Paper ID [ME206]

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B.Tech. (Sem.- 4th)

FLUID MECHANICS - I (ME-206/208)

Time : 03 Hours **Maximum Marks : 60**

Instruction to Candidates:

1) Section - A is **Compulsory**.
2) Attempt any **Four** questions from Section - B.
3) Attempt any **Two** questions from Section - C.

Section - A

Q1) *(10 × 2 = 20)*

a) Show graphically the variation of shear stress with velocity gradient for ideal plastic, ideal, Newtonian, Pseudo plastic fluids.

b) State Pascal Law.

c) What is the value of Mach number for subsonic and hypersonic flow.

d) Discuss the limitations and characteristics of flow net.

e) State the assumptions used in derivation of Bernoulli's theorem.

f) What is Froude's number. State its significance.

g) Write the Darcy equation for head loss due to friction in turbulent flow.

h) Classify turbulent motion.

i) What are the advantages of using venturimeter and orifice meter in fluid flow measurements?

j) Why is a triangular weir more suitable than a rectangular weir for measuring discharge?

Section - B

(4 × 5 = 20)

Q2) An inclined rectangular gate 5m wide and 1.5m deep has been installed to control the discharge of fluid. It is immersed in fluid such that its edge view makes an angle of 50° with the free surface of fluid. The upper end is hinged and lies at a distance of 2.5m vertically from the free surface of water. Find the force normal to the gate be applied at the lower end to open it.

Q3) A 2-D flow is developed by the velocity components:

$u = 6x^3$ and $v = -20x^2y$

Evaluate the stream function, velocity and acceleration at point A(x = 2m and y = 3m)

Q4) Using dimensional analysis, find the power developed by a hydraulic turbine if it depends on mass density of liquid, ρ, rotational speed, N, diameter of runner, D, working head, H and the gravitational acceleration, g.

Q5) A venturimeter is to be fitted in a pipe of 15cm diameter where pressure head is 8m of flowing fluid and the maximum flow is 8000 litres per minute. Find the least diameter of the throat to ensure that the pressure head does not become negative. Take discharge coefficient for the meter at 0.96.

Q6) Find the expression for discharge per unit width between two parallel plates distance b apart, when one plate is moving at velocity v while the other one is held stationary, for the condition of zero shear stress at the fixed plate.

Section - C

(2 × 10 = 20)

Q7) Derive the differential equation of continuity in the Cartesian coordinates. Thereafter deduce the same into 2-D steady flow for compressible and incompressible flow.

Q8) (a) How do you account for friction loss when applying Bernoulli's equation to real fluid flows?

(b) A pipe bend placed in a horizontal plane tapers from 45cm diameter at inlet to 20cm diameter at outlet. A fluid of density 900 kg/m^3 enters the reducing bend horizontally and get turned through 45° in the clockwise direction. The fluid flows at the rate of 0.5 m^3/s, the pressure of 50kN/m^2 at the inlet section drops to 25kN/m^2 at the outlet section due to frictional effects. Calculate the magnitude and direction of the resultant force on the bend.

Q9) (a) Derive an expression for head loss at sudden expansion in pipe flow.

(b) At sudden enlargement of waterline from 30cm to 50cm diameter pipe, the hydraulic gradient rises by 1cm. Calculate the rate of flow.