2]	CO2	2
Q.1(b)	Derive an expression for the acceleration flow field and explain the various terms.	[3]	CO3	3
Q.2	Consider 2-D, steady, incompressible flow through the plane converging channel shown in Fig. 1. The velocity on the horizontal centerline (x axis) is given by $\vec{V} = V_1[1 + x/L]\hat{\imath}$. Find an expression for the acceleration of a particle moving along the centerline using (a) the Eulerian approach and (b) the Lagrangian approach. Evaluate the acceleration when the particle is at the beginning and at the end of the channel.	[5]	CO4	4

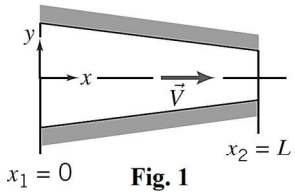
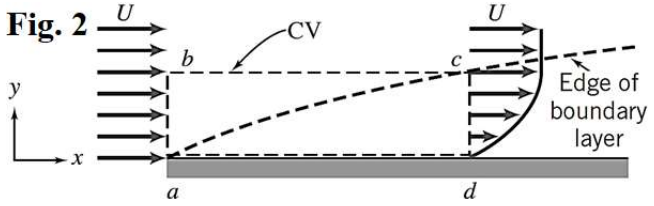


Fig. 1

Q.3	The fluid in direct contact with a stationary solid boundary has zero velocity; there is no slip at the boundary. Thus, the flow over a flat plate adheres to the plate surface and forms a boundary layer, as depicted below. The flow ahead of the plate is uniform with velocity $\vec{V} = U\hat{\imath}$; U=30 m/s. The velocity distribution within the boundary layer ($0 \le y \le \delta$) along *cd* is approximated as $u/U = 2(y/\delta) - (y/\delta)^2$. The boundary-layer thickness at location *d* is δ=5 mm. The fluid is air with density ρ=1.24 kg/m^3. Assuming the plate width perpendicular to the paper to be w=0.6 m, calculate the mass flow rate across surface *bc* of control volume *abcd*.	[5]	CO5	4

Fig. 2



Q.4	Derive the differential form of continuity equation in Cartesian coordinate system. Also express the same in terms of material derivative.	[5]	CO5	3
Q.5	Consider a fluid particle with velocity $\vec{V} = 2x\hat{\imath} - 3y\hat{\jmath} + z\hat{k}$. Describe the deformation of the fluid particle.	[5]	CO4	2

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