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

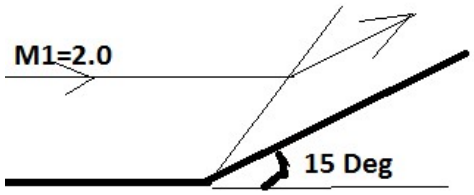
CLASS: M.TECH. **SEMESTER : II**
BRANCH: MECHANICAL ENGG. **SESSION : SP/2023**

SUBJECT: ME593 ADVANCED FLUID MECHANICS

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.
6. Use the Gas Tables for compressible flow calculations where ever it is required.

			CO	BL
Q.1(a)	With a suitable examples explain the Lagrangian and Eulerian description of fluid flow.	[5]	1	L
Q.1(b)	Two discs are placed in a horizontal plane, one over other. The lower plate has a small hole through which fluid enters and spreads radially outwards from a source of strength, q= 0.628 m^2/s. The radial velocity at radius r is given as u(r) = q/(2*Pi*r) and Ψ=(q/2*Pi)*θ. The pressure at a radius 50 mm is 200 kN/sq.m. Using Bernoulli's equation, determine (i) pressure in kN/sq.m at a radius of 500 mm and (ii) stream function at an angle of 30 deg if Ψ=0 at θ=0.	[5]	1	M
Q.2(a)	Show that the discharge per unit width(q) between two parallel plates having 'b' distant apart, when one plate is moving with a velocity U, while the other is stationary is given by q = Ub/3, assume that no pressure gradient exists in the flow.	[5]	2	M
Q.2(b)	Determine the (i) pressure gradient (ii)shear stress at the two fixed parallel plates(80 mm apart), for a laminar flow of oil of viscosity 1.962 Ns/sq.m. Take the maximum oil flow velocity as 1.5 m/s.	[5]	2	M
Q.3(a)	What is a shock wave? Explain with suitable diagram how a shock wave is formed in compressible flows.	[5]	3	L
Q.3(b)	The velocity of a normal shock wave moving into a stagnant air (P=1 bar,t = 17 deg C) is 500 m/s. If the area of the cross section of the duct is constant, determine(i) pressure,(ii) temperature,(iii) velocity of air, (iv) stagnation temperature, (v) mach number behind the shock.	[5]	3	M
Q.4(a)	With suitable diagram, explain the mechanism of formation of an expansion fan when a supersonic flow encounters a convex surface.	[5]	4	L
Q.4(b)	Air having inlet Mach number 2.0 is deflected through an angle 15 degrees by a frictionless surface as shown in Figure below. Assume a weak shock occurs. Determine (i) Downstream Mach number, (ii) Wave angle, (iii) Static pressure ratio, and (iv) Static temperature ratio across the shock.	[5]	4	M



Q.5(a)	Explain the Rayleigh and Fanno flow with suitable examples.	[5]	5	L
Q.5(b)	Air enters a constant area duct at M1= 0.2, P1= 1 atm, T1 = 273 Kelvin. Inside the duct, heat is added per unit mass, q=1.0 x 10^6 J/kg. Determine the flow properties M2, P2, T2, ρ2,, T02, and P02 at the exit of the duct.	[5]	5	M

::::::28/04/2023::::::E