UCE-305 FLUID MECHANICS
Tutorial No. 9 (Flow Measuring Devices)

Q1: Oil of specific gravity 0.80 flows upwards with flow rate 0.1 m^3/s through a vertical venturimeter having inlet diameter = 300 mm, throat diameter = 120 mm and $\mathbf{C_d}$ = 0.98. The vertical difference between the pressure tappings is 400 mm. Find (i) the pressure difference in two gauges installed at the inlet and the throat (ii) U-tube mercury manometer reading.

Q2: A vertical venturimeter carries a liquid of specific gravity 0.80 and has inlet and throat diameters of 150 mm and 75 mm, respectively. The pressure tapping at the throat is 150 mm above that at the inlet. If actual flow rate is 40 litres per sec and the coefficient of discharge is 0.96, calculate **(i)** the pressure difference between the inlet and the throat and **(ii)** U-tube differential mercury manometer reading connected between these points.

Q3: A venturimeter has inlet and throat diameters of 200 mm and 100 mm, respectively. The flow of water is downward and the inclination of the meter with the horizontal is 60^o. The mercury manometer connected to the inlet and the throat indicates a differential head of 75 mm. Find the discharge if $\mathbf{C_d}$ of the venturimeter is 0.97.

Q4: A venturimeter is to be introduced in a 250 mm diameter pipe conveying flow of 0.15 m^3/s. The pressure at the inlet is 6 m of water. Find the minimum diameter of the throat of venturimeter so that the pressure head is zero. Also, calculate the discharge when a U- tube differential manometer reads a deflection of 200 mm. Take $\mathbf{C_d}$ = 0.98.

Q5: An orificemeter with orifice diameter 150 mm is inserted in a pipe of 300 mm diameter. The pressure difference measured by a mercury-oil manometer on the two sides of orificemeter gives a reading of 500 mm of mercury. Find the rate of flow of oil of specific gravity 0.90 when the coefficient of discharge of meter = 0.64.

Q6: A Pitot-static tube placed at the centre of a 250 mm pipe. The mean velocity in the pipe is 75% of the central velocity. Find the discharge through the pipe if pressure difference recorded by the Pitot static tube is 80 mm of water.

Q7: A Pitot tube is placed at the centre of a pipe having diameter of 250 mm in which water is flowing. The Pitot tube records 7.85 kN/m^2 as stagnation pressure. The static pressure in

the pipe is 0.04 m of mercury (vacuum). Find the discharge if mean velocity is 0.80 times the maximum velocity.

Q8: Water discharges at the rate of 98.2 lps through a 120 mm diameter vertical sharp-edged orifice. A point (4.5 m, 0.54 m) on the jet trajectory is measured from the vena-contracta. The head acting on the orifice is 10 m. Find the hydraulic coefficients of the orifice.

Q9: A tank containing water upto depth of 3 m has an orifice in its vertical side at a depth **h** below the water surface. Find the value of **h** so that the water jet strikes the ground at the maximum distance from the tank. Also, determine this maximum distance if $\mathbf{C_v}$ = 0.97.

Q10: A vertical cylindrical tank 1.5 m in diameter has a 50 mm diameter sharp edged orifice at its bottom. If water enters the tank at a constant rate of 10 lps, find the depth of water above the orifice when the level of water in the tank becomes steady. Thereafter, the water runs into the tank at a constant rate of 15 lps, calculate the rate of rise in water level when the water level has reached 4 m above the orifice.

Answers

Q1: 34.9 kN/m^2, 0.253 m **Q2:** 34.5 kN/m^2, 0.265 m **Q3:** 0.034 m^3/s **Q4:** 130 mm, 0.095 m^3/s **Q5:** 0.133 m^3/s **Q6:** 0.046 m^3/s **Q7:** 0.196 m^3/s **Q8:** 0.62, 0.64, 0.97 **Q9:** 1.5 m, 2.9 m **Q10:** 3.4 m, 143.2 mm/min.