LABORATORY MANUAL

FLUID MECHANICS
ME-214 E

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EXPERIMENT NO. 1

Aim: - To determine the co efficient of impact for vanes.

Apparatus Used:- Collecting tank, Transparent cylinder, Two nozzles of dia 10 mm & 12mm, Vane of different shape (flat, inclined or curved)

Theory:- Momentum equation is based on Newton's second law of motion which states that the algebraic sum of external forces applied to control volume of fluid in any direction is equal to the rate of change of momentum in that direction. The external forces include the component of the weight of the fluid & of the forces exerted externally upon the boundary surface of the control volume. If a vertical water jet moving with velocity is made to strike a target, which is free to move in the vertical direction then a force will be exerted on the target by the impact of jet, according to momentum equation this force (which is also equal to the force required to bring back the target in its original position) must be equal to the rate of change of momentum of the jet flow in that direction.

Formula Used:-

$F' = \rho\, Q\, v(1-\cos\beta)$

$F' = \rho\, Q^2 (1-\cos\beta)$ as $v = Q/a$

Where   F' =force (calculated)

ρ = density of water

β=angle of difference vane

V =velocity of jet angle

Q =discharge

A =area of nozzle   ($\pi/4 d^2$)

(i) for flat vane $\beta=90^o$

$F = \rho Q^2/a$

(ii) for hemispherical vane $\beta=180^o$

for % error $= F - F'/\, F' \times 100$

$F = 2\, \rho Q^2/a$

F = Force (due to putting of weight)

(iii)   for inclined vane

$F' = \rho\, Q\, v(1-\cos\beta)$

$F' = \rho\, Q^2 (1-\cos\beta)$

Procedure:-
1. Note down the relevant dimension or area of collecting tank, dia of nozzle, and density of water.
2. Install any type of vane i.e. flat, inclined or curved.
3. Install any size of nozzle i.e. 10mm or 12mm dia.
4. Note down the position of upper disk, when jet is not running.
5   Note down the reading of height of water in the collecting tank.
6. As the jet strike the vane, position of upper disk is changed, note the reading in the scale to which vane is raised.
7. Put the weight of various values one by one to bring the vane to its initial position.
8. At this position finds out the discharge also.
9. The procedure is repeated for each value of flow rate by reducing the water supply.
10. This procedure can be repeated for different type of vanes and nozzle.

Observation table:-

> Dia of nozzle   =
> Mass density of water ρ =
> Area of collecting tank   =
> Area of nozzle   =

Horizontal flat vane

When jet is not running, position of upper disk is at =

SNO	Discharge measurement				Balancing		Theoretical Force F'= $\rho Q^2/a$	Error in % = F-F'/F'
	Initial (cm)	Final (cm)	Time (sec)	Discharge (cm^3/sec) Q	Mass W (gm)	Force F (dyne)		

Inclined vane

When jet is not running, position of upper disk is at =

Angle of inclination $\beta = 45^0$

SNO	Discharge measurement				Balancing		Theoretical Force F'= $\rho Q^2(1-\cos\beta)/a$ (dyne)	Error in % = F-F'/F'
	Initial (cm)	Final (cm)	Time (sec)	Discharge (cm^3/sec) Q	Mass W (gm)	Force F (dyne)		

Curved hemispherical vane

When jet is not running, position of upper disk is at =

SNO	Discharge measurement				Balancing		Theoretical Force F'= $2\rho Q^2/a$ (dyne)	Error in % = F-F'/F'
	Initial (cm)	Final (cm)	Time (sec)	Discharge (cm^3/sec) Q	Mass W (gm)	Force F (dyne)		

Precautions:-
1. Water flow should be steady and uniform.
2. The reading on the scale should be taken without any error.
3. The weight should be put slowly & one by one.
4. After changing the vane the flask should be closed tightly.

Viva Questions:-
1. Define the terms impact of jet and jet propulsion?
2. Find the expression for efficiency of a series of moving curved vane when a jet of water strikes the vanes at one of its tips?

EXPERIMENT NO. 2

Aim:- To determine the coefficient of discharge of Orifice meter.

Apparatus Used:- Orifice meter, installed on different pipes, arrangement of varying flow rate, U- tube manometer, collecting tube tank, vernier calliper tube etc.

Formula Used: -

$$C_d = = \frac{Q \sqrt{A^2 - a^2}}{A\, a\, \sqrt{2\, g\, \Delta h}}$$

Where

A = Cross section area of inlet
a = Cross section area of outlet
Δh = Head difference in manometer
Q = Discharge
C_d = Coefficient of discharge
g = Acceleration due to gravity

Theory:- Orifice meter are depending on Bernoulli's equation. Orificemeter is a device used for measuring the rate of fluid flowing through a pipe. It is a cheaper device then Venturimeter.

Procedure:-
1. Set the manometer pressure to the atmospheric pressure by opening the upper valve.
2. Now start the supply at water controlled by the stop valve.
3. One of the valves of any one of the pipe open and close all other of three.
4. Take the discharge reading for the particular flow.
5. Take the reading for the pressure head on from the u-tube manometer for corresponding reading of discharge.
6. Now take three readings for this pipe and calculate the C_d for that instrument using formula.
7. Now close the valve and open valve of other diameter pipe and take the three reading for this.
8. Similarly take the reading for all other diameter pipe and calculate C_d for each.

Observations:-
 Diameter of Orifice meter =
             Area of cross section =
             Area of collecting tank =

Discharge					Manometer Reading				$C_d = \dfrac{Q \sqrt{A^2 - a^2}}{A a \sqrt{2g\Delta h}}$
Initial reading	Final reading	Difference	Time (sec)	Q	h_1	h_2	h_2-h_1	h_2-h_1 Δh= $13.6(h_2$-$h_1)$	

Result:-

Precautions:-
1. Keep the other valve closed while taking reading through one pipe.
2. The initial error in the manometer should be subtracted final reading.
3. The parallax error should be avoided.
4. Maintain a constant discharge for each reading.
5. The parallax error should be avoided while taking reading the manometer.

Viva Questions:-
1. Orificemeter are used for flow measuring. How?
2. Difference between Orificemeter and Venturimeter?

EXPERIMENT NO. 3

Aim: - To determine the coefficient of discharge of Notch (V, Rectangular and Trapezoidal types).

Apparatus Used:- Arrangement for finding the coefficient of discharge inclusive of supply tank, collecting tank, pointer, scale & different type of notches

Theory:- Notches are overflow structure where length of crest along the flow of water is accurately shaped to calculate discharge.

Formula Used:-
For V notch the discharge coefficient

$$C_d = \frac{Q}{8/15 \sqrt{2g} \ H^{5/2} \ \tan \theta / 2}$$

For Rectangular notch

$$C_d = \frac{Q}{2/3 \sqrt{2g} \ BH^{3/2}}$$

For Trapezoidal notch

$$C_d = \frac{Q}{(2/3) \sqrt{2g} \ (B + \tan \theta / 2) \ H^{3/2}}$$

Where:-
   Q = Discharge
   H = Height above crest level
   θ = Angle of notch
   B = Width of notch

Procedure:-
1. The notch under test is positioned at the end of tank with vertical sharp edge on the upstream side.
2. Open the inlet valve and fill water until the crest of notch.
3. Note down the height of crest level by pointer gauge.
4. Change the inlet supply and note the height of this level in the tank.
5. Note the volume of water collected in collecting tank for a particular time and find out the discharge.
6. Height and discharge readings for different flow rate are noted.

Observations:-
Breath of tank =
Length of tank =
Height of water to crest level for rectangular notch is =
Height of water to crest level for V notch =
Height of water to crest level for Trapezoidal notch =
Angle of V notch =
Width of Rectangular notch =

Type Of notch	Discharge					Final height reading above width	Head above crest level	C_d
	Initial height Of tank	Final height Of tank	Difference In height	Volume	Q			

Result:-

Precaution:-
1. Make the water level surface still, before takings the reading.
2. Reading noted should be free from parallax error.
3. The time of discharge is noted carefully.
4. Only the internal dimensions of collecting tank should be taken for consideration and calculations.

Viva Questions:-
1. Differentiate between :-
   - Uniform and non uniform flow
   - Steady and unsteady flow
2. Define notch?
3. What is coefficient of discharge?

EXPERIMENT NO. 4

Aim:- To determine the friction factor for the pipes.(Major Losses).

Apparatus Used:- A flow circuit of G. I. pipes of different diameter viz. 15 mm, 25 mm, 32 mm dia, U-tube differential manometer, collecting tank.

Theory:- Friction factor in pipes or Major losses:-

A pipe is a closed conduit through which fluid flows under the pressure. When in the pipe, fluid flows, some of potential energy is lost to overcome hydraulic resistance which is classified as:-

1. The viscous friction effect associated with fluid flow.
2. The local resistance which result from flow disturbances caused by

- ❖ Sudden expansion and contraction in pipe
- ❖ Obstruction in the form of valves, elbows and other pipe fittings.
- ❖ Curves and bend in the pipe.
- ❖ Entrance and exit losses.

The viscous friction loss or major loss in head potential energy due to friction is given by

$$h_f = \frac{4 \, f \, l \, v^2}{2 \, g \, d}$$

Hence the major head loss is friction loss

$$h_f = \frac{4 \, f \, l \, v^2}{2 \, g \, d} \qquad \text{-------- Darey equation}$$

Where,

h_f = Major head loss
l = Length of pipe
$4f$ = Friction factor
V = Inlet velocity
g = Acceleration due to gravity
d = Diameter of pipe

Procedure:-

1. Note down the relevant dimensions as diameter and length of pipe between the pressure tapping, area of collecting tank etc.
2. Pressure tapping of a pipe is kept open while for other pipe is closed.
3. The flow rate was adjusted to its maximum value. By maintaining suitable amount of steady flow in the pipe.
4. The discharge flowing in the circuit is recorded together with the water level in the left and right limbs of manometer tube.
5. The flow rate is reduced in stages by means of flow control valve and the discharge & reading of manometer are recorded.
6. This procedure is repeated by closing the pressure tapping of this pipe, together with other pipes and for opening of another pipe.

Observation:-

Diameter of pipe   D =
Length of pipe between pressure tapping   L =
Area of collecting tank   =

SNo	Manometer Reading			Discharge Measurement				$F = \pi^2\, gD^5/\, 8LQ^2\ h_f$
	Left limb h_1 (cm)	Right limb H_2 (cm)	Difference of head in terms of water $h_f = 13.6(h_1 - h_2)$	Initial (cm)	Final (cm)	Time (sec)	Discharge Q (cm3/sec)	
1.								
2.								
3.								
4.								

Result:-

Precautions:-

1. When fluid is flowing, there is a fluctuation in the height of piezometer tubes, note the mean position carefully.
2. There in some water in collecting tank.
3. Carefully keep some level of fluid in inlet and outlet supply tank.

Viva Questions:-

1. Define major loss in pipe?
2. Define equilent pipe?
3. Define friction factor in the pipe?

EXPERIMENT NO. 5

Aim:- To determine the coefficient of discharge of Venturimeter.

Apparatus Used:- Venturimeter, installed on different diameter pipes, arrangement of varying flow rate, U- tube manometer, collecting tube tank, vernier calliper tube etc.

Formula Used:-

$$C_d = \frac{Q \sqrt{A^2 - a^2}}{A\, a \sqrt{2\, g\, \Delta h}}$$

Where

$A =$ Cross section area of inlet
$a =$ Cross section area of outlet
$\Delta h =$ Head difference in manometer
$Q =$ Discharge
$C_d =$ Coefficient of discharge
$g \; =$ Acceleration due to gravity

Theory:-Venturimeter are depending on Bernoulli's equation. Venturimeter is a device used for measuring the rate of fluid flowing through a pipe. The consist of three part in short
1. Converging area part
2. Throat
3. Diverging part

Procedure:-
1. Set the manometer pressure to the atmospheric pressure by opening the upper valve.

2. Now start the supply at water controlled by the stop valve.

3. One of the valves of any one of the pipe open and close all other of three.

4. Take the discharge reading for the particular flow.

5. Take the reading for the pressure head on from the u-tube manometer for corresponding reading of discharge.

6. Now take three readings for this pipe and calculate the C_d for that instrument using formula.

7. Now close the valve and open valve of other diameter pipe and take the three reading for this.

8. Similarly take the reading for all other diameter pipe and calculate C_d for each.

Observations:-
Diameter of Venturimeter=
Area of cross section =
Venturimeter=
Area of collecting tank=

Discharge					Manometer Reading				Cd= $\dfrac{Q\sqrt{A^2 - a^2}}{Aa\sqrt{2g\Delta h}}$
Initial reading	Final reading	Difference	Time (sec)	Q	h_1	h_2	$h_2\text{-}h_1$	$h_2\text{-}h_1$ $\Delta h=$ $13.6(h_2\text{-}h_1)$	

Result:-

Precautions:-

1. Keep the other valve closed while taking reading through one pipe.
2. The initial error in the manometer should be subtracted final reading.
3. The parallax error should be avoided.
4. Maintain a constant discharge for each reading.
5. The parallax error should be avoided while taking reading the manometer.

Viva Questions:-

1. Venturimeter are used for flow measuring. How?

2. Define co efficient of discharge?

3. Define parallax error?

4. Define converging area part?

5. Define throat?

6. Define diverging part?

EXPERIMENT NO. 6

Aim:- To determine the coefficient of discharge, contraction & velocity of an Orifice.

Apparatus Used:- Supply tank with overflow arrangement, Orifice plate of different diameter, hook gauge, collecting tank, piezometric tube.

Formula Used:-

$$C_d = \frac{Q_{actual}}{Q_{theoretical}}$$

$Q_{theatrical}$ =Theoretical velocity x Theoretical area

$$= \sqrt{2gh} \cdot a$$

$$C_d = \frac{Q}{a\sqrt{2gh}}$$

$$C_v = \frac{\text{Actual velocity of jet at vena contracta}}{\text{Theoretical velocity}}$$

$$C_v = V / V_{TH} = \sqrt{2x^2/2y} \cdot \sqrt{1}/\sqrt{2gh} = x/2\sqrt{yh}$$

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$$\text{Coefficient of contraction} = \frac{\text{Area of jet at vena contracta}}{\text{Theoretical velocity}}$$

$$C_c = \frac{a_c}{a}$$

Theory:- A mouthpiece is a short length of pipe which is two or three times its diameter in length. If there pipe is filled externally to the orifices, the mouthpiece is called external cylindrical mouthpiece and discharge through orifice increase is a small opening of any cross- section on the side of bottom of the tank, through which the fluid is flowing orifice coefficient of velocity is defined as the ratio of two actual discharge to orifice ratio of the actual velocity of the jet at vena- contracta to the coefficient of theoretical velocity of the jet coefficient of contraction of defined as ratio of the actual velocity of jet at vena- contracta.

Vena- Contracta:- The fluid out is in form of jet goes on contracting form orifice up to dispute of about ½ the orifice dia. After the expend this least relation.

Coefficient of velocity:- It is a ratio of actual velocity jet at vena-contracta to theoretical velocity.

Coefficient of contraction:- $C_d = \dfrac{a_c}{a}$

$$= \frac{\text{Area of jet}}{\text{Area of orifice}}$$

Coefficient of discharge:- $C_d = \dfrac{Q_{actual}}{Q_{theoretical}}$

Procedure:-

1. Set the mouthpiece of orifice of which the C_c, C_u, C_d are to be determined.

2. Note the initial height of water in the steady flow tank and the height of datum from the bottom of orifice and mouthpiece. These remains constant for a particular mouthpiece or orifice.

3. By using the stop valve, set a particular flow in tank and tank height of water in tank.

4. Take the reading of discharge on this particular flow.

5. Using hook gauge, find the volume of Xo Y for mouthpiece.

6. Take three readings using hook gauge for one particular orifice.

7. Using the formula get value of C_d, C_u, and C_c for a particular orifice and mouthpiece.

Observation:-

x' + y' are reading on horizontal/vertical scale

a_o	$h=\mu\ a_o$	x'	y'	X= x'-x_0y	Y= y'-y_0	Cu=x/2gh	Average

h = Reading on piezometer
a0 = Reading on piezometer at level on centre of mouthpiece
y0 = Reading on vertical scale at exit of orifice
x0 = Reading on horizontal scale at exit of orifice

Sr.No	X	Z P	F R	volume	Time	Q = V	Cd=Q/2gh	Average
1.								
2.								
3.								
4.								

Result:-

Precautions:-

1. Take the reading of discharge accurately.

2. Take value of h without any parallax error.

3. Set the orifice and mouthpiece.

4. Height of water in the steady flow.

5. Take reading from hook gauge carefully.

Viva Questions:-

1. Define Orifice?

2. Define Mouth piece?

3. Define vena contracta?

4. Define co efficient of velocity?

EXPERIMENT NO. 7

Aim:- To verify the Bernoulli's theorem.

Apparatus Used:- A supply tank of water, a tapered inclined pipe fitted with no. of piezometer tubes point, measuring tank, scale, stop watch.

Theory:- Bernoulli's theorem states that when there is a continues connection between the particle of flowing mass liquid, the total energy of any sector of flow will remain same provided there is no reduction or addition at any point.

Formula Used:-
$$H_1 = Z_1 + p_1/w + V_1^2/2g$$

$$H_2 = Z_2 + p_2/w + V_2^2/2g$$

Procedure:-

1. Open the inlet valve slowly and allow the water to flow from the supply tank.
2. Now adjust the flow to get a constant head in the supply tank to make flow in and out flow equal.
3. Under this condition the pressure head will become constant in the piezometer tubes.
4. Note down the quantity of water collected in the measuring tank for a given interval of time.
5. Compute the area of cross-section under the piezometer tube.
6. Compute the area of cross- section under the tube.
7. Change the inlet and outlet supply and note the reading.
8. Take at least three readings as described in the above steps.

	1	2	3	4	5	6	7	8	9	10	11
Discharge Of piezometer Tube from inlet											
Area of Cross-section Under foot Of each point											
Velocity Of water Under foot Of each point											
$V^2/2g$											
p/ρ											
$p/\rho + V^2/2g$											

Result:-

Precautions:-

1. When fluid is flowing, there is a fluctuation in the height of piezometer tubes, note the mean position carefully.
2. Carefully keep some level of fluid in inlet and outlet supply tank.

Viva Questions:-

1. Briefly explain the various terms involved in Bernoulli's equation?
2. Assumption made to get Bernoulli's equation from Euler's equation by made?
3. What is piezometer tube?

EXPERIMENT NO. 8

Aim:- To find critical Reynolds number for a pipe flow.
Apparatus Used:- Flow condition inlet supply, elliptical belt type arrangement for coloured fluid with regulating valve, collecting tank.

Formula Used:-   Reynolds No = $\dfrac{\text{Inertia force}}{\text{Viscous force}}$

Theory:-

 Reynolds Number:-

It is defined as ratio of inertia force of a flowing fluid and the viscous force of the fluid. The expression for Reynolds number is obtained as:-

Inertia force(Fi) = mass . acceleration of flowing

$$= \delta . \text{ Volume. Velocity/ time}$$
$$= \delta . \frac{\text{Volume.Velocity}}{\text{time}}$$
$$= \delta .\text{area .Volume . Velocity}$$
$$= \delta .A .V^2$$

Viscous force(Fv) = Shear stress . area

$$= \tau . A$$
$$= \mu \, du/dy . A$$
$$= \mu VA/\tau$$

By definition Reynolds number:-

$$\text{Re= Fi/Fu } = \delta AV2/\mu/t.A$$
$$= V.L /\mu/s$$
$$= V.L /v$$

{ $v = \mu / \rho$ is kinematics viscosity of the fluid }

In case of pipe flow, the linear dimension L is taken as dia (d) hence Reynolds number for pipe flow is :-

$$\text{Re} = V .d /v \quad \text{or}$$
$$\text{Re} = \rho Vd /v$$

Procedure:-

1. Fill the supply tank some times before the experiment.

2. The calculated fluid is filled as container.

3. Now set the discharge by using the valve of that particular flow can be obtained.

4. The type of flow of rate is glass tube is made to be known by opening the valve of dye container.

5. Take the reading of discharge for particular flow.

6. Using the formula set the Reynolds no. for that particular flow, aspect the above procedure for all remaining flow.

Observation:-

Type	Time	Discharge			Volume	$Q=m^3/3$	$Re=4Q/\pi\Delta V$
		Initial	Final	Difference			

Result:-

Precaution:-
    1. Take reading of discharge accurately.
    2. Set the discharge value accurately for each flow.

Viva Questions:-

1. Reynolds number importance?

2. Describe the Reynolds number experiments to demonstrate the two type of flow?

3. Define laminar flow, transition flow and turbulent flow?

EXPERIMENT NO. 9

Aim: - To determine the Meta-centric height of a floating body.

Apparatus Used: - Take tank 2/3 full of water, floating vessel or pontoon fitted with a pointed pointer moving on a graduated scale, with weights adjusted on a horizontal beam.

Theory: - Consider a floating body which is partially immersed in the liquid, when such a body is tilted, the center of buoyancy shifts from its original position 'B' to 'B' (The point of application of buoyanant force or upward force is known as center of G which may be below or above the center of buoyancy remain same and couple acts on the body. Due to this couple the body remains stable.
At rest both the points G and B also Fb x Wc act through the same vertical line but in opposite direction. For small change (θ) B shifted to B.
The point of intersection M of original vertical line through B and G with the new vertical, line passing through 'B' is known as metacentre. The distance between G and M is known as metacentre height which is measure of static stability.

Formula Used: - $GM = \dfrac{W_m . X_d}{(W_c + W_m) \tan \theta}$

Where: -
W_m is unbalanced mass or weight.
W_c is weight of pontoon or anybody.
X_d is the distance from the center of pointer to striper or unbalanced weight.
θ is angle of tilt or heel.

Procedure: -

1. Note down the dimensions of the collecting tank, mass density of water.
2. Note down the water level when pontoon is outside the tank.
3. Note down the water level when pontoon is inside the tank and their difference.
4. Fix the strips at equal distance from the center.
5. Put the weight on one of the hanger which gives the unbalanced mass.
6. Take the reading of the distance from center and angle made by pointer on arc.
7. The procedure can be repeated for other positioned and values of unbalanced mass.

Observation Table:-

Length of the tank =
Width of the tank =
Area of the tank =
Initial level of the water without pontoon =
Final level of the water without pontoon =
Difference in height of water(X) = $X_2 - X_1$ =

Height of water In tank with Pontoon (X_2) (m)	Difference in Height X = X_2-X_1 (m)	Weight of Pontoon W_c = XAρ (kg)	Unbalanced Mass, Wm (kg)	Q	G M = Metacentric Height (m)	X_d (m)

Result: - Meta centric height of the pontoon is measured with different positions and weights.

Precautions: -

1. The reading taking carefully without parallax error.
2. Put the weight on the hanger one by one.
3. Wait for pontoon to be stable before taking readings.
4. Strips should be placed at equal distance from the centre.

Viva Questions:-

1. Define Buoyancy?
2. Define Meta-centre?
3. Define Meta- centric height?
4. With respect to the position of metacentre, state the condition of equilibrium for a floating body?

EXPERIMENT NO. 10

Aim:- To determine the minor losses due to sudden enlargement, sudden contraction and bend.

Apparatus Used:- A flow circuit of G. I. pipes of different pipe fittings viz. Large bend, Small bend, Elbow, Sudden enlargement from 25 mm dia to 50 mm dia, Sudden contraction from 50 mm dia to 25 mm dia, U-tube differential manometer, collecting tank.

Theory:- Minor Losses:-
The local or minor head losses are caused by certain local features or disturbances .The disturbances may be caused in the size or shape of the pipe. This deformation affects the velocity distribution and may result in eddy formation.

Sudden Enlargement:-
Two pipe of cross-sectional area A1 and A2 flanged together with a constant velocity fluid flowing from smaller diameter pipe. This flow breaks away from edges of narrow edges section, eddies from and resulting turbulence cause dissipation of energy. The initiations and onset of disturbances in turbulence is due to fluid momentum and its area. It is given by:-

$$h_{exit} = V2/2g$$

Eddy loss:-
Because the expansion loss is expended exclusively on eddy formation and continues substance of rotational motion of fluid masses.

Sudden Contraction:-
It represents a pipe line in which abrupt contraction occurs. Inspection of the flow pattern reveals that it exists in two phases.

$$h_{con} = (V_c - V_2)2/2g$$

Where

V_c = velocity at vena contracta

Losses at bends, elbows and other fittings:-
The flow pattern regarding separation and eddying in region of separations in bends, valves. The resulting head loss due to energy dissipation can be prescribed by the relation h = KV2/2g. Where V is the average flow velocity and the resistance coefficient K depends on parameter defining the geometry of the section and flow.
Resistances of large sizes elbows can be reduced appreciably by splitting the flow into a number of streams by a jet of guide vanes called cascades.

Procedure:-
1. Note down the relevant dimensions as diameter and length of pipe between the pressure tapping, area of collecting tank etc.
2. Pressure tapping of a pipe a is kept open while for other pipe is closed.
3. The flow rate was adjusted to its maximum value. By maintaining suitable amount of steady flow in the pipe.
4. The discharge flowing in the circuit is recorded together with the water level in the left and right limbs of manometer tube.
5. The flow rate is reduced in stages by means of flow control valve and the discharge & reading of manometer are recorded.

6. This procedure is repeated by closing the pressure tapping of this pipe, together with other pipes and for opening of another pipe.

Observation:-

Diameter of pipe   D   =
Length of pipe between pressure tapping L =
Area of collecting tank   =
Types of the fitting   =

SNo	Manometer Reading			Discharge Measurement				Loss of coefficient $K = 2g/V^2\ h_L$
	Left limb h_1 (cm)	Right limb h_2 (cm)	Difference of head in terms of water $h_f = 13.6(h_1-h_2)$	Initial (cm)	Final (cm)	Time (sec)	Discharge Q (cm³/sec)	
1.								
2.								
3.								
4.								

Result:-

Precautions:-

1. When fluid is flowing, there is a fluctuation in the height of piezometer tubes, note the mean position carefully.

2. There in some water in collecting tank.

3. Carefully keep some level of fluid in inlet and outlet supply tank.

Viva Questions:-

1. Define hydraulic gradient and total energy lines?

2. Define eddy loss?

3. Define sudden contraction?

4. Define sudden enlargement?

EXPERIMENT NO. 11

Aim:- To study Viscosity, Velocity & Pressure measuring device.

Theory:-Viscosity measuring device:-

1. Capillary tube
2. Viscometer.

Capillary tube: - Poiseiulle showed that the volume (v) of a liquid or gas flowing per second through a horizontal capillary tube of a given radius length (L) under a constant difference of pressure (ΔP) between two ends is inversely proportional to the viscosity of fluid. The volume of fluid through the f tube in t is given by

The lesser the volume of flowing fluid through the tube per unit time, the larger the viscosity.

Viscometer:- It is an instrument to measure the viscosity. It measures some quantity which is a function of viscosity. The quantity measured is usually time taken to pass certain volume of the liquid through an orifice fluid at the bottom of the viscometer. The temperature of liquid, while it is being passed through the orifice should be maintained constant. Some viscometer is used are say bolt universally, redwood, Engler viscometer which has a vertical tube. The times in second to pass 60cc of fluid liquid for the determination of viscosity is "say bolt second".

The following empirical relations are used to determine kinematics viscosity in stokes:-

        A) Say bolt universal viscometer
        B) Red wood viscometer
        C) Engler viscometer

Velocity measuring device:-
Rota Meter.
Construction: - A Rota meter is a device to find the velocity of a flow in a pipe with the aid of rotating free float. It is essentially an orifice meter with fixed pressure drop and variable orifice area. Fluid is allowed to flow vertically upward through a tapered transparent tube placed vertically with a large end at the top. The float is freely suspended upside the tube. The maximum diameter of float is slightly less then the minimum bore. There are two L-bend lies on the inlet and outlet of the tube. Guide wire for float is calibrated at the centre of the tapered tube. The outlet portion for fluid generally less then the inlet portion. The tapered tube is generally having the glass covering on the part of taking the reading of the float

Working: - When there is no flow, float rests at bottom, but fluid when some velocity float has rises upward to make way for fluid motion. The float rises to such a position that the pressure loss across the amuler orifice just balances to the weight of the float mechanism which is attached to it. The float therefore attains a state of equilibrium and the distance from the stop to float is a measure of the discharge in liter/second. The float is provided with slantwise slots to enable it to occupy a stable position at the center of tube.

Pressure measuring device:-

A) Dead weight piston gauge

B) Mechanical gauge

A) Dead weight piston gauge:- This is the direct method for precise determination to of a piston steady pressure measurement. The instrument consists of a piston & a cylinder of known area connected to a fluid pressure on the piston equal to the pressure times the piston area. This force can be balanced by weight fitted on the top of the vertical piston. This is the most accurate device and used for precision and for calibrating other pressure gauge. The pressure of liquid is balanced by known weight. Pressure in Kgf/cm2   or KN/m2

B) Mechanical gauge:-By the help of spring or dead weight balanced the liquid column whose pressure is to be measured. In gauge are the liquid exert the force on a movable diaphragm or piston, which is the resisted by a spring of known valve. The intensity of pressure then would be equal to the force F divided by the area a of the diaphragm or piston   P =F/a

They are suited for the measurement of high pressure when it is more then to atmospheres. The most accurate and reliable region on the scale of mechanical gauge in between 40% & 70% of the maximum may give direct pressure reading, portability and wider operating gauge. They can fairly accurate reading if properly calibrated.

1   Bourdon tube pressure gauge
2   Diaphragm pressure gauge
3   Dead weight pressure gauge

Viva Questions:-
1   Define and explain the Newton's law of viscosity?
2   Define construction of bourdon tube pressure gauge?
3   Define construction of Rotameter?
4   What is meant by calibration?
5   Which type of fluid is used in bourdon tube pressure gauge?

FLUID MECHANICS LAB (ME-214 E)

Sessional   : 25 Marks
Practical / Viva: 25 Marks
Total : 50 Marks
Duration of Exam : 3 hours

List of Experiments:-

1. To determine the coefficient of impact for vanes.

2. To determine the coefficient of discharge of an Orifice Meter.

3. To determine the coefficient of discharge of Notch (V, Rectangular &Trapezoidal types).

4. To determine the friction factor for the pipes.

5. To determine the coefficient of discharge of Venturimeter.

6. To determine the coefficient of discharge, contraction & velocity of an orifice.

7. To verify the Bernoulli's Theorem.

8. To find critical Reynolds number for a pipe flow.

9. To determine the Meta- centric height of a floating body.

10. To determine the miner losses due to sudden enlargement, sudden contraction and bends.

11. To study Velocity, Viscosity & Pressure measuring device.

12. To show the velocity and pressure variation with radius in a forced vertex flow.

Note:
  1. **At least ten experiments are to be performed in the semester.**
  2. **At least eight experiments should be performed from the above list. Remaining two experiments may either be performed from the above list or designed & set by the concerned institute as per the scope of syllabus.**