Birla Institute of Technology and Science, Pilani

Semester I Session: 2022-2023

CHE F212 FLUID MECHANICS

Mid-semester Test (Closed Book)

Date: 4/11/2022 Maximum Marks: 50

Duration: 60 minutes Weightage: 17 %

Q 1 **[5 x 2 = 10]**

i. How Rheopectic fluid differs from Thixotropic fluid?.

ii. For a hydraulic system, the energy grade line decreases as fluid travels. It is observed that at a particular location, there is a step rise in it. What could be the reason for it?

iii. Derive the formula of velocity for a pitot tube system.

iv. Write the x-component equation of creeping flow.

v. What is the difference between the Lagrangian and Eulerian approaches of flow analysis?

Q 2 **[12]**

Consider the flow field given by:

$$\vec{V} = xy^2\hat{i} - \tfrac{1}{3}y^3\hat{j} + xy\hat{k}$$

Determine:

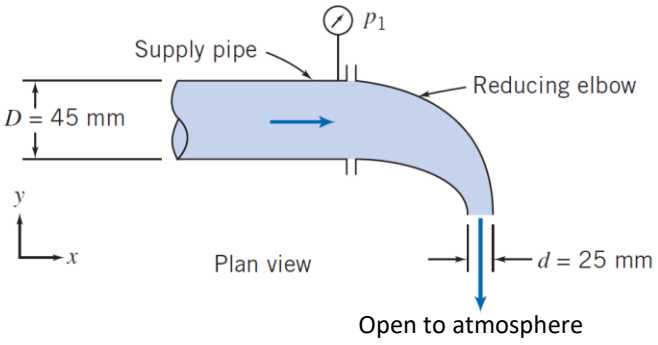
(a) the number of dimensions of the flow and whether the flow is incompressible or not?

(b) the acceleration of a fluid particle at point $(x, y) = (1, 2)$.

(c) develop the equation of the streamline passing through the same point.

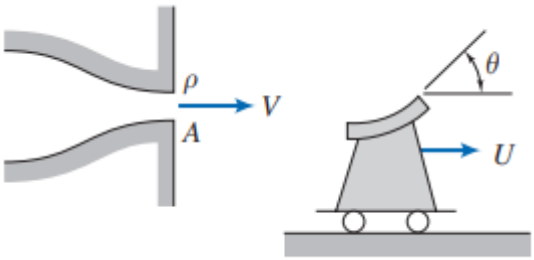
Q 3 **[13]**

Water flows steadily through the reducing elbow shown. The elbow is smooth and short, and the flow accelerates, so the effect of friction is small. The volume flow rate is 2.5 L/s. The elbow is in a horizontal plane. Estimate the absolute pressure (Pa) at section 1.



Q 4 **[15]**

Water from a stationary nozzle impinges on a moving vane with a turning angle $\theta = 60$ degrees. The vane moves away from the nozzle with constant speed, $U = 10$ m/s, and receives a jet that leaves the nozzle with speed $V = 30$ m/s. The nozzle has an exit area of 0.004 m^2. Find the force that must be applied to maintain the vane speed constant.



Birla Institute of Technology and Science, Pilani

Semester I Session: 2022-2023

CHE F212 FLUID MECHANICS

Mid-semester Test (Open Book)

Date: 4/11/2022 Maximum Marks: 25

Duration: 30 minutes Weightage: 8 %

Q 1 **[25]**

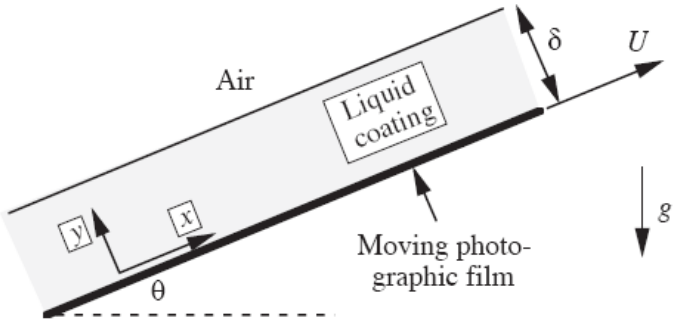


Fig. Q1 Liquid coating on a photographic film

Fig. Q1 shows a coating experiment involving a flat photographic film that is being pulled up from a processing bath by rollers with a steady velocity U at an angle θ to the horizontal. As the film leaves the bath, it entrains some liquid, and in this particular experiment, it has reached the stage where: (a) the velocity of the liquid in contact with the film is $v_x = U$ at $y = 0$, (b) the thickness of the liquid is constant at a value δ. Using the equation of motion approach, find the velocity profile, shear stress profile, average velocity and thickness of the liquid coating. Consider p is not a function of x.