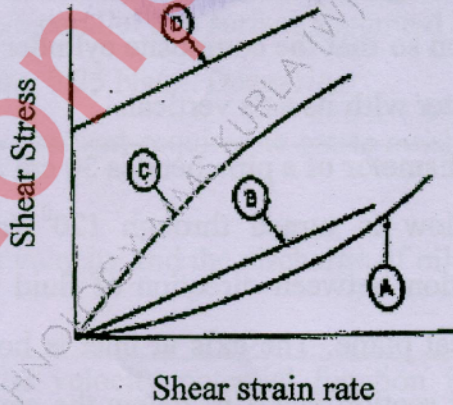**QP Code 12437**

N.B.:
(1) **Question No.1 is compulsory**
(2) Attempt any **three** questions out of remaining **five** questions
(3) Figures to right indicate full marks
(4) Assume suitable data if **necessary and justify the same.**

Q.1(A)	Figure 1 shows the rheological behavior of four types of viscous fluids. With reference to this figure, match the following two lists.	04

List I (Curves In Figure 1)	List II (Classification)
a. Curve A	1. Dilatant
b. Curve B	2. Ideal Bingham
c. Curve C	3. Pseudo Plastic
d. Curve D	4. Newtonian

Figure 1

(B)	Steady, incompressible flow consist of following velocity components: $u = -cx/y$, $v = c \ln(xy)$ Obtain a relevant stream function for the fluid flow.	06

(C)	If the velocity distribution in a laminar boundary layer on a flat plate is $$\frac{u}{U} = a + b\left(\frac{y}{\delta}\right) + c\left(\frac{y}{\delta}\right)^2 + d\left(\frac{y}{\delta}\right)^3$$ Determine the coefficient a, b, c and d. Here u is the velocity at the distance y from the surface of the flat plate and U be the free stream velocity at the boundary layer thickness δ.	05
(D)	Find the speed of sound in oxygen at a pressure of 100 kPa (abs) and 25^0 C. Take R= 260 J/kg.K and k=1.4.	05
Q. 2(A)	An 80 mm diameter composite solid cylinder consists of an 80 mm diameter 20 mm thick metallic plate having specific gravity 4 attached at the lower end of an 80 mm diameter wooden cylinder of specific gravity 0.8. Find the limits of the length of the wooden portion so that the composite cylinder can float in stable equilibrium in water with its axis vertical.	10
(B)	The diameter of a pipe bend is 30 cm at inlet and 15 cm at outlet and the flow is turned through 120^0 (angle measured in clockwise direction between direction of fluid flow at inlet and outlet) in a vertical plane. The axis at inlet is horizontal and the centre of the outlet section is 1.5 m below the centre of the inlet section. Total volume of water in the bend is 0.9 m^3. Neglecting friction, calculate the magnitude and direction of the force exerted on the bend by water flowing through it at 250 litres/s and when inlet pressure is 0.15 N/mm^2.	10
Q.3 (A)	Determine the maximum discharge of water that can be carried without cavitation by a horizontal 100 mm X 50 mm (inlet diameter 100 mm and throat diameter 50 mm) venturimeter, which has a	10

		coefficient of discharge of 0.95. The inlet pressure is 10 kPa (gauge), the vapour pressure of water is 4 kPa (abs) and the local atmospheric pressure is 96 kPa (abs).	
	(B)	Given the velocity distribution in a laminar boundary layer on a flat plate as $$\frac{u}{U} = 2\left(\frac{y}{\delta}\right) - 2\left(\frac{y}{\delta}\right)^3 + \left(\frac{y}{\delta}\right)^4$$ where u is the velocity at the distance y from the surface of the flat plate and U be the free stream velocity at the boundary layer thickness δ. Obtain an expression for boundary layer thickness, shear stress, and force on one side of the plate in terms of Reynolds number.	10
Q. 4(A)		A belt conveyor consists of a flat belt 0.5 m wide which slides at a velocity of 4 m/s parallel to a surface separated by a 6 cm thick layer of oil of viscosity 0.25 Ns/m. Determine (i) the pressure gradient required to cause no shear stress at the belt surface (ii) the average velocity and the discharge of oil to be maintained for the above.	10
	(B)	Following is the velocity potential function for two dimensional irrotational flow in cylindrical coordinates: $$\phi = \frac{m\cos\theta}{r}$$ Determine the conjugate function (stream function).	10
Q.5(A)		Draw rough nature of Moody Chart showing different regimes of fluid flow and explain its significance	05
	(B)	What is critical pressure ratio for compressible flow in nozzle?	05

	Explain its significance.	
(C)	In a normal shock wave occurring in a helium (k=1.66) the density downstream of the shock is three times that on the upstream. Calculate the corresponding pressure ratio and velocity ratio. What are the Mach numbers upstream and downstream of the shock?	10
Q.6 (A)	Three pipes with details as following are connected in parallel between two points Pipe Length Diameter f 1 1000 m 20 cm 0.02 2 1200 m 30 cm 0.015 3 800 m 15 cm 0.02 When the total discharge of 0.30 m³/sec flows through the system, calculate distribution of discharge and head loss between the junctions.	10
(B)	Explain Prandtl mixing length theory for turbulent fluid flow.	05
(C)	Write short note on induced drag on an aerofoil.	05

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