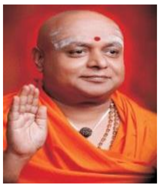
|| Jai Sri Gurudev ||



"SRI ADICHUNCAHANAGIRI SHIKSHANA TRUST {REGD.}"

Sri Balagangadharanatha Swamiji Institute of Technology

Bellur Cross, Nagamangala Taluk, Mandya District, Karnataka

FLUID MECHANICS AND HYDRAULIC MACHINES LABORATORY (18CVL48)

(As per V.T.U Syllabus)

Prepared By

KAVYA B M

B.E. M.Tech

ASSISTANT PROFESSOR

DEPARTMENT OF CIVIL ENGINEERING

B.G.S.I.T, B.G. NAGAR

"SRI ADICHUNCAHANAGIRI SHIKSHANA TRUST {REGD.}"

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Laboratory Manual

FLUID MECHANICS AND HYDRAULIC MACHINES LABORATORY (18CVL48)

NAME	:	
USN	:	
DEPARTMENT	:	

INTRODUCTION

Aim of laboratory work

The primary aims of laboratory investigations are as follows:

(i) To set up the equipment which accurately represents the specific conditions?

(ii) To provide all instrumentation for the measurement of the variably (flow rate, fluid levels, pressure etc.)

(iii) To carry out the experiment in such a way that a number of accurate measurements are taken in order to produce meaningful results.

(iv) To represent the results in a clear and concise fashion.

(v) To discuss and interpret the results and to draw conclusions.

Laboratory Reports

A laboratory report should discuss the following:

1. **Title of the experiment**
2. **Objective of experiment**
3. **Apparatus**
4. **Theory**
5. **Experimental procedure**
6. **Observations**
7. **Analysis**
8. **Conclusions**

(i) Title of the experiment: Very often the title does not state the object of the experiment but does help in a brief statement of the principle to be used.

Example: Notches and Weirs

(ii) Object of experiment: To determine the coefficient of discharge.

(iii) Apparatus: A brief description of the apparatus together with neat sketch wits the main features indicated is all that is required.

(iv) Theory: It is useful to make necessary reference to any assumptions which have been made in order to develop the theory. Very often experimental finding: throw light on the validity of such assumptions, if so reference can be made to the end.

(v) Experimental Procedure: The various steps in the procedure should be listed in correct sequence using past tense.

(vi) Observations: Particulars of numerical values observed during the experiment should be presented in the tabular column. As a general rule the table of results should be completed in the laboratory during or immediately following the experiment.

(vii) Analysis: Any relationship between variables can be illustrated by means of a graph. Measured values should be clearly plotted and care taken in constructing a line or curve through the points. In the results show a linear relationship between the variables. If the purpose of experiment is to evaluate certain constants or coefficients, the experimental values should be clearly stated at the end of the analysis.

INDEX

Sl. No	Title of the Experiment	Date of conduction	Date of submission	Marks obtained
1	Calibration of Rectangular notch			
2	Calibration of 90^0 V-notch			
3	Calibration of Orifice meter			
	Calibration of Venturimeter			
4	Determination of Darcy's friction factor (Major and Minor Loss)			
5	Determination of vane coefficients for a flat vane & semicircular vane			
6	Performance characteristics of a single stage centrifugal pump			
7	Performance characteristics of a Pelton wheel			
8	Performance characteristics of a Kaplan turbine			

GENERAL INSTRUCTIONS

1. **Students should attend the practical classes in time, if any student comes late beyond 10 minutes of regular time, will not be allowed to attend class.**
2. **Student should wear uniform along with college Identity card.**
3. **Student should record each and every practical conducted, in the prescribed observation book only and obtain faculty signature at the end of the class.**
4. **In all the practical classes student should submit the record for valuation, failing which the marks will be deducted.**
5. **Student should maintain discipline and should not cause any damage/breakage to the equipments in the laboratory. Any damage/breakage attracts fine twice the cost of the material.**
6. **Students should keep their bags and other items in the racks provided in the laboratory.**
7. **The students should conduct the experiment in an allotted batch throughout the whole semester.**
8. **Use of mobiles inside the laboratory is prohibited.**
9. **Every batch of students should enter the name with signature as a record of apparatus taken while conducting the experiment in laboratory.**
10. **Students should operate the experimental setup only in the presence of instructor or concerned faculty.**

Faculty in charge **HOD**

Hydraulics and Hydraulic machinery Laboratory (10CVL57)

Course Objectives:

1. Student will be able to describe the procedure of calibration of Measuring tank, Pressure gauge and verification of Bernoulli's equation.
2. Student will be able to explain the procedure of calibration of various flow measuring devices in open flow and pipe flow.
3. Student will be able to explain the procedure of determination of Darcy's friction factor for a pipe and Hydraulic coefficient for a vertical Orifice, Vane coefficient for a flat and hemispherical vane.
4. Student will be able to analyse the Performance Characteristics of various Hydraulic machines like Turbines and Pumps.

Course Outcome:

1. Student will be able to conduct experiment independently, for the calibration of Measuring tank, Pressure gauge and verification of Bernoulli's equation.
2. Student will be able to conduct experiment independently, related to calibration of various flow measuring devices in open flow and pipe flow.
3. Student will be able to conduct experiment independently, related to determination of Darcy's friction factor for a pipe and Hydraulic coefficient for a vertical Orifice, Vane coefficient for a flat and hemispherical vane.
4. Student will be able to conduct experiment independently and analyse the Performance Characteristics of various Hydraulic machines like Turbines and Pumps.

EXPERIMENT No:1 CALIBRATION OF RECTANGULAR NOTCH

Aim : determine the co-efficient of discharge of Rectangular notch.

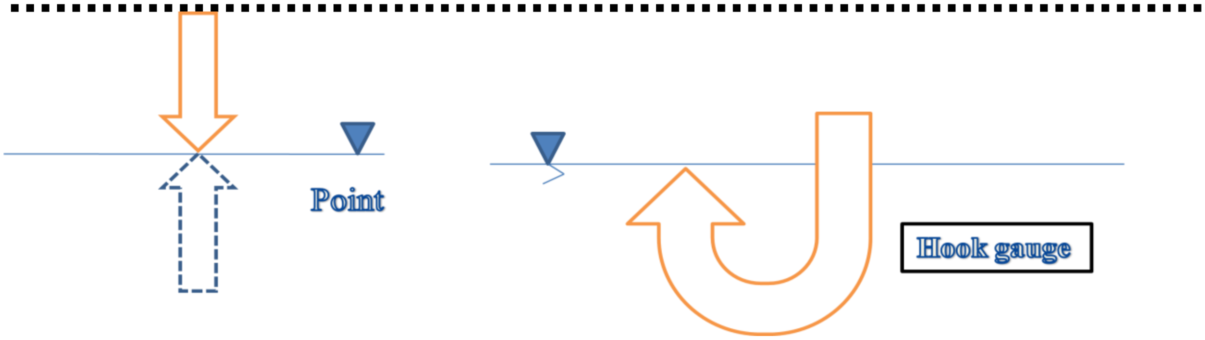
Apparatus : notch, stop watch ,scale ,measuring tank, open channel set up with inlet and outlet.

Theory : notches are used for determination of discharge through the open channel . The commonly used notches are v-notch, rectangular notch, trapezoidal notch, square notch. The bottom of the notch is known as crust.

Procedure:

- Fix the Rectangular Notch in channel
- Measure the angle of notch and area of measuring tank and note down the values
- Start the centrifugal pump and allow the water into the fluid channel until the water just flow over the crest level then stop the water supply
- When the water is at sill level of notch take initial gauge reading and it’s taken by adjusting the tip of the gauge to touch the free surface of water
- Then open the control value to desire extent so as to flow water over the notch
- When the head of water level over the notch and adjust the hook gauge and note down the hook gauge reading
- For the same discharge find out the depth water connected (R) collected in measuring tank to know interval of time ‘t’ in seconds.
- Repeat the steps 5,6,7 for different discharges

- Calculate the readings and calculate the co-efficient of discharge and plot the graph logH vs logQ_{act}

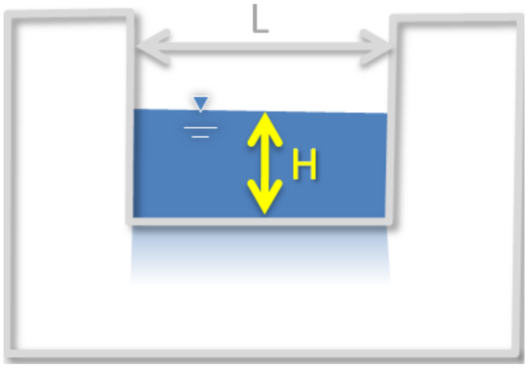


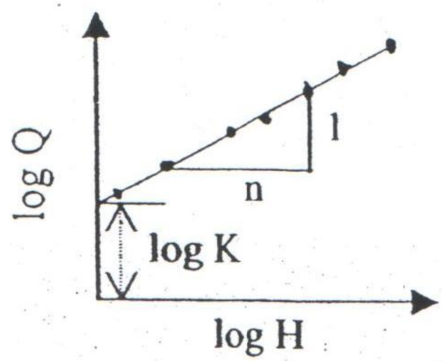
Result: Co-efficient of discharge of the given Rectangular notch is ______________

Observation and calculation:

- Least count of Hook gauge __________
- Head over the crest __________
- Area of the measuring tank , A = ______________
- Hook gauge correction is MSR + [VSD * LC]
- Length of the notch L= ____________
- actual area of the measuring tank , A= area of measuring tank –Area of the over flow pipe =_______________________
- Theoretical discharge (Q_{the})=2/3* sqrt(2g)*tanα/2*$H^{3/2}$
- co-efficient of discharge = Q_{act}/Q_{the}
- Actual discharge Q_{act} = (A*R)/t

Figure and Graph





Tabular column :

SL No	Hook gauge readings		$H=h_2-h_1$ in cm	Q_{the} M^3/sec	Measuring tank readings				$Q_{act}=(A*R)/t$ M^3/sec	$Cd=Q_{act}/Q_{the}$	Log Q_{act}	log H
	Initial reading in cm (h_1)	Final reading in cm (h_2)			A in cm^2	R_1 in cm	R_2 in cm	$R=R_2-R_1$ in cm				

EXPERIMENT No:2 CALIBRATION OF 90^0 V- NOTCH

Aim : To determine the co-efficient of discharge of 90^0 V- notch.

Apparatus : Notch, stop watch ,scale ,measuring tank, open channel set up with inlet and outlet.

Theory : notches are used for determination of discharge through the open channel . The commonly used notches are v-notch, rectangular notch, trapezoidal notch, square notch. The bottom of the notch is known as crest.

Procedure:

- Fix the V- Notch in channel
- Measure the angle of V- notch and area of measuring tank and note down the values
- Start the centrifugal pump and allow the water into the fluid channel until the water just flow over the crest level then stop the water supply
- When the water is at sill level of notch take initial gauge reading and it’s taken by adjusting the tip of the gauge to touch the free surface of water
- Then open the control value to desire extent so as to flow water over the notch
- When the head of water level over the notch and adjust the hook gauge and note down the hook gauge reading
- For the same discharge find out the depth water connected (R) collected in measuring tank to know interval of time ‘t’ in seconds.
- Repeat the steps 5,6,7 for different discharges

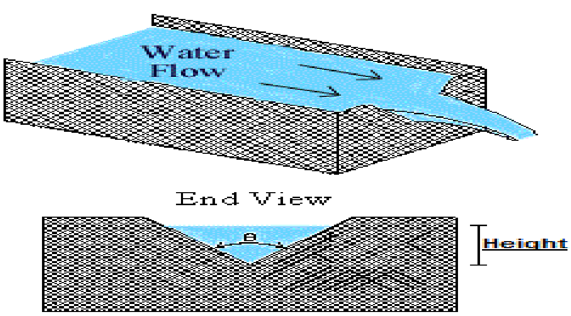
- Calculate the readings and calculate the co-efficient of discharge and plot the graph logH vs $\log Q_{act}$

Result: Co-efficient of discharge of the given Triangular or V-notch is ____________

Observation and calculation:

- Least count of Hook gauge _________
- Head over the crest _________
- Area of the measuring tank , A = _____________
- Hook gauge correction is MSR + [VSD * LC]
- Length of the notch L= ___________
- actual area of the measuring tank , A= area of measuring tank –Area of the over flow pipe =_____________________
- Theoretical discharge $(Q_{the})=8/15*\sqrt{(2g)}*\tan\Theta/2*H^{5/2}$
- co-efficient of discharge = Q_{act}/Q_{the}
- **Actual discharge Q_{act} = (A*R)/t**

Figure



Tabular column :

SL No	Hook gauge readings		H=h_2-h_1 in cm	Q_{the} M^3/s	Measuring tank readings				Q_{act}=(A*R)/t M^3/sec	Cd =Q_{act}/Q_{the}	LogQ_{act}	Log H
	Initial reading in cm (h_1)	Final reading in cm(h_2)			A in cm^2	R_1 in cm	R_2 in cm	R = R_1 - R_2 cm				

EXPERIMENT No:3 CALIBRATION OF ORIFICE METER

Aim: To determine co-efficient of discharge of orifice meter apparatus

Apparatus: Orifice measuring tank, stop watch and u-tube differential monometer

Theory: Orifice is a device used to measure the discharge and pressure in pipe flow by Bernoulli's equation to the upstream and the vena contracted the expression of discharge can be obtained by

$$Q=C_d\, a\sqrt{2gh} \text{ in } m^3/sec$$

C_d=co-efficient of discharge

a=area of c/c of orifice

H=pressure difference

Pressure difference H is determined from the equation of monometer liquid

$$H=h\,[S_h/S_L-1]$$

Where the fluid flow in the pipe is water

S_L=1, when mercury in the monometer

S_h=13.6

H=12.6h

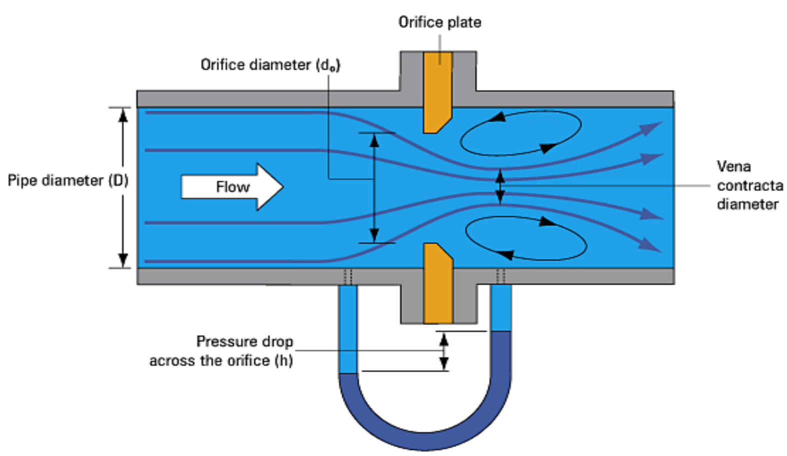
Procedure:

1. Select the required pipe to which orifice meter is fitted and note down the diameter of inlet and vena contracta of the orifice meter
2. Gradually open exit valve and regulate it till the flow become constant

3. Observe the left and right limb of orifice meter reading and tabulate it in tabular column and calculate the pressure difference 'h' in the manometer
4. Collect the water in collecting tank ,done the drain water and note down the time take for 10cm raise in the collecting tank
5. By increasing or by decreasing the discharge or by operating the regulating valve the different reading of monometer are taken and tabulated
6. Repeat the procedure for further 1-3 trials and plot the graph logH v/s logQ_{act}

Result: The co-efficient of discharge of the given orifice C_d=

Figure



OBSERVATION and CALCULATION:

1. The inlet diameter of the pipe d_1= mm
2. Area of the pipe a_1= mm^2
3. Diameter of an orifice meter d_2= mm
4. Area of the pipe a_2= mm^2
5. Actual area of the measuring tank= mm^2
6. Theoretical discharge $Q_{the}=\frac{a1a2\times\sqrt{2gh}}{\sqrt{a1^2+a2^2}}$

= m^3/sec

7. Actual discharge $Q_{act}=\frac{A\times R}{T}$

 = m^3/sec

8. The co-efficient of discharge $c_d=Q_{act}/Q_{the}$

$C_d=\frac{Cd1+Cd2+Cd3}{3}$

 =

TABULAR COLUMN:

Sl.no	**TRIAL**	**1**	**2**	**3**
1	Left limb reading h_1(cm)			
2	Right limb reading h_2(cm)			
3	$h=(h_2-h_1)$m			
4	$H=12.6\times h$ (cm)			
5	$Q_{the}=\frac{a1a2\sqrt{2gH}}{\sqrt{a1^2+a2^2}}$			
6	Rise in (cm)			
7	Time taken in (sec)			
8	$Q_{act}=\frac{A\times R}{T}$			
9	$C_d=Q_{act}/Q_{the}$			
10	Log H			
11	Log Q_{act}			

EXPERIMENT No 4: CALIBRATION OF VENTURIMETER

Aim: To determine co-efficient of discharge of the Venturimeter

Apparatus: Measuring tank, stop watch and u-tube differential monometer, Venturimeter

Theory: Venturimeter is a simple device which is used to measure the discharge in a pipe flow, it consider of 3 components

- **Convergent cone**
- **Throat**
- **Divergent cone**

The diameter gradually decrease in the convergent cone and reaches minimum at the throat and it is having some cross-section area continue in small length and further gradually increasing and reaches the original diameter of the pipe

The divergent cone is comparatively higher than convergent because of the smooth of water

Procedure:

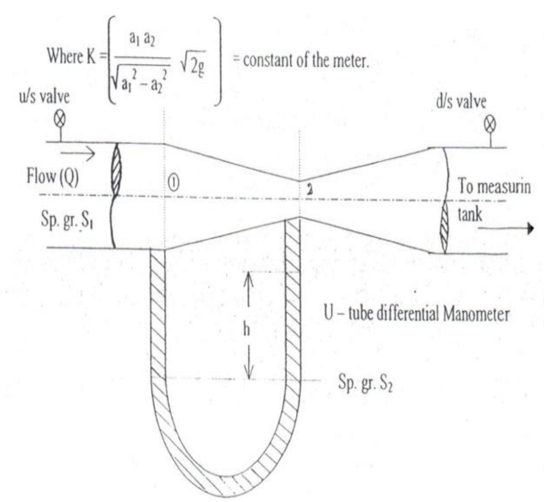
- Select the pipe to which the Venturimeter is pitted
- Open the valve and choose the valve so that only pressure for the meter is used to communicate to the monometer
- Open the regulating valve and allow the certain amount of water and find the reading in the monometer
- Observe the left limb reading and the right limb reading of the monometer and tabulated thus reading in the tabular column

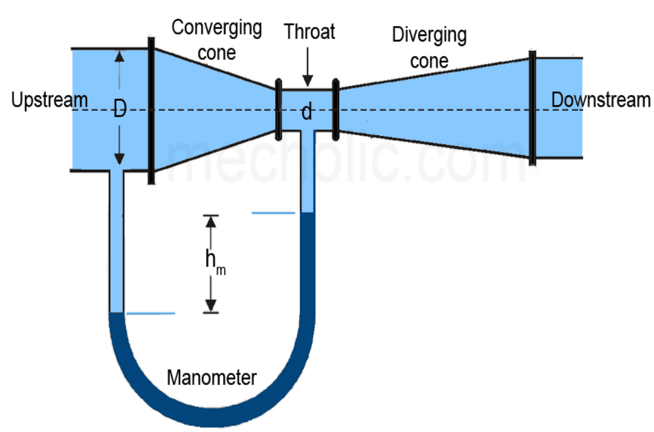
- Collect the water in the collecting tank close the regulating valve and note down the time taken for 10cm rise of water in the collecting tank

- On increasing or decreasing the discharge by operating the regulating valve the different monometer readings are taken and tabulated it
- Repeat the procedure for further 2-3 trials
- Plot the graph logH v/s logQ_{act}

Result: Co-efficient of discharge of the given Venturimeter is Cd=

Observation and Calculation:





- Inner diameter d_1 = mm
- The inlet $a_1 = \frac{\pi d1^2}{4}$ = m^2
- The diameter d_2= mm
- The area of throat $a_2 = \frac{\pi d_2^2}{4}$= m^2
- Theoretical discharge $Q_{the} = \frac{a_1 a_2 \sqrt{2gh}}{\sqrt{a_1^2 - a_2^2}}$ =

- Actual discharge $Q_{act}=\frac{A\times R}{T}$ m^3/sec
- Actual area of measuring tank =

Tabular Column:

Sl.no	Trial No	1	2	3
1	Left limb reading h_1 in (m)			
2	Right limb reading h_2 in (m)			
3	$h=(h_1-h_2)$ in (m)			
4	$H=12.6\times h$			
5	$Q_{the}=\frac{a_1 a_2\sqrt{2gh}}{\sqrt{a_1^2-a_2^2}}$			
6	rise in m			
7	Time taken to rise insec			
8	$Q_{act}=\frac{A\times R}{T}$ in (m^3/sec)			
9	$C_d=Q_{act}/Q_{the}$			
10	logH			
11	Log Q_{act}			

EXPERIMENT NO 5: FRICTION THROUGH PIPES

Aim: To determine the friction factor in a given pipe

Apparatus: Stop watch, u-tube differential monometer, scale

Theory: Pipe is used to transit liquid from one place to another during the transmission pressure taken place due to friction where the quantity of water flows through the pipe certain amount of energy is loosed due to the roughness of pipe the roughness of the pipe depends on material and scale formation where a surface is smooth the roughness effects is less, similarly when the roughness effects is more where the surface is more rough

Procedure:

- Select the required pipe fitting or the pipe line
- Connect the inlet and the out let of the pressure taps of the pipes to the monometer and remove the air bubble present inside the monometer with the help of air vent valve
- Allow certain amount of water to flow through the pipe
- Observe the left limb and right limb reading of the monometer and tabulated the reading in tabular column
- Collect the water in collecting tank, close the drain valve and note down the time taken for 10cm rise in collecting tank
- On increasing or decreasing the discharge by operating the regulating valve the different monometer readings are taken and tabulated
- Calculate the friction factor of the given pipe

Result: co-efficient of friction of Darcy's co-efficient fraction for the given pipe 18mm is f= and 16mm is f=

Observation and Calculation:

- Diameter of the pipe d= mm and d= mm
- Area of the pipe a=$\frac{\pi d^2}{4}$

  = m^2

....

- The length of the pipe L= m
- Hydraulic mean depth R=m=$\frac{d}{4}$
- Flow velocity V=$\frac{Q_{act}}{area\ of\ pipe}$
- Area of collecting tank
- Chezy's co-efficient c=$\frac{V}{\sqrt{mxi}}$

Calculation :

- **D_{18}=$\frac{\quad}{3}$**

=

- **D_{16} =$\frac{\quad}{3}$**

=

Tabular Column:

Dia of pipe (m)	Monometer reading			$h_f = H \times 12.6$ (m)	collecting tank			Q_{act}= in m3/s $\frac{A \times R}{t}$	Velocity of flow V= $\frac{Q_{act}}{area\ of\ flow}$	co-efficient of friction f= $\frac{hf2gd}{4lv^2}$
	left limb h_1(m)	Right limb h_2(m)	Difference H=h2-		Effective area of tank(m^2)	Rise of water	Time taken to rise			

EXPERIMRNT NO 6: MINAR HEAD LOSS IN PIPE

Aim:- Estimation of coeffient of minor losses for various fittings.

Apparatus:- Pipes of 3 different diameters fitted with sudden enlargement, sudden contraction elbow supply valves and out let valves. Measuring tank with piezometer, scale differential u-tube monometer and stop watch.

Theory:- Losses due to change of section, bends, elbows valves and fitting of all types fall into the category which contribute minor losses in pipe lines. In long pipe line the friction losses - pipe lines. They are much larger than this minor and hence the later are often neglected, but is shorter pipe lines it is necessary to consider the minor head losses from the experiment observations with the water at Reynolds's number the following general equations are proposed for minor losses in pipes

hf=k[v/2g]

Procedure

1. Open the nipple valves at both ends of a particular fitting for which the minor loss coefficient k is to be estimated also done all other nipple valves by doing , so the a manometer will be connected to measure the head loss in particular fittings.

2. Open the inlet ball valve fully on supply pipe and done the outlet valve at discharging end of all the pipes

3. Remove all the air bubbles present in the manometer and flexible connecting pipe with the help of the air unit valve provided at the head of manometer.

4. Open the outlet of the pipe to the same percentage for the stabilization of flow.

5. Take the readings of the levels on both the limbs of manometer say h1 and h2.

6. Close the outlet of the measuring tank and rate time "t" in seconds for 50mm rise of water by piezometer.

7. Repeat the above steps for different percentage of the outlet valve openings.

8. Repeat the whole procedure for all other fittings.

Results:-

1. Contraction constant due to the sudden contraction K =

2. Contraction constant due to the sudden enlargement K =

3. Contraction constant due to the elbow K =

4. Contraction constant due to bend in the pipe K =

<u>Observation</u>

1. Diameter of the small pipe, d_2 =.............m

2. Diameter of the big pipe, d_1 =.............m

3. Diameter of the elbow pipe, d_e =.............m

4. Diameter of the bent pipe, d_b =.............m

5. area of the measuring tank , A =.............m^2

<u>Loss of head due to sudden contraction</u>

SL. NO	Head loss hf in mm of water	Timne require for rise of water	Q_a in m^3/sec	velocity of liquide v_g in m/sec	contraction constant K
1.					
2.					
3.					

Specimen calculation:-

Q_a = AH/2..................

$V_2 = Q_a/A_2$..................

$K = h_f.2g/v_1^2$..................

Loss of head due to sudden enlargement

SL. NO	Head loss hf in mm of water	Timne require for rise of water	Q_a in m^3/sec	velocity of liquide v_g in m/sec	contraction constant K
1.					
2.					

Specimen calculation:-

Q_a = AH/t

$V_1 = Q_a/A_1$

$V_2 = Q_a/A_2$

$K = h_f..2g/(v_2-v_1)^2$

Loss of head due to elbow

SL. NO	Head loss hf in mm of water	Timne require for rise of water	Q_a in m^3/sec	velocity of liquide v_g in m/sec	contraction constant K
1.					
2.					

Specimen calculation:-

$Q_a = AH/2$

$V_e = Q_A/A$

$K = h_f.2g/v_e^2$

Loss of head due to bending pipe

SL. NO	Head loss hf in mm of water	Timne require for rise of water	Q_a in m^3/sec	velocity of liquide v_g in m/sec	contraction constant K
1.					
2.					
3.					

Specimen calculation:-

$Q_a = AH/2$

$V_e = Q_A/A$

$K = h_f.2g/v_e^2$

EXPERIMENT NO:7: IMPACT OF JET ON VANES

Aim: TO DETERMINE THE impact of jet different vanes and overall efficiency of the given vane

Apparatus: flat vanes semicircular vanes

Theory: a jet of fluid emerging from a nozzle at name velocity and hence passes some amount of kinetic energy. If this jet slinks on obstruction placed in its path if will rest the force on the obstruction this impressed force is known as impact of jet. It is designed as hydrodynamic force in order to distinguish it forms force due to hydrostatic force, since a dynamic force is rested by the fluid motion it involves the change in momentum unlike a force due to hydrostatic pressure that impulse the motion hence the impulse momentum principle may be utilize to evaluate a hydrodynamic rested on a body by a fluid

Procedure:

- Fix the required wave with the lives on to the beam and fix the handles
- measure the angle θ of vane also the diameter of nozzle
- Fix the vane at the bottom end of the vertical rod so that above the nozzle and it is symmetrical regulator the inlet valve of the supply pipe so that the jet issuing from nozzle vane actually
- Note down the force exerted by the impact of jet in the digital indicator in terms of KG
- Repeat the experiment for different flow, write the tabulate and calculate the overall efficiency of vane

Result: The efficiency of the flat vane η =%

The efficiency of Hemispherical or Semi Circular vane η = %

Observation & Calculation :

Velocity of the jet V=

Actual force F(act) = kN

Theoretical force F(the)=ρ*Q(act)*v[1+cos θ]N

=

$\eta=[F_{act}/F_{the}]*100$

=

Pressure (p) in kg/cm3=

Pressure head H= m

Tabular Column

For Flat Vane

No Of Trials	1	2	3
Pressure in kg/m3			
Pressure head			
V=√2gH in m/sec			
Weight in kg			
Q(act)			
Q(act) m3/sec			
F(act)=w*9.81			
F(the)=ʃ *Q(act) *v(1+cos0)KN			
ɳ =[F(act)/F(the)]*100			

For Semi Circular

No of Trials	1	2	3
Pressure in KG/Cm2			
Pressure head H=G*10m			

V=√2gH in m/sec			
Weight w in Kg			
Q(act)			
Q(act) m3/sec			
F(act)=w*9.81KN			
F(the)=∫*Q(act)*[1+cos0]			
ɳ =(F(act)/F(the)]*100			

EXPERIMENT No: 8 CENTRIFUGAL PUMP

Aim: To determine the overall efficiency of centrifugal pump under a constant speed with variable head

Apparatus: Stop watch, energy meter, measuring tank and scale

Theory: Pump is a hydraulic meter which converts the mechanical energy to hydraulic energy by means of centrifugal force that device is called centrifugal pump.

A centrifugal pump considers of impellers and has number of curved vanes or plates.

The energy meter is provided to measure the inert to the meter and provided to calculate the discharge from pump. The pressure and vacuum gauges are provides in the delivery and the section pipes of the pump to measure the respective heads.

Procedure:

Prime the pump as to remove the air bubbles which is present in the pipe. Close the delivery valve and start the motor open the delivery valve slowly as soon as the motor starts running measure the speed with the help of tachometer and maintain the same speed or different openings of the delivery valve and note down the following readings.

1. Section pressure or vacuum pressure reading
2. Delivery pressure, gauge reading
3. Time taken for 10 cm raise in collecting tank
4. Time taken for five revolution of the energy meter

Result: The overall efficiency of the centrifugal pump is=........

Observation: Specification, 1. Energy meter constant k:

2. Efficiency of the meter :

3. Gauge correction z:

4. Area of the measuring tank :

Formulae:

1. Input = $\frac{n * 3600 * \eta}{T * K}$ in kw

Where n= number of rotation in energy meter

η = efficiency of motor

T= time taken for n revolution

K= energy meter constant

2. Head against pump is working

H=HS+Hd=Z in m

HS= $\frac{Ps * 13.6}{1000}$ in m

Hd = (Pd * 10) in m

3. Output : O/P -W Where

w = 9.81 X QX H

Q= actual discharge m^3/sec, H= head again pump is working

Tabular Column:

Trail no	1	2	3
Pressure mm			
Delivery pressure kg/cm^2			
Time taken for 5 revolution (T) in sec			
Speed in Rpm			
Rise (R) in m			
Time taken for rise (t) sec			
HS= PS*13.6 /1000 (m)			
Hd = (Pd * 10) in m			
H=HS+Hd=Z in m			
IP= (n *3600 *η)/(T *K) in kW			
OP= n X 1000/IP			

EXPERIMENT No 9: PELTON WHEEL

Aim; to determine the overall efficiency of the Pelton wheel turbine

Theory; Pelton wheel is a high impulse reaction turbine with low specific speed which is used to generate the electricity Pelton wheel is a type of impulse turbine work under high head and requires small quantity of water.

The water from which high head source is applied to the nozzle provided with a needle which controls the quantity of the water flowing out of the nozzle the pressure pressurized water is converted into a kinetic energy as if flows throughout the nozzle. The jet of water coming out of the nozzle at a high velocity strikes implunger on the curved blades known as a Pelton cups at the center of the Pelton cups set upon on the Pelton wheel to rotate in direction to impinging jet the pressure energy is converted into mechanical energy

Procedure:

Constant speed and variable head

1: fill the sump, tank with clean water keep the opening at a constant value and speed is measured with no load on the break drum

2: place the weight on the scale pan which reduces the speed

3: keep valve say 25% & 50%

4: now rather the supply need by operating the constant control value to bring the speed into the original value

5: when steady speed is reached nuts down the readings are an flows

* supply head pressure gauge
* Load on break down (w)
* Spring balanced readings (s)
* Pressure gauge readings across the venturimeter (p1,p2)

Constant head and variable speed

1: start centrifugal pump and open the delivery valve to required extent to get the deserved head which is to be maintained constant throughout the experiment

2: keep the gate opening at a constant particular valve says 25%.

3: note down the speed of turbine at the load condition

4: place the weight at the scale pan

5: when the speed is steady nuts down the following readings

* Load on the break drum

* Spring the balanced reading

* Pressure gauge reading across the Venturimeter*

6: repeat the steps 3, 4, 5 for 50% & 25% and nozzle opening

Result:

The overall efficiency of the Pelton wheel turbine for a constant head and variables speed 25% of gate opening η=

The overall efficiency of the Pelton wheel turbine for a constant head and variables speed for 50% of gate opening η=

The overall efficiency of the Pelton wheel turbine for a constant speed and variable head for 25% in 28% and for 50% discharge is 23% η=

OBSERVATION AND CALCULATION:

No buckets=

Normal speed jet ratio =

Jet diameter =

Weight of hanger w=

Dia of the rope =

Dia of break drum=

Area of the pipe a1=

Area of the pipe a2=

FORMULA:

Input power =WQH/1000 Kw

Output power= 2лNT/60000 Kw

Overall efficient η= input/output

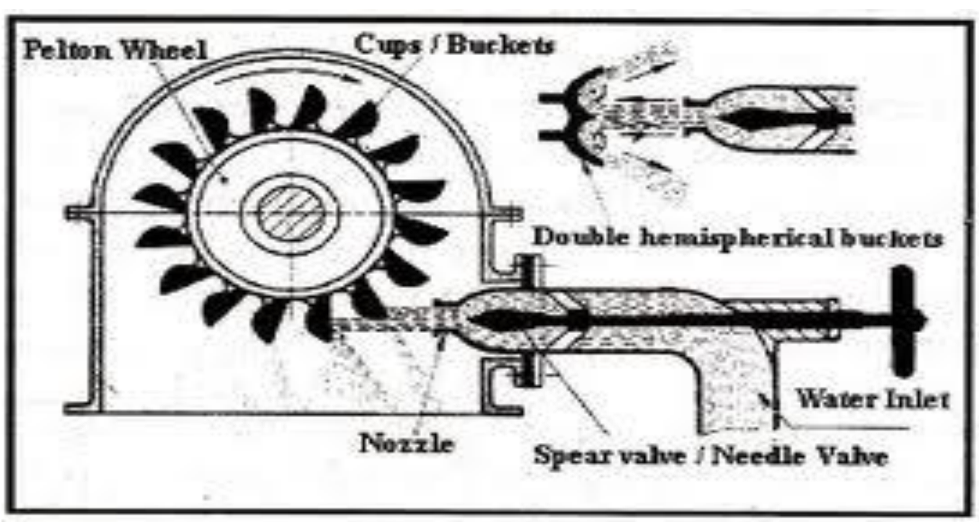
Specific speed=

Unit speed Nu= N/√H

Unit discharge= Q/√H

Unit power Pu= output/H¾

Figure



Tabular Column:

Trial No.	25%			50%		
	1	2	3	1	2	3
Supply at inlet pressure gauge reading PF Kg/cm^3						
Across gauge reading P1 (Kg/cm^3)						
Across venturimeter P2 (Kg/cm^3)						
Delivery head (H) PX10 (m)						
Inlet pressure head at venturimeter H1=P1X10(m)						
Throat pressure H2=P1X10(m)						
H=H1-H2(m)						
$Q=a1a2\sqrt{2gh}/\sqrt{a1^2-a2^2}$						
N in rpm						
Torque load w(Kg)						

Spring load s(Kg)						
Torque T(KN-m)						
O/p=2лNT/60000 Kw						
I/p=WQH/1000 Kw						
Ho=(OP/IP)*100						

Viva Voce Questions for examination

1. Define a fluid and give examples?
2. What is Newton?
3. Define a scalar and a vector quantity?
4. Define the terms, Specific weight, Mass Density Specific Gravity, And specific Volume .Give Their Units And Dimensions.
5. What is Viscosity?
6. State Newton's law of viscosity.
7. Define Newtonian and Non Newtonian Fluids and Give examples.
8. What are ideal and real fluids? Give examples.
9. What is a Thixotripic Fluid? Give examples.
10. What are the units and Dimension of absolute and Kinematic Viscosity?
11. State the relation between dynamic and kinematic Viscosity?
12. State Newton II law of motion.
13. What is (i) Adhesion (ii) Cohesion?
14. What is the effect of temperature on Viscosity for (i) Liquid (ii) Gas?
15. Define Surface tension; give its units and dimensions.
16. Define Capillarity, What are its Units and Dimension?
17. Give reasons for the following :
    a) Water Has Capillary rise.
    b) Mercury has capillary fall.
18. Give the values of contact angles for Hg and H_2O.
19. Define the terms (i) Bulk Modulus (ii) Compressibility of a liquid.
20. Explain why a manometer tube should not have a diameter less than 6mm.
21. Define Pressure, give units and dimension.
22. Give an Equation for variation of pressure with depth and explain.
23. What is the principle of a manometer?
24. Define (a) positive gauges pressure (b) absolute pressure and (c) Vacuum pressure
25. What is gauge zero? Explain.
26. Name different types of Manometer, indicating specific uses.
27. How do you measure Vacuum pressure at a point in pipe using a simple manometer? Explain.
28. Define the terms (i) Centre of pressure (ii) Meta centre (iii) Buoyancy.
29. Define (i) Uniform and non uniform flow (ii) Steady and unsteady flow (iii) Rotational and irrigational flow.
30. Define (a) stream line (ii) Streak line (iii) Path line (iv) Stream tube.
31. Write the principle of continuity equation.
32. Write the Differential form of continuity equation in Cartesian co-ordinates.

33. Write the general continuity equation and explain.
34. What is the principle of conservation of energy?
35. Define Bernoulli's energy equation for a steady, incompressibility fluid flow?
36. Write Bernoulli's equation and explain each of th quantities giving their respective dimensions.
37. What are the assumptions made in deriving Bernoulli8's equation?
38. What are the limitations of Bernoulli's energy equation?
39. Give a brief list of the applications of Bernoulli's equation?
40. What is a Venturimeter? What is the principle on which it is derived explain?
41. What is the difference between a horizontal and inclined Venturimeter, Write the discharge equation for both the cases.
42. What is an orifice? Write the discharge equation.
43. What ratios of the inlet of throat diameters are suggested in the case of a Venturimeter and an orificemeter?
44. What are the advantages and disadvantages of Venturimeter over an orificemeter?
45. Define least count of an instrument?
46. What is meant by calibration of an instrument?
47. a). Define a weir and a notch

    b).Give the classification of notches and weir.

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48. Write the general equation of discharge over a weir.
49. Write the3 discharge equation for a triangular weir and a rectangular notch.
50. Write the shape of Q vs. H curves for a V-notch and rectangular notch.
51. Write the definition sketch for the flow over a weir.
52. Name the different types of nappe.
53. What is meant by velocity of approach?
54. What is meant by end contraction in a rectangular notch?
55. What is Cipolletti notch? How does it differ from a trapezoidal notch?
56. What is meant by percentage error in the discharge measurement over a notch?
57. What is meant by sensitiveness of weir?
58. Define a Ogee (or Spillway) weir. How is its shape achieved?
59. What is a broad crested weir? Explain.
60. What is meant by ventilation of weir when is it required.
61. Why is it necessary to place the hook (or point) gauge away from the weir, on the upstream side?
62. What is an orifice? Give the classification.
63. What is the main difference between an orifice and notch?

64. Define vena contracta for an orifice.
65. Write the definition sketch of an orifice.
66. Define the hydraulic co-efficient, of an orifice.
67. What is meant by time of emptying a tank by an orifice? Write the equation for emptying a circular tank OR a rectangular tank of uniform area of cross section.
68. Differentiate between a vertical and an horizontal orifice.
69. What are the uses of an orifice?
70. What is Pitot tube? What is its use?
71. What is meant by stagnation pressure in Pitot tube?
72. What is Pitot static tube? How does it differ from a Pitot tube?
73. Differentiate between an open channel flow and pipe flow.
74. What are the various losses that occur in a pipe flow? Discuss.
75. Differentiate between laminar, transition and turbulent flow through pipe.
76. What is Reynolds number? What is its role in pipe flow classification?
77. Write Darcy's equation. Explain the various quantities.
78. Write Chezy's and manning's equation.
79. Write the relation between Chezy's C and manning's N.
80. What is most economical section? Explain.
81. What is meant by specific energy? How does it differ from total energy?
82. Define critical, subcritical and supercritical flow. How are these zones classified?
83. Define Froude number, critical depth and minimum specific energy.
84. What is momentum principle?
85. What is an hydraulic jump? Give its uses.
86. What is meant by loss of energy due to a hydraulic jump?
87. What is momentum principle?
88. What is the maximum efficiency of a wheel fitted with flat radial vanes, when a jet of water strikes the vanes normally (i.e., jet is tangent to the wheel).
89. What are the practical applications of impulse-momentum equation?
90. What is a turbine?
91. What are the ways of classifying turbines?
92. Why draft tubes are required in the case of reaction turbines?
93. Why draft tubes are not required for impulse turbines?
94. Which type of turbine is proffered when the head available is very high?
95. What is specific speed of a turbine?
96. What are unit quantities of turbines?
97. How does the controlling device/arrangements for flow of water into a pelton wheel work?
98. What is the shape of pelton wheel bucket and why is that so? why should not the deflection angle be chosen as 180^0 ?

99. What is the name of the automatic equipment which controls the inflow of water to a turbine?
100. Is generator coupled to a turbine in the laboratory? If not what alternate arrangement is done to measure the output of a turbine?
101. Can efficiency be calculated for no load condition in the turbine experiments?
102. How is the discharge measured for the turbine experiment?
103. How is the experiment conducted for constant speed conditions in the case of turbines?
104. What is the basis of selection of a turbine at particular site?
105. What are the ranges of specific speed of pelton, Francis and Kaplan turbines?
106. What are the guide-vanes in turbines?
107. Define flow ratio and speed ratio of turbines?
108. What are the disadvantages of outward flow turbines?
109. What are hydraulic efficiency, mechanical-efficiency and overall efficiency of a turbine?
110. Differentiate between W.H.P and B.H.P of a turbine.
111. What are the functions of draft tube?
112. What are the various types of draft tubes?
113. What is cavitation? What are the effects of cavitations?
114. In what regions of a turbine Cavitation is likely to occur?
115. How can cavitations be avoided?
116. How is Kaplan turbine different from a Francis turbine?
117. What are the speed ratio and flow ratio of Kaplan turbine?
118. Why are hydraulic losses less in a Kaplan turbine than in a Francis turbine?
119. Differentiate between inward and outward flow turbines?
120. What are characteristics curves of a turbine?
121. What are the different types of casing for centrifugal pumps?
122. Explain the working of single stage Centrifugal pump.
123. What is the role of the volute chamber of a centrifugal pump?
124. What do you mean by multistage-Centrifugal pump?
125. Describe multistage pump with
    a). Impeller in series, and
    b). Impeller in parallel

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126. What is specific speed of centrifugal pump?
127. What is manometric head of a centrifugal pump?
128. How is manometric head different from the head generated by impeller?
129. Explain (i) Impeller horse-power (ii) Manometric efficiency (iii) Mechanical efficiency (iv) Overall efficiency applicable to centrifugal pump.

130. Is there any limit to the suction lift of the pump?
131. What is priming of a centrifugal pump?
132. How do you calculate the power input to the motor by noting down the time taken for 10 revolutions of the disc of energy meter?
133. What is end-thrust in centrifugal pumps?
134. Give examples for forced vortex and free vortex flow.
135. Mercury is generally used as a manometric liquid. Give reasons.