Q. P. Code: 13609

Instructions: Question no.**1 is compulsory**.

Attempt any **THREE** from question no. 2 to 6.

Use illustrative diagrams where ever required.

Q1 **Solve any 4**

a Match the following pairs 5

Lemonade	Dilatant
Blood	Bingham Plastic
Mud	Pseudo Plastic
Tooth paste	Newtonian

b Prove that the Stream function and Velocity Potential functions are perpendicular to each other at all points of intersections. 5

c Explain the working of an Orifice meter. 5

d Define Reynold's number and its significance. 5

e Define the following i) Displacement thickness ii) Momentum thickness 5

Q2 a A sliding gate 3m wide and 1.5m high situated in a vertical plane has a co efficient of friction between itself and the guide of 0.18. If the gate weighs 19 kN and its upper edge is at a depth of 9m, what vertical force is required to raise it ? Neglect the buoyant force on the gate. 10

b Explain i) Prandtl's mixing length theory 10

and ii) Minor losses in pipes

Q3 a A flow field is given by 10

$$U = x^2 i + yx^2 j - (2xyz + yz^2)k$$

Prove that it is a case of possible steady incompressible fluid flow. Calculate the velocity and acceleration at a point (2,1,3)

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b Given the velocity distribution in a laminar boundary layer on a flat plate as 10

$$\frac{u}{U} = 2\left(\frac{y}{\delta}\right) - 2\left(\frac{y}{\delta}\right)^3 + \left(\frac{y}{\delta}\right)^4$$

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.

Q4 a Fluid is in laminar motion between two parallel plates separated by distance *b* under the action of motion of one of the plates and also under the presence of pressure gradient in such a way that the net forward discharge across any section is zero. Consider U to be the velocity of the moving plate. 10

i) Find the point where minimum velocity occurs and its magnitude.
ii) Draw a rough sketch of velocity distribution across any section.

b A normal shock wave occurs in a duct in which air is flowing at a Mach number of 1.5. The static pressure and temperature upstream of the shock wave is 1.5 bar and 270°C. Determine pressure, temperature and Mach number downstream of the shock. 10

Q5 a A 120^0 reducing bend is placed in a horizontal plane. The diameter at the inlet is 100mm and at the exit is 50mm. If the pressure at the inlet is 0.5 kgf/cm^2 and the discharge is 1200 *lpm*. Calculate the net flow. Use control volume approach. 10

b Three pipes of diameters 300 mm, 200 mm & 400 mm and lengths 450 m, 255 m, & 315 m respectively are connected in series. The difference in water surface levels in two tanks is 18 m. Determine the rate of flow of water if coefficients of friction are 0.0075, 0.0078 & 0.0072 respectively (Consider minor losses). 10

Q6 a Draw a neat sketch of Venturimeter and derive an expression for discharge through the Venturimeter. Explain the terms C_d, C_v and C_c. 10

b **Solve any 2**

i) Explain Boundary layer Separation 5

ii) Write a note on flow through Convergent-Divergent Nozzle. 5

iii) State and explain the hydrostatic law. 5

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