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MANIPAL INSTITUTE OF TECHNOLOGY

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A Constituent Institution of Manipal University

DEPARTMENT OF CHEMICAL ENGINEERING

III Semester B.Tech.

End-Semester Examination – Jan 2022 (Proctored Online Examination)

CHE 2153: Momentum Transfer

PART B

DATE: 20/1/2022 **TIME: 75 + 10 MINUTES** **MAX. MARKS: 20**

Note: Answer ALL questions
Assume missing data if any

Q.1A) Express the Bernoulli's equation in three different ways using energies and heads. Define static, dynamic and hydrostatic pressure. Under what conditions is their sum constant for a flow stream.
Explain the following (i) Loss coefficient (ii) Vena contracta effect (1+2+1)

Q.1B) What is the effect on streamlining on (a) friction drag (b) pressure drag. Does the total drag on a body necessarily decrease as a result of streamlining. Explain. (3)

Q. 1C) A 20 mm diameter vertical pipe conveys oil having density 910 kg/m^3 and viscosity 1.4 poise. A pressure guage kept at the lower end of the vertical pipe records 700kN/m^2 and another pressure guage kept at 25 m above the first one records 200 kN/m^2. Find the direction and rate of flow of oil through the pipe. (3)

Q.2A) Water flows through a pipe of 8 cm diameter. The velocity at the center of the pipe and 2.5 cm from the center are 2 m/s and 1.6 m/s respectively. Find out the thickness of the laminar sublayer (δ) and the wall shearing stress. Assume the flow to be turbulent. Take the kinematic viscosity of water as 0.015 stokes. Also find the average velocity and flow rate. Given: $\delta = 11.6\nu/u^*$ (3)

Q.2B) The outlet at the bottom of the tank is so formed that the velocity of water at point A is 2.0 times the mean velocity within the outlet pipe. What is the required length of the pipe. Atmospheric pressure is 95.48kPa (abs) and the pressure at point A is 4.00 kPa. Neglect all the other losses. (3)

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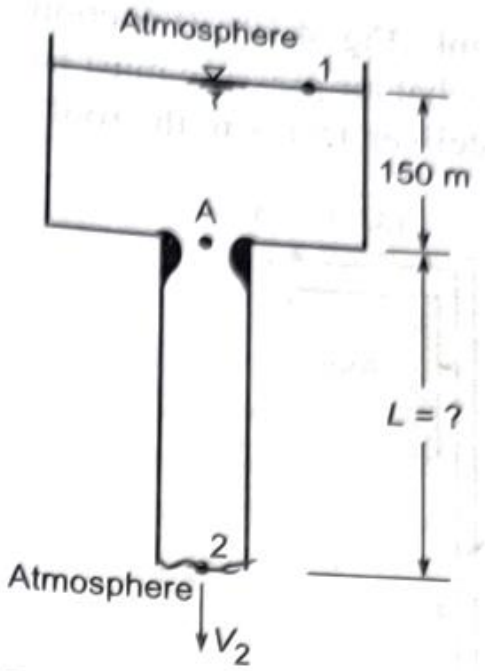

Fig: Figure pertaining to question 2B.

Q.2C) Water flows through a pipe AB of diameter d_1= 50 mm which is in series with a pipe of diameter 70 mm in which the mean velocity v_2=3 m/s. At C the pipe forks and one branch CD is of diameter d_3 such that the mean velocity v_3 is 1.5m/s. The other branch CE is of diameter d_4 = 35mm and the conditions are such that the discharge Q_2 from BC divides so that $Q_4=(Q_3/2)$. Calculate the values Q_1, Q_2, Q_3, v_1, d_3, Q_4 and v_4. (4).

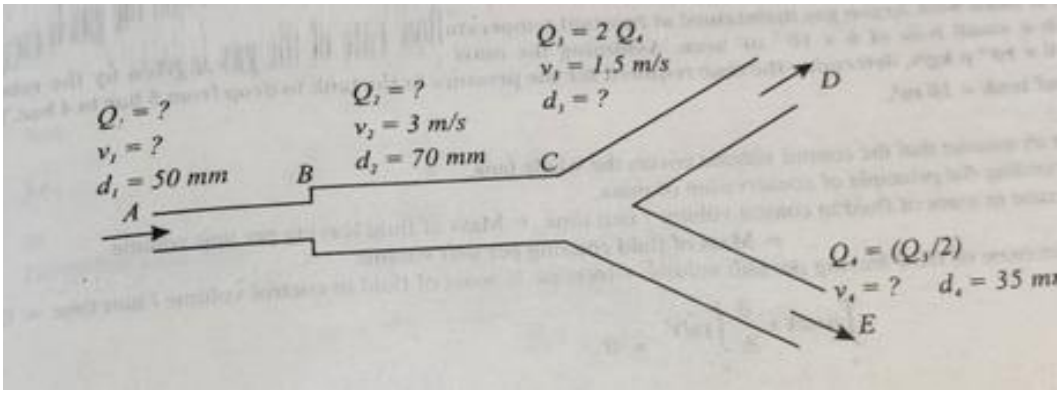

Fig: Figure pertaining to question 2C.