Ref No:

SRI KRISHNA INSTITUTE OF TECHNOLOGY

LABORATORY PLAN

Academic Year 2019-20

Program:	B E – Civil Engineering
Semester :	4
Course Code:	18CVL48
Course Title:	Fluid Mechanics and Hydraulics Machinery Lab
Credit / L-T-P:	2 / 0-0-3
Total Contact Hours:	42
Course Plan Author:	Priyankashri K N

Academic Evaluation and Monitoring Cell

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INSTRUCTIONS TO TEACHERS

- Classroom / Lab activity shall be started after taking attendance.
- Attendance shall only be signed in the classroom by students.
- Three hours attendance should be given to each Lab.
- Use only Blue or Black Pen to fill the attendance.
- Attendance shall be updated on-line & status discussed in DUGC.
- No attendance should be added to late comers.
- Modification of any attendance, over writings, etc is strictly prohibited.
- Updated register is to be brought to every academic review meeting as per the COE.

Table of Contents

Note : Remove "Table of Content" before including in CP Book
Each Laboratory Plan shall be printed and made into a book with cover page
Blooms Level in all sections match with A.2, only if you plan to teach / learn at higher levels

A. LABORATORY INFORMATION

1. Laboratory Overview

Degree:	B.Tech	*Program:*	CV
Year / Semester :	2/4	*Academic Year:*	2019-20
Course Title:	Fluid mechanics and Hydraulics Machinery lab	*Course Code:*	18CVL48
Credit / L-T-P:	2 / 0-0-3	*SEE Duration:*	180 Minutes
Total Contact Hours:	42 Hrs	*SEE Marks:*	100 Marks
CIA Marks:	40 Marks	*Assignment*	5/1 Experiment
Lab. Plan Author	Priyankashri K N	*Sign*	Dt : 03/08/18
Checked By:	Shivaprasad D G	*Sign*	Dt :

2. Laboratory Content

Expt.	Title of the Experiments	Lab Hours	Concept	Blooms Level
1	Verification of Bernoulli's equation	03	Bernoullis theorem	L4 analyse
2	Determination of Cd for Venturimeter and Orifice meter	03	Venturimeter,orificemeter	L4 analyse
3	Calibration of Rectangular and Triangular notch	03	Rectangular triangualr Notch	L4 analyse
4	Calibration of Ogee and Broad crested weir	03	Ogee, Broad crested Wier	L4 analyse
5	Determination of Cd for Venturiflume	03	venturiflume	L4 analyse
6	Experimental determination of force exerted by a jet on flat and curved plates (Hemispherical Vane).	03	Flat vanes and curved plates vanes	L4 analyse
7	Experimental determination of operating characteristics of Pelton turbine	03	Pelton turbine efficiency	L4 analyse
8	Determination of efficiency of Francis turbine	03	Francis turbine efficiency	L4 analyse
9	Determination of efficiency of Kaplan turbine	03	Kaplan turbine efficiency	L4 analyse
10	Determination of efficiency of centrifugal pump	03	Centrifugal pump efficiency	L4 analyse
11	Determination of Major and Minor Losses in Pipes	03	Losses in pipes	L4 analyse

3. Laboratory Material

Books & other material as recommended by university (A, B) and additional resources used by Laboratory teacher (C).

Expt.	Details	Expt. in book	Availability
A	**Text books (Title, Authors, Edition, Publisher, Year.)**	-	-
1, 2, 3, 4, 5	Mohd. Kaleem Khan, "Fluid Mechanics and Machinery", Oxford University Press "Standard methods for the examination of water and wastewater" 1995, ALPHA, AWWA, WPCF Publication		In Lib / In Dept
B	**Reference books (Title, Authors, Edition, Publisher, Year.)**	-	-
1, 2	Mohd. Kaleem Khan, "Fluid Mechanics and Machinery", Oxford University		In Dept

	Press Text booksHydraulics and Fluid Mechanics' – Dr. P.N. Modi & D r S.M. Seth, Standard Book House- New Delhi. 2009 Edition Sarbjit Singh ,Experiments in Fluid Mechanics- PHI Pvt. Ltd.- New Delhi		
C	**Concept Videos or Simulation for Understanding**	**-**	**-**
c1	http://youtu.be/Ptf8icUjT1U (Bernollis theorem)		
c2	http://youtu.be/olNBqDpvSlc (venturimeter)		
c3	http://youtu.be/qbyL--6q7_4 (Pelton turbine)		
c4	http://youtu.be/3BCiFeykRzo (Francis turbine)		
c5	http://youtu.be/DmJCDOTIDRY (Centrifugal pump)		
E	**Recent Developments for Research**	**-**	**-**
		?	In lib
F	**Others (Web, Video, Simulation, Notes etc.)**	**-**	**-**
1			

4. Laboratory Prerequisites:

Refer to GL01. If prerequisites are not taught earlier, GAP in curriculum needs to be addressed. Include in Remarks and implement in B.5.
Students must have learnt the following Courses / Topics with described Content . . .

Expt.	Lab. Code	Lab. Name	Topic / Description	Sem	Remarks	Blooms Level
1	18CV33	Fluid Mechanics-1	Basic knowledge of pipe flow and Bernoulli's Equation	3		Understand L2

5. Content for Placement, Profession, HE and GATE

The content is not included in this course, but required to meet industry & profession requirements and help students for Placement, GATE, Higher Education, Entrepreneurship, etc. Identifying Area / Content requires experts consultation in the area.
Topics included are like, a. Advanced Topics, b. Recent Developments, c. Certificate Courses, d. Course Projects, e. New Software Tools, f. GATE Topics, g. NPTEL Videos, h. Swayam videos etc.

Expt.	Topic / Description	Area	Remarks	Blooms Level
1	Bernollis theorem/knowledge of pressure energy, kinetic energy ,potential energy	Higher Education/ GATE	Gap A seminar on Bernollis theorem	L4 analyse
3	Venturimeter,orificemeter/knowledge pressure difference	Higher Education/ GATE	A seminar on pipe flow	L4 analyse
3	Notches /knowledge pressure difference	Higher Education/ GATE	A seminar on discharge through channels	L4 analyse
4	Turbines /knowledge power generation	Higher Education/ GATE	A seminar on different types of turbines and principles of flow	L4 analyse
5	pumpes /knowledge pressure difference	Higher Education/ GATE	A seminar on lifting of water from lower to higher elevation	L4 analyse

B. Laboratory Instructions

1. General Instructions

SNo	Instructions	Remarks
1	Observation book and Lab record are compulsory.	
2	Students should report to the concerned lab as per the time table.	
3	After completion of the program, certification of the concerned staff in-charge in the observation book is necessary.	
4	Student should bring a notebook of 100 pages and should enter the readings /observations into the notebook while performing the experiment.	
5	The record of observations along with the detailed experimental procedure of the experiment in the Immediate last session should be submitted and certified staff member in-charge.	
6	Should attempt all problems / assignments given in the list session wise.	
7	When the experiment is completed, should return all the components/instruments taken for the purpose.	
8	Any damage of the equipment or burn-out components will be viewed seriously either by putting penalty or by dismissing the total group of students from the lab for the semester/year	
9	Completed lab assignments should be submitted in the form of a Lab Record in which you have to write the algorithm, program code along with comments and output for various inputs given	
10	Be careful while using chemicals acids and glassware	

2. Laboratory Specific Instructions

SNo	Specific Instructions	Remarks
1	Before conducting any test, students shall come prepared with theoretical background of the corresponding test (indicated under the section 'theory' in each test).	
2	Students shall make sure to have the knowledge of using weighing balance ,oven.	
3	Students shall give importance to accuracy and precision while conducting the test and interpreting the results	
4	Students shall acquaint themselves with the safe and correct usage of instruments / equipment's under the guidance of teaching / supporting staff of the laboratory	

C. OBE PARAMETERS

1. Laboratory Outcomes

Expt.	Lab Code #	COs / Experiment Outcome	Teach. Hours	Concept	Instr Method	Assessment Method	Blooms' Level
-	-	**At the end of the experiment, the student should be able to . . .**	-	-	-	-	-
1	18CVL48.1	Applying Bernoullis theorem for steady flow through pipes	02	Bernoulli's equation	Lecture and demonstration	C.IA	L4 Analyse
2	18CVL48.2	Analyze the flow through rectangular and Venturimeter and Orifice meter	02	Flow through Venturimeter and Orifice meter	Lecture and demonstration	C.IA	L4 Analyse
3	18CVL48.3	Analyze the flow through Rectangular and V-notch	02	Flow through Rectangular and V notch	Lecture and demonstration	C.IA	L4 Analyse
4	18CVL48.4	Examine the flow through Ogee and Broad crested weir and	02	Flow through	Lecture and	C.IA	L4 Analyse

		venturiplume		Ogee and Broad crested weir and venturiplume	demonstration			
5	18CVL48.5	Understand the Impact of jet on Flat and curved vanes	02	Impact of jet on Flat and curved vanes	Lecture and demonstration	C.IA		L4 Analyse
6	18CVL48.6	Examine the operating charecteristics of kaplan, turbine	02	kaplan Turbines efficiency	Lecture and demonstration	C.IA		L4 Analyse
7	18CVL48.7	Examine the operating charecteristics of pelton wheel turbine	02	pelton Turbines efficiency	Lecture and demonstration	C.IA		L4 Analyse
8	18CVL48.8	Examine the operating characteristics of Francis turbine	02	Francis Turbines efficiency	Lecture and demonstration	C.IA		L4 Analyse
9	18CVL48.9	Examine the efficiency of centrifugal and reciprocating pumps	02	Pump efficiency	Lecture and demonstration	C.IA		L4 Analyse
10	18CVL48.10	Understand the concept of pipe flow losses	02	Losses in pipes	Lecture and demonstration	C.IA		L4 Analyse
-		**Total**	**16**	-	-	-		-

Note: Identify a max of 2 Concepts per unit. Write 1 CO per concept.

2. Laboratory Applications

Expt.	Application Area	CO	Level
1	To apply Bernoullis theorem flow through pipes	CO1	L3
2	Measure discharge through Venturimeter, orificemeter for pipes	CO2	L3
3	Measure discharge through Rectangular triangualr Notch for open channels	CO3	L3
4	Measure discharge through Ogee, Broad crested Wier for open channels	CO4	L3
5	Measure discharge through venturiflume for open channels	CO5	L3
6	Force exerted through Flat vanes and curved plates vanes	CO6	L3
7	To know characteristics of Pelton turbine and to measure efficiency	CO7	L3
8	To know characteristics of Francis turbine To know characteristics of	CO8	L3
9	To know characteristics of Kaplan turbine efficiency To know characteristics of	CO9	L3
10	To measure Centrifugal pump efficiency	CO10	L3

Note: Write 1 or 2 applications per CO.

3. Mapping And Justification

CO – PO Mapping with mapping Level along with justification for each CO-PO pair.
To attain competency required (as defined in POs) in a specified area and the knowledge & ability required to accomplish it.

Expt.	Mapping		Mapping Level	Justification for each CO-PO pair	Level
-	**CO**	**PO**	-	**'Area': 'Competency' and 'Knowledge' for specified 'Accomplishment'**	-
1	CO1	PO1	MEDIUM	The students will be able to apply the knowledge of mathematics, science, engineering fundamentals inferring the quality of water	L4
1	CO1	PO2	HIGH	The students will be able to apply the knowledge of mathematics,	L4

				science, engineering fundamentals for dissolved oxygen content in water	
2	CO2	PO1	HIGH	The students will be able to apply the knowledge of mathematics, science, engineering fundamentals for finding out chemical parameters like pH, acidity, alkalinity	L4
2	CO2	PO2	HIGH	The students will be able to identify, formulate, review research literature, and analyse pH, acidity, alkalinity using Indian standard methods in reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	L4
2	CO2	PO3	MEDIUM	The students will be able to design solutions for making the pH, acidity, alkalinity within the standard levels	L4
3	CO3	PO1	HIGH	The students will be able to apply the knowledge of mathematics, science, engineering fundamentals for finding out the physical characteristics viz. colour, turbidity, and conductivity of a given water sample	L4
3	CO3	PO2	HIGH	The students will be able to identify and examine physical characteristics viz. colour, turbidity, and conductivity of a given water sample using natural sciences, and engineering sciences	L4
4	CO4	PO2	HIGH	The students will be able to identify, formulate and review research literature for dissolved oxygen content in water reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	L4
4	CO4	PO4	HIGH	The students will be able to use research-based knowledge and research methods including design of experiments, analysis and interpretation of dissolved oxygen content	L4
5	CO5	PO2	HIGH	The students will be able to identify, formulate and review research literature for chloride content in water reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	L4
5	CO5	PO4	HIGH	The students will be able to use research-based knowledge and research methods including design of experiments, analysis and interpretation of chlorides content	L4
6	CO6	PO1	HIGH	The students will be able to apply the knowledge of mathematics, science, engineering fundamentals to examine the chemical characteristics viz. chlorides, Iron, Available Chlorine and sulphates content to assess its suitability for drinking purposes.	L4
6	CO6	PO2	HIGH	The students will be able to identify, formulate, review research literature, and analyse chemical characteristics viz. chlorides, Iron, Available Chlorine and sulphates content in samples	L4
7	CO7	PO1	HIGH	The students will be able to apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to find the optimum dosage of alum using Jar test	L4
7	CO7	PO2	HIGH	The students will be able to identify, formulate, review research literature, and analyse the optimum dosage of alum using Jar test reaching substantiated conclusions natural sciences, and engineering sciences	L4
8	CO8	PO1	HIGH	The students will be able to apply the knowledge of mathematics, science, engineering fundamentals to examine the chemical characteristics viz. chlorides, sodium potassium, Iron, nitrates, manganese content to assess its suitability for drinking purposes.	L4
8	CO8	PO2	HIGH	The students will be able to identify, formulate, review research literature, and analyse chemical characteristics viz. sodium, potassium, Iron, nitrates, manganese content in samples	L4
9	CO9	PO1	MEDIUM	The students will be able to apply the knowledge of mathematics, science, engineering fundamentals to understand the COD to assess its suitability for drinking purposes.	L4
10	CO10	PO1	MEDIUM	The students will be able to apply the knowledge of mathematics, science, engineering fundamentals to understand the Air quality Monitoring and sound levels	L4

4. Articulation Matrix

CO – PO Mapping with mapping level for each CO-PO pair, with course average attainment.

-	-	Experiment Outcomes	Program Outcomes															-
Expt.	CO.#	**At the end of the experiment student should be able to . . .**	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	Lev el
1	CO1	Applying Bernoullis theorem for steady flow through pipes	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	L4
2	CO2	Analyze the flow through rectangular and Venturimeter and Orifice meter	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	L4
3	CO3	Analyze the flow through Rectangular and V-notch	3	2	3	-	-	-	-	-	-	-	-	-	-	-	-	L4
4	CO4	Examine the flow through Ogee and Broad crested weir and venturiplume	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	L4
5	CO5	Understand the Impact of jet on Flat and curved vanes	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	L4
6	CO6	Examine the operating charecteristics of kaplan, turbine	3	2		-	-	-	-	-	-	-	-	-	-	-	-	L4
7	CO7	Examine the operating charecteristics of pelton wheel turbine	3	2		-	-	-	-	-	-	-	-	-	-	-	-	L4
8	CO8	Examine the operating characteristics of Francis turbine	3	2		-	-	-	-	-	-	-	-	-	-	-	-	L4
9	CO9	Examine the efficiency of centrifugal and reciprocating pumps	3	2		-	-	-	-	-	-	-	-	-	-	-	-	L4
10	CO10	Understand the concept of pipe flow losses	1	2		-	-	-	-	-	-	-	-	-	-	-	-	L4
-		**Average attainment (1, 2, or 3)**	**2.7**	**2.5**	**2.5**	**1.5**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
-	*PO, PSO*	*1.Engineering Knowledge; 2.Problem Analysis; 3.Design / Development of Solutions; 4.Conduct Investigations of Complex Problems; 5.Modern Tool Usage; 6.The Engineer and Society; 7.Environment and Sustainability; 8.Ethics; 9.Individual and Teamwork; 10.Communication; 11.Project Management and Finance; 12.Life-long Learning; S1.Software Engineering; S2.Data Base Management; S3.Web Design*																

5. Curricular Gap and Experiments

Topics & contents not covered (from A.4), but essential for the course to address POs and PSOs.

Expt	Gap Topic	Actions Planned	Schedule Planned	Resources Person	PO Mapping
1					
2					
3					
4					
5					

Note: Write Gap topics from A.4 and add others also.

D. COURSE ASSESSMENT

1. Laboratory Coverage

Assessment of learning outcomes for Internal and end semester evaluation. Distinct assignment for each student. 1 Assignment per chapter per student. 1 seminar per test per student.

Unit	Title	Teaching Hours	No. of question in Exam							CO	Levels
			CIA-1	CIA-2	CIA-3	Asg-1	Asg-2	Asg-3	SEE		
1	Applying Bernoullis theorem for steady flow through pipes	03	-	-	-	-	-	-	1	CO1	L4
2	Analyze the flow through rectangular and Venturimeter and Orifice meter	03	-	-	-	-	-	-	1	CO2	L4
3	Analyze the flow through Rectangular and V-notch	03	-	-	-	-	-	-	1	CO3	L4
4	Examine the flow through Ogee and Broad crested weir and venturiplume	03	-	-	-	-	-	-	1	CO4	L4
5	Understand the Impact of jet on Flat and curved vanes	03	-	-	-	-	-	-	1	CO5	L4
6	Examine the operating charecteristics of kaplan, turbine	03	-	-	-	-	-	-	1	CO6	L4
7	Examine the operating charecteristics of pelton wheel turbine	03	-	-	-	-	-	-	1	CO7	L4
8	Examine the operating characteristics of Francis turbine	03	-	-	-	-	-	-	1	CO8	L4
9	Examine the efficiency of centrifugal and reciprocating pumps	03	-	-	-	-	-	-	1	CO9	L4
10	Understand the concept of pipe flow losses	03	-	-	-	-	-	-	1	CO10	L4
-	**Total**	**42**	**-**	**-**	**-**	**-**	**-**	**-**	**10**	**-**	**-**

2. Continuous Internal Assessment (CIA)

Assessment of learning outcomes for Internal exams. Blooms Level in last column shall match with A.2.

Evaluation	Weightage in Marks	CO	Levels
CIA Exam – 1	15	CO1, CO2, CO3,	L4
CIA Exam – 2	15	CO4, CO5, CO6,	L4
CIA Exam – 3	15	CO7, CO8,CO9,CO10	L4
Assignment - 1	05	CO1, CO2, CO3,	L4
Assignment - 2	05	CO4, CO5, CO6,	L4
Assignment - 3	05	CO7, CO8,CO9	L4
Seminar - 1	-		
Seminar - 2	-		
Seminar - 3	-		
Other Activities – define – Slip test		CO1 to Co10	L2, L3, L4 . ..
Final CIA Marks	**20**	**-**	**-**

-

SNo	Description	Marks
1	Observation and Weekly Laboratory Activities	05 Marks
2	Record Writing	10 Marks for each Expt
3	Internal Exam Assessment	20 Marks
4	Internal Assessment	40 Marks
5	SEE	80 Marks
-	**Total**	**100 Marks**

E. EXPERIMENTS

Experiment 01 : CALIBRATION OF COLLECTING TANK (GRAVIMETRIC METHOD)

-	Experiment No.:	1	Marks		Date Planned		Date Conducted	
1	Title	Collecting tank by Gravimetric method						
2	Course Outcomes	Applying Bernoullis theorem for steady flow through pipes						
3	Aim	To calibrate the collecting tank by Gravimetric method						
4	Material / Equipment Required	weight scale, collecting tank, sump tank, piezometer, stop watch.						
5	Theory, Formula, Principle, Concept	Calibration is a comparison between measurements of one of the known magnitude and another measurement made in as similar way as possible with a second device. The device with the know correctness is called the standard. The second device is the unit under test.						
6	Procedure	• Keep the delivery valve closed and check for electrical connections. • Switch on the electronic weighing scale and motor. • Note down the dimension of measuring tank • Allow an initial discharge of water to measuring tank by regulating the valve. • Press the tare button to set zero in the weighing scale. • Allow discharge for know rise „R", (say 10cm) water to be collected in the collecting tank. • Note down the mass of the water collected in the measuring tank. • Tabulate the reading and repeat the procedure for different rise						
7	Diagram							
8	Observation Table, Look-up Table, Output	(see table below)						
9	Sample Calculations	• Length of the collecting/measuring tank, L = • m Breadth of the collecting/measuring tank B= • Area of collecting/ measuring tank A = m2Mass Density of water						
10	Graphs, Outputs							
11	Results & Analysis	The Given collecting tank is verified by Gravimetric method and the mass density of water is assumed as 1000 Kg/m3=---------------						
12	Application Areas							
13	Remarks							

Observation table (item 8):

Sl.no.	Rise of water(R) in 'm'	Mass of water in 'Kg'	Volume of water collected	Volume of water by gravimeter method

14	Faculty Signature with Date	

Experiment 02 : CALIBRATION OF PRESSURE GAUGE (DEAD WEIGHT METHOD)

-	**Experiment No.:**	2	**Marks**		**Date Planned**		**Date Conducted**	
1	Title	PRESSURE GAUGE (DEAD WEIGHT METHOD)						
2	Course Outcomes	Applying Bernoullis theorem for steady flow through pipes						
3	Aim	To CALIBRATE PRESSURE GAUGE (DEAD WEIGHT METHOD)						
4	Material Equipment Required	Pressure cell, Dial type pressure indicator, Hydraulic dead weight, Pressure gauge Tester to develop the pressure, Digital pressure indicator						
5	Theory, Formula, Principle, Concept	Pressure is defined as force power unit area and is measured in Newton per square meter (Pascal) or in terms of an equivalent head of some standard liquid (mm of mercury or mater of water). A typical pressure gauge will measure the difference in pressure between two pressures. Thus a pressure gauge is connected to the hydraulic line and the gauge itself stands in atmospheric pressure. The gauge reading will be the difference between the air pressure and the atmospheric pressure and is called gauge pressure. The absolute pressure (the actual pressure within the air line) is the sum of the gauge pressure and atmospheric pressure.						
6	Procedure	• Ensure that sufficient oil is there in the oil cap . • Put the standard dead weight on the pan and close the needle valve. • Then slowly operate the pump lever up and down and observe the pressure builds up and • plunger is rises up. • Observe the pressure gauge reading against the known weight • While taking reading gently rotate the pan so that no friction will occur. • Increase the dead weight and repeat the procedure and note down the readings.						
7	Diagram							
8	Observation Table							
9	Sample Calculations	Dia of the plunger : 6 mm • Oil used : SAE 20 /40 Capacity : 0 to 20 kg / cm2 Dead weight supplied: 1 kg - 1 no 2kg - 2 nos 5 kg - 1 no 10 kg - 1 no Total = 20 kg Pan weight = ½ kg Master gauge : 0 to 28 kg / cm2						
10	Graphs, Outputs							
11	Results & Analysis							
12	Application Areas							
13	Remarks							
14	Faculty Signature with Date							

Experiment 03 :VERIFICATION OF BERNOULLI'S EQUATION

-	**Experiment No.:**	3	**Marks**		**Date Planned**		**Date Conducted**	
1	Title	BERNOULLI'S EQUATION						

2	Course Outcomes	Applying Bernoullis theorem for steady flow through pipes
3	Aim	Verification of BERNOULLI'S EQUATION
4	Material / Equipment Required	Venturimeter, multi-tube piezometer, stopwatch, collecting tank set-up.
5	Theory, Formula, Principle, Concept	The objective is to validate Bernoulli"s assumptions and theorem by experimentally proving that the sum of the terms in the Bernoulli equation along a streamline always remains a constant The Bernoulli theorem is an approximate relation between pressure head, velocity head, and elevation (datum), and is valid in regions of steady, incompressible flow where net frictional forces are negligible. The key approximation in the derivation of Bernoulli"s equation is that viscous effects are negligibly small compared to inertial, gravitational, and pressure effects. We can write the theorem as
6	Procedure	• Observe the dimensions of the convergent-divergent duct of the apparatus, not it down. Measure the cross section area of collecting tank. • Keep the delivery valve closed. • Check electrical connection and switch on the pump • Slowly open the inlet valve and allow water to fill up to a high head level. • Adjust the flow rate to obtain steady flow and to maintain constant head. • Note down the pressure head at different points of venture meter on the multi tube peizometer. • Close the ball valve of the collecting tank and measure the time for the known rise of water. • Repeat the experiment for medium and low head levels. • Tabulate the readingsVerify the Bernoulli"s" equation by considering any two or more points on the venture meter. • Plot the curves showing the variation of Pressure head (Hp), Velocity Head (Hv), and Total Head (Ht) with position.

7 Diagram

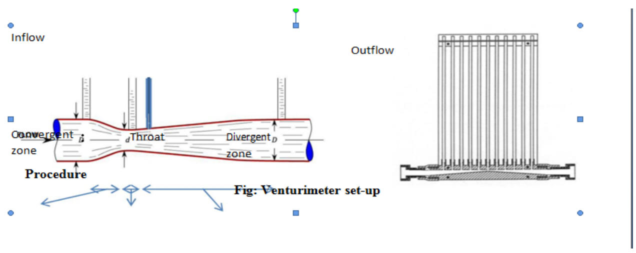


Fig: Venturimeter set-up

8 Observation Table

S.NO	Pizeometer Reading	time for 5cm rise	Discharge Qm/sec	Pressure Head m	Velocity Head m	Datum head m	Total Head

9	Sample Calculations	Pressure head $= \frac{P}{\rho g}$ m Velocity head $= \frac{v2}{2g}$ m Datum head = Z = 0 m (for this experiment) Velocity of water flow = v Q (Discharge) = [Volume of water collected in tank/time taken to collect water] = [Area of tank × height of water collected in tank]/ t m^3/sec Also Q= velocity of water in pipe × area of cross section = v × A_x m^3/sec Area of cross section (A_x) = $A_t + [\frac{(Ai-At)xLn}{L}]$ m^2 A_t = Area of Throt A_i = Area of Inlet Dia of throt = 25mm Dia of inlet = 50mm L_n= distance between throt and corresponding pizeometer L=length of the diverging duct or converging duct = 300mm Distance between each piezometer = 75mm
10	Graphs, Outputs	• - • -
11	Results & Analysis	Bernoullis eqations varified
12	Application Areas	
13	Remarks	
14	Faculty Signature with Date	

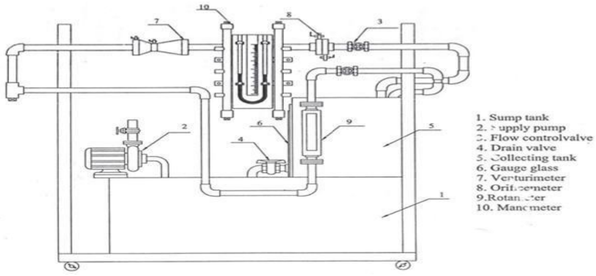
Experiment 04 :**CALIBERATION OF VENTURIMETER AND ORIFICEMETER**

-	Experiment No.:	4	Marks		Date Planned		Date Conducted	
1	Title	Venturimeter						
2	Course Outcomes	Analyze the flow through rectangular and Venturimeter and Orifice meter						
3	Aim	Calibration of venturimeter						
4	Material / Equipment Required	A pipe provided with inlet and outlet and pressure tapping and venturimeter in between them, Differential u-tube manometer, Collecting tank with piezometer, Stopwatch, Scale, A pipe provided with inlet and outlet and pressure tapping and Orifice in between them						
5	Theory, Formula, Principle, Concept	Venturimeter the Italian engineer, discovered in 1791 that a pressure difference related the rate of flow could be created in pipe by deliberately reducing its area of cross-section. The modern version of the venturimeter was first developed and employed for measurement of flow of water by Clemens Herschel in 1886. Venturimeter continues to be the best and most precise instrument for measurement of all types of fluid flow in pipes. The meter consists of a short length of gradual convergence throat and a longer length of gradual divergence. The semi-angle of convergence is 8 to 10 degrees and the semi-angle of divergenceis3 to 5 degrees. By measuring the difference in fluid pressure becore and after throt the flow rate can be obtained from Bernoulli's equation.						

6 Procedure

- The pipe is selected for conducting venturimeter experiment.
- The motor is switched on, as a result water will flow
- According to the flow, the ccl4 level fluctuates in the U-tube manometer
- The reading of H1 and H2 are noted
- The time taken for 5 cm rise of water in the collecting tank is noted
- The experiment is repeated for various flow in the same pipe
- The co-efficient of discharge is calculated
- The same procedure is followed for conducting orifice experiment

7 Block, Circuit, Model Diagram, Reaction Equation, Expected Graph



8 Observation Table,

S.NO	Manometric head			Time taken for h cm raise of water in tank t	Time taken for h cm raise of water in tank t	Theoretical Discharge (Qt)	Actual Discharge (Qa)
	h1	h2	H				

9 Sample Calculations

t = Time taken for h cm raise of water in tank

h_1= Manometric head in first limb m

h_2 = Manometric head in second limb m

h_w = Venturi head in terms of flowing liquid m

$= (h_2-h_1) \times \{\frac{\text{Specific gravity of ccl 4}}{\text{specific gravity of water}}-1\}$

Specific gravity of carbon tetra chloride (ccl_4) = 1.6

Specific gravity of water = 1

Diameter of the pipe = 4 cm

Diameter of the throat = 2.4 cm

Area of collecting tank = 50×50 cm^2

Theoretical Discharge (Qt) = $K\times\sqrt{h}$ m^3/sec

$K=\frac{a1\times a2\times\sqrt{2g}}{\sqrt{a1^2-a2^2}}$

a_1=area of cross section of pipe

a_2=area of cross section of pipe at throat

Actual Discharge (Q_a) = [Volume of water collected in tank/time taken to collect water]

= [Area of tank × height of water collected in tank]/ t

Coefficient of discharge $\mathbf{C_d} = Q_a/Q_t$

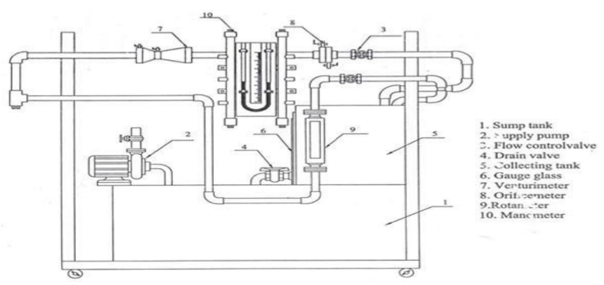
10 Graphs, Outputs

11 Results & Analysis

Coefficient of discharge through Venturimeter=------------------

12	Application Areas	
13	Remarks	
14	Faculty Signature with Date	

Experiment 05: **CALIBERATION OF ORIFICEMETER**

-	Experiment No.:	5	Marks		Date Planned		Date Conducted	
1	Title	ORIFICEMETER						
2	Course Outcomes	Analyze the flow through rectangular and Venturimeter and Orifice meter						
3	Aim	Calibration of orificemeter						
4	Material / Equipment Required	A pipe provided with inlet and outlet and pressure tapping and venturi in between them, Differential u-tube manometer, Collecting tank with piezometer, Stopwatch, Scale, A pipe provided with inlet and outlet and pressure tapping and Orifice in between them						
5	Theory, Formula, Principle, Concept	An orifice plate is a thin plate with a hole in it, which is usually placed in a pipe. When a fluid passes through the orifice, its pressure builds up slightly upstream of the orifice, but as the fluid is forced to converge to pass through the hole, the velocity increases and the fluid pressure decreases. A little downstream of the orifice the flow reaches its point of maximum convergence, afterd that, the flow expands, the velocity falls and the pressure increases. By measuring the difference in fluid pressure across tappings upstream and downstream of the plate, the flow rate can be obtained from Bernoulli's equation						
6	Procedure,	• The pipe is selected for conducting venturimeter experiment. • The motor is switched on, as a result water will flow • According to the flow, the ccl4 level fluctuates in the U-tube manometer • The reading of H1 and H2 are noted • The time taken for 5 cm rise of water in the collecting tank is noted • The experiment is repeated for various flow in the same pipe • The co-efficient of discharge is calculated • The same procedure is followed for conducting orifice experiment						
7	Block, Circuit, Model Diagram, Reaction Equation, Expected Graph							

8	Observation Table,	S.NO	Manometric head	Time taken for h cm Raise of water in tank (R)	Time taken for h cm raise of water in tank (t)	Theoretical Discharge (Qt)	Actual Discharge (Qa)

	h1	h2	H				

9	Sample Calculations	t = Time taken for h cm raise of water in tank h_1 = Manometric head in first limb m h_2 = Manometric head in second limb m h_w = Venturi head in terms of flowing liquid m $= (h_2 - h_1) \times \{\frac{\text{Specific gravity of ccl 4}}{\text{specific gravity of water}} - 1\}$ Specific gravity of carbon tetra chloride (ccl_4) = 1.6 Specific gravity of water = 1 Diameter of the pipe = 4 cm Diameter of the throat = 2.4 cm Area of collecting tank = 50×50 cm^2 Theoretical Discharge (Qt) = K× $\sqrt{h}$ m^3/sec $K = \frac{a1 \times a2 \times \sqrt{2g}}{\sqrt{a1^2 - a2^2}}$ a_1=area of cross section of pipe a_2=area of cross section of pipe at throat Actual Discharge (Q_a) = [Volume of water collected in tank/time taken to collect water] = [Area of tank × height of water collected in tank]/ t Coefficient of discharge $C_d = Q_a/Q_t$
10	Graphs, Outputs	
11	Results & Analysis	Coefficient of discharge through Orificemeter=------------------
12	Application Areas	
13	Remarks	
14	Faculty Signature with Date	

Experiment 06 : DETERMINATION OF PIPE FLOW LOSSES IN CIRCULAR PIPES

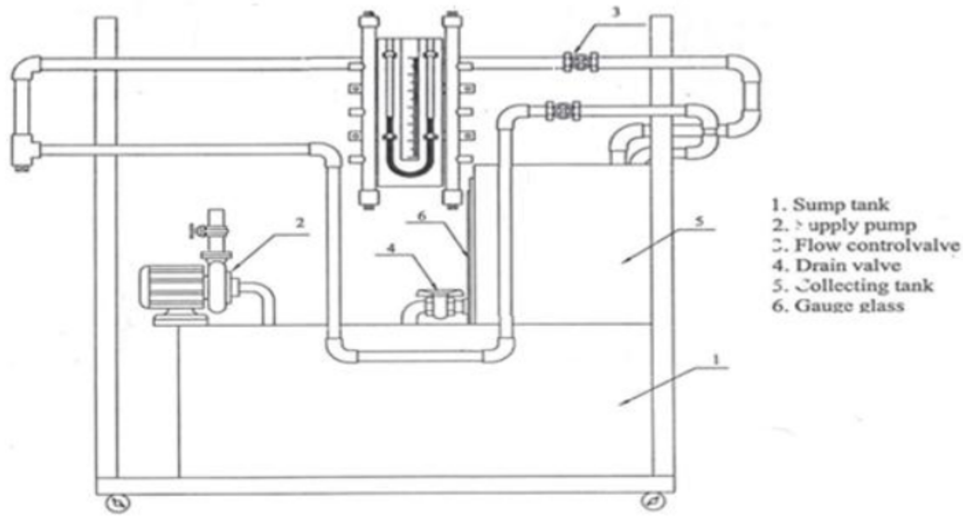
-	Experiment No.:	6	Marks		Date Planned		Date Conducted	
1	Title	PIPE FLOW LOSSES IN CIRCULAR PIPES						
2	Course Outcomes	Analyze the flow through Rectangular and V-notch						
3	Aim	Determination of lo						
4	Material / Equipment Required	A pipe provided with inlet and outlet and pressure tapping and venturi in between them, Differential u-tube manometer, Collecting tank with piezometer, Stopwatch, Scale, A pipe provided with inlet and outlet and pressure tapping and Orifice in between them						
5	Theory, Formula, Principle, Concept	When the fluid flows through a pipe the viscosity of the fluid and the inner surface of the pipe offer resistance to the flow. In overcoming the resistance some energy of the flowing fluid is lost. This is called the major loss in pipe flow. Boundary roughness, which has little significance in laminar flow, plays an important role in turbulence. This, together with transverse momentum exchange of fluid particles due to the perpetual turbulent intermixing, are the						

main sources of tangential or shear stresses in turbulent flow. Various equations have been proposed to determine the head losses due to friction. These equations relate the friction losses to physical characteristics of the pipe and various flow parameters

6 Procedure,

- The pipe is selected for doing experiments
- The motor is switched on, as a result water will flow
- According to the flow, the mercury level fluctuates in the Utube manometer
- The reading of H1 and H2 are noted
- The time taken for 5cm rise of water in the collecting tank is noted
- The experiment is repeated for various flow in the same pipe
- The coefficient of discharge is calculated

7 Block, Circuit, Model Diagram, Reaction Equation, Expected Graph



8 Observation Table,

S.NO	Manometric head			Time taken for h cm raise of water in tank t	Time taken for h cm raise of water in tank t	Theoretical Discharge (Qt)	Velocity (v) m/sec	Friction factor (f)
	h1	h2	H					

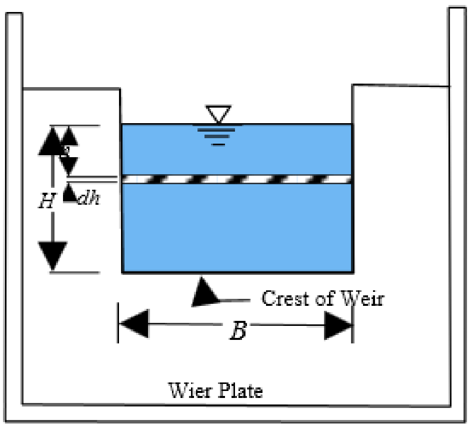
9	Sample Calculation	Friction factor (f) $= \frac{2 \times g \times D \times hf}{4l \times v2}$ Where, g = Acceleration due to gravity (m/sec^2) $D_{\text{for circular pipe}} = 4x \frac{\text{cross sectional area}}{\text{wetted perimeter}} = 4x \frac{\pi r^2}{\pi d} = d$ d= Diameter of the pipe = 2cm $D_{\text{for squarer pipe}} = 4x \frac{\text{cross sectional area}}{\text{wetted perimeter}} = 4x \left[\frac{wxh}{2x(w+h)}\right]$ w= 2cm ,width of pipe, h= 2cm , height of pipe(for a square) l = Length of the pipe = 200cm v = Velocity of liquid following in the pipe (m / s) h_f= Loss of head due to friction (m) $= (h_2-h_1) \times \{\frac{\text{Specific gravity of Hg}}{\text{specific gravity of water}} - 1\}$ Where h_1 = Manometric head in the first limbs h_2 = Manometric head in the second limbs Actual Discharge $Q = \frac{A \times h}{t}$ (m^3/sec) Where A = Area of the collecting tank (m^2) h = Rise of water for 5 cm (m) t = Time taken for 5 cm rise (sec) Also Q=Velocity in the pipe X Area of the pipe = v X a V = Q/a
10	Graphs, Outputs	
11	Results & Analysis	
12	Application Areas	
13	Remarks	
14	Faculty Signature with Date	

Experiment 07:FLOW THROUGH NOTCHES

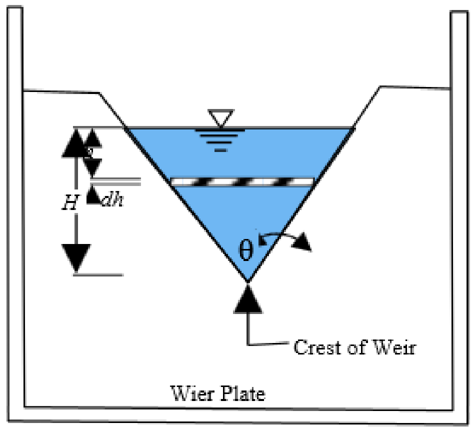
-	Experiment No.:	7	Marks		Date Planned		Date Conducted	
1	Title	FLOW THROUGH NOTCHES						
2	Course Outcomes							
3	Aim	To determine the coefficients of discharge of the rectangular, triangular and trapezoidal notches						
4	Material / Equipment	Hydraulic bench Notches – Rectangular, triangular, trapezoidal shape.						

	Required	Hook and point gauge Calibrated collecting tank Stop watch
5	Theory, Formula, Principle, Concept	In open channel hydraulics, weirs are commonly used to either regulate or to measure the volumetric flow rate. They are of particular use in large scale situations such as irrigation schemes, canals and rivers. For small scale applications, weirs are oftenreferred to as notches and invariably are sharp edged and manufactured from thinplate material. Water enters the stilling baffles which calms the flow. Then, theflowpasses into the channel and flows over a sharp-edged notch set at the other end of thechannel. Water comes of the channel in the form of a nappe is then directed into thecalibrated collection tank. The volumetric flow rate is measured by recording the time taken to collect a known volume of water in the tank A) RECTANGULAR NOTCH Coefficient of discharge $Q_{th} = \frac{2}{3}\sqrt{2g}\, B H^{3/2}$ $Q_{act} = \frac{\text{Volume Collected}}{\text{Time Taken}}$ $C_d = \frac{Q_{act}}{Q_{th}}$ B) TRIANGULAR NOTCH Coefficient of discharge $Q_{th} = \frac{8}{15}\sqrt{2g}\, H^{5/2} \tan\frac{\theta}{2}$ $Q_{act} = \frac{\text{Volume Collected}}{\text{Time Taken}}$ C) TRAPEZOIDAL NOTCH Coefficient of discharge $Q_{th} = \frac{8}{15}\sqrt{2g}\, H^{5/2} \tan\frac{\theta}{2} + \frac{2}{3}\sqrt{2g}\, B H^{3/2}$ $Q_{act} = \frac{\text{Volume Collected}}{\text{Time Taken}}$ $C_d = \frac{Q_{act}}{Q_{th}}$
6	Procedure,	• Preparation for experiment: 1.Insert the given notch into the hydraulic bench and fit tightly by using bolts in order to prevent leakage. 2.Open the water supply and allow water till over flows over the notch. Stop water supply, let excess water drain through notch and note the initial reading of the water level 'h0'using the hook and point gauge. Let water drain from collecting tank and shut the valve of collecting tank after emptying the collecting tank. • Experiment steps: 3.After initial preparation, open regulating valve to increase the flow andmaintain water level over notch. Wait until flow is steady. 4.Move hook and point gauge vertically and measure the current water level 'H to find the water head 'H' above the crest of the notch. 5.Note the piezometric reading 'z in the collecting tank while switch on the stopwatch. 6.Record the time taken 'T' and the piezometric reading 'z in the collecting tank after allowing sufficient water quantity of water in the collecting tank Repeat step 3 to step 6 by using different flow rate of water, which can be done by adjusting the water supply. Measure and record the H, the time and piezometric reading in the collecting tank until 5 sets of data have been taken. If collecting tank is full, just empty it before the step no 3. 8.To determine the coefficient of discharge for the other notch.

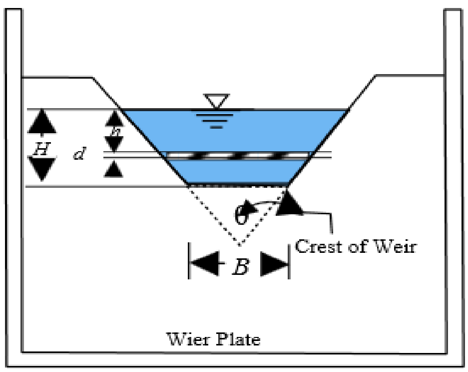
7 Block, Circuit, Model Diagram, Reaction Equation, Expected Graph



Rectangular Notch θ=0



Triangular Notch B=0



Trapezoidal Notch

8 Observation Table,

SL. NO	Theoretical Discharge Measurement			Actual Discharge Measurement				Cd
	h_1	H	Theoretical Discharge	Water Rise in Collecting Tank R (m)	Time Taken 'T' (sec)	Volume of water collected	Discharge, Qact	

Determination of Cd of rectangular notch

SL. NO	Theoretical Discharge Measurement			Actual Discharge Measurement				Cd
	h_1	H	Theoretical Discharge	Water Rise in Collecting Tank R (m)	Time Taken 'T' (sec)	Volume of water collected	Discharge, Qact	

Determination of Cd of rectangular notch								
SL. NO	Theoretical Discharge Measurement			Actual Discharge Measurement				Cd
	h_1	H	Theoretical Discharge	Water Rise in Collecting Tank R (m)	Time Taken 'T' (sec)	Volume of water collected	Discharge, Qact	

9	Sample Calculation	
10	Graphs, Outputs	
11	Results & Analysis	• Rectangular notch : Average Value of Cd = ... • triangular notch : Average Value of Cd = ... • trapezoidal notch : Average Value of Cd = ...
12	Application Areas	
13	Remarks	
14	Faculty Signature with Date	

Experiment 08: IMPACT OF JET ON PLATES

-	**Experiment No.:**	8	**Marks**		**Date Planned**		**Date Conducted**	
1	Title	IMPACT OF JET ON PLATES						
2	Course Outcomes							
3	Aim	Determine the vane coefficient for a flat vane &semicircular vane						
4	Material / Equipment Required	A hydraulic work bench setup containing nozzle for striking jet on plate. Collecting tank Stop watch Weights						
5	Theory, Formula, Principle, Concept	when a jet of water is directed to hit a vane of any particular shape, the force is exerted on it by the fluid in the opposite direction. The amount of force exerted depends on the diameter of the jet, shape of the vane and flow rate of water. The force also depends on whether the vane is moving or stationary. The current experiment deals with the force exerted on stationary vanes. The following are the theoretical formulae for calculating the force for different shapes of vanes based on the flow rate. 1. Hemi – spherical Plate: $F_t = 2\rho A$ V□/g 2. Flat Plate: $F_t = \rho A$ V□/g 3. Inclined Plate: $F_t = (\rho A$ V□/g) Sin θ Where, 'g' = 9.81 m/s 'A' = Area of jet in m□ 'ρ' = Density of water = 1000 Kg/m□ *'V' = Velocity of jet in m/s* 'θ' = Angle the deflected jet makes with the axis of the						

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<tr><td></td><td></td><td></td></tr>
<tr><td>6</td><td>Procedure,</td><td>a. Fill in the sump tank with clean water.
b. Keep the delivery valve closed.
c. Connect the power cable to 1Ph, 220V,10Amps with earth connection.
d. Fix the vane & jet in position with care applying minimum force.
e. Press tare button on the force indicator to balance (if zero does not appear).
f. Switch on the pump & open the delivery valve.
g. Adjust the flow using control valve of the Rotameter.
h. Note down the force exerted by the jet on the vane indicated by force indicator.
i. Change the flow rate and repeat the above steps</td></tr>
<tr><td>7</td><td>Block, Circuit, Model Diagram, Reaction Equation, Expected Graph</td><td></td></tr>
<tr><td>8</td><td>Observation Table,</td><td>
<table>
<tr><th>SL.NO</th><th>Dia of Jet</th><th>type of vane</th><th>Rotameter Reading LPM 'Qlpm'</th><th>Pressure gauge 'P' in Kg/Cm^2</th><th>Force Indicator 'Fa' Kgf</th></tr>
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<tr><th>SL.NO</th><th>Jet Dia in mm</th><th>Type of vane</th><th>Qlpm</th><th>Actual Force Fa in Kgf</th><th>Theoretical Force F_{th} in Kgf</th><th>Coefficient of impact Ci= Fa/Fth</th></tr>
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<tr><td>9</td><td>Sample Calculation</td><td></td></tr>
<tr><td>10</td><td>Graphs, Outputs</td><td></td></tr>
<tr><td>11</td><td>Results & Analysis</td><td>• Actual Force, Fa in Kgf=
• Theoretical Force, Fth in Kgf=
• Co –efficient of Impact = Fa/Fth=</td></tr>
<tr><td>12</td><td>Application Areas</td><td></td></tr>
<tr><td>13</td><td>Remarks</td><td></td></tr>
<tr><td>14</td><td>Faculty Signature with Date</td><td></td></tr>
</table>

Experiment 09: Pelton Wheel turbine

-	Experiment No.:	9	Marks		Date Planned		Date Conducted	

1	Title	Pelton wheel turbine
2	Course Outcomes	
3	Aim	To study performance characteristics of a Pelton Wheel
4	Material / Equipment Required	A hydraulic work bench setup containing nozzle for striking jet on plate. Collecting tank Stop watch Weights
5	Theory, Formula, Principle, Concept	Turbines are classified as Impulse and Reaction Types. In Impulse Turbine, the head of the water is completely converted into a jet, which impulse the force on the Turbine. In Reaction Turbine, it is the pressure of the flowing water, which rotates the runner of the Turbine. Of many types of Turbine, the Pelton Wheel, most commonly used, falls into this category of Impulse Turbine while the Francis & Kaplan fall into the category of Reaction Turbines. Normally, Pelton Wheel requires high Heads and Low Discharge while the Francis & Kaplan (Reaction Turbines) requires relatively low Heads and high Discharge.
6	Procedure,	**PROCEDURE:** **A. TO OBTAIN CONSTANT HEAD CHARACTERISTICS.** 1.Keep the Delivery valve open at Maximum. 2.Set the head at required value. 3.Now apply the load. 4.Operating the Sphere Rod Assembly, maintain the head to the Set value.Repeat the steps 4 and 5 till the maximum load the turbine can take. 5.In the meantime, Note down the turbine speed, vacuum head and Venturimeter readings for each loadings **B. TO OBTAIN CONSTANT SPEED CHARACTERISTICS.** 1.Keep the Delivery valve open at Maximum. 2.Now apply the load. 3.Operating the Sphere Rod Assembly, maintain the speed tothe Set value.Repeat the steps 4 and 5 till the maximum load the turbine can take. 4.In the meantime, Note down the turbine speed, vacuum head and Venturimeter readings for each loadings.
7	Block, Circuit, Model Diagram, Reaction Equation, Expected Graph	
8	Observation Table,	

SL. NO	Turbine speed N rpm	Delivery Pressure` P' Kg/cm^2	Venturimeter Head		Load, Kg		
			P1	P2	F1	F2	F=F1~F

			Kg/c m²	Kg/c m²			2

9 Sample Calculation

CALCULATIONS:

Where,

6. **Total Head of Turbine in meters of water, H**

$$H = \left(P + \frac{P_v}{760}\right) * 10$$ m of water

P = Pressure gauge readings in Kg/Cm²

Pv = vacuum Pressure gauge readings in mm of hg

$$Q = \frac{Cd * A1 * A2 * \sqrt{2gh}}{(\sqrt{A1^2 - A2^2})} \; m^3/s$$

Where,

h = (P1 - P2) x 10

A1 = Area of the Venturimeter

$$A_1 = \frac{\pi \, x \, D_1{}^2}{4} \; m^2$$

Where, D1 = Venturimeter Inlet diameter = 50mm

A2 = Area of the throat of the Venturimeter

$$A_2 = \frac{\pi \, x \, D_2{}^2}{4} \; m^2$$

Where, D2 = Venturimeter Throat diameter = 26mm

Cd = 0.95 (Constant)

8. **Input to the turbine, IP(Hydraulic)**

$$IP = \frac{WQH}{1000} \; kW$$

Where,

W = 9810 Kg/m³

Sl. No	Total Head H, m	Discharge Q, m^3/sec	IP, KW	OP, KW	Turbine efficiency %

10 Graphs, Outputs

11 Results & Analysis

1)Graphs plotted show the constant head/speed characteristics of the Kaplan turbine.
2)An attempt has been made to provide the facility to understand the various components of the Kaplan turbine & present the characteristic curves.

		3)The unit head and other quantities are calculated from the knowledge of constant head characteristics. 4)The numerical values in graphs and design calculations should be looked upon as qualitative figures rather than quantitative ones as some of the components available in the market for constructing the turbine are limited.
12	Application Areas	
13	Remarks	
14	Faculty Signature with Date	